2016 RIO GRANDE REGIONAL WATER PLAN

VOLUME I

RIO GRANDE
REGIONAL WATER PLANNING GROUP

Prepared by:
Rio Grande Regional Water Planning Group

With administration by:
Lower Rio Grande Valley Development Council

DECEMBER 1, 2015

BLACK & VEATCH
Building a world of difference.

Texas Water
Development Board

Acknowledgements

Rio Grande Regional (Region M) Water Planning Group, including current and former members who contributed to the 2016 Regional Water Plan

Interest	Name	Resident County
Public	Mary Lou Campbell, Secretary/Treasurer * City of Mercedes	Hidalgo
Counties	Joe Rathmell County Judge, Zapata	Zapata
	Humberto Gonzalez County Judge, Jim Hogg	Jim Hogg
Former member	Joel Quintana County Commissioner, Hidalgo County Precinct No. 1	Hidalgo
Municipalities	Jorge Barrera Eagle Pass Water Works, Eagle Pass	Maverick
	John Bruciak Brownsville PUB, Brownsville	Cameron
	Tomas Rodriguez, Vice-Chairman * City of Laredo	Webb
Industries	Donald K. McGhee Hydro Systems, Inc., Harlingen	Cameron
Agriculture	Robert E. Fulbright, Hinnant & Fulbright, Hebbronville	Jim Hogg
	Ray Prewett, formerly of Texas Citrus Mutual, Mission	Hidalgo
Environmental	Jaime Flores The Arroyo Colorado Watershed	Hidalgo
Small Business	Carlos Garza AEC Engineering, LLC, Edinburg	Hidalgo
	Nick Benavides Nick Benavides Co.	Webb
Electric Generating Utilities	Robert Pena, Jr. Texas Energy Consultants, Edinburg	Hidalgo
Former member	Ella de la Rosa Magic Valley Electric Cooperative	Hidalgo
River Authorities	James Darling Attorney, Doctors Hospital at Renaissance, Edinburg	Hidalgo
Water Districts	Sonny Hinojosa * HCID No. 2, San Juan	Hidalgo
	Sonia Lambert CCID No. 2, San Benito	Cameron
Water Utilities	Dennis Goldsberry North Alamo Water Supply Corporation	Hidalgo
Groundwater Management Area	Armando Vela Red Sands GCD	Hidalgo
Other	Glenn Jarvis, Chairman * Attorney, McAllen	Hidalgo
	Frank Schuster * Val Verde Vegetable Co.	Hidalgo

* Executive Committee

RIO GRANDE
REGIONAL WATER PLANNING GROUP

Administered by:

LRGVDC

Lower Rio Grande Valley Development Council

Prepared by:

BLACK & VEATCH
Building a world of difference.

Kennedy Resource Company

DBS&A
Daniel B. Stephens & Associates, Inc.

TEXAS A&M AGRILIFE RESEARCH

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS

Table of Contents

VOLUME I

VOLUME II

Appendices

Electronic Appendices

Texas Water Development Board

RIO GRANDE REGIONAL WATER PLANNING GROUP

2016 Region M Water Plan
Executive Summary

BLACK & VEATCH
Building a world of difference.

Table of Contents

Figures

Tables

List of Abbreviations

BRACS	Brackish Resource Aquifer Characterization System
CONAGUA	Water Commission of Mexico
DCP	Drought Contingency Plan
DMI	Domestic, Municipal, & Industrial
DOR	Drought of Record
ESA	Endangered Species Act
HB4	House Bill #4
IBWC	International Boundary Waters Commission
IWRP	Integrated Water Resources Plan
LLM	Lower Laguna Madre
LRGV	Lower Rio Grande Valley
LRGVDC	Lower Rio Grande Valley Development Council
NWR	National Wildlife Refuge
RWPG	Regional Water Planning Group
SB1	State Bill #1
SP	State Park
STRWSP	South Texas Regional Water Supply Plan
SWIFT	State Water Implementation Fund
SWP	State Water Plan
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
USFWS	United States Fish and Wildlife Service
WAM	Water Availability Model
WMS	Water Management Strategy
WSC	Water Supply Corporation
WWP	Wholesale Water Provider

Executive Summary

ES. 1 Water Planning in Texas

The Texas Water Development Board (TWDB) is charged with preparing a comprehensive and flexible long-term plan for the development, conservation, and management of the state's water resources. Historically, the state water plan had been prepared by the TWDB with input from other state and local agencies and the public. Senate Bill 1 (SB1) was enacted in 1997 by the 75th Legislature, which established a "bottom up" approach whereby state water plans are based on regional water plans prepared and adopted by the 16 appointed Regional Water Planning Groups (RWPGs). SB1 states that the purpose of regional water planning is to:

> *"Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of that particular region."*

SB1 also provides that future regulatory and financing decisions of the Texas Commission on Environmental Quality (TCEQ) and the TWDB be consistent with the current State Water Plan (SWP). In 2013 House Bill 4 (HB4) was enacted, which lends greater weight to the SWP by committing an additional funding pool to the implementation of projects recommended in the plan by way of the State Water Implementation Fund for Texas (SWIFT).

Each Regional Water Planning Group (RWPG) member is appointed to serve without pay, representing a range of stakeholders and act as the decision-making body for the regional water planning effort. The Rio Grande Regional Water Planning Group (Region M) members are listed in the Acknowledgements . The Lower Rio Grande Development Council (LRGVDC) has served as the political subdivision to administer the Regional Water Planning Grant, and Black and Veatch Corporation was selected as the prime consultant for the planning and engineering tasks required for development of the plan.

The regional water plans are updated every five years and a year after their adoption an updated SWP is released. This RWP covers a 50-year planning horizon from 2020 to 2070.

The RWPGs work with the TWDB to evaluate current demands and project future water demands for each category of water user group (WUG); municipal, irrigation, livestock, steam-electric power generation, manufacturing, and mining. Measured quantities, conservation goals, and modeling are used to develop availability data for all major water resources which indicate how much water can be relied on in a drought year within the management goals for each resource. In Region M these values are largely based on the Firm Yield from the Amistad-Falcon Reservoir System and the Modeled Available Groundwater values for the Gulf Coast, Yegua-Jackson, and Carrizo-Wilcox Aquifers.

For each WUG, the currently available water supplies are evaluated and projected over the planning horizon. Estimated future needs are identified and quantified by comparing the reliable, drought year supplies with the drought year demands. These projections for needs drive the development of specific recommendations for Water Management Strategies (WMS). WMS include both approaches to reduce demands, increase supplies, and minimize losses.

The plan also includes recommendations regarding policy at the state and local level including environmental protection, drought response, and resource management.

The chapters of the Regional Water Plan (RWP) are described below:

Chapter 1. *Description of the Regional Water Planning Area* The region's physical characteristics, climate, natural resources, population, economy, current planning and drought preparation efforts

Chapter 2. *Water Demand Projections* Water demands for the 50 year planning horizon for each water user group and wholesale water provider, including how demands were calculated

Chapter 3. *Water Supply Analysis* Evaluation of current supplies from surface water, groundwater, and reuse across the region, including suppliers and conveyance losses

Chapter 4. *Identification of Water Needs* Projected shortages, given the projections for supply and demand

Chapter 5. *Water Management Strategies* Description of each general type of WMS (i.e. direct potable reuse, brackish groundwater desalination) and descriptions of each recommended strategy including project requirements, costs, and impacts, (Chapter 5B alternative and not recommended strategies are in Appendix A)

Chapter 6. *Impacts of Regional Water Plan and Protection of Resource* Impacts of the plan including environmental, agricultural, and economic

Chapter 7. *Drought Response Information, Activities, and Recommendations* Drought of record description and drought response plans including drought stage triggers and recommended responses

Chapter 8. *Policy Recommendations & Unique Sites* Policy recommendations at the regional, state, and federal levels from the RWPG

Chapter 9. *Infrastructure Financing Analysis* Reporting of financing mechanisms for WMS in the RWP

Chapter 10. *Public Participation and Plan Adoption* Summary of public involvement through the planning process

Chapter 11. *Implementation and Comparison to the Previous Regional Water Plan* Compares the 2011 RWP to the present 2016 RWP, and includes a summary of implemented WMS from the 2011 RWP

ES. 2 The Rio Grande Regional Water Planning Area

ES.2.1 Population, Economy, and Natural Resources

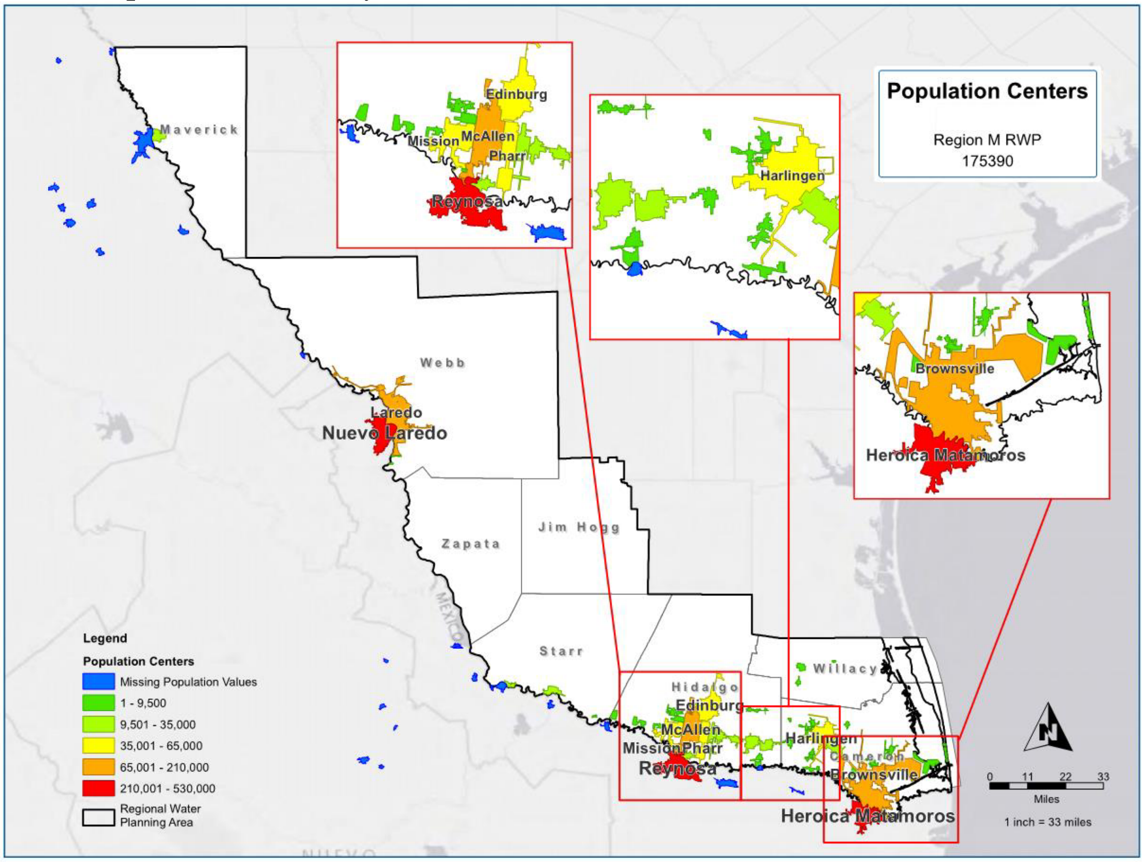

Figure 1 Major Metropolitan Areas of Region M

The Rio Grande Regional Water Planning Area (Region M) consists of the eight counties along the middle and lower Rio Grande nearest the river's mouth at the Gulf of Mexico. From the earliest settlement, this area has been tied to the waters of the Rio Grande for domestic and agricultural uses. The tropical or sub-tropical climate allows for a long growing season most years. 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, mostly from thunderstorms in the spring and occasional hurricanes in the late summer and fall. These storms can generate tremendous amounts of rainfall over a short period of time causing extensive flooding due to the region's relatively flat terrain.

Figure 1 shows current population centers in Region M. The population of the region is expected to grow to over 4 million people by the end of the current planning horizon which represents a 106% population increase from 2020 to 2070. Chapter 2 describes the population and municipal demand projections in detail.

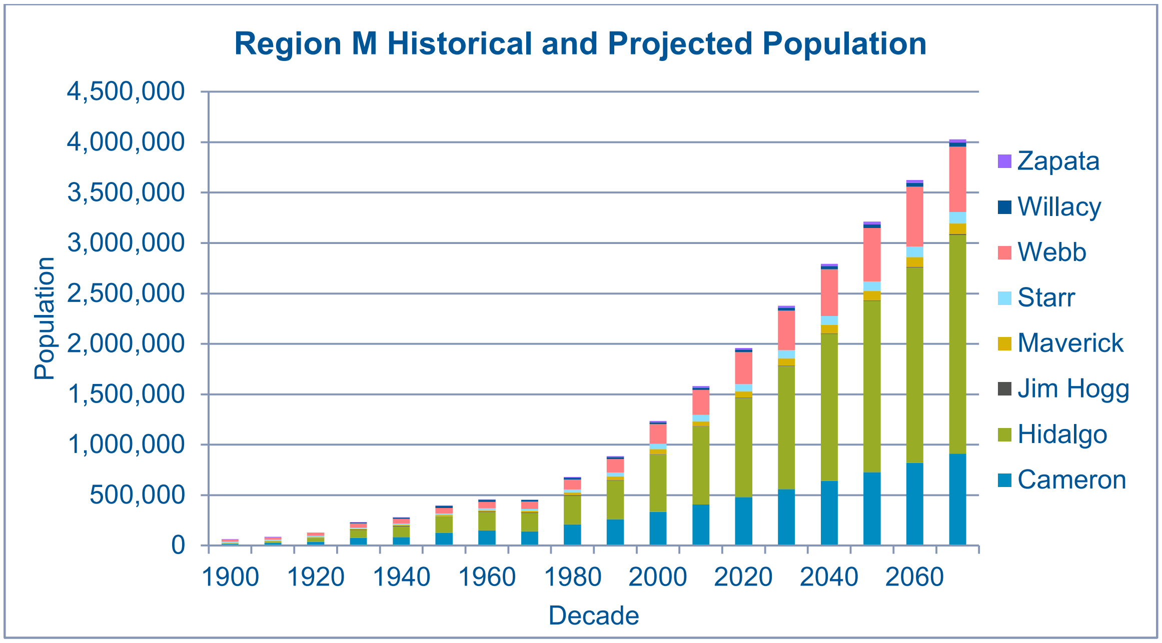

Figure 2 Region M Historical and Projected Population, US Census Bureau & TWDB

Region M's population is concentrated in Cameron, Hidalgo, and Webb counties, accounting for 90.5% of the regional total in 2010. The US Census Bureau estimates the total population of Region M in 2013 at 1,237,942, up 4.8% from 2010 (compared with 5.2% growth statewide). Figure 2 shows historical and projected population in each county, based on US Census Historical Data.

Table 1 Population Projections by County

County	2020	2030	2040	2050	2060	2070
Cameron	478,974	559,593	641,376	729,461	820,068	912,941
Hidalgo	981,890	1,219,225	1,457,502	1,696,257	1,935,015	2,167,137
Jim Hogg	5,853	6,356	6,790	7,274	7,694	8,082
Maverick	63,107	72,491	81,243	90,304	98,988	107,327
Starr	70,803	80,085	88,633	97,107	104,687	111,555
Webb	318,028	393,284	464,960	530,330	591,945	647,433
Willacy	25,264	28,479	31,559	34,840	38,012	41,121
Zapata	16,819	19,709	22,876	26,365	29,976	33,742
Total	**1,960,738**	**2,379,222**	**2,794,939**	**3,211,938**	**3,626,385**	**4,029,338**

An important factor driving rapid population growth in the Rio Grande Region is its cultural, social, economic relationship with Mexico. Nation-wide, Mexico's population growth rate in 2013 was 1.2%, compared with 0.7% for the United States.[1] The Mexican portion of the Rio Grande watershed was home to approximately 10.31 million people in 2005, and is anticipated to

[1] World Bank Population Growth Data http://data.worldbank.org/indicator/SP.POP.GROW visited 10/10/14

have 12.67 million inhabitants by 2025, which is a higher rate of growth than the nation as a whole. Using the growth rate identified by the National Water Commission of Mexico, for the Rio Grande watershed, the population in 2070 would be over 20 million people.

Aquifers in Mexico's Rio Grande Watershed are overextended, and it is clear that the growth on both sides of the border will continue to put pressure on the capabilities of both surface and groundwater.

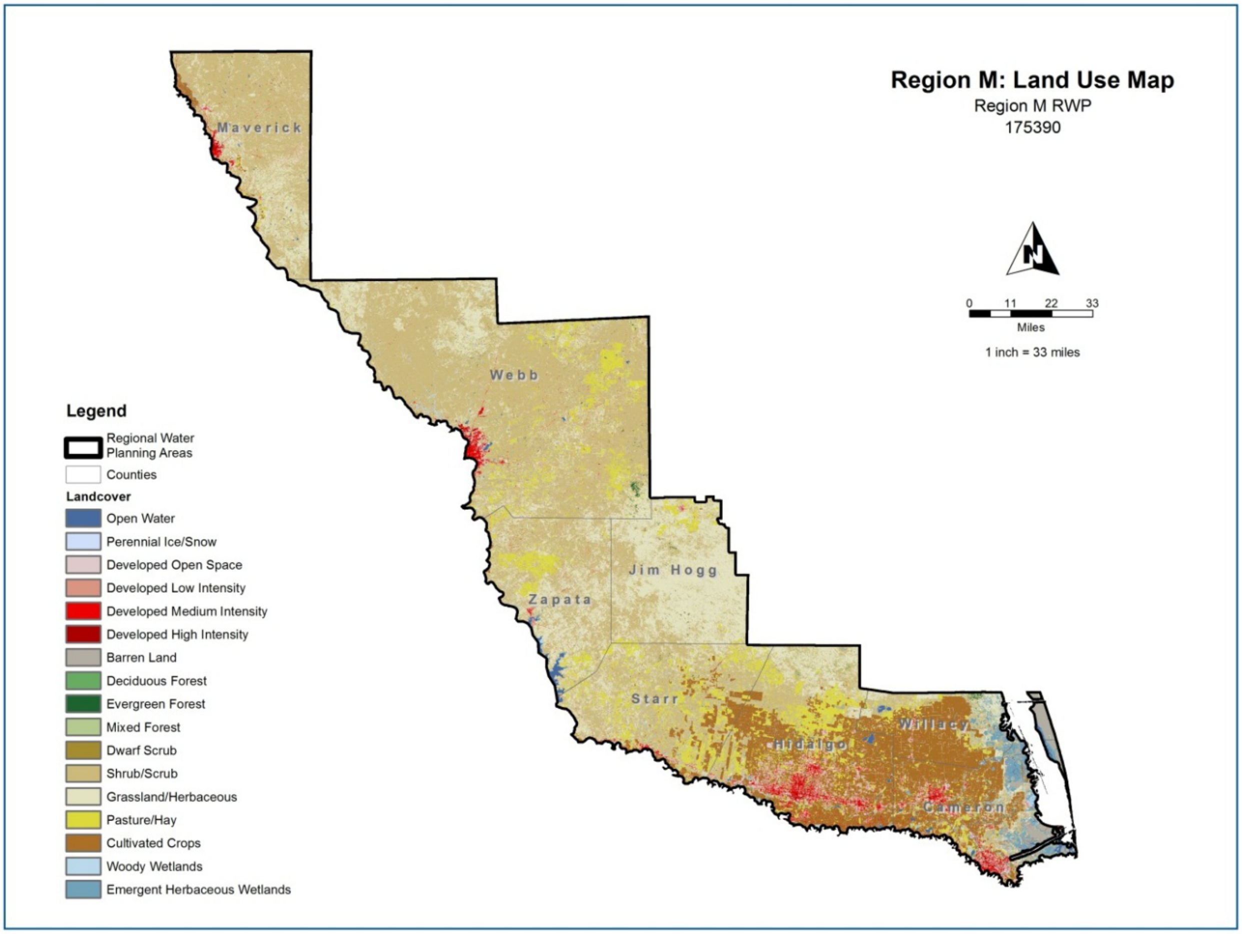

Figure 3 Region M Land Use Map

Historically, agriculture has dominated the economy of the Rio Grande Region. Increased pressure on water available for irrigation, combined with the way that water is allocated in drought years, has been difficult for farmers across the region, especially those with perennial crops and citrus or pecan trees. Grain sorghum, sugarcane, cotton, citrus, and onions make up the bulk of the agriculture receipts in the region, centered in Hidalgo and Cameron Counties (Figure 3). Cattle and farmland accounted for almost six million acres, or 80% of the region's land area.

There is a shift toward urbanization and diversification of the economy, but agriculture still plays a major role in the region. The Texas labor market forecasts show growth in the Lower Rio Grande associated with health care services, administration, service industry, professional, scientific, and technical services, as well as local government between 2012 and 2015.

Some areas of Cameron and Willacy Counties have seen recent growth of wind power generation, which may allow some farmers to maintain farmlands which were otherwise not economically viable.

Oil and gas production in the region has changed considerably from traditional oil drilling to hydraulic fracturing and nontraditional development, which has a significant impact on the regional economy and associated water demands. Webb and Maverick Counties experienced significant oil and gas activity in the Eagle Ford Shale region. Mining water demands are discussed further in Chapter 2.

In spite of growth in some sectors of the economy, Region M experiences lower income and higher unemployment than the rest of Texas (Table 2). According to the TWDB, seven out of the eight counties in Region M are labeled as eligible for funds through the Economically Distressed Areas Program.

Table 2 Median Household Income, Poverty, and Unemployment Rate, by County

County	Median Household Income, 2008-2012 ($/year)[2]	Persons Below Poverty Level, 2008-2012 (%)[3]	Unemployment Rate, 2013 (%)[4]
Cameron	$32,558	34.9%	10.1%
Hidalgo	$33,218	35.0%	10.8%
Jim Hogg	$36,919	12.0%	5.4%
Maverick	$30,959	31.2%	12.6%
Starr	$24,653	39.9%	15.4%
Webb	$38,421	30.6%	6.7%
Willacy	$26,369	37.7%	13.8%
Zapata	$28,617	33.4%	6.2%

Colonias are semi-rural subdivisions that are often developed with sub-standard or no potable water and sanitary sewer systems. Without potable water lines, many colonia residents rely on buckets or drums of water, which may become contaminated. Improper wastewater disposal can add to the health and safety concerns. There are colonias across Texas, Arizona, New Mexico, and California, but south Texas has the largest number of colonias (2,294) and the largest population living in colonias (estimated at 400,000 people).

There have been efforts at the state, county, and local levels to provide basic services in many of the colonias in Region M. These efforts are complicated by the fact that, when sewer and water lines are brought into a colonia, many of the homes do not meet building codes and are therefore unable to pass inspections to qualify for water or sewer hookups. Some areas of Region M have been very successful in improving services to colonias, but growth in the colonia population is still a challenge to residents, state, county, and local government.[5]

---

[2] US Census Bureau State & County QuickFacts, http://quickfacts.census.gov/qfd/states/48/48505.html, 8/27/14
[3] US Census Bureau State & County QuickFacts, http://quickfacts.census.gov/qfd/states/48/48505.html, 8/27/14
[4] Texas Counties: Unemployed Rate, Texas Association of Counties
[5] Texas Secretary of State website, http://www.sos.state.tx.us/border/colonias/faqs.shtml, accessed 2/25/2015

ES.2.2 Surface Water Resources

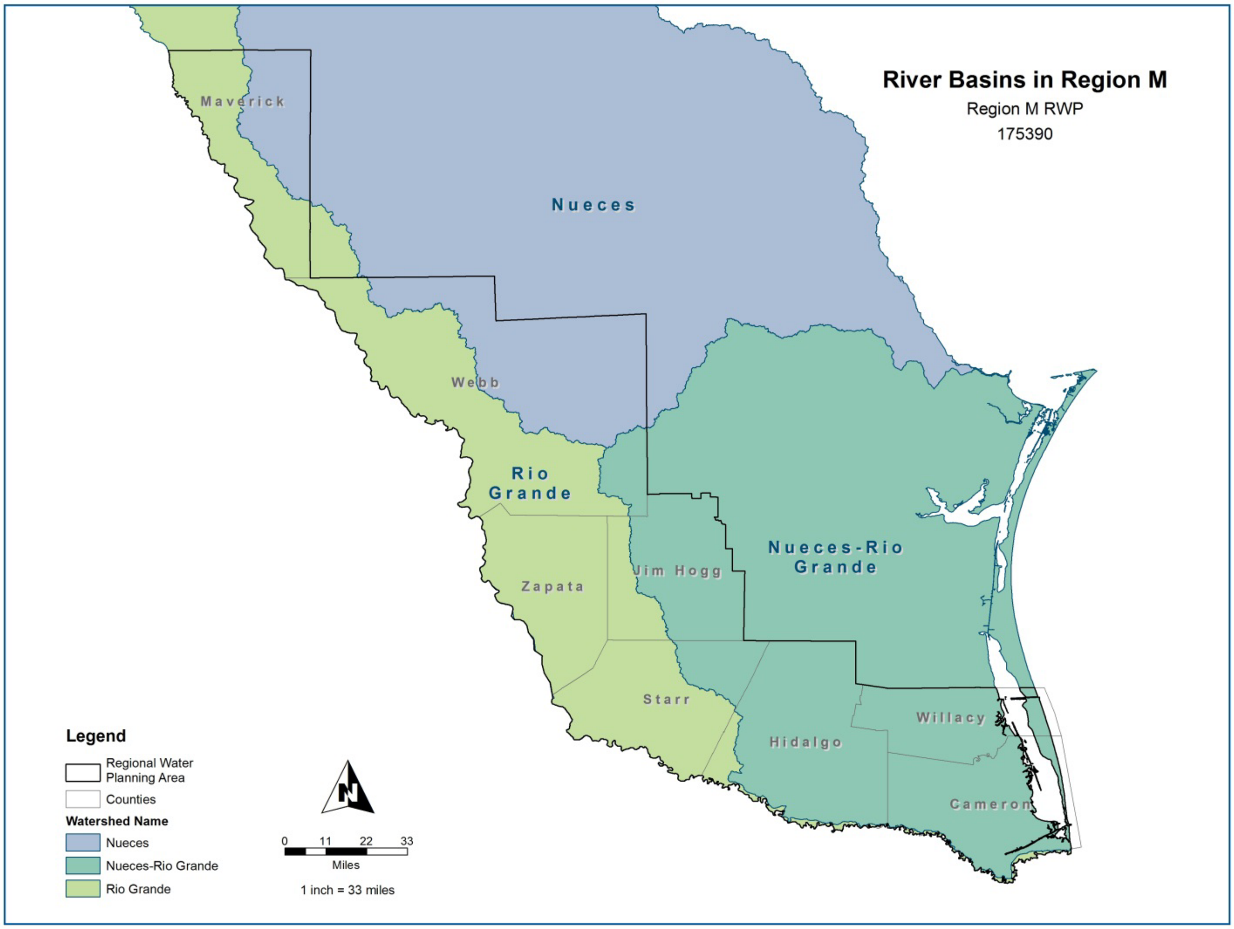

Figure 4 River Basins in Region M

The Rio Grande

Region M draws the vast majority of its water from the Rio Grande, via the Amistad-Falcon Reservoir system, which is shared with Mexico. The waters of the Middle- and Lower-Rio Grande are managed by the International Boundary Waters Commission (IBWC) and the TCEQ's Rio Grande Watermaster.

The majority of the inflows in this section of the river are from the Mexican watershed. Two major agreements between Mexico and the US (in 1906 and 1944) establish how these waters are shared. Annually, Mexico is to deliver a minimum of 350,000 acre-feet to the United States on an average over a 5-year cycle, except for years of extraordinary drought, when the watershed in Mexico cannot provide sufficient runoff water, or in cases of serious accident to hydraulic systems.

The Rio Grande Watermaster coordinates releases from Amistad and Falcon Reservoirs to deliver water to American users throughout Region M. The system of water rights is unique to the Rio Grande: there is a tiered system that prioritizes Domestic, Municipal, and Industrial (DMI) water rights, and establishes two classes (A and B) of mining and irrigation water rights. Each tier of water rights has a dedicated 'storage pool' in the reservoir accounting system, and at the end of each month, the DMI pool is replenished to ensure that those water rights can be delivered in full. After this and an operational reserve have been set aside, what remains, if any, is available to the Class A and B accounts. In a severe drought, there may not be any water after the DMI and operational reserves are met, and Class A and B rights can be completely curtailed. This impacts farmers as well as the functionality of the delivery systems, many of which rely on irrigation water for the operational baseline flows.

Water in the Rio Grande is normally of suitable quality for irrigation, municipal use with standard treatment, livestock, and industrial uses; however, portions of the river are considered impaired by the TCEQ based on high levels of bacteria, chlorides, sulfate, mercury, and low dissolved oxygen. Total dissolved solids (TDS) are not removed with standard treatment, and can be an aesthetic concern for cities. Drainage waters in the Nueces-Rio Grande basin tend to have very high TDS as a result of high influent TDS and additional salinity from passing over farmland. The RWP has been developed with the intent to improve or maintain water quality and uses as shown in the state water quality management plan.

Drought of Record

The Rio Grande Basin and the Amistad-Falcon Reservoir System refer to the drought spanning from February 1993 to October of 2000 as the Drought of Record (DOR). This 7.75 year period is the most severe hydrologic drought since 1949 according to the Rio Grande Water Availability Model (WAM), and is used to predict firm yield, a reliable drought year supply, as shown in Table 3.

Table 3 Firm yield projections for the Amistad-Falcon Reservoir system 2020-2070 (Acre-feet/year)

Source	2020	2030	2040	2050	2060	2070
Amistad-Falcon Reservoir	1,060,616	1,059,260	1,057,903	1,056,547	1,055,191	1,053,834

The current DOR extends through the year 2000, although the actual drought extended through approximately 2003. The model is limited by the extent of naturalized flow data in the WAM, which may redefine the DOR if it were expanded. Recent years have also seen severe drought in the region, and 2011 and 2012 data could also impact the drought of record, and therefore the firm yield projections. It was recommended in the 2011 Regional Water Plan, and is the opinion of the RWPG, that the Rio Grande WAM should be updated regularly. The DOR is discussed in detail in Chapter 7.

The Nueces-Rio Grande Basin and the Arroyo Colorado

Within the Rio Grande Region the Nueces-Rio Grande Coastal 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 4). There are two major drainage courses in the basin: the main floodway and the Arroyo Colorado.

The Arroyo Colorado drains an area of approximately 706 square miles or 500,000 acres covering portions of three Texas counties (Hidalgo, Cameron, and Willacy), and over twenty-five municipalities in the LRGV. In addition to natural drainage, most of the surface water diverted from the lower Rio Grande is pumped into this basin, and discharges into the Arroyo Colorado. The Arroyo Colorado River is the primary source of freshwater for the Lower Laguna Madre (LLM) estuary. It is imperative that not only adequate amounts of fresh water flow into the LLM, and the water quality meet the needs of the various uses of the water body including irrigation, recreation, industrial, municipal, and aquatic life uses.

ES.2.3 Groundwater Resources

The major aquifer that underlies Region M is the Gulf Coast, which runs the extent of the Texas coast and Hidalgo, Starr, Jim Hogg, and the western portions of Willacy and Cameron Counties. This aquifer is predominantly brackish, with irregular pockets of fresh and very saline water. The Carrizo – Wilcox Aquifer extends through Webb and part of Maverick Counties.

Table 4 Managed Available Groundwater for Significant Aquifers in Region M (Acre-feet /year)

Aquifer	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer	2,959	2,940	2,593	2,486	2,448	2,448
Gulf Coast Aquifer	147,441	147,441	147,441	147,441	147,441	147,441
Yegua-Jackson Aquifer	27,998	27,998	27,998	27,998	27,998	27,998
Total	**178,398**	**178,379**	**178,032**	**177,925**	**177,887**	**177,887**

The minor and alluvial aquifers in the region may produce significant quantities of water that supply relatively small areas, including the Rio Grande Alluvium, the Laredo Formation, and the Yegua-Jackson aquifer.

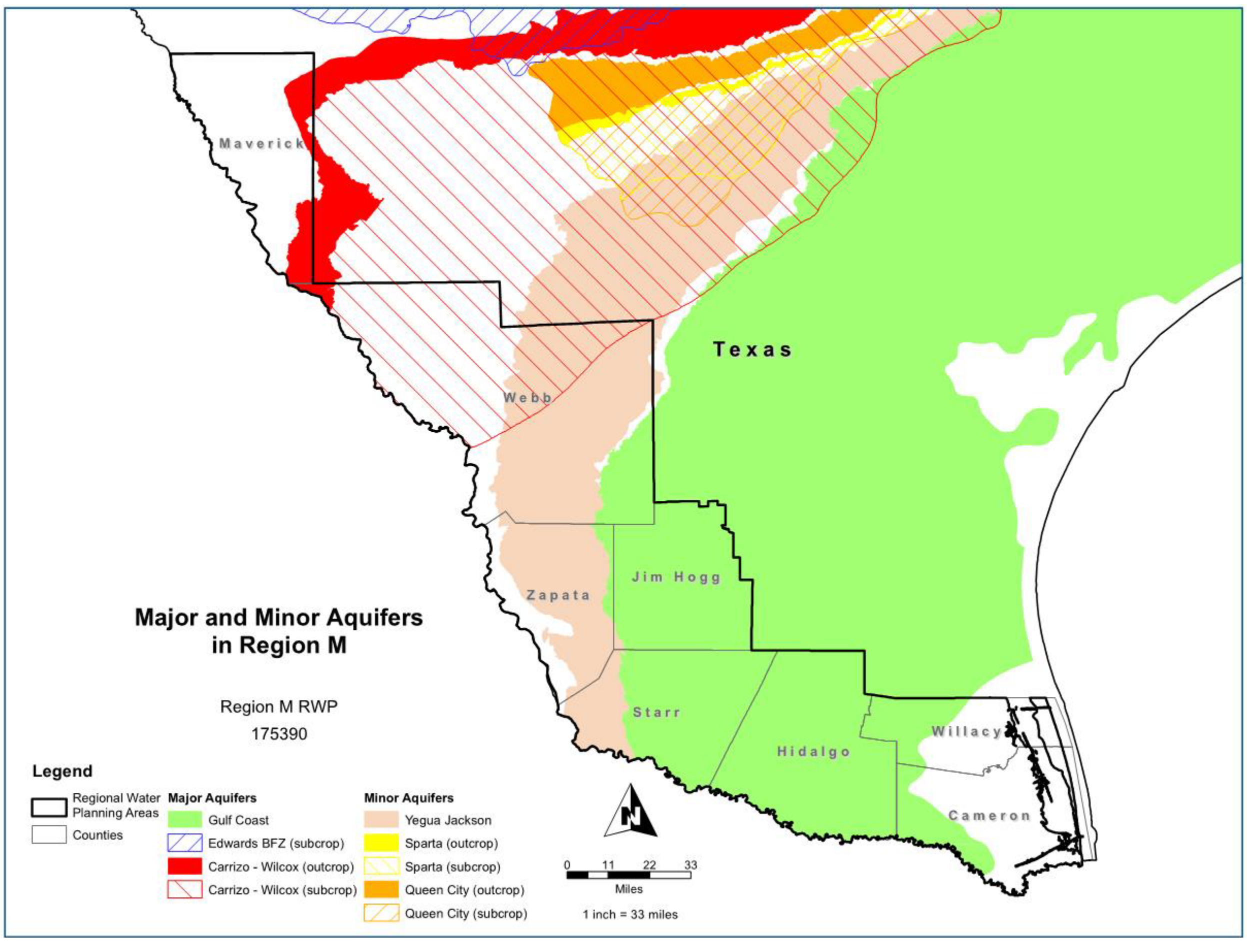

Figure 5 Major and Minor Aquifers in Region M

In general, groundwater from the major 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). There are, however, some areas of fresh and useable groundwater which constitutes a critical supply for many towns, domestic needs in rural areas, as well as livestock. Localized areas of high boron content occur throughout the study area.

A recent report from TWDB's Brackish Resource Aquifer Characterization System (BRACS) program presented information on the brackish groundwater resources of the Lower Rio Grande Valley, in response to increased development of these resources. 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.

ES. 3 Current and Projected Water Use

Both irrigation and municipal demands are greatest in the Lower Rio Grande, which is primarily served by a network of irrigation districts that divert water to farmers and municipal utilities from the Rio Grande. Demand in other water user groups is comparatively very small, as shown in Figure 6.

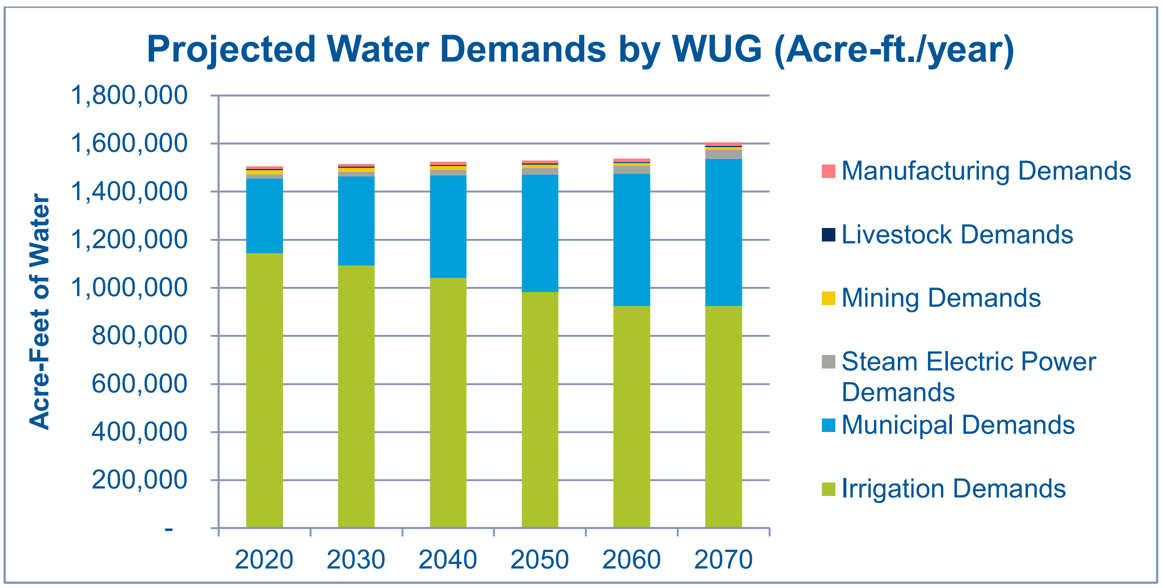

Figure 6 **Water demand projections for each water user group type in Region M (Acre-feet/year)**

ES.3.1 Wholesale Water Providers

Region M has two general types of Wholesale Water Provider (WWP): those that provide raw water to irrigators, cities, and other types of users, most commonly Irrigation Districts, and those who provide retail and/or wholesale treated water to municipal users and industrial users.

Irrigation Districts divert and deliver raw water to irrigated farmland, and sometimes municipalities and industrial or livestock users. There are 27 Irrigation Districts in Region M which operate under the Texas Water Code, but each one has its own internal operating policies. The physical distribution networks are mostly earthen canal, some concrete lined canals, and some pipeline. The losses within Irrigation districts, as a result of seepage, evaporation, and operational losses, are anywhere between 15% and 40%. Irrigation District operations are discussed in more detail in Chapter 3.

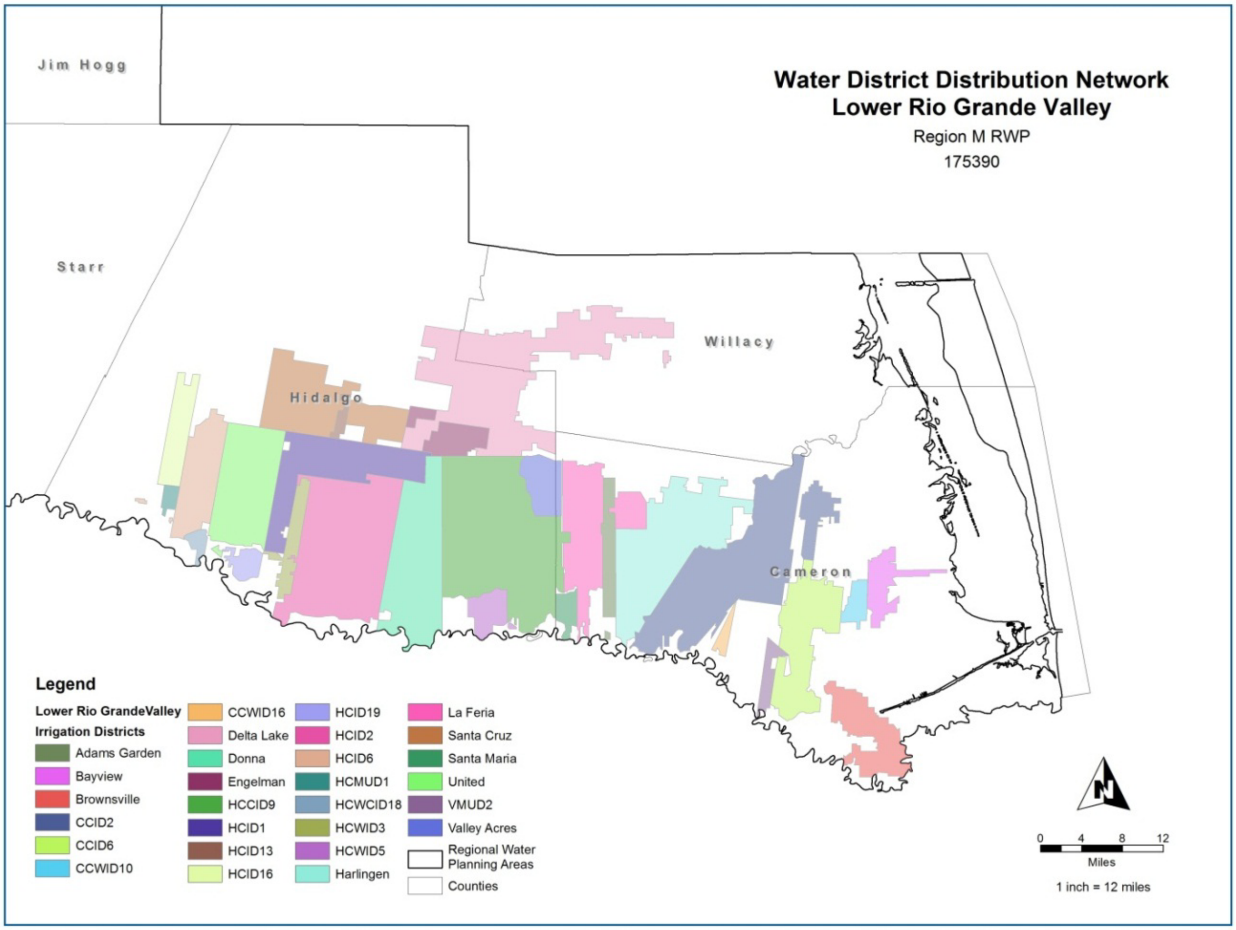

Figure 7 Water District Distribution Network, Lower Rio Grande Valley

Water supply corporations (WSCs) cover most of the rural area in the lower Rio Grande Valley, and supply many of the populated rural areas in the western counties. The largest are North Alamo WSC, East Rio Hondo WSC, Sharyland WSC, and Military Highway WSC, which all treat and deliver both surface and groundwater to significant unincorporated and rural areas and portions of cities. Other WSCs in the region include Southmost Regional Water Authority, Valley Municipal Utility District #2, Webb County Water Utility, and Laguna Madre Water District. Brownsville, Eagle Pass, Harlingen, Laredo, Rio Grande City, and Weslaco also sell water to other WUGs in sufficient quantity to be considered WWPs.

ES.3.2 Municipal Demands

Municipal demands are expected to increase regionally from a projected 311,591 acre-ft./year in 2020 to 612,127 acre-ft./year in 2070.

The majority of this demand is currently met by surface water from the Rio Grande, most commonly delivered by Irrigation Districts. However, eight brackish groundwater desalination plants have been built since 2000, supplying approximately 24,000 acre-ft./year of potable water. Fresh groundwater availability is limited in the region, and is used mostly as a back-up water supply for utilities or for individual homes, particularly in rural and unincorporated areas, with a few exceptions.[6]

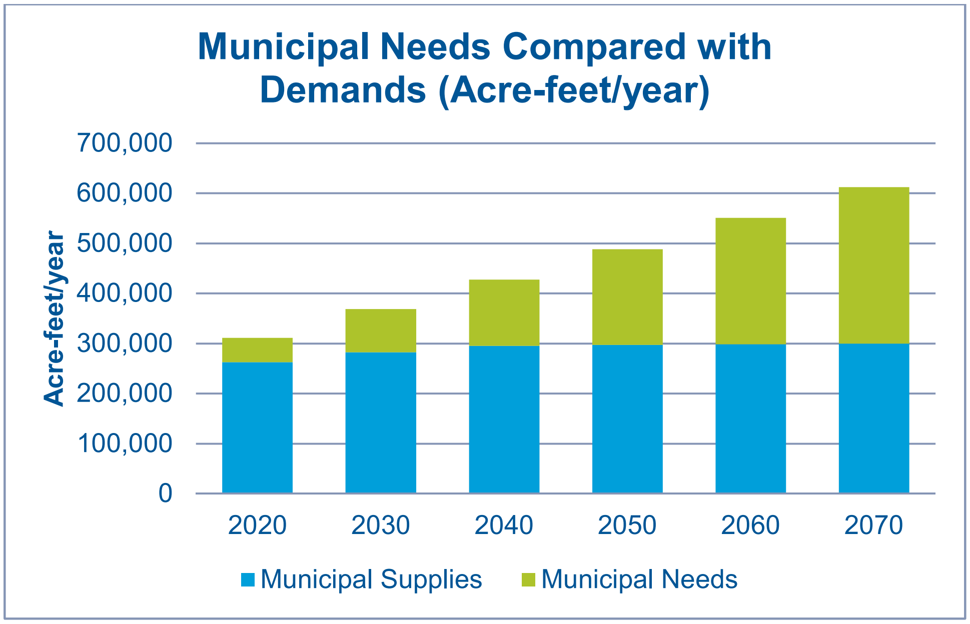

Figure 8 **Municipal Supplies Shown relative to Municipal Demands (Acre-feet /year)**

The surface water rights of every municipal utility that is diverted by an Irrigation District are reduced by the estimated conveyance losses for that Irrigation District. These losses represent regular losses through seepage, evaporation, and operations in a drought year, but not a scenario where push-water is required. For those Irrigation Districts that primarily serve irrigation users, there can be long periods between irrigations in drought years, especially when the District goes on allocation and limits irrigation water use. Because the Irrigation District conveyance systems generally require an operational minimum of water to charge the canals, there can be periods of time when municipal water rights are not sufficient to meet operational requirements and require additional water, or push-water, in order to be delivered. Cities in Region M have been alerted that they may need push water, but have not yet had to use this water as of April, 2015.

Table 5 **Municipal Demand by County (Acre-feet /year)**

County	2020	2030	2040	2050	2060	2070
Cameron	81,393	92,861	104,873	118,439	132,937	147,932
Hidalgo	158,629	192,687	227,640	263,440	300,014	335,816
Jim Hogg	692	720	746	787	829	871
Maverick	10,273	11,538	12,752	14,085	15,430	16,738
Starr	10,597	11,631	12,620	13,694	14,732	15,689
Webb	43,754	52,567	61,171	69,260	77,161	84,343
Willacy	3,257	3,557	3,871	4,235	4,610	4,982

[6] Military Highway Water Supply Corporation and the City of Hidalgo both have significant sources of well water.

County	2020	2030	2040	2050	2060	2070
Zapata	2,996	3,436	3,938	4,509	5,117	5,756
Total	**311,591**	**368,997**	**427,611**	**488,449**	**550,830**	**612,127**

ES.3.3 Irrigation Demands

Irrigation represents the largest water demand in Region M (1.14 million acre-ft./year in 2020 and 0.9 million acre-ft./year in 2070), but is projected to decrease as a result of both urbanization of lands and increasing pressure on the region's water resources. Irrigation water rights are not guaranteed to be available in full, and therefore supply shortages impact irrigation supplies.

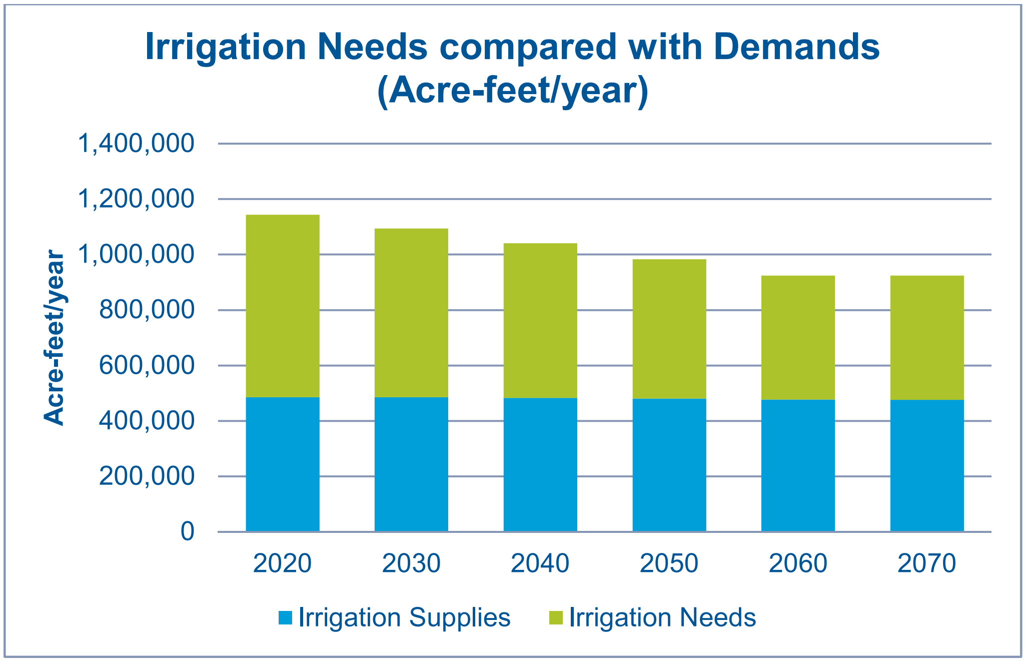

Figure 9 Irrigation Supplies as a Portion of Irrigation Demands (Acre-feet /year)

Irrigation demands shown in this plan represent the worst-case scenario, wherein the demands are based on a dry year, and the supplies are what can be expected in the worst drought year. The difference between drought year demand and actual use in a particular year for agricultural users can be significant. If a drought year is anticipated, farmers can prepare by planting crops and vegetables with lower water demands, which are often of lower value, but may require fewer or no irrigations. Increases in farming efficiency can also allow irrigators to maintain higher value crops or higher yields in times with less available water.

ES.3.4 Industrial Demands

Livestock, Mining, Steam-Electric Power Generation, and Manufacturing demands make up a very small portion of the region's water use as a whole. However, a localized analysis reveals that mining demands represent a significant portion of water usage in Webb and Zapata Counties, and Livestock demand is over 25% of the county total in Jim Hogg.

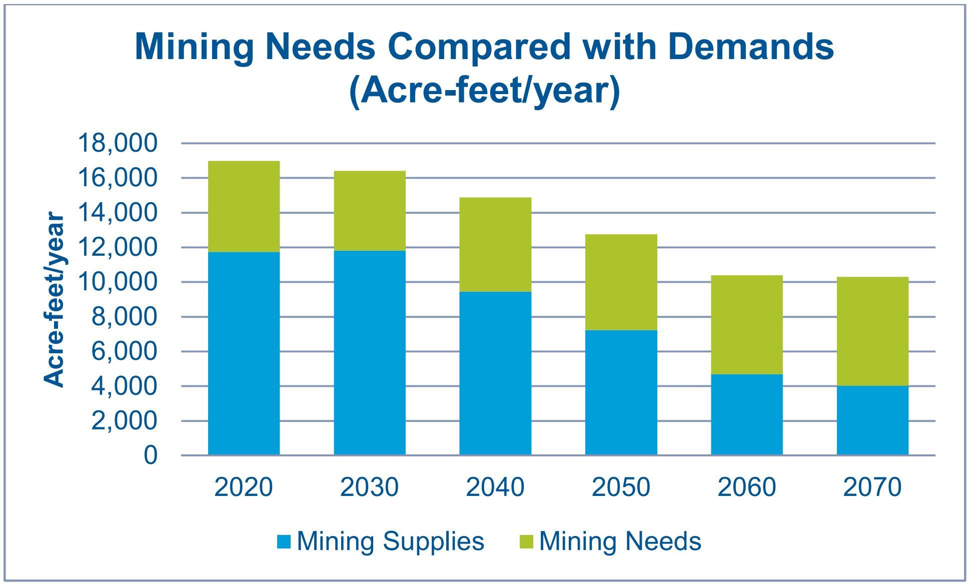

Figure 10 Mining Supplies as a Portion of Mining Demands (Acre-feet /year)

Mining supplies are shown to decrease slightly over the planning horizon because the demands and supplies presented here are aggregated over the region. In reality, supplies and demands are associated with each other within specific counties and river basins. Regionally, the total supplies exceed the total demand, but because surpluses are shown as zero in the needs calculation, the counties that still have needs (Hidalgo in particular) cause the region to show an overall need. A local supply in one county does not meet needs in a different county without additional measures taken, like selling or moving water, which are discussed separately as Water Management Strategies. The supplies shown here are supplies that are already in the right place/ownership to meet a demand, so as the demands decrease so do the supplies.

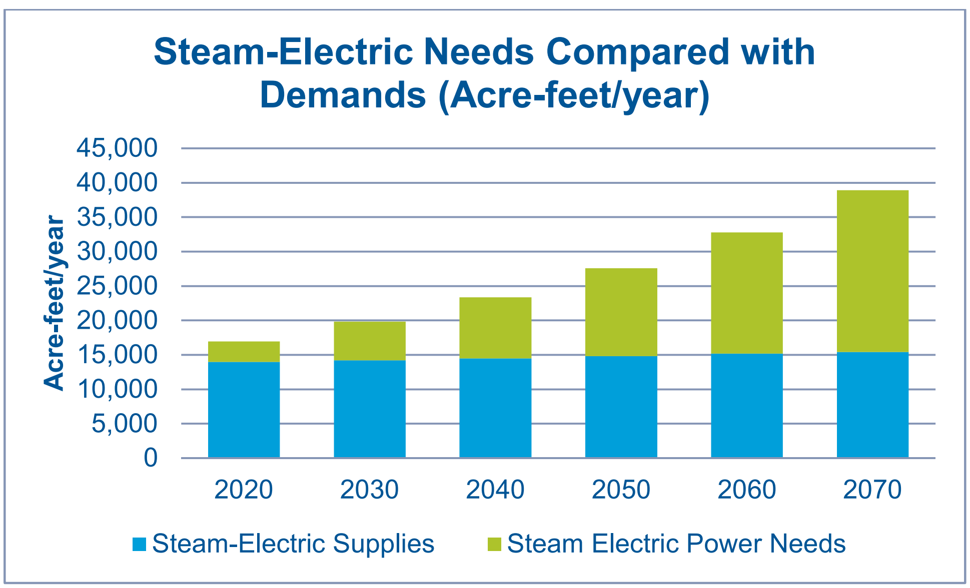

Figure 11 Steam Electric Water as a Portion of Steam Electric Demands (Acre-feet /year)

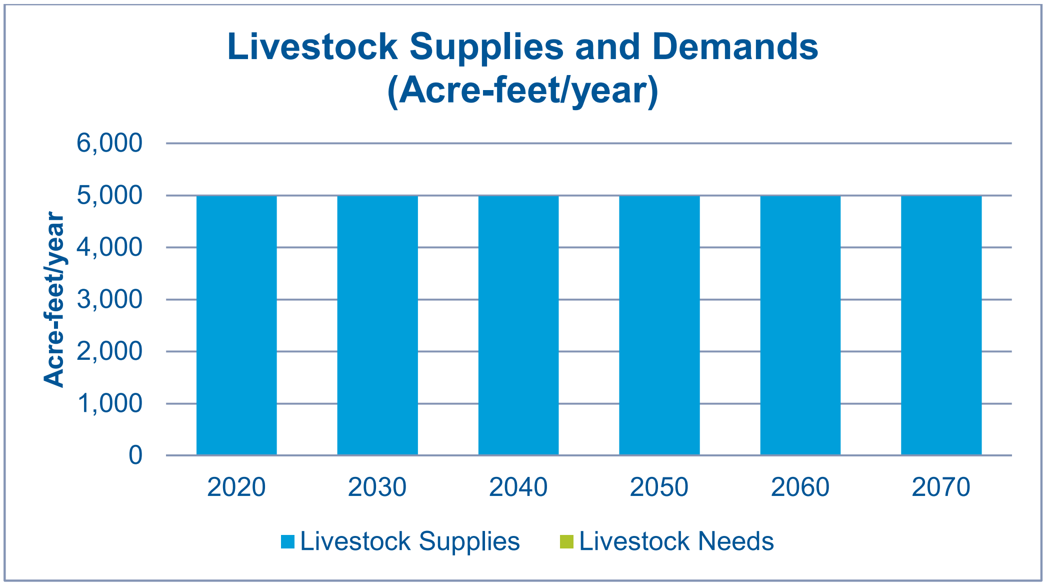

Figure 12 Livestock Water as a Portion of Livestock Demands (Acre-feet /year)

Livestock demands are shown as being 100% met by existing supplies. This rests on the assumption that livestock is managed such that drought year demands are limited to the supplies known to be available. Livestock demands are met with Rio Grande water, groundwater, and some local supplies of surface water reserved particularly for livestock.

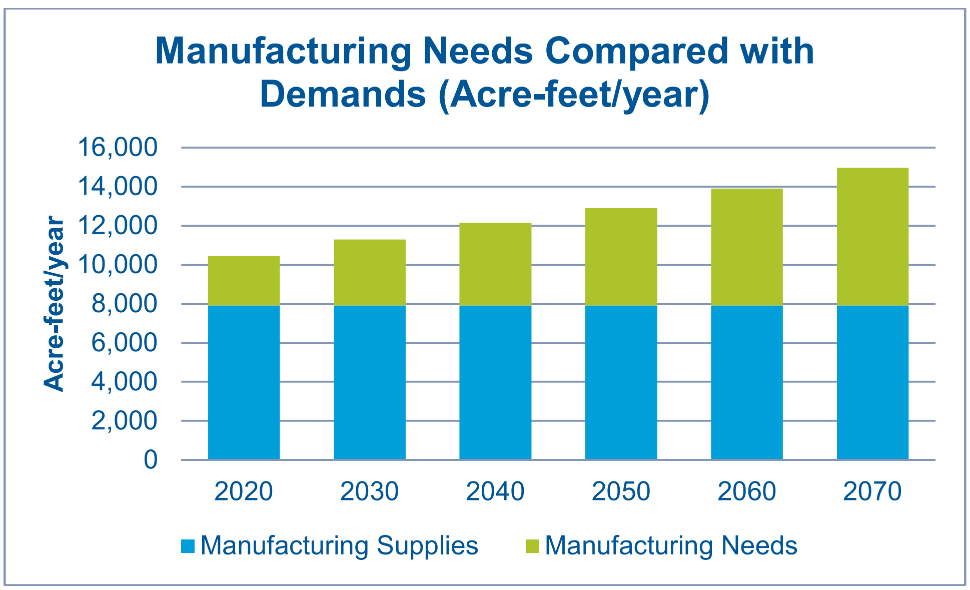

Figure 13 Manufacturing Supplies as a Portion of Manufacturing Demands (Acre-feet /year)

Table 6 summarizes the population, demand, supply and needs for each WUG within Region M.

Table 6 Population, Demand, Supply, and Needs[7] for each WUG (Acre-feet /year)

Region M	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MUNICIPAL						
POPULATION	1,799,926	2,194,660	2,587,179	2,980,668	3,372,124	3,752,822
DEMANDS (acre-ft./year)	289,511	344,462	400,547	458,649	518,212	576,729
EXISTING SUPPLIES (acre-ft./year)	288,986	289,059	289,132	289,201	289,233	289,233
NEEDS (acre-ft./year)	-38,425	-74,269	-117,948	-174,353	-233,168	-291,303
COUNTY-OTHER						
POPULATION	160,812	184,562	207,760	231,270	254,261	276,516
DEMANDS (acre-ft./year)	22,080	24,535	27,064	29,800	32,618	35,398
EXISTING SUPPLIES (acre-ft./year)	14,939	14,939	14,939	14,939	14,939	14,939
NEEDS (acre-ft./year)	-10,109	-12,124	-14,225	-16,481	-18,808	-21,107
MANUFACTURING						
DEMANDS (acre-ft./year)	10,433	11,292	12,147	12,898	13,896	14,971
EXISTING SUPPLIES (acre-ft./year)	7,904	7,904	7,904	7,904	7,904	7,904
NEEDS (acre-ft./year)	-2,529	-3,388	-4,243	-4,994	-5,992	-7,067
MINING						
DEMANDS (acre-ft./year)	17,051	16,480	14,952	12,823	10,458	10,361
EXISTING SUPPLIES (acre-ft./year)	12,099	12,098	12,068	12,044	12,019	12,002
NEEDS (acre-ft./year)	-5,290	-4,641	-5,488	-5,565	-5,758	-6,337
STEAM ELECTRIC POWER						
DEMANDS (acre-ft./year)	16,972	19,842	23,340	27,605	32,806	38,916
EXISTING SUPPLIES (acre-ft./year)	15,415	15,415	15,415	15,415	15,415	15,415
NEEDS (acre-ft./year)	-2,984	-5,635	-8,866	-12,805	-17,608	-23,501
LIVESTOCK						
DEMANDS (acre-ft./year)	4,986	4,986	4,986	4,986	4,986	4,986
EXISTING SUPPLIES (acre-ft./year)	9,625	9,625	9,625	9,625	9,625	9,625
NEEDS (acre-ft./year)	0	0	0	0	0	0
IRRIGATION						
DEMANDS (acre-ft./year)	1,144,135	1,093,749	1,040,789	983,283	924,558	924,558
EXISTING SUPPLIES (acre-ft./year)	486,490	485,574	484,164	483,717	482,530	481,912
NEEDS (acre-ft./year)	-658,049	-608,580	-557,158	-502,526	-447,439	-448,029
REGION TOTALS						
POPULATION	1,960,738	2,379,222	2,794,939	3,211,938	3,626,385	4,029,338
DEMANDS (acre-ft./year)	1,505,168	1,515,346	1,523,825	1,530,044	1,537,534	1,605,919
EXISTING SUPPLIES (acre-ft./year)	835,458	834,614	833,247	832,845	831,665	831,030
NEEDS (acre-ft./year)	-717,386	-708,637	-707,928	-716,724	-728,773	-797,344

ES.3.5 Source Balance

The Source Water Balance data for Region M's water resources are shown in the tables below. This shows the portion of each source which is not supplied to a WUG, by county and river basin. For surface water, this includes the portion of Rio Grande water that is lost in the

[7] Needs are shown as negative, surpluses shown as positive.

conveyance systems or water that Irrigation Districts are able to divert but otherwise do not deliver to an end user, such as unused water rights.

Table 7 Groundwater Source Water Balance (Acre-feet /year)

Source	County	Basin	Salinity	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer	Maverick	Nueces	Fresh	312	312	7	7	7	7
Carrizo-Wilcox Aquifer	Maverick	Rio Grande	Fresh	1,106	1,087	1,045	938	900	900
Carrizo-Wilcox Aquifer	Webb	Nueces	Fresh	0	0	0	0	0	0
Carrizo-Wilcox Aquifer	Webb	Rio Grande	Fresh	282	282	282	282	282	282
Gulf Coast Aquifer	Cameron	Nueces-Rio Grande	Fresh/ Brackish	29,560	29,560	29,560	29,560	29,560	29,560
Gulf Coast Aquifer	Cameron	Rio Grande	Fresh/ Brackish	1,324	1,324	1,324	1,324	1,324	1,324
Gulf Coast Aquifer	Hidalgo	Nueces-Rio Grande	Fresh/ Brackish	14,618	14,618	14,618	14,618	14,618	14,618
Gulf Coast Aquifer	Hidalgo	Rio Grande	Fresh/ Brackish	302	302	302	302	302	302
Gulf Coast Aquifer	Jim Hogg	Nueces-Rio Grande	Fresh/ Brackish	20,486	20,482	20,507	20,526	20,545	20,557
Gulf Coast Aquifer	Jim Hogg	Rio Grande	Fresh/ Brackish	3,184	3,184	3,184	3,184	3,184	3,184
Gulf Coast Aquifer	Starr	Nueces-Rio Grande	Fresh/ Brackish	2,028	2,028	2,028	2,028	2,028	2,028
Gulf Coast Aquifer	Starr	Rio Grande	Fresh/ Brackish	3,427	3,427	3,427	3,427	3,427	3,427
Gulf Coast Aquifer	Webb	Nueces	Fresh/ Brackish	0	0	0	0	0	0
Gulf Coast Aquifer	Webb	Nueces-Rio Grande	Fresh/ Brackish	1,725	1,725	1,725	1,725	1,725	1,725
Gulf Coast Aquifer	Webb	Rio Grande	Fresh/ Brackish	182	182	182	182	182	182
Gulf Coast Aquifer	Willacy	Nueces-Rio Grande	Fresh/ Brackish	16,147	16,147	16,147	16,147	16,147	16,147
Gulf Coast Aquifer | Catahoula Formation	Zapata	Rio Grande	Fresh	0	0	0	0	0	0
Other Aquifer	Maverick	Nueces	Fresh	0	0	0	0	0	0
Other Aquifer	Webb	Rio Grande	Fresh	0	0	0	0	0	0
Other Aquifer	Zapata	Rio Grande	Fresh	0	0	0	0	0	0
Other Aquifer | Alluvium	Maverick	Rio Grande	Fresh	0	0	0	0	0	0
Other Aquifer | Alluvium	Starr	Rio Grande	Fresh	0	0	0	0	0	0
Other Aquifer | Alluvium	Webb	Nueces	Fresh	0	0	0	0	0	0
Other Aquifer | Rio Grande Alluvium	Hidalgo	Nueces-Rio Grande	Fresh	0	0	0	0	0	0
Other Aquifer | Rio Grande Alluvium	Hidalgo	Rio Grande	Fresh	0	0	0	0	0	0
Queen City Aquifer	Webb	Nueces	Fresh	0	0	0	0	0	0

Source	County	Basin	Salinity	2020	2030	2040	2050	2060	2070
Queen City Aquifer	Webb	Rio Grande	Fresh	0	0	0	0	0	0
Sparta Aquifer	Webb	Nueces	Fresh	0	0	0	0	0	0
Sparta Aquifer	Webb	Rio Grande	Fresh	0	0	0	0	0	0
Yegua-Jackson Aquifer	Jim Hogg	Rio Grande	Fresh	0	0	0	0	0	0
Yegua-Jackson Aquifer	Starr	Rio Grande	Fresh	1,785	1,785	1,785	1,785	1,785	1,785
Yegua-Jackson Aquifer	Webb	Nueces	Fresh	11,969	11,969	11,969	11,969	11,969	11,969
Yegua-Jackson Aquifer	Webb	Rio Grande	Fresh	8,030	8,030	8,030	8,030	8,030	8,030
Yegua-Jackson Aquifer	Zapata	Rio Grande	Fresh	6,802	6,802	6,802	6,802	6,802	6,802
Groundwater Total Source Water Balance				**123,269**	**123,246**	**122,924**	**122,836**	**122,817**	**122,829**

Table 8 Surface-Water Source Water Balance (Acre-feet /year)

Source	County	Basin	Salinity	2020	2030	2040	2050	2060	2070
Amistad-Falcon Reservoir System	--	Rio Grande	Fresh	300,609	300,101	300,086	299,113	298,918	298,184
Livestock Local Supply	Jim Hogg	Nueces-Rio Grande	Fresh	0	0	0	0	0	0
Livestock Local Supply	Jim Hogg	Rio Grande	Fresh	0	0	0	0	0	0
Livestock Local Supply	Maverick	Nueces	Fresh	0	0	0	0	0	0
Livestock Local Supply	Maverick	Rio Grande	Fresh	0	0	0	0	0	0
Livestock Local Supply	Starr	Rio Grande	Fresh	0	0	0	0	0	0
Livestock Local Supply	Webb	Nueces	Fresh	0	0	0	0	0	0
Livestock Local Supply	Webb	Nueces-Rio Grande	Fresh	0	0	0	0	0	0
Livestock Local Supply	Webb	Rio Grande	Fresh	0	0	0	0	0	0
Livestock Local Supply	Zapata	Rio Grande	Fresh	0	0	0	0	0	0
Nueces-Rio Grande Run-Of-River	Cameron	Nueces-Rio Grande	Fresh	0	0	0	0	0	0
Nueces-Rio Grande Run-Of-River	Hidalgo	Nueces-Rio Grande	Fresh	7,522	7,522	7,522	7,522	7,522	7,522
Nueces-Rio Grande Run-Of-River	Willacy	Nueces-Rio Grande	Fresh	0	0	0	0	0	0
Rio Grande Run-Of-River	Maverick	Rio Grande	Fresh	0	0	0	0	0	0
Rio Grande Run-Of-River	Webb	Rio Grande	Fresh	0	0	0	0	0	0
Surface Water Total Source Water Balance				**308,131**	**307,623**	**307,608**	**306,635**	**306,440**	**305,706**

Table 9 Reuse Source Water Balance (Acre-feet /year)

Source	County	Basin	Salinity	2020	2030	2040	2050	2060	2070
Direct Reuse	Maverick	Rio Grande	Fresh	650	650	650	650	650	650
Direct Reuse	Cameron	Nueces-Rio Grande	Fresh	7,541	11,542	13,367	13,367	14,367	14,367
Direct Reuse	Webb	Rio Grande	Fresh	0	5,725	5,725	5,725	8,960	11,760
Direct Reuse	Cameron	Rio Grande	Fresh	23	23	23	23	23	23
Direct Reuse	Hidalgo	Nueces-Rio Grande	Fresh	18,206	19,876	20,996	25,796	28,036	28,036
Direct Reuse	Hidalgo	Rio Grande	Fresh	2,887	4,887	6,283	7,493	7,493	7,493
Reuse Total Source Water Balance				**29,307**	**42,703**	**47,044**	**53,054**	**59,529**	**62,329**

ES. 4 Water Management Strategies

The regional water planning group is tasked with evaluating all potentially feasible Water Management Strategies (WMS) and recommending selected strategies to meet current and future needs in the region. The potentially feasible water management strategies came from three major sources:

1. The recommended WMS from the 2011 Region M Plan,
2. Responses to a request sent to all water providers and stakeholders for project and strategy descriptions in 2013, and
3. The list of WMS for consideration listed in the water planning guidance documents provided by the TWDB.

All of the submitted strategies are included in Electronic Appendix EA-6.i, and the complete list of potentially feasible strategies is located in Appendix C.

The 2011 Regional Water Plan strategies for Irrigation District Conservation and Municipal Water Conservation were considered and re-developed with additional conservation measures and updated cost estimates and yield projections. Most of the specific projects that were re-evaluated from the 2011 RWP were infrastructure, brackish groundwater desalination facilities, and expansion of existing groundwater supplies.

The request for WMS from stakeholders took place over 2 months in 2013, with follow-up taking place over the next 18 months. Forty-six entities submitted 180 projects and strategies to be evaluated. Municipal utilities and irrigation districts submitted most of the projects and strategies, and some additional conservation measures were submitted by Texas A&M AgriLife Extension services and the USDA. The costs, projected yield, feasibility, and impacts were evaluated for accuracy, consistency, and compliance with TWDB rules and guidance where that information was available, and where information was not available assumptions were made and documented.

The WMS components that are included in this RWP are limited to the infrastructure and costs that are required to develop and convey increased water supplies from water supply sources and to treat the water for end WUG requirements. Conservation WMS that are needed to address water loss or infrastructure bottlenecks in an existing water supply conveyance system and result in increased supplies or decreased demands are also included. Infrastructure components associated with internal water distribution networks that do not convey an additional water supply volume or address current losses are not included in the RWP.

For every WUG, the projected water saved through Irrigation District improvements and Advanced Municipal Conservation that affects the WUG was subtracted from the original need to obtain a revised need after conservation. If a need still existed, additional WMS were considered for the WUG. In cases where two or more alternatives were available without significant negative impacts, an evaluation process was used to select the most appropriate WMS. The evaluation process ranked each potential WMS in order based on the following criteria:

1. The exclusion of projects considered regular maintenance and internal distribution (not providing new or supplemented supplies), and WMS that did not have sufficient information to evaluate (yes/no)
2. Requires changes to existing law or policy for implementation (yes/no)
3. Significant risk with permitting or implementation, including environmental impacts (yes/no)
4. Limited source availability/exclusion of other WMS. This has been indicated as a "yes" for WMS that rely on fully appropriated sources, or are competing with other strategies for the same water source as other current and future supplies. (yes/no)
5. Ranking of unit cost from lowest to highest (n/a is ranked as the 'highest' cost)
6. Ranking of yield from largest to smallest (many recommended projects don't have a specific drought year yield associated with them, but they're considered important, and are listed as recommended with zero yield).

The highest ranked WMS or portfolio of strategies with sufficient yield to meet the needs after conservation were recommended for each WUG and any additional viable WMS that ranked well were listed as alternative recommended strategies. Only WMS with insufficient information or major feasibility concerns were evaluated but not recommended.

The Water Management Strategy Committee of the Region M Water Planning Group evaluated special cases, including Irrigation Conservation, Biological Control of Arundo Donax, and brush control as WMS for Irrigation WUGs. This Committee made recommendations to the Planning Group for the action taken in each special case. The total number of projects recommended and the yield projected for each type of strategy is shown in Table 10.

Table 10 Summary of Recommended WMS

Category	Number of WMS	2020 Yield (AF/Y)	2070 Yield (AF/Y)
Acquisition of Water Rights	25	6,045	76,976
Brush Control/Bio. Control of A. Donax	20	20,024	23,384
Brackish Groundwater	19	3,491	5,315
Distribution & Transmission	3	982	870
Fresh Groundwater	13	11,005	11,805
Industrial Conservation	23	4,445	6,424
Irrigation District Conservation	27	85,973	209,561
Municipal Conservation	67	7,290	123,092
On Farm Conservation	12	138,169	138,169
Direct Reuse	17	26,726	58,077
Seawater Desalination	1	2,800	28,000
Storage	4	12,729	12,800
Surface Water Treatment	5	4,370	15,180

Environmental impacts of each WMS were evaluated and categorized based on the type of WMS. The categories of impacts that were quantified include: Acres Impacted Permanently, Estimated Construction Impacted Acreage, Inundation Acreage, Wetland Impact, Habitat Impacted Acreage, Threatened and Endangered Species Count, Cultural Resources Impact, Farmland Acres, Volume and TDS of Brine from desalination WMS, and Reduction in WWTP Effluent for Reuse WMS.

ES.4.1 Water Infrastructure and Distribution Systems, Assumptions and Methodology

Irrigation District Conservation

Irrigation Districts (IDs) carry over 85% of the water that is used from the Rio Grande system in Region M. These districts were initially built to deliver water for agricultural use, but many districts now serve municipal and industrial users as well. Most of these systems have similar components, with initial pump stations to divert water from the river, some storage in either off-channel reservoirs or in the main canals, and canal or pipeline networks that deliver water to municipal utilities for treatment and distribution, or to farmlands. Black and Veatch worked with Texas A&M AgriLife Research (AgriLife) to develop expected water conservation and costs for Irrigation District Conservation water management strategies (WMS) for all 27 Irrigation Districts in Region M.

Stakeholder meetings were held with IDs and agricultural producers to discuss potential WMS, estimated costs, water savings and implementation feasibility. Stakeholder input is especially critical because of the unique nature of the Rio Grande Valley's IDs. This effort included a review and analysis of the water conservation strategies submitted by IDs and development of WMS for the IDs that did not submit specific projects. Sixty-four WMS were submitted by 15 IDs, representing a fairly consistent approach to reducing losses.

It is intended that these IDs could implement any water conservation or storage improvements, including, but not limited to: metering, control automation, gates, canal lining, repair of canal lining, pipeline installation, district interconnects, new reservoirs, reservoir improvements, or any other strategy which provides provide beneficial, measureable conservation improvements to the ID.

Municipal Infrastructure Improvements

Operational, treatment, and distribution projects that allow a WUG to either access a new supply, eliminate known losses, or develop new supplies are included as Municipal Infrastructure Improvements. Municipal Infrastructure Improvements focus on problem-specific water management strategies that relate to treatment, storage, or distribution and transmission. Insufficient treatment capacity or capability can be a supply limitation, inadequate storage can disrupt operations, and transmission and distribution projects may be required for entities that are experiencing significant water losses due to eroded pipelines, or leaking water tanks. Because these projects are particular to the municipal utility systems, these projects were evaluated individually based on the available information.

ES.4.2 Wastewater Reuse

With increasing pressure state-wide on water resources, Texas water users are considering and pursuing reuse or recycling of wastewater. Wastewater can be treated and reused for either potable or non-potable uses, and can include a step that returns water to the environment for a period of time (indirect) or not (direct). All approaches to reuse have been evaluated and the most appropriate alternatives recommended.

Non-Potable Reuse

Wastewater reuse is most commonly used for agriculture, landscape, public parks, and golf course irrigation, industrial uses, dust control, and construction activities. This WMS is feasible if several factors are taken into consideration: 1) the location of wastewater treatment facilities relative to the location 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.

Non-potable Reuse was evaluated for those entities that identified it as a desired WMS. In each case, the end user's demands were evaluated to verify that the supply was only considered where a demand would have otherwise been filled by municipal water, either raw or treated. In the cases where a non-potable reuse WMS was evaluated but there was no specific end user associated with the strategy, that WMS was categorized as having an possible implementation risk in the ranking matrix during the evaluation process because of the possibility that customers could not be identified. For these WMS the yield was estimated as 5% of the WUG's 2020 demand.

Potable Reuse

Highly treated wastewater effluent can be used as a supplemental water supply for potable use. Indirect potable reuse is commonly practiced in Texas when surface water supplies are deliberately augmented with treated wastewater effluent. Direct potable reuse has becoming a feasible alternative in recent years, due to advances in technology and public acceptance as well as precedent in regulatory acceptance.

This WMS is feasible if several factors are taken into consideration: 1) the location of wastewater treatment facilities relative to the location of potential surface waters and water treatment facilities, 2) the level of treatment and quality of the reclaimed water, 3) the water quality requirements for potable water, and 4) the public acceptance of reuse.

TCEQ is currently in the process of establishing the requirements for both indirect and direct potable reuse. In 2012, TWDB funded a study to assess the potential for direct potable reuse in Texas and develop a resource document that provides scientific and technical information for the implementation of direct potable reuse.[8] The study was scheduled for completion in December 2014. There are two direct potable reuse projects to date in Texas. The City of Wichita Falls and the City of Big Spring have both implemented direct potable reuse projects. Both of the cities were issued permits from the TCEQ following extensive testing of the drinking water. Until official requirements are set by the TCEQ, indirect and direct potable reuse projects are being approved on a case-by-case basis pending testing and confirmation of the drinking water quality.

[8] http://www.twdb.texas.gov/innovativewater/reuse/projects/directpotable/index.asp

All of the potable reuse strategies recommended in this Regional Water Plan are considered direct reuse, because none of them have sufficient evidence that the reuse water would be retained in a natural environmental buffer for what would be considered an extended amount of time. By TWDB definition, indirect reuse refers to water that is returned to a natural water body such that an additional permit is required to access that water after buffering.

In addition to the submitted potable reuse water management strategies, an evaluation of wastewater treatment plants in the Region was performed in order to determine other entities that could benefit from potable reuse. All of the wastewater treatment plants not included in a recommended reuse water management strategy with an average effluent flow greater than 2.0 MGD were considered suitable to potentially provide a cost effective yield of reuse water. It was assumed that half of the average effluent flow would be available for reuse on a consistent basis. The wastewater treatment plants that had at least 1.0 MGD of water available after the amount of reclaimed water currently being used and are within reasonable distances to water treatment plants have been further evaluated for potable reuse strategies.

Many of the locations where potable reuse was recommended are in the Nueces-Rio Grande Basin, but the source waters are predominantly from the Rio Grande. Impacts of wastewater reuse projects will primarily impact the flows into the drainage network, including the Arroyo Colorado. There are water rights holders along the Arroyo Colorado and other drainage canals in the Nueces Rio-Grande basin that could potentially be impacted, including irrigators, some shrimp farming and other aquaculture.

ES.4.3 Desalination

There are several desalination methods to treat brackish and saline groundwater and seawater, the most common of which is membrane technology. The most prevalent membrane technology today is reverse osmosis (RO). Brackish or saline water is highly pressurized and pushed through semi-permeable membranes, which separate the brackish or saline water into fresh water and a concentrated by-product. For higher total dissolved solids (TDS) found in seawater, RO becomes significantly more energy intensive and has a lower yield of permeate, or fresh water. 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, which generally requires disposal and can add significant costs to a project. This compares to approximately 80% with the lower salinity brackish water facilities. Surface water intakes will require additional pretreatment of suspended solids prior to the RO treatment.

Local Brackish Groundwater Development and Treatment

Texas currently has more than 40 municipal brackish desalination plants, with a combined capacity of about 123 million gallons per day. That includes 73 million gallons per day of brackish groundwater desalination and 50 million gallons per day of brackish surface water desalination.[9] The average cost to produce desalinated water from brackish groundwater ranges from approximately $350 to $780 per acre-foot.

The disposal of concentrate from desalination facilities will increase levels of Total Dissolved Solids (TDS) in the receiving streams. Many of the facilities that are currently treating brackish groundwater dispose of concentrate in the drainage canal network in the Nueces-Rio Grande Basin, which is a part of why desalination is affordable for some Utilities in the Region. This network of canals is usually brackish, and discharges into the Laguna Madre, parts of which are naturally hyper-saline. The greatest recent threat to wildlife in the Lower Laguna Madre has been increased inflows of low-salinity water.

As with any groundwater development project, there is potential to affect the quality of the aquifer as more water is drawn from it. Land subsidence may be a by-product of increased groundwater pumping.

Seawater Desalination

Texas does not yet have a seawater desalination plant. Charged with developing the first seawater desalination plant in Texas, the TWDB has completed three feasibility studies and two pilot-plant studies. To this date two desalination plants have been proposed – one by the Brownsville Public Utilities Board and the other by the Laguna Madre Water District.

Seawater desalination still remains one of the higher cost water management strategies, but costs have declined over the years as technology advances. The average cost to produce desalinated water from seawater ranges 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.

ES.4.4 Fresh Groundwater

While there is not abundant fresh groundwater available in Region M, there are numerous entities and individuals that rely on minimally treated groundwater to meet their needs. Cities that are farther from the Rio Grande and surface water distribution networks have few alternative sources, and have identified portions of the aquifer(s) that produce acceptable water for municipal use without advanced treatment technology.

In some cases, where there appears to be additional available fresh groundwater, further development of that source is recommended, within the Managed Available Groundwater values for the applicable aquifer. In many cases this is the recommendation for County-Other entities, where domestic wells are distributed over a large area and pump small amounts for a single household.

---

[9] TWDB Desalination Plant Database, http://www2.twdb.texas.gov/apps/desal/default.aspx updated in 2011, accessed 4/14/2015. Only public water supply plants with a capacity greater than 0.025 MGD are reported in the database.

ES.4.5 Advanced Municipal Conservation

Advanced Water Conservation is recommended for every municipal WUG in Region M. A variety of conservation measures are recommended as described in the TWDB Best Management Practices (BMP), any combination of which can be used to meet the specific goals for a municipality or utility.[10] Conservation can be achieved using a variety of strategies, including the following:

1. System Operations
2. Landscaping
3. Education and Public Awareness
4. Rebate, Retrofit, and Incentive Programs
5. Conservation Technology
6. Regulatory Enforcement

In addition to some specific WMS submitted, Advanced Municipal Conservation is recommended for every WUG. For every municipal WUG with a projected need or a per capita water use rate greater than 140 gallons per capita per day (GPCD), municipal conservation yield and costs were estimated. The amount of water that can be conserved by implementing Advanced Municipal Conservation measures and associated costs were estimated with the assistance of the Unified Costing Model (UCM) tool.

ES.4.6 On-Farm Conservation

On-Farm conservation measures can be grouped into the following categories: water use management practices, land management systems, on-farm water delivery systems, water district delivery systems, and tailwater recovery systems. Water District delivery system improvements, including conveyance infrastructure, metering, and telemetry, are discussed in detail in Section 5.2.1 and addressed as a separate WMS, although the operational effectiveness and efficiency of the Irrigation Districts (ID) are necessary to reap the full benefits of on-farm measures. On-farm efficiency depends on timely delivery of water, adequate head to push water across a field, and an available supply whether on farm or from the ID.

These measures are considered on-farm conservation measures, but in most cases implementation of these measures in a drought year increases the potential yield of a crop per acre-foot of water but may not reduce irrigator's overall demand for water. When water is available in a drought year, farmers are likely to use it. Making better use of the water that is available is critical to helping farmers through drought, and the Region M Planning Group recommends continued research, education, demonstration, and large-scale implementation of these and any other irrigation conservation measures that farmers find to be appropriate.

A select subset of on-farm water conservation strategies which were developed based on input from stakeholders and ID are discussed in detail in Section 5.2.8. These are strategies that are of particular interest to the region, although the full range of BMP described in TWDB literature are

---

[10] Water Conservation Implementation Task Force, "Water Conservation Best Management Practices Guide," November 2004.

recommended where appropriate.[11] On-Farm Conservation is recommended for all irrigators in the planning area.

ES.4.7 Implementation of Best Management Practices for Industrial Users

Implementation of Best Management Practices for Industrial Users is recommended for every Manufacturing, Mining, and Steam Electric Power user in Region M. The TWDB Water Implementation Task Force recommended strategies for industrial users to conserve water in the "Best Management Practices for Industrial Water Users" guidance.[12] The guide provides BMPs for specific industries, as well as general BMPs that are recommended for any type of industrial user.

ES.4.8 Conversion and Purchase of Surface Water Rights

Urbanization of agricultural lands within Region M is projected to increase throughout the planning period. As areas that are currently farmed are developed, the water associated with irrigating that land will become available for other uses. For the purpose of this plan, it was assumed that the increase in Municipal Water Demand is proportional to the decrease in Irrigation Demand due to urbanization, and estimates for urbanization rates were made for each county.

Table 11 Urbanization Rates and Available Converted Water Rights per County (Acre-feet /year)

	2020	2030	2040	2050	2060	2070
Cameron County						
Agricultural Demands	355,962	339,470	322,622	305,522	288,601	288,601
Exclusion Rate	1.82%	3.47%	3.72%	3.98%	4.15%	0.00%
Reduction in Agricultural Supplies (Cumulative)	4,852	12,633	21,149	29,929	38,756	38,757
Reduction in Irrigated Acreage (Cumulative)	4,039	11,593	19,403	27,434	35,492	35,492
Hidalgo County						
Agricultural Demands	639,676	609,754	577,457	540,797	502,563	502,563
Exclusion Rate	1.84%	3.51%	3.97%	4.76%	5.30%	0.00%
Reduction in Agricultural Supplies (Cumulative)	7,015	18,280	31,272	46,184	61,968	61,955
Reduction in Irrigated Acreage (Cumulative)	5,815	16,687	28,566	42,238	56,739	56,739
Jim Hogg County						
Agricultural Demands	439	413	398	414	451	451
Exclusion Rate	2.33%	4.44%	2.72%	-3.02%	-6.70%	0.00%
Reduction in Agricultural Supplies (Cumulative)	0	0	0	0	0	0
Reduction in Irrigated Acreage (Cumulative)	0	0	0	0	0	0
Maverick County						
Agricultural Demands	52,993	51,886	50,903	49,951	49,076	49,076
Exclusion Rate	0.82%	1.57%	1.42%	1.40%	1.31%	0.00%

[11] Texas Water Development Board, Best Management Practices for Agricultural Water users http://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp accessed 4/21/2015
[12] Water Conservation Implementation Task Force, "Water Conservation Best Management Practices: Best Management Practices for Industrial Water Users," February 2013.

	2020	2030	2040	2050	2060	2070
Reduction in Agricultural Supplies (Cumulative)	627	1,490	2,381	3,270	4,117	4,129
Reduction in Irrigated Acreage (Cumulative)	444	1,282	2,031	2,759	3,432	3,432
Starr County						
Agricultural Demands	13,483	11,085	8,646	6,192	3,714	3,714
Exclusion Rate	7.00%	13.34%	16.50%	21.29%	30.01%	0.00%
Reduction in Agricultural Supplies (Cumulative)	753	2,031	3,415	4,896	6,529	6,519
Reduction in Irrigated Acreage (Cumulative)	291	806	1,358	1,950	2,607	2,607
Webb County						
Agricultural Demands	7,612	7,612	7,612	7,612	7,612	7,612
Exclusion Rate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Reduction in Agricultural Supplies (Cumulative)	0	0	0	0	0	0
Reduction in Irrigated Acreage (Cumulative)	0	0	0	0	0	0
Willacy County						
Agricultural Demands	69,253	69,074	68,936	68,814	68,741	68,741
Exclusion Rate	0.10%	0.19%	0.15%	0.13%	0.08%	0.00%
Reduction in Agricultural Supplies (Cumulative)	309	422	690	980	1,262	1,290
Reduction in Irrigated Acreage (Cumulative)	81	236	356	461	524	524
Zapata County						
Agricultural Demands	4,717	4,455	4,215	3,981	3,800	3,800
Exclusion Rate	2.19%	4.17%	4.04%	4.16%	3.41%	0.00%
Reduction in Agricultural Supplies (Cumulative)	81	215	345	474	577	577
Reduction in Irrigated Acreage (Cumulative)	83	238	383	525	637	637
Total Reduction in Agricultural Supplies	**13,638**	**35,071**	**59,252**	**85,734**	**113,210**	**113,227**
Total Reduction in Irrigated Acreage	**10,754**	**30,843**	**52,096**	**75,368**	**99,431**	**99,431**

Purchase of water rights through urbanization was recommended for all Municipal WUGs with recommended strategies that required additional water rights in order to be feasible (such as expansion of a surface water treatment plant), to accompany those strategies. Additionally, the strategy for Acquisition of Water Rights through Urbanization was evaluated for all Municipal, Manufacturing, and Steam Electric Power WUGs with needs prior to 2070.

ES. 5 Unmet Needs

Unmet needs after WMS include the needs that remain after the demand reduction and/or supply from all conservation and WMS are applied to an entity's initial need. For Region M there are only unmet needs for Irrigation, Mining, and Manufacturing which are presented in Table 12.

Table 12 Summary of Unmet Needs for Region M (Acre-feet /year)

County	Basin	WUG	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	Irrigation	163,370	150,607	138,749	126,068	114,058	109,605
Cameron	Nueces-Rio Grande	Manufacturing	65	391	544	542	541	537
Cameron	Rio Grande	Irrigation	10,137	9,324	8,567	7,757	6,990	6,707
Hidalgo	Nueces-Rio Grande	Irrigation	271,498	243,145	214,381	183,363	151,750	141,441
Hidalgo	Nueces-Rio Grande	Manufacturing	0	0	566	736	738	743
Hidalgo	Nueces-Rio Grande	Mining	865	1,495	1,956	2,458	3,040	3,779
Hidalgo	Rio Grande	Irrigation	11,460	10,281	9,081	7,790	6,474	6,045
Hidalgo	Rio Grande	Mining	117	169	204	244	290	348
Maverick	Nueces	Mining	270	403	437	322	208	125

BLACK & VEATCH Building a world of difference.

County	Basin	WUG	2020	2030	2040	2050	2060	2070
Maverick	Rio Grande	Mining	1,052	1,587	1,722	1,264	805	472
Starr	Nueces-Rio Grande	Mining	36	62	78	95	117	144
Starr	Rio Grande	Irrigation	3,714	2,624	1,601	662	0	0
Starr	Rio Grande	Mining	0	6	60	119	191	281
Webb	Nueces	Mining	378	0	0	0	0	0
Webb	Nueces-Rio Grande	Mining	68	0	0	0	0	0
Webb	Rio Grande	Irrigation	343	351	359	366	372	381
Webb	Rio Grande	Mining	795	0	0	0	0	0
Willacy	Nueces-Rio Grande	Irrigation	38,842	36,918	35,114	33,346	31,936	29,899
Zapata	Rio Grande	Irrigation	774	655	554	458	390	399

ES. 6 Drought Planning and Threats to Resources

TCEQ requires water conservation plans to be developed, implemented, and submitted by municipal, industrial/mining, and other non-agricultural water right holders of 1,000 acre-ft. of water per year, and agricultural water right holders of 10,000 acre-ft. per year or more. Additionally, all wholesale and retail public water suppliers and irrigation districts are required to develop a drought contingency plan (DCP). Water conservation plans are required to include quantified five and ten year targets for water savings and DCPs outline entity responses to drought, including triggers for conservation stages and the restrictions of water use in each drought stage.

The drought response varies from entity to entity, primarily between those who serve customers, including irrigators, with raw water, and those who deliver treated water. For those entities, like Irrigation Districts, that deliver water to irrigators, the response to drought is focused on the allocation system, and how agricultural water rights are fulfilled when supplies are limited by the TCEQ Watermaster. Each water district responds slightly differently, in some cases allowing water to be sold between farmers in their district, or for a farmer to consolidate their allocation on a portion of their land, leaving other areas for dry land farming.

Those entities who deliver treated water generally developed triggers that were either based on the remaining municipal water rights available to the city for that year or the capacities of their treatment plants, such that high demands on the plants trigger a conservation stage. The conservation stages for cities included limitations on car washing and lawn watering, ranging from voluntary in early stages to some fines or other penalties in later stages.

ES.6.1 Threats to Agricultural and Natural Resources

As described 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.

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.

An additional threat to the region's water supplies is unchecked development of groundwater resources. Only a small portion of the Region is in a Groundwater Conservation District (GCD), and none of the GCDs in the Region are actively managing groundwater development. Without a GCD, the conservation goals described in the Desired Future Conditions for each aquifer cannot be implemented or monitored.

Pumping groundwater in some locations may impact surface water, especially near the Amistad Dam. Water marketing companies are actively seeking water sources to be sold to entities in need of new water sources. In and around Val Verde County, there is strong evidence of interaction between groundwater and surface water. The pumping of groundwater in the Devils and Pecos river basins have been shown to directly impact these streamflows and the flows in Goodenough Springs, which play a significant role in supplying water for Region M. Any reduction in the water supply in the Amistad Reservoir presents a threat to the whole region.

Another threat to agricultural and natural resources of the region is the impact of urbanization on currently undeveloped areas, and the loss of water and habitat availability for wildlife. This would have a negative impact on ecotourism. Urbanization plays a major role in determining how water resources will be used in the futures. Particularly in Cameron and Hidalgo counties, projected urbanization is expected to significantly reduce the area of irrigable farmland. 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).

The Conservation WMS discussed in this plan aim to assist water users in making the most of what water is available in drought years. Irrigation Districts play a major role in the delivery of water, and improvements of their operations and efficiency represent a significant portion of the strategy for meeting future demands. Given the uncertainty associated with irrigation water rights for all of the reasons described above, it will become increasingly critical for all users in Region M to carefully manage their water.

Texas Water Development Board

2016 Region M Water Plan

Chapter 1: Description of Regional Water Planning Area

Table of Contents

Figures

Tables

List of Abbreviations

BRACS	Brackish Resource Aquifer Characterization System
CONAGUA	Water Commission of Mexico
DCP	Drought Contingency Plan
DMI	Domestic, Municipal, & Industrial
DO	Dissolved Oxygen
DOR	Drought of Record
ESA	Endangered Species Act
HB4	House Bill #4
IBWC	International Boundary Waters Commission
IWRP	Integrated Water Resources Plan
LLM	Lower Laguna Madre
LRGV	Lower Rio Grande Valley
LRGVDC	Lower Rio Grande Valley Development Council
RWPG	Regional Water Planning Group
NWR	National Wildlife Refuge
SB1	Senate Bill #1
SP	State Park
STRWSP	South Texas Regional Water Supply Plan
SWIFT	State Water Implementation Fund
SWP	State Water Plan
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
TPWD	Texas Parks and Wildlife Department
USFWS	United States Fish and Wildlife Service
WAM	Water Availability Model
WMS	Water Management Strategy
WSC	Water Supply Corporation
WWP	Wholesale Water Provider

Chapter 1. Description of Regional Water Planning Area

1.1 Planning Background

The Texas Water Development Board (TWDB) was established in 1957 through a state constitutional amendment, and is charged with preparing a comprehensive and flexible long-term plan for the development, conservation, and management of the state's water resources. Historically, the State Water Plan had been prepared by the TWDB with input from other state and local agencies and the public. Senate Bill 1 (SB1) was enacted in 1997 by the 75th Legislature, which established a "bottom up" approach whereby State Water Plans are based on Regional Water Plans prepared and adopted by the 16 appointed Regional Water Planning Groups (RWPGs). SB1 states that the purpose of regional water planning is to:

> *"Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of that particular region."*

SB1 also provides that future regulatory and financing decisions of the Texas Commission on Environmental Quality (TCEQ) and the TWDB be consistent with the current State Water Plan (SWP). In 2013 House Bill 4 (HB4) was enacted, which lends greater weight to the SWP by committing an additional funding pool to the implementation of projects recommended in the plan by way of the State Water Implementation Fund for Texas (SWIFT).

The TWDB is the state agency designated to oversee the planning effort, with Ms. Connie Townsend currently serving as the Project Manager for Region M. Each Regional Water Planning Group (RWPG) member is appointed to serve without pay, representing a range of stakeholders and act as the decision-making body for the regional water planning effort. The Rio Grande Regional Water Planning Group (Region M) members are listed in Table 1-1. The Lower Rio Grande Development Council (LRGVDC) has served as the political subdivision to administer the Regional Water Planning Grant, and Black and Veatch Corporation was selected as the prime consultant for the planning and engineering tasks required for development of the plan.

Table 1-1 Region M Water Planning Group

Interest	Name	Resident County
Public	Mary Lou Campbell, Secretary/Treasurer * City of Mercedes	Hidalgo
Counties	Joe Rathmell County Judge, Zapata	Zapata
	Humberto Gonzalez County Judge, Jim Hogg	Jim Hogg
Municipalities	Jorge Barrera Eagle Pass Water Works, Eagle Pass	Maverick
	John Bruciak Brownsville PUB, Brownsville	Cameron
	Tomas Rodriguez, Vice-Chairman * City of Laredo	Webb

Interest	Name	Resident County
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	Jaime Flores The Arroyo Colorado Watershed	Hidalgo
Small Business	Carlos Garza AEC Engineering, LLC, Edinburg	Hidalgo
	Nick Benavides Nick Benavides Co.	Webb
Electric Generating Utilities	Robert Pena, Jr. Texas Energy Consultants, Edinburg	Hidalgo
River Authorities	James Darling Attorney, Doctors Hospital at Renaissance, Edinburg	Hidalgo
Water Districts	Sonny Hinojosa * HCID No. 2, San Juan	Hidalgo
	Sonia Lambert CCID No. 2, San Benito	Cameron
Water Utilities	Dennis Goldsberry North Alamo Water Supply Corporation	Hidalgo
Groundwater Management Area	Armando Vela Red Sands GCD	Hidalgo
Other	Glenn Jarvis, Chairman * Attorney, McAllen	Hidalgo
	Frank Schuster * Val Verde Vegetable Co.	Hidalgo

* Executive Committee

The Regional Water Plans are updated every five years and one year after their adoption an updated SWP is released. The Regional Water Plans are based on an assessment of future water demands and currently available water supply, and include specific recommendations for meeting identified water needs through the end of a 50-year planning horizon (2020-2070 for this plan). The plans may also include recommendations regarding policy at the state and local level including environmental protection, drought response, and resource management.

1.2 The Rio Grande Regional Water Planning Area

The Rio Grande Regional Water Planning Area (Region M) consists of the eight counties along the middle and lower Rio Grande up to the river's mouth at the Gulf of Mexico (Figure 1-1). Since its settlement, this area has been tied to the Rio Grande for domestic and agricultural uses.

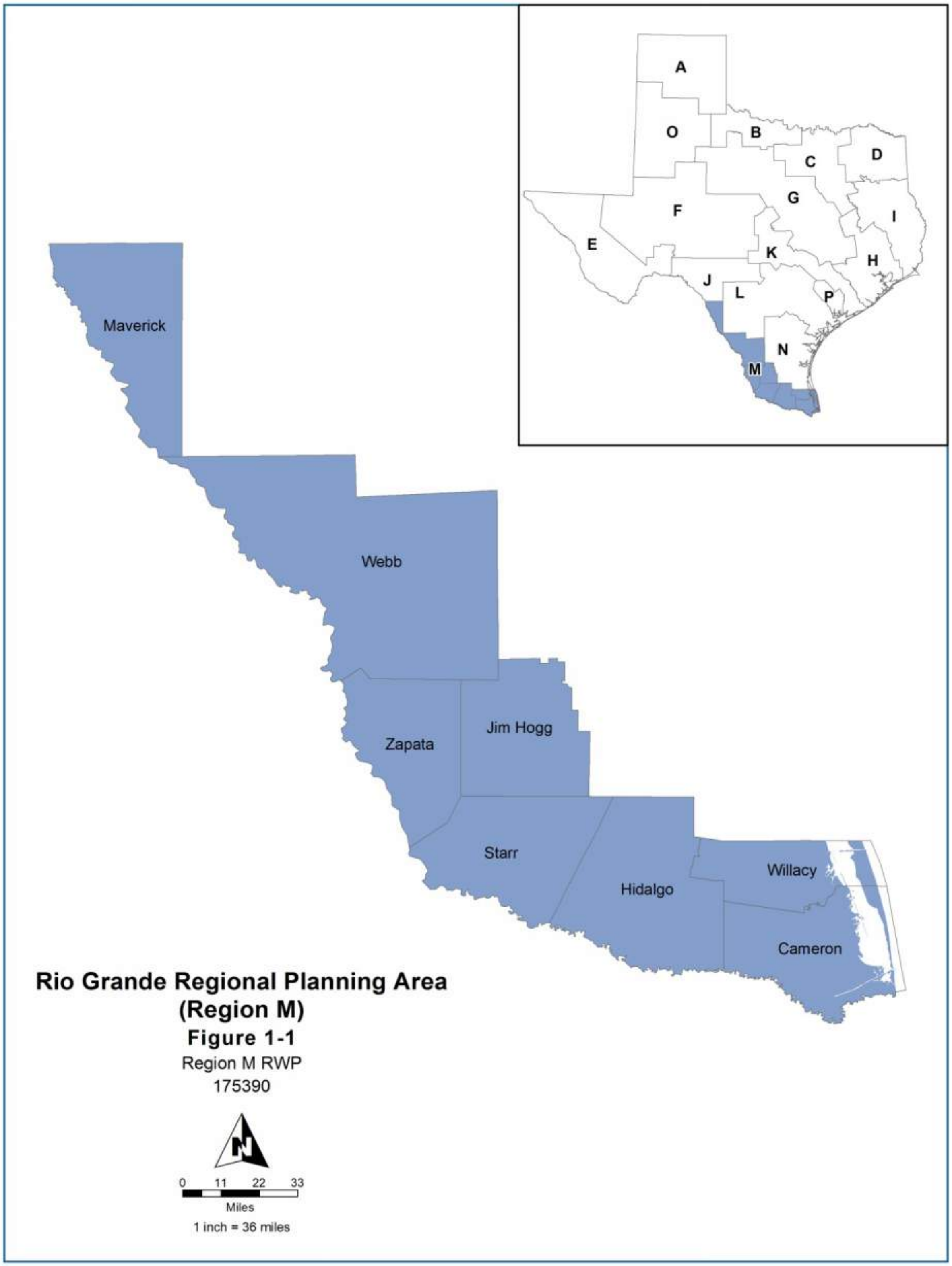

Figure 1-1 **Rio Grande Regional Planning Area (Region M)**

1.2.1 Climate

The climate ranges from humid sub-tropical in the eastern portion, nearest to the Gulf Coast, and drier tropical to sub-tropical in the west. The number of frost-free days varies from 320 days at the coast to 230 days in the northwestern portion of the region near Maverick County, resulting in a long growing season most years. 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, mostly from thunderstorms in the spring and occasional hurricanes in the late summer and fall. These storms can generate tremendous amounts of rainfall over a short period of time causing extensive flooding due to the region's relatively flat terrain. The fall storms provide a large portion of the surface water runoff captured in water supply reservoirs within the Rio Grande Basin.

1.2.2 Population and Economy

Region M's population is concentrated in Cameron, Hidalgo, and Webb counties, accounting for 90.5% of the regional total in 2010. The US Census Bureau estimates the total population of Region M in 2013 at 1,237,942, up 4.8% from 2010 (compared with 5.2% growth statewide). Figure 1-2 shows the historical population in each county (US Census Historical Data).

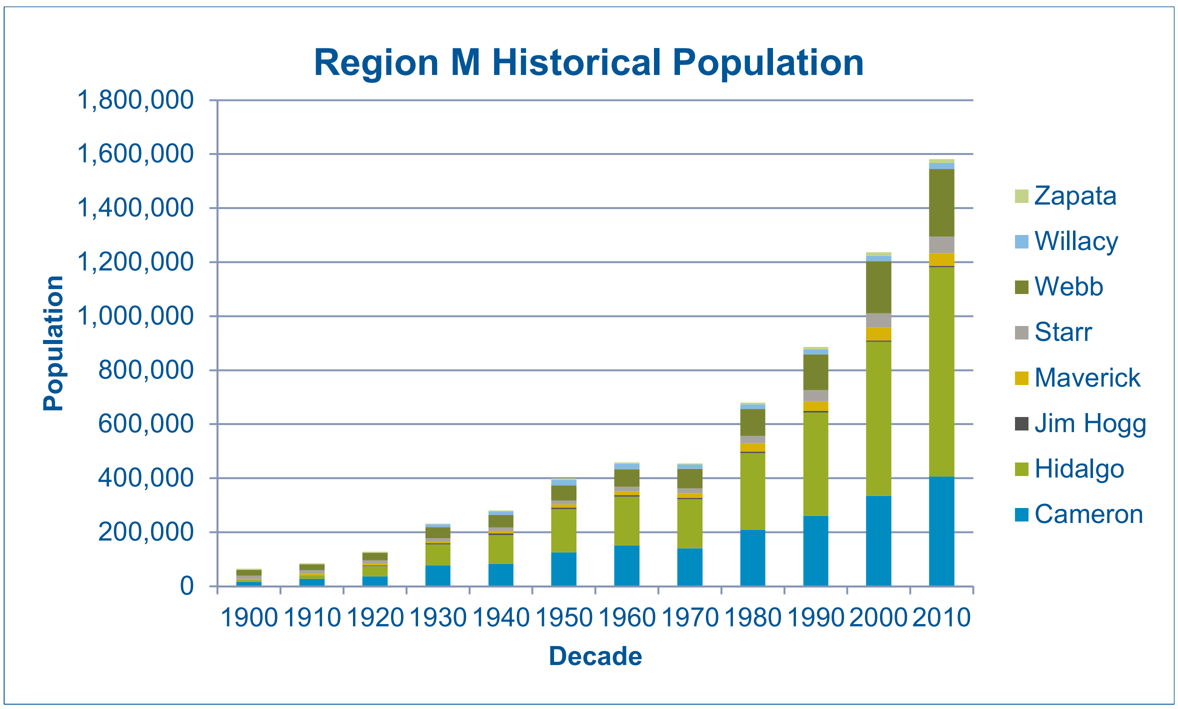

Figure 1-2 Region M Historical Population, US Census Bureau

Figure 1-3 shows current population centers in Region M. The population of the region is expected to grow to over 4 million people by the end of the current planning horizon which represents a 106% population increase from 2020 to 2070. Chapter 2 describes the population and municipal demand projections in detail.

An important factor driving rapid population growth in the Rio Grande Region is its cultural, social, and economic relationship with Mexico. Nation-wide, Mexico's population growth rate in

2013 was 1.2%, compared with 0.7% for the United States.[1] The Mexican portion of the Rio Grande (known as the Rio Bravo in Mexico) watershed was home to approximately 10.31 million people in 2005, and is anticipated to have 12.67 inhabitants by 2025, which is a higher rate of growth than the nation as a whole.[2] Using the growth rate identified by the National Water Commission of Mexico (CONAGUA) for the Rio Bravo watershed, the population in 2070 would be over 20 million people. Aquifers in Mexico's Rio Bravo Watershed are overextended, and it is clear that the growth on both sides of the border will continue to put pressure on the capabilities of both surface and groundwater.

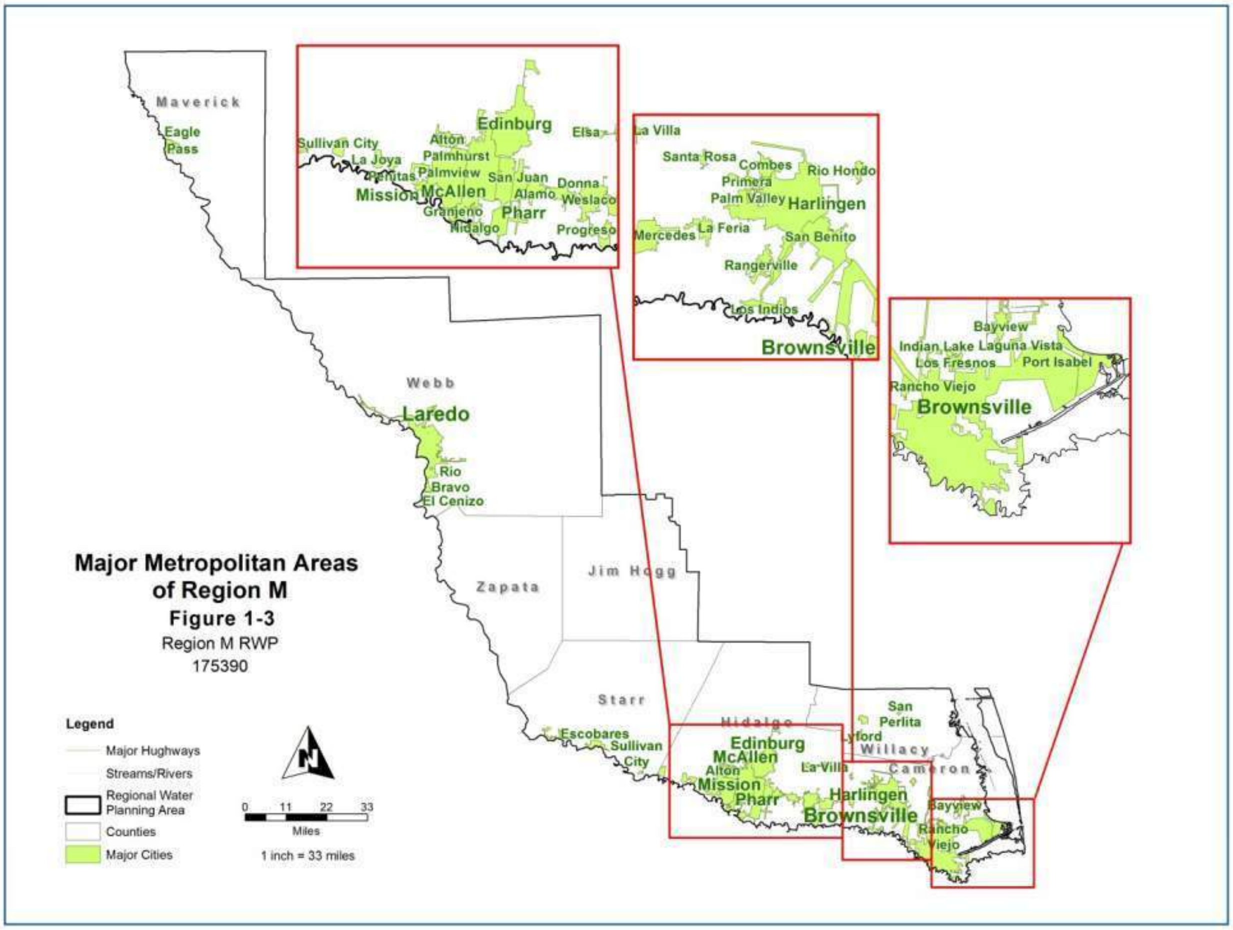

Figure 1-3 Major Metropolitan Areas of Region M

Historically, agriculture has dominated the economy of the Rio Grande Region. The increased pressure on water available for irrigation, combined with the way that water is allocated in drought years, has been difficult for farmers across the region, especially those with perennial crops and citrus or pecan trees. There is a shift toward urbanization and diversification of the

---

[1] World Bank Population Growth Data http://data.worldbank.org/indicator/SP.POP.GROW visited 10/10/14
[2] CONAGUA, Comission Nacional del Agua, Organizmo de Cuenca Rio Bravo, www.conagua.gob.mx/OCRB, accessed 10/29/2014.

economy, but agriculture still plays a major role in the region. The Texas labor market forecasts projected between 2012 and 2015 show growth in the Lower Rio Grande associated with health care services, administration, service industry, professional, scientific, and technical services, as well as local government.

The 2012 USDA Census of Agriculture lists the total pre-tax income from farm-related sources as $47.57 Million for Region M, of $1.35 Billion across Texas. Grain sorghum, sugarcane, cotton, citrus, and onions make up the bulk of the agriculture receipts in the region, centered in Hidalgo and Cameron Counties (Figure 1-4). Cattle and farmland accounted for less than six million acres, almost 80% of the region's land area.

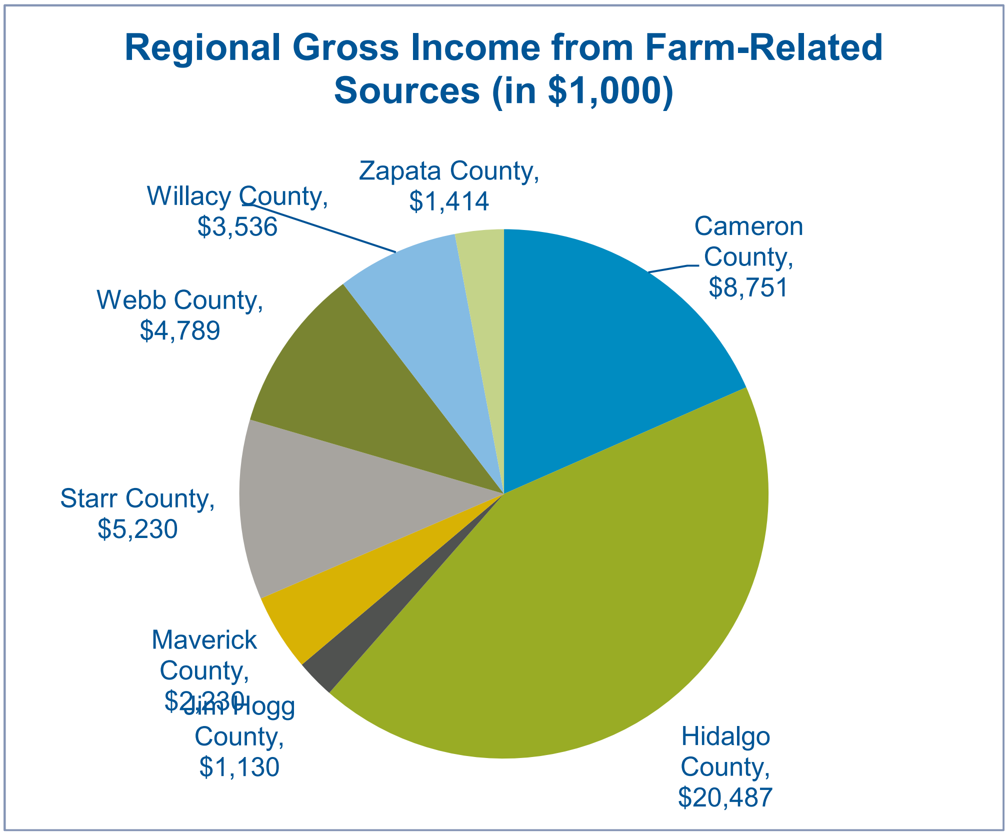

Figure 1-4 Pre-Tax Gross Farm Income by County, USDA 2012 Agriculture Census

Oil and gas production in the region has changed considerably from traditional oil drilling to hydraulic fracturing and nontraditional development, which has a significant impact on the regional economy and associated water demands. Webb and Maverick Counties experienced significant oil and gas activity, and are in the Eagle Ford Shale region. Mining water demands are discussed further in Chapter 2.

Nature tourism contributes considerably to the Rio Grande Valley economy. A 2011 study by Texas A&M University estimated an economic impact of over $344 Million per year in

Cameron, Willacy, Hidalgo, and Starr counties on nature tourism.[3] That comprises a significant portion of the impact of all travel to the region, estimated at $675 Million per year.[4] The quality of the river and its adjacent wildlife habitat will directly affect the number of eco-tourists visiting the region in the future.

In spite of growth in some sectors of the economy, the region as a whole experiences significantly lower income and higher unemployment than the rest of Texas and the nation as a whole (Table 1-2). There is a clear division between the urban growth centers, (Brownsville, McAllen, Harlingen, and Laredo) and smaller rural towns and colonias. Colonias are semi-rural subdivisions that are often built with sub-standard potable water and sanitary sewer systems. The properties are often sold through a contract for deed, which is a loan from the seller to the buyer, paid in installments while the seller retains the title. This arrangement does not allow the homeowner to access traditional home ownership financing. There have been efforts at the state, county, and local levels to provide basic services in many of the colonias in Region M.[5]

Table 1-2 Median Household Income, Poverty, and Unemployment Rate, by County

County	Median Household Income, 2008-2012 ($/year)[6]	Persons Below Poverty Level, 2008-2012 (%)[7]	Unemployment Rate, 2013 (%)[8]
Cameron	$32,558	34.9%	10.1%
Hidalgo	$33,218	35.00%	10.8%
Jim Hogg	$36,919	12.00%	5.4%
Maverick	$30,959	31.20%	12.6%
Starr	$24,653	39.90%	15.4%
Webb	$38,421	30.60%	6.7%
Willacy	$26,369	37.70%	13.8%
Zapata	$28,617	33.40%	6.2%

According to the TWDB, seven out of the eight counties in Region M are labeled as eligible for funds through the Economically Distressed Areas Program.

1.2.3 Surface Water Resources

Region M draws the vast majority of its water from the Rio Grande via the Amistad-Falcon Reservoir system, which is shared with Mexico. The waters of the Middle- and Lower-Rio

[3] An Initial Examination of the Economic Impact of Nature Tourism on the Rio Grande Valley. Report prepared for the South Texas Nature Marketing Coop by: Department of Recreation, Park & Tourism Sciences and Department of Agricultural Economics, Texas A&M University, College Station, TX. September, 2011.
4 The Economic Impact of Travel on Texas, 190-2013p. Prepared for Texas Tourism, Office of the Governor, Texas Economic Development & Tourism, by Dean Runyan and Associates, June 2014.
[5] Texas Secretary of State website, http://www.sos.state.tx.us/border/colonias/faqs.shtml, accessed 2/25/2015
[6] US Census Bureau State & County QuickFacts 8/27/14 http://quickfacts.census.gov/qfd/states/48/48505.html
[7] US Census Bureau State & County QuickFacts 8/27/14 http://quickfacts.census.gov/qfd/states/48/48505.html
[8]Texas Counties: Unemployed Rate, Texas Association of Counties

Grande are managed by the International Boundary Waters Commission (IBWC) and the TCEQ's Rio Grande Watermaster. The majority of the inflows in this section of the river are from the Mexican watershed. Two major treaties between Mexico and the US (1906 and 1944) establish how these waters are shared. Annually, Mexico is to deliver a minimum of 350,000 acre-ft. to the United States on an average over a 5-year cycle. Exceptions are provided for years of extraordinary drought, when the watershed in Mexico cannot provide sufficient runoff water, or in cases of serious accident to hydraulic systems.

Releases from Amistad and Falcon Reservoirs are coordinated to deliver water to users throughout the region. The system of water rights is unique to the Rio Grande and is the result of over a century of varied legal and governance influences. As a result, there is a tiered system that prioritizes Municipal, Domestic, and Industrial (DMI) water rights, and establishes two classes (A and B) of Mining and Irrigation water rights which are fulfilled only in part when supplies are limited. Each tier of water rights has a dedicated 'storage pool' in the reservoir accounting system, and at the end of each month, the DMI pool is replenished to ensure that those water rights can be delivered in full. After this and an operational reserve have been set aside, what remains is available to the Class A and B accounts. In a severe drought, there may not be any water after the DMI and operational reserves are met, and Class A and B rights can be completely curtailed. This impacts not only farmers, but also the functionality of the delivery systems, which rely on irrigation water for the operational baseline flows.

The Arroyo Colorado flows approximately 90 miles from its headwaters southwest of the City of Mission, to its confluence with the Lower Laguna Madre in the northeast portion of Cameron County. The Arroyo Colorado is an ancient distributary channel of the Rio Grande River. The land area that drains into the Arroyo Colorado is known as the Arroyo Colorado Watershed. This area is approximately 706 square miles or 500,000 acres covering portions of three Texas counties (Hidalgo, Cameron, and Willacy), and over twenty-five municipalities in the LRGV. Approximately 330,000 acres of the watershed are used for Agriculture. Agricultural producers in the watershed grow cotton, grain sorghum, corn, sugar cane, citrus and vegetables due to the fertile soil, temperate climate and access to irrigation water. Almost all of the runoff and return flows from these areas are discharged into the Arroyo Colorado and are the main source of excess nutrients entering the waterbody. Perennial (year-round) flow is sustained mainly by flows from municipal wastewater treatment facilities. Irrigation return flows and urban runoff supplement the flow on a seasonal basis.

The Arroyo Colorado River is the primary source of freshwater for the Lower Laguna Madre (LLM) which one of only three hyper-saline lagoons (i.e. saltier than the ocean) in the world and is considered to be the most productive hyper-saline lagoon system. As a result of this, it is imperative that not only adequate amounts of fresh water flow into the LLM, but the water quality meet the needs of the various uses of the water body including irrigation, recreation, industrial, municipal, and aquatic life uses. Having water of good quality improves not only the uses of the Arroyo Colorado, but also improves the economy in the region. The Rio Grande and the Arroyo Colorado are discussed in detail in Chapter 3.

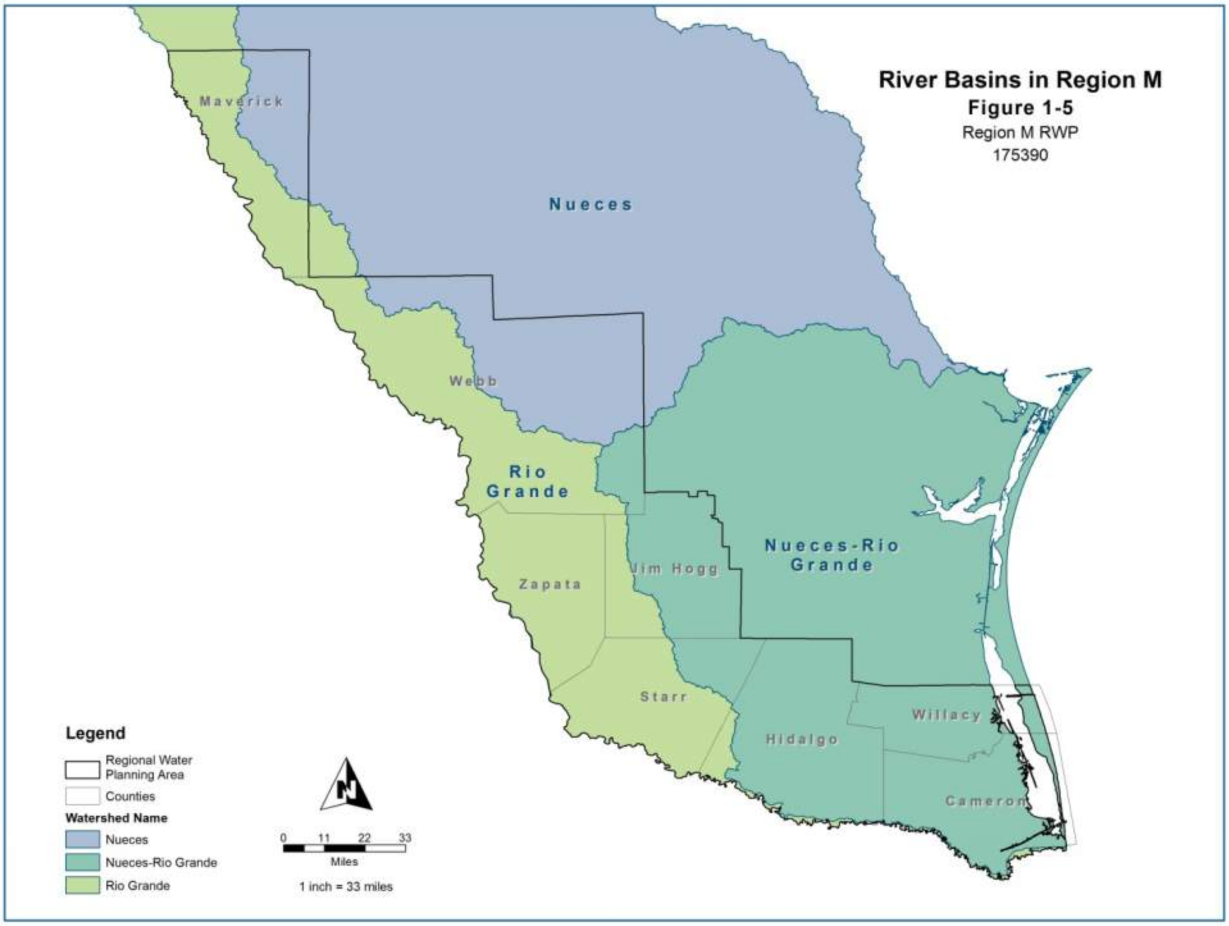

Figure 1-5 River Basins in Region M

The three river basins in Region M are shown in Figure 1-5. The Rio Grande basin in Hidalgo and Cameron Counties is a very narrow strip of land as a result of the river delta. The majority of water that is used in these counties is transported through Irrigation Districts from the Rio Grande basin for use in the Nueces-Rio Grande basin, and these supplies are therefore considered inter-basin transfers.

1.2.4 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. In 1991, the Texas Legislature created the Texas Clean Rivers Program (CRP) in order to address water quality concerns in a coordinated manner.[9] CRP conducts water quality monitoring, assessment, and public outreach across the state through partnerships between TCEQ and local agencies. The International Boundary and

[9] International Boundary and Water Commission, US Section Texas Clean Rivers Program. 2015 Basin Highlights Report, Texas Rio Grande Basin Program Update, May 2015. Accessed online: http://www.ibwc.state.gov/CRP/Publications.html

Water Commission (USIBWC) administers the CRP in the Rio Grande Basin, and the Nueces River Authority administers both the Nueces and Nueces-Rio Grande Basins. The programs include regular water sampling, and coordination with other agencies and residents to identify and evaluate water quality issues. The Region M Planning Group has considered the issues identified through the Texas CRP and Clean Water Act, which are discussed below.

The 1972 Federal Water Pollution Control Act, now called the Clean Water Act, is the federal law that establishes the framework for monitoring and control of point-source discharges through National Pollutant Discharge Elimination System (NPDES), requires cities to obtain permits for stormwater or non-point-source discharges, and authorizes federal assistance for public owned treatment works.[10] The Clean Water Act has a national goal of "fishable, swimmable" water bodies, and states are required to identify any waters that do not meet this goal and develop total maximum daily loads (TMDLs) for them. TMDLs are intended to guide watershed management, and are the basis of the monitoring and identification of river segments as impaired that is undertaken in the CRP.

Rio Grande water quality within Region M is evaluated in 4 segments over the Middle Rio Grande Sub-Basin, and three segments in the Lower Rio Grande Sub-Basin. From Amistad Dam south to the confluence with the Rio Salado from Mexico, the river is impaired for contact recreation due to high bacteria below, nitrates and low dissolved oxygen (DO), and concern for toxicity and bacteria near Laredo as a result of urban runoff and discharges outside of U.S. jurisdiction. Manadas Creek, an unclassified water body northwest of Laredo, has high bacteria and chlorophyll-a due to urban runoff and high metal content due to industrial activity. Falcon Reservoir is not impaired, but there is concern for toxicity near Zapata. San Felipe Creek is impaired for bacteria, but has a positive effect on the Rio Grande water quality. The Lower Rio Grande Sub-Basin is separated into the freshwater stream and the stream impacted by tidal flows. The freshwater portion, which runs from Falcon Reservoir to downstream of Brownsville, is impaired in small reaches from consistently high bacteria counts near urban areas. Additionally, there are concerns across the entire segment for fish consumption due to elevated mercury levels. The tidal stream portion has no impairments but there can be high chlorophyll-a levels.

The Arroyo Colorado is the major drainage-way for approximately two dozen cities in this area, and almost 300,000 acres of farmland. The Arroyo Colorado includes the TCEQ Classified Stream Segment 2201 and 2202, which are impaired for high bacteria, and experience high nutrient concentrations. Segment 2201 is also impaired for low DO.

Regular monitoring of water quality as a result of these programs draws attention to the need for continued assessment and evaluation of water data and integrated regional approaches to managing the watersheds to meet quality goals.

1.2.5 Drought of Record

The Drought of Record (DOR) is the basis of the Firm Yield projection for each river basin. The DOR identifies the worst drought on record and the Firm Yield is the supply that can be expected from that river or system in that most severe drought scenario.

---

[10] USEPA Clean Water Act website: http://www.epa.gov/agriculture/lcwa.html

The Rio Grande Basin and the Amistad-Falcon Reservoir System DOR refers to the drought spanning from February 1993 to October of 2000. This 7.75 year period is the most sever hydrologic drought according to the Rio Grande Water Availability Model (WAM), and is used to predict firm yield over the planning horizon, as shown in Table 1-3.

Table 1-3 Firm Yield Projections, Amistad-Falcon Reservoir System 2020-2070 (Acre-feet/year)

Source	2020	2030	2040	2050	2060	2070
Amistad-Falcon Reservoir System	1,060,616	1,059,260	1,057,903	1,056,547	1,055,191	1,053,834

The current drought of record extends through the year 2000, limited by the extent of naturalized flow data in the WAM. The actual drought extended through approximately 2003, and if the WAM were updated to include those years, may impact the drought of record. Recent years have also seen severe drought in the region, and 2011 and 2012 data could similarly impact the drought of record, and therefore the firm yield projections. It was recommended in the 2011 Regional Water Plan, and is the opinion of the RWPG, that the Rio Grande WAM should be updated regularly. The drought of record is discussed in detail in Chapter 7.

1.2.6 Groundwater Resources

The major aquifer that underlies Region M is the Gulf Coast, which runs the extent of the Texas coast and Hidalgo, Starr, Jim Hogg, and the western portions of Willacy and Cameron Counties. This aquifer is predominantly brackish, with irregular pockets of fresh and very saline water. The Carrizo – Wilcox also spans Texas and extends through Webb and part of Maverick Counties.

The minor aquifers in the region may produce significant quantities of water that supply relatively small areas, including the Rio Grande Alluvium, the Laredo Formation, and the Yegua-Jackson aquifer. Figure 1-6 shows the major and minor aquifers in Region M. A more detailed discussion of each of these groundwater sources is presented in Chapter 3.

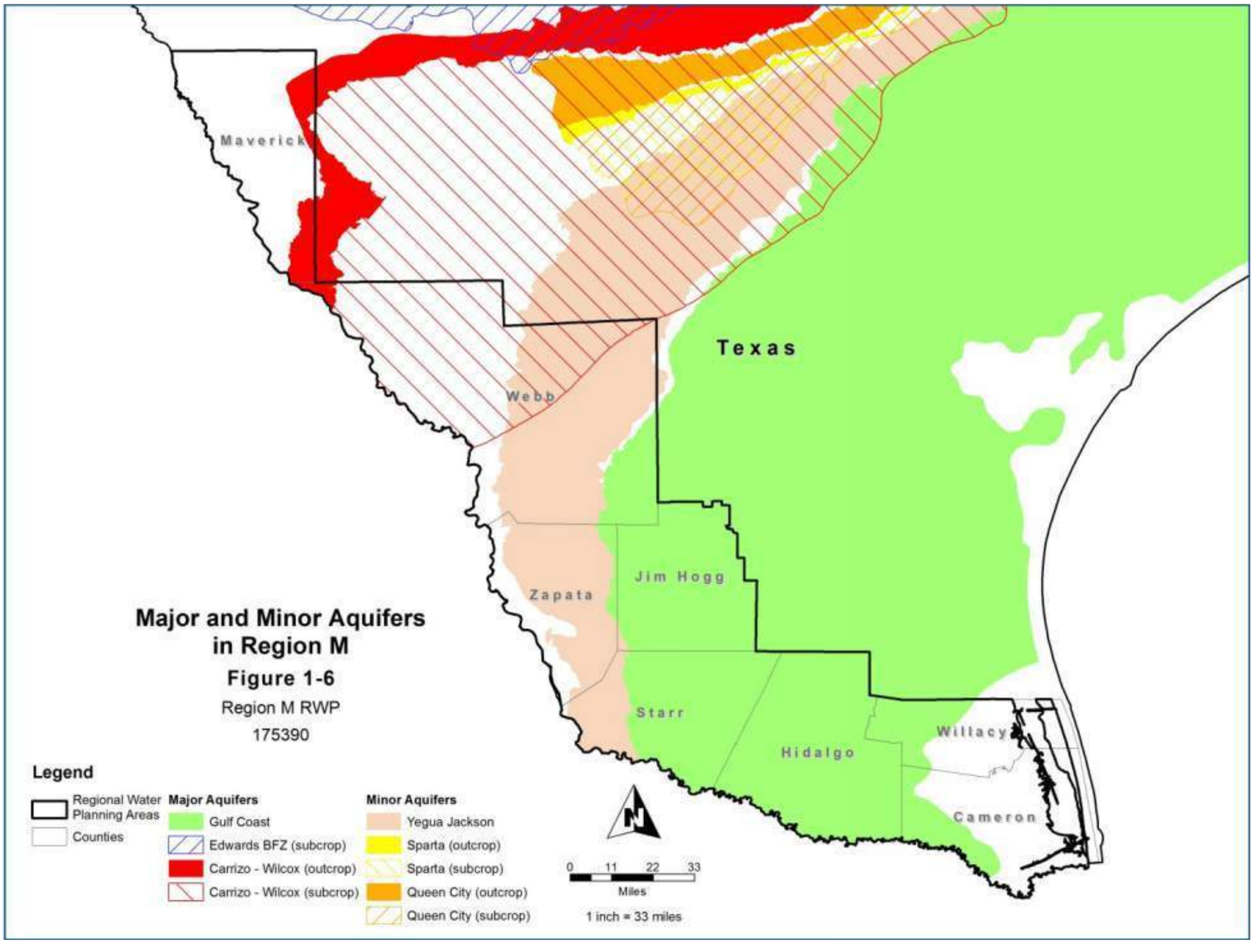

Figure 1-6 Major and Minor Aquifers in Region M

1.2.7 Ground Water Quality

In general, groundwater from the major 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). There are, however, some areas of fresh and useable groundwater which constitutes a critical supply for many towns, domestic needs in rural areas, as well as livestock. Localized areas of high boron content occur throughout the study area. A recent report from TWDB's Brackish Resource Aquifer Characterization System (BRACS) program presented information on the brackish groundwater resources of the Lower Rio Grande Valley, in response to increased development of these resources. 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.

1.3 Current Water Use

The water user group with the largest demand in Region M is Irrigation, followed by Municipal. Demand in other water user groups is comparatively very small, as shown in Figure 1-7. Regional demand is concentrated in the Lower Rio Grande Valley, specifically Cameron, Hidalgo, Willacy Counties, with a significant municipal demand in the Laredo area of Webb

County. Lower Rio Grande Valley users are primarily served by a network of Irrigation Districts which divert water to farmers and municipal utilities from the Rio Grande.

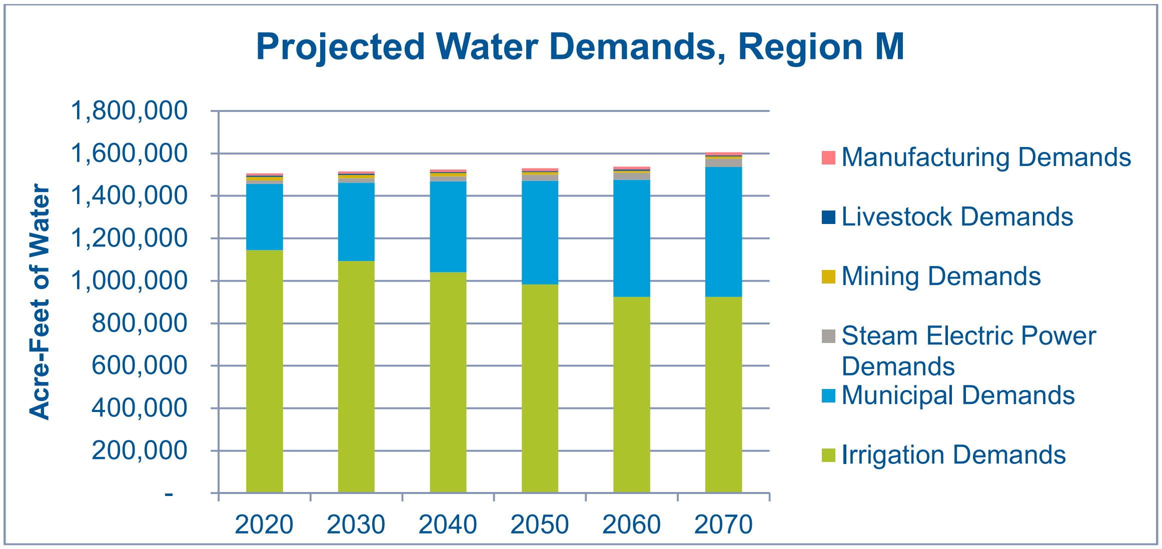

Figure 1-7 Water Demand Projections for Each WUG Type in Region M (Acre-feet/year)

1.3.1 Demands

Municipal demands are expected to increase regionally from a projected 311,591 acre-ft./year in 2020 to 612,127 acre-ft./year in 2070. The majority of this demand is currently met by treated surface water from the Rio Grande, however eight brackish groundwater desalination plants have been built since 2000, supplying a total of approximately 24,000 acre-ft./year of treated potable water. Fresh groundwater availability is limited in the region, and is used mostly as a back-up water supply for utilities or for individual homes, particularly in rural and unincorporated areas, with a few exceptions.[11]

Projected irrigation demands are significantly greater than municipal demands (1.4 million acre-ft./year in 2020 and 0.9 million acre-ft./year in 2070), and are projected to decrease as a result of both urbanization of lands and increasing pressure on the region's water resources. Supplies available to irrigators are curtailed significantly in drought years, because 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 use must adjust to the available water supply.

The difference between drought year demand and actual use in a particular year for agricultural users can be significant. If a drought year is anticipated, farmers can prepare by planting crops and vegetables with lower water demands, which are often of lower value, but may require fewer or no irrigations. Increases in farming efficiency can also allow irrigators to maintain higher value crops or higher yields in times with less available water. This RWP represents the worst-

[11] Military Highway Water Supply Corporation, and the City of Hidalgo both have significant sources of well water.

case scenario, wherein the demands are based on a dry year, and the measures taken by farmers to prepare for and respond to the drought are considered as Water Management Strategies.

Livestock, Mining, Steam-Electric Power Generation, and Manufacturing demands make up a very small portion of the region's water use as a whole. However, a localized analysis reveals that in some counties mining demands represent a significant portion of water usage (Webb and Zapata Counties), and in Jim Hogg, Livestock demand is over 25% of the county total.

1.3.2 Wholesale Water Providers

Wholesale Water Provider (WWP)--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. The regional water planning groups shall include as wholesale water providers other persons and entities that enter or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 acre-ft. of water wholesale during the period covered by the plan.

The Texas Administrative Code, Title 31, Rule 357.10

Region M has two general types of Wholesale Water Provider (WWP): those that provide raw water to irrigators, cities, and other types of users, most commonly Irrigation Districts, and those that provide retail and/or wholesale treated water to municipal users and industrial users.

Irrigation Districts[12] divert and deliver raw water to irrigated farmland, and sometimes municipalities, and industrial or livestock users. There are 27 Irrigation Districts in Region M which operate under the Texas Water Code, but each of which has its own internal operating policies. The physical distribution networks are mostly earthen canal, some concrete lined canals, and some pipeline. The water losses within Irrigation Districts, as a result of seepage, evaporation, and operational losses, are as high as 40%. Some districts have worked hard to improve the efficiency of their systems, and others have fallen into disrepair. Irrigation Districts are discussed in more detail in Chapter 3.

[12] For simplicity, the following designations will be referred to collectively as Irrigation Districts in this Plan in reference to their delivery of raw water supplies: Irrigation Districts, Water Control and Improvement Districts, Water Improvement Districts, and other similar designations. Those entities that treat and deliver potable water as well will be noted.

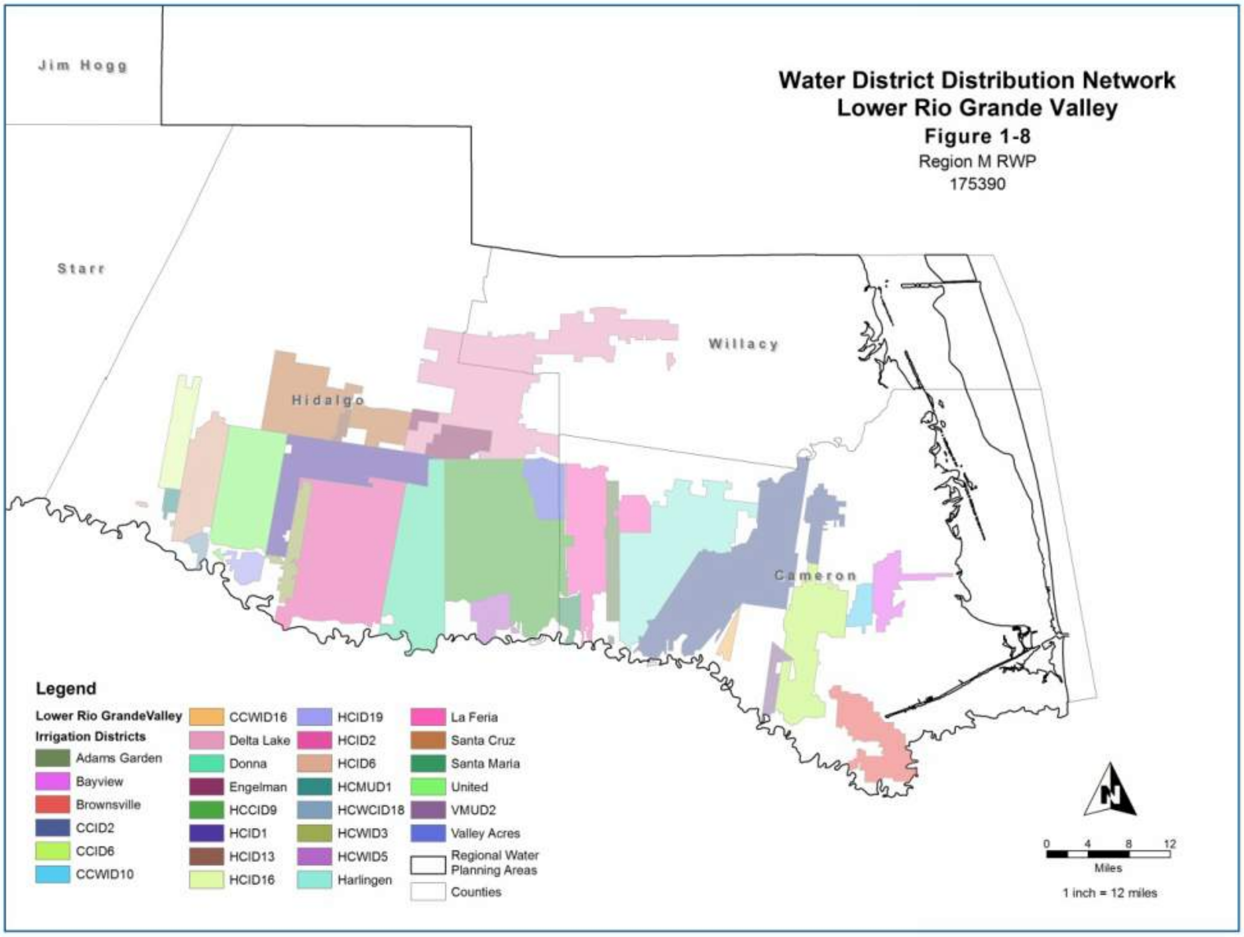

Figure 1-8 Water District Distribution Network, Lower Rio Grande Valley

Water supply corporations (WSCs) cover most of the rural area in the lower Rio Grande Valley, and supply many of the populated rural areas in the western counties. The largest are North Alamo WSC, East Rio Hondo WSC, Sharyland WSC, and Military Highway WSC, which all treat and deliver both surface and groundwater to significant unincorporated and rural areas and portions of cities. Other WSCs in the region include Southmost Regional Water Authority, Valley Municipal Utility District #2, Webb County Water Utility, and Laguna Madre Water District. Brownsville, Eagle Pass, Harlingen, Laredo, Rio Grande City, and Weslaco also sell water to other WUGs in sufficient quantity to be considered WWPs.

The Rio Grande Regional Water Authority has expressed interest in becoming a WWP for the region. The Authority, under a TWDB Regional Facility Planning Grant, is developing the Regional Facility Plan Project, which intends to evaluate preliminary engineering and opinions of probable cost for a regional water supply system or systems. This project is happening concurrently with the 2016 planning process, and is included as a recommended alternative Water Management Strategy (WMS) in Chapter 5.

1.3.3 Agricultural and Natural Resources

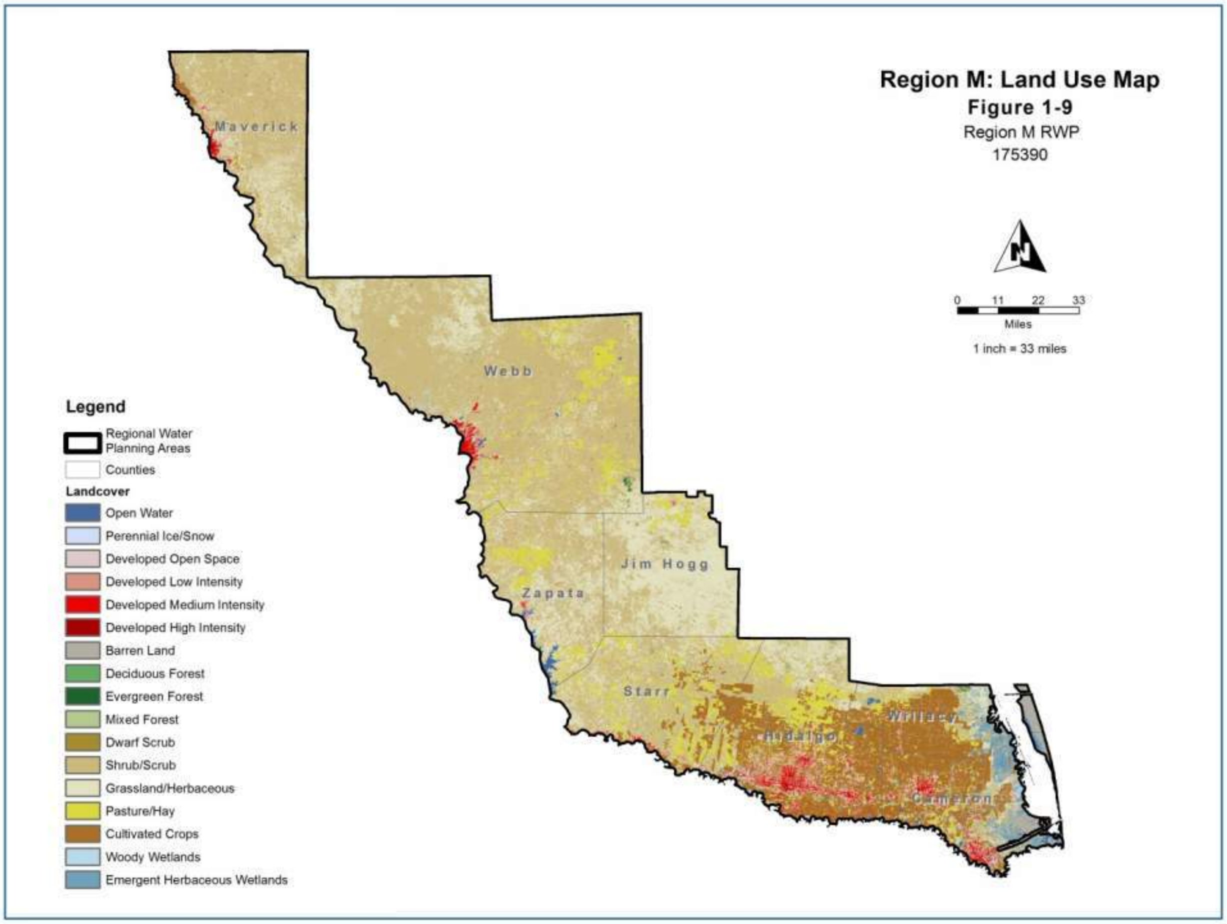

Figure 1-9 Region M Land Use Map

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 most recent sediments are located in Cameron County. In general, soils in the Rio Grande Region generally consist of calcareous to neutral clays, clay loams and sandy loams.

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.

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 1-9).

<u>Ramaderos</u>

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

<u>Chihuahuan Thorn Forest</u>

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).

<u>Upper Valley Flood Forest</u>

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).

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.

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.

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).

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.

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).

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.

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.

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.

LOWER LAGUNA MADRE

The lower Laguna Madre is a hypersaline bay, in the eastern portions of Cameron and Willacy counties. The Lower Laguna Madre is characterizes by its shallow depth, approximately 2' average, extensive seagrass meadows, and tidal flats. 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 dependent 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.

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 considered world class birding destinations attracting thousands of visitors to view migratory birds and learn about conservation of natural resources.

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.

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.

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.

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.

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.

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.

EAST WILDLIFE FOUNDATION RANCHLAND

The East Wildlife Foundation is a nonprofit tax exempt organization, the mission of which is to support wildlife conservation and other public benefits of ranching and private land stewardship. The Foundation includes management of over 215,000 acres of native South Texas rangeland. This land is operated as six separate ranches in parts of Jim Hogg, Starr, Willacy and Kenedy Counties. Traditionally maintained as native rangeland and as working cattle ranches, the lands operated by the Foundation are now managed as a field laboratory for discovery and problem solving.

Rare, Threatened, or Endangered Plant and Animal 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.

Within the Rio Grande Region, six plant species designated by the USFWS as rare, threatened, or endangered. An additional 24 species are of great conservation need with no regulatory status. Species designated as threatened or endangered receive full protection under the ESA. Species of need are those species for which there is some information showing evidence of vulnerability, but lacking sufficient data to support listing at the present time.

There are sixteen federally listed threatened or endangered animal species and two species considered candidates for listing with habitat found within the Rio Grande Region that are listed by the USFWS. These include four birds, two fishes, five mammals, and five reptiles. The Texas Parks and Wildlife Department (TPWD) has indicated that an additional 80 species are of great conservation need with no regulatory listing status.[13]

1.3.4 Threats to Agricultural and Natural Resources

As described 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.

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.

An additional threat to the region's water supplies is the drilling and marketing of groundwater in locations which may impact surface water, especially near the Amistad Dam. Water marketing companies are actively seeking water sources to be sold to entities in need of new

---

[13] Texas Parks and Wildlife Rare, Threatened, and Endangered Species of Texas database, http://tpwd.texas.gov/gis/rtest/ accessed 3/15/2015.

water sources. Recently there has been substantial interest in groundwater in and around Val Verde County. In this particular area, there is strong evidence of interaction between groundwater and surface water, as well as continued study. The pumping of groundwater in the Devils and Pecos river basins have been shown to directly impact these streamflows and the flows in Goodenough Springs, which play a significant role in supplying water for Region M. Any reduction in the water supply in the Amistad Reservoir presents a threat to the whole region, but particularly to irrigators, which would absorb reductions in supply under current reservoir system operation.

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 and habitat availability for wildlife. 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. WMS in this plan that recommend groundwater use will be limited to the managed available groundwater for each aquifer.

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, with some additional development 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).

The Irrigation Conservation WMS discussed in this plan aim to assist farmers in making the most of what water is available in drought years. Given the uncertainty associated with irrigation water rights for all of the reasons described above, it will become increasingly critical for farmers to carefully manage their water.

Irrigation Districts play a critical role in the delivery almost 85% of the water used in the Region, including irrigation and municipal water. The improvements discussed in this plan for Irrigation Districts are intended not only to reduce the losses in their systems, but also to allow for better management and controls over their systems, which will enable greater service to farmers and other users.

1.4 Existing Local and Regional Water Plans

1.4.1 Drought Planning

TCEQ requires water conservation plans to be developed, implemented, and submitted by municipal, industrial/mining, and other non-agricultural water right holders of 1,000 acre-ft. of water per year, and agricultural water right holders of 10,000 acre-ft. per year or more. Additionally, all wholesale and retail public water suppliers and irrigation districts are required to develop a drought contingency plan (DCP). Water conservation plans are required to include quantified five and ten year targets for water savings, and DCPs outline entity responses to drought, including triggers for conservation stages and the restrictions of water use in each drought stage.

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 1-4 lists the entities that have prepared and filed Water Conservation and Drought Contingency Plans as of October 2015. It should be noted that smaller public water systems (i.e., those with fewer than 3,300 connections) were required to prepare drought plans, but do not have to file their drought plans with the TCEQ.

The drought response varies from entity to entity, primarily between those who serve customers, including irrigators, with raw water, and those who deliver treated water. For those entities, like Irrigation Districts, that deliver water to irrigators, the response to drought is focused on the allocation system, and how agricultural water rights are fulfilled when supplies are limited by the TCEQ Watermaster. Each water district responds slightly differently, in some cases allowing water to be sold between farmers in their district, or for a farmer to consolidate their allocation on a portion of their land, leaving other areas for dry land farming.

The entities that deliver treated water generally developed triggers that were either based on the remaining municipal water rights available to the city for that year or the capacities of their treatment plants, such that high demands on the plants trigger a conservation stage. The conservation stages for cities included limitations on car washing and lawn watering, ranging from voluntary in early stages to some fines or other penalties in later stages.

Table 1-4 Local Water Plans Filed with TCEQ

Entity	Water Conservation Plan	Drought Contingency Plan
Adams Garden Irrigation District	✓	✓
Agua Special Utility District	✓	✓
City of Alamo		✓
Brownsville Irrigation District	✓	✓
Brownsville Public Utilities Board	✓	✓
Cameron County Irrigation District No. 2	✓	
Cameron County Irrigation District No. 16		✓
Delta Lake Irrigation District	✓	✓
City of Donna		✓
Eagle Pass Water Works System	✓	✓
East Rio Hondo Water Supply Corporation	✓	✓
Harlingen Irrigation District	✓	✓
Harlingen Waterworks System	✓	✓
Hidalgo Co. Drainage District No. 1	✓	✓
Hidalgo Co. Irrigation District No. 1		✓
Hidalgo Co. Irrigation District No. 16	✓	✓

Entity	Water Conservation Plan	Drought Contingency Plan
Hidalgo Co. Irrigation District No. 2	✓	✓
Hidalgo Co. Irrigation District No. 5	✓	✓
Hidalgo Co. Irrigation District No. 6	✓	✓
Hidalgo Water Improvement District No. 3	✓	✓
La Feria Irrigation District		✓
Laguna Madre Water District	✓	✓
City of Laredo	✓	✓
City of Lyford		✓
Maverick County Water Control and Improvement District No. 1	✓	✓
City of McAllen, McAllen Public Utility	✓	✓
Military Highway Water Supply Corporation	✓	✓
North Alamo Water Supply Corporation	✓	✓
North Cameron Regional Water Supply Corporation		✓
Pharr	✓	✓
Raymondville	✓	✓
City of Rio Grande City		✓
City of Roma	✓	✓
San Benito	✓	✓
San Juan	✓	
San Ygnacio Municipal Utility District		✓
Southmost Regional Water Authority	✓	✓
Union Water Supply Corporation		✓
United Irrigation district	✓	✓
Valley Municipal Utility District No. 2		✓
City of Weslaco	✓	✓
Zapata County Waterworks	✓	✓

1.4.2 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 reviewed as a part of this water planning process and serve as valuable references for this regional water plan.

Arroyo Colorado Watershed Protection Plan (WPP) The Arroyo Colorado WPP is a comprehensive watershed-based strategy to improve water quality and aquatic and riparian habitat in the Arroyo Colorado in South Texas. The Arroyo Colorado WPP is in Phase 1 of the WPP process (The implementation period for phase 1 is 2006-2015) but is considered a "living" document subject to revision and modification every 5 years. The Arroyo Colorado Watershed Partnership, which is comprised of stakeholders, has grown to over 720 members. In collaboration with the lower Rio Grande Valley TPDES Storm water Task Force and local citizens, the Arroyo Partnership installed more than 1,000 storm drains that read "No Dumping, Drains to Laguna Madre". Education and outreach activities occur on a daily basis and over 32,000 individuals have experienced the watershed model, a hands-on water quality education tool which demonstrates the impact of pollution within the watershed. Numerous agriculture and wastewater infrastructure BMPs have been implemented.

The Lower Rio Grande Water Quality Initiative has been formed in order to address persistent high bacteria and salinity levels in the Lower Rio Grande. The group is attempting to identify feasible options for the prevention and control of pollution, including a bi-national effort to identify all potential discharges and develop a hydrologic model with recently collected data.

In 2013, the Bureau of Reclamation and the Rio Grande Regional Water Authority evaluated the impacts of climate change on the Lower Rio Grande Valley in a Basin Study, and recommended brackish groundwater desalination as the best alternative water source to ensure reliability in the face of uncertain supplies. The study, funded by a grant through the WaterSMART program, reviewed a range of climate scenarios, and identified a median which resulted in an average of 84,000 acre-ft./year less being available. In response to this reduction, the Basin Study proposed four brackish groundwater desalination facilities and a trunk line to connect three clusters of municipalities, centering around McAllen, Weslaco, and Harlingen. The concept was sized and phased using the Southmost Regional Water Authority model, which was designed to meet 40% of the demands of the member cities. The Basin Study has been used, in conjunction with detailed groundwater data gathered by the TWDB in the BRACS report, to inform other studies, including the Regional Facility Plan Project, currently underway through a Facility Planning Grant from TWDB to the RGRWA.

1.4.3 Public Water Supply Systems

The TWDB conducts water loss audits annually for retail water utilities. The breakdown of all of the aggregated water loss audits from Region M is summarized in Table 1-5 below. The regional percentages of revenue and non-revenue water are very similar to the total revenue and non-revenue water percentages for the entire state: 80.7% and 19.3% respectively. The reported leaks and breaks percentage is slightly higher than the statewide average of 2.2%, and the customer meter accuracy loss is also slightly higher than the 2.7% statewide average.

Table 1-5 Summary of Region M Water Loss Audit Data, 2010 (gallons, %)

<table>
<tr><td rowspan="9">Region M:
37 Audits
Submitted</td><td rowspan="9">System Input
Volume
62,947,376,502</td><td rowspan="4">Authorized
Consumption
51,935,881,430
82.5%</td><td rowspan="2">Billed
Consumption
50,497,957,231
80.2%</td><td>Billed Metered
50,476,734,231
80.2%</td><td rowspan="2">Revenue Water
50,497,957,231
80.2%</td></tr>
<tr><td>Billed
Unmetered
21,223,000
0.0%</td></tr>
<tr><td rowspan="2">Unbilled
Consumption
1,437,924,199
2.3%</td><td>Unbilled
Metered
549,336,235
0.9%</td><td rowspan="7">Non-Revenue
Water
12,449,419,271
19.8%</td></tr>
<tr><td>Unbilled
Unmetered
888,587,964
1.4%</td></tr>
<tr><td rowspan="5">Water Loss
11,011,495,072
17.5%</td><td rowspan="3">Apparent Loss
2,265,061,883
3.6%</td><td>Unauthorized
Consumption
97,702,525
0.2%</td></tr>
<tr><td>Customer Meter
Accuracy Loss
2,137,306,713
3.4%</td></tr>
<tr><td>Systematic Data
Handling
Discrepancy
30,052,645
0.0%</td></tr>
<tr><td rowspan="2">Real Loss
8,746,433,189
13.9%</td><td>Reported Breaks
and Leaks
2,179,358,799
3.5%</td></tr>
<tr><td>Unreported Loss
6,600,194,826
10.5%</td></tr>
</table>

Texas Water Development Board

2016 Region M Water Plan

Chapter 2: Water Demand Projections

Table of Contents

Figures

Tables

List of Abbreviations

BEG	Bureau of Economic Geology
GPCD	Gallons per Capita per Day
NAICS	North American Industry Classification System
RGWM	Rio Grande Water Master
RWP	Regional Water Plan
RWPG	Regional Water Planning Group
SWP	State Water Plan
SIC	Standard Industrial Classification
TRC	Texas Railroad Commission
TSDC	Texas State Data Center
TWDB	Texas Water Development Board
WMS	Water Management Strategy
WUG	Water User Group

Chapter 2. Water Demand Projections

2.1 Introduction

In order to plan for future growth, the current water demands must be quantified and trends must be identified in the change in demands. Region M has experienced changes in both the quantity and type of demands as a result of population growth, changes in irrigated farmland and the type of crops that are grown in any given year, and changes in industrial water demand as a result of oil and gas mining operations, and other factors.

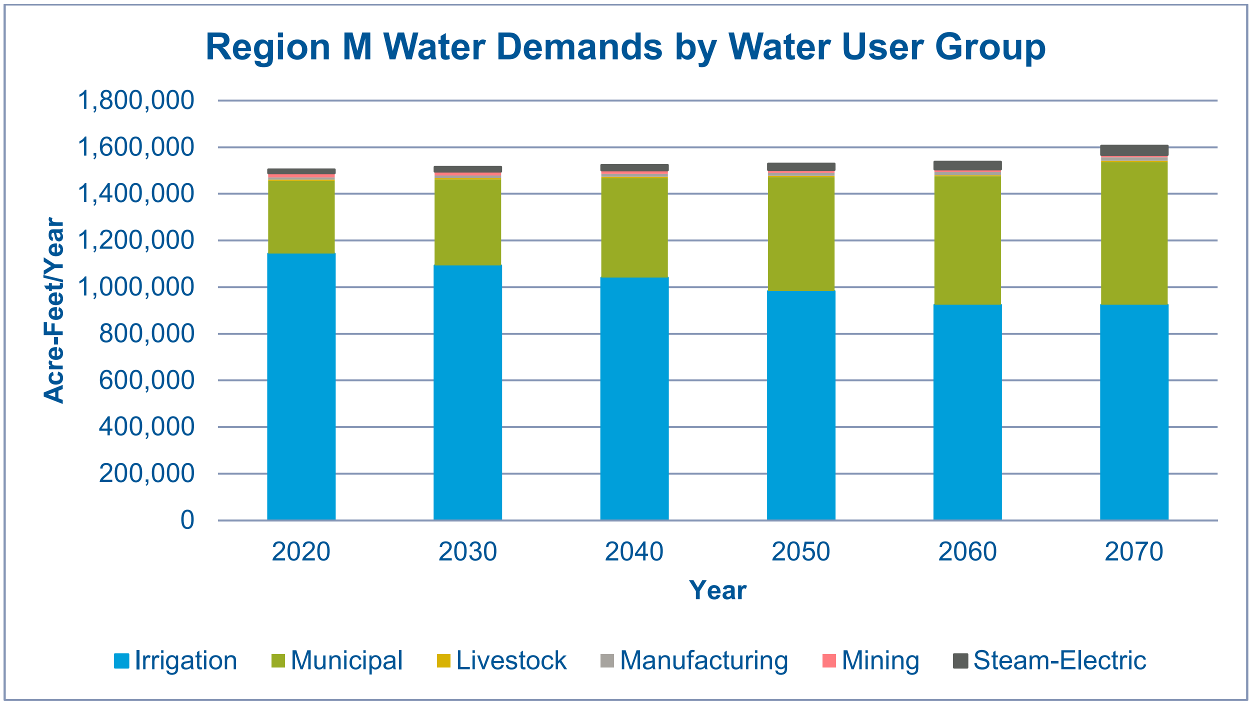

Figure 2-1 Aggregated Demands by Water User Group, Region M (Acre-feet/year)

The TWDB has collaborated with the RWPGs to develop demand projections for the region's water users, shown in Figure 2-1 and Table 2-1. Population and municipal demands were estimated for cities and unincorporated areas for municipal water user group (WUG) projections. Other users were aggregated into geographical areas defined by county and river basin boundaries, such as Irrigation and Steam Electric Power Generation, to form the demand projections for all other WUGs. TWDB estimated demands based on historical data and recent studies for each category, establishing the *base year*. The base year was used with a *rate of change* to project decadal estimates over the 50-year planning horizon.

The TWDB draft demand projections were distributed to the RWPGs for review and were revised where necessary based on local information. The Region M Planning Group agreed with the TWDB estimates for population and municipal demand, manufacturing, steam-electric, and livestock demand. Revisions were requested and adopted for irrigation and mining demands based on recent studies and an alternative approach to estimating changes in irrigation demands.

Table 2-1 Regional Demand Projections by Water User Group (Acre-feet/year)

Water User Group	2020	2030	2040	2050	2060	2070
Municipal	311,591	368,997	427,611	488,449	550,830	612,127
Irrigation	1,144,135	1,093,749	1,040,789	983,283	924,558	924,558
Livestock	4,986	4,986	4,986	4,986	4,986	4,986
Manufacturing	10,433	11,292	12,147	12,898	13,896	14,971
Mining	17,031	16,458	14,937	12,813	10,453	10,359
Steam-Electric	16,972	19,842	23,340	27,605	32,806	38,916
Total	**1,505,148**	**1,515,324**	**1,523,810**	**1,530,034**	**1,537,529**	**1,605,917**

2.2 Municipal Demands

2.2.1 Population Projections

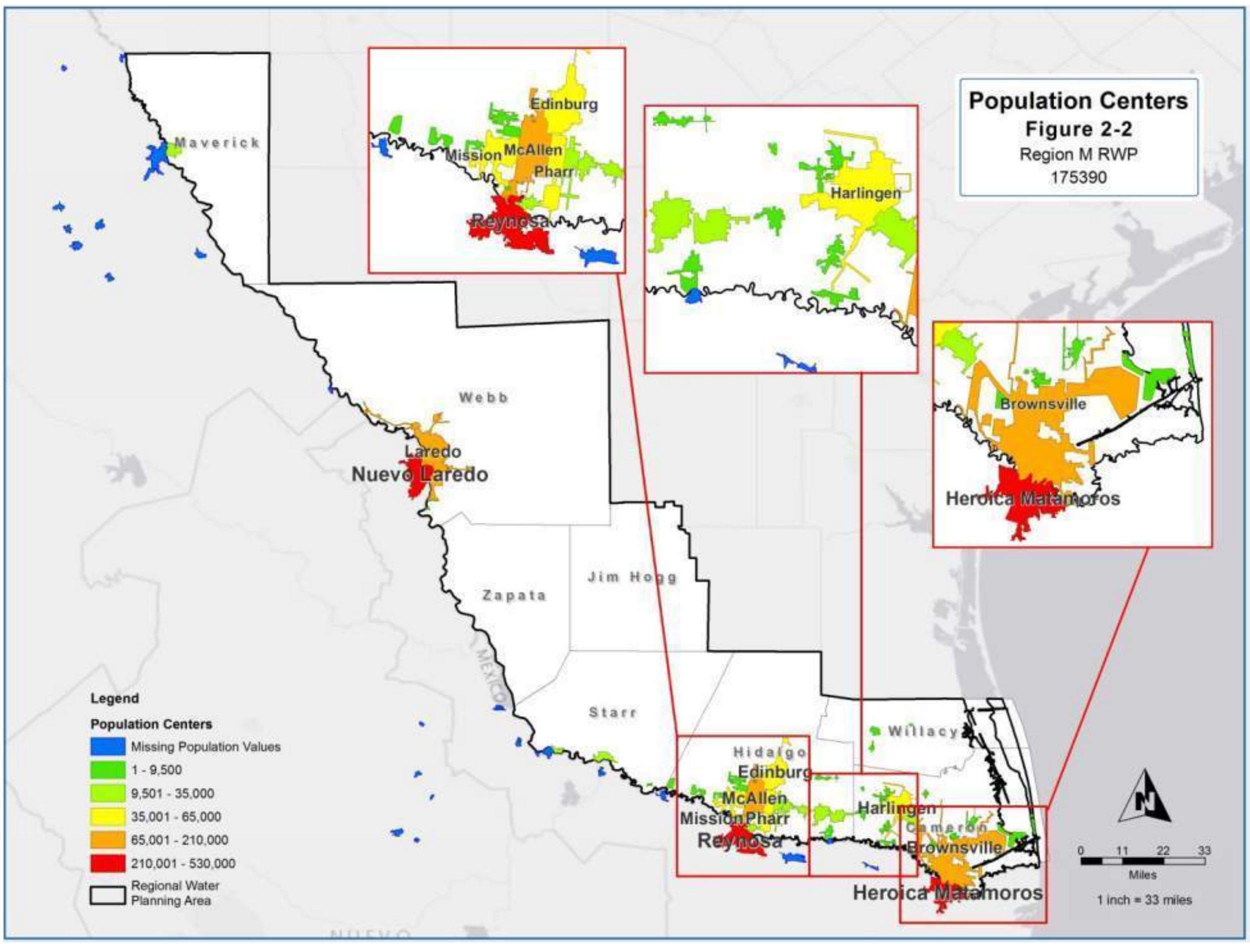

Figure 2-2 Population Projections for Region M by County

The population of Region M has been growing at about the same rate as the rest of the state of Texas. Figure 2-2 shows the major population centers within the Region. Table 2-2 shows the population growth by county over the planning horizon.

Table 2-2 Population Growth Projections for Region M

County	2020	2030	2040	2050	2060	2070
Cameron	478,974	559,593	641,376	729,461	820,068	912,941
Hidalgo	981,890	1,219,225	1,457,502	1,696,257	1,935,015	2,167,137
Jim Hogg	5,853	6,356	6,790	7,274	7,694	8,082
Maverick	63,107	72,491	81,243	90,304	98,988	107,327
Starr	70,803	80,085	88,633	97,107	104,687	111,555
Webb	318,028	393,284	464,960	530,330	591,945	647,433
Willacy	25,264	28,479	31,559	34,840	38,012	41,121
Zapata	16,819	19,709	22,876	26,365	29,976	33,742
Total	**1,960,738**	**2,379,222**	**2,794,939**	**3,211,938**	**3,626,385**	**4,029,338**

The TWDB generated draft projections for population and municipal demand, which were adopted by the Planning group on August 16, 2013. County-level population projections are based on Texas State Data Center (TSDC) / Office of the State Demographer county-level population estimates. These projections are based on recent and projected demographic trends, including birth rates, survival rates, and net migration rates for population cohorts separated by age, gender, and race/ethnicity.

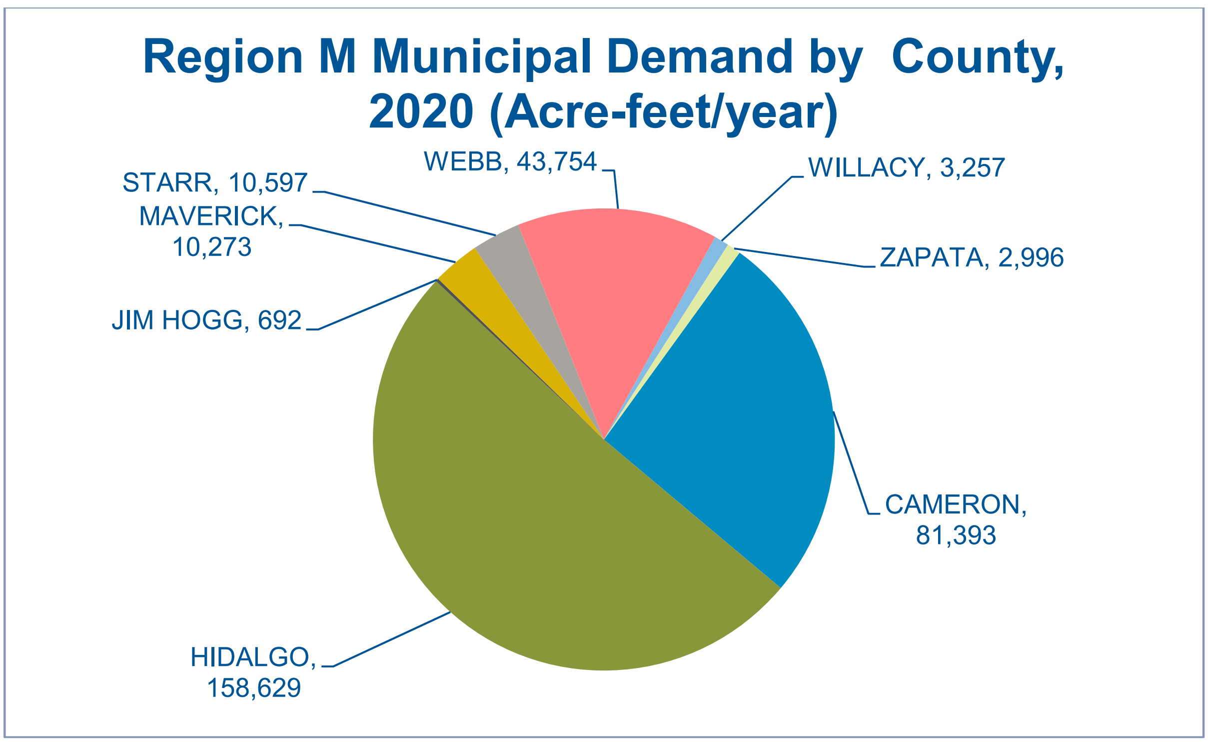

Figure 2-3 Municipal Demand Distribution among the Eight Counties of Region M (Acre-feet/year)

The TSDC developed county-level population projections from 2011 to 2050 under three migration scenarios:

1. No net migration (natural growth/decline only),

2. Continued net migration rates of 2000-2010 ("full migration scenario"), and
3. Half of the 2000-2010 migration rates ("half-migration scenario").

TSDC's projections extend to 2050, and the TWDB staff extended the projection to the extent of the planning horizon, through 2060 and 2070, by using the trend average annual growth rates of the 2011-2050 TSDC projections.

The county-level projections were then distributed to a municipal WUG-level. [1] Municipal WUGs in the regional planning process include:

- Cities with a 2010 population greater than 500;[2]
- Select Census Designated Places, such as military bases and in counties with no incorporated cities;
- Utilities (areas outside the places listed above) providing more than 280 acre-ft. of municipal water per year;
- Collections of utilities with a common water supplier or water supplies (collective reporting units); and
- Remaining rural, unincorporated population summarized as "County-Other."

The projections for the individual WUGs were developed by allocating growth from the county projections to each of the cities, utilities, and rural areas within that county. A combination of factors influenced the allocation of growth, including that WUG's share of historical growth or historical population, and instances where a WUG is expected to have a constant population, like a prison or military base.

Table 2-3 Historical and Projected Population, by Decade

County/City	Census 2010	2020	2030	2040	2050	2060	2070
Cameron County							
Brownsville	175,023	211,200	251,288	291,955	335,755	380,809	426,990
Combes	2,895	3,414	3,989	4,571	5,199	5,845	6,507

[1] In some cases, the boundaries of qualifying water user groups may overlap. Examples and the method of population and water use allocation include: (1) City utility serving beyond city limits – The service area boundary of a city-owned water utility may extend beyond the city boundaries; in such cases the population and associated water use outside of the city limits are allocated not to the city but to the County-Other WUG. (2) Non-city utility serving city residents – a non-city water utility may provide water directly to residents of a city that qualifies as a WUG; in such cases the population and associated water use in the shared area are attributed to the city rather than the non-city utility in the regional water plan.

[2] The criterion for including only cities with populations greater than 500 has been used throughout the regional planning process, beginning with the 2001 regional water plans and the 2002 state water plan. Smaller cities are included in the aggregated County-Other water use, but are not separately delineated because many such small cities may not have a public water system or may not be the owner of the system. Regional planning groups do have the option of combining smaller water systems/cities into a collective water use group when the systems share a similar source or provider and are anticipated to coordinate in meeting their future water needs. In addition, regions may request the inclusion of cities or systems below the threshold criteria as distinct water user groups. This can be accommodated in the online planning database.

County/City	Census 2010	2020	2030	2040	2050	2060	2070
County-Other	44,311	47,407	50,849	54,339	58,099	61,967	65,934
East Rio Hondo WSC	23,267	27,435	32,052	36,736	41,782	46,971	52,291
El Jardin WSC	12,805	15,099	17,640	20,218	22,995	25,851	28,779
Harlingen	64,849	76,464	89,334	102,390	116,452	130,916	145,742
Indian Lake	640	755	882	1,011	1,150	1,293	1,439
La Feria	7,302	8,610	10,059	11,530	13,113	14,742	16,411
Laguna Vista	3,117	3,676	4,294	4,922	5,598	6,293	7,006
Los Fresnos	5,542	6,535	7,635	8,751	9,952	11,189	12,456
Los Indios	1,083	1,277	1,492	1,710	1,945	2,187	2,434
Military Highway WSC	16,505	19,462	22,737	26,060	29,639	33,320	37,094
North Alamo WSC	408	482	563	645	733	824	917
Olmito WSC	3,361	3,963	4,630	5,307	6,036	6,786	7,554
Palm Valley	1,304	1,538	1,797	2,059	2,342	2,633	2,931
Port Isabel	5,006	5,903	6,897	7,904	8,990	10,107	11,251
Primera	4,070	4,799	5,607	6,427	7,309	8,217	9,147
Rancho Viejo	2,437	2,874	3,358	3,848	4,377	4,920	5,477
Rio Hondo	2,356	2,778	3,246	3,720	4,231	4,757	5,295
San Benito	24,250	28,594	33,406	38,289	43,547	48,956	54,500
Santa Rosa	2,873	3,388	3,958	4,537	5,160	5,800	6,457
South Padre Island	2,816	3,321	3,880	4,447	5,057	5,685	6,329
Cameron County Total	*406,220*	*478,974*	*559,593*	*641,376*	*729,461*	*820,068*	*912,941*
Hidalgo County							
Agua SUD	41,133	52,129	64,729	77,379	90,055	102,731	115,054
Alamo	18,353	23,259	28,881	34,525	40,181	45,837	51,335
Alton	12,341	15,640	19,420	23,215	27,019	30,822	34,519
County-Other	32,223	40,847	50,722	60,632	70,564	80,490	90,146
Donna	15,798	20,021	24,860	29,719	34,587	39,456	44,189
Edcouch	3,161	4,006	4,974	5,946	6,920	7,894	8,841
Edinburg	77,100	97,711	121,329	145,041	168,800	192,560	215,659
Elsa	5,660	7,173	8,906	10,647	12,391	14,136	15,831
Hidalgo	11,198	14,191	17,621	21,065	24,516	27,967	31,322
Hidalgo County MUD #1	5,412	6,858	8,516	10,181	11,848	13,516	15,138
La Joya	3,985	5,050	6,271	7,496	8,724	9,952	11,146
La Villa	1,957	2,480	3,079	3,681	4,284	4,887	5,474
McAllen	129,877	164,597	204,382	244,325	284,348	324,372	363,284
Mercedes	15,570	19,732	24,501	29,290	34,088	38,886	43,551
Military Highway WSC	9,581	12,142	15,077	18,023	20,976	23,928	26,799
Mission	77,058	97,658	121,263	144,962	168,708	192,455	215,541
North Alamo WSC	116,890	148,138	183,945	219,894	255,915	291,937	326,957
Palmhurst	2,607	3,303	4,102	4,904	5,707	6,511	7,292
Palmview	5,460	6,919	8,592	10,271	11,953	13,636	15,272
Penitas	4,403	5,580	6,928	8,282	9,639	10,996	12,315
Pharr	70,400	89,220	110,785	132,437	154,131	175,826	196,918
Progreso	5,507	6,979	8,666	10,359	12,056	13,753	15,403
San Juan	33,856	42,906	53,277	63,690	74,123	84,556	94,699

County/City	Census 2010	2020	2030	2040	2050	2060	2070
Sharyland WSC	35,567	45,075	55,970	66,908	77,869	88,829	99,485
Sullivan City	4,002	5,071	6,297	7,528	8,761	9,995	11,194
Weslaco	35,670	45,205	56,132	67,102	78,094	89,087	99,773
Hidalgo County Total	*774,769*	*981,890*	*1,219,225*	*1,457,502*	*1,696,257*	*1,935,015*	*2,167,137*
Jim Hogg County							
County-Other	742	819	889	950	1,018	1,077	1,131
Hebbronville	4,558	5,034	5,467	5,840	6,256	6,617	6,951
Jim Hogg County Total	*5,300*	*5,853*	*6,356*	*6,790*	*7,274*	*7,694*	*8,082*
Maverick County							
County-Other	28,010	31,983	36,197	40,127	44,196	48,095	51,839
Eagle Pass	26,248	31,124	36,294	41,116	46,108	50,893	55,488
Maverick County Total	*54,258*	*63,107*	*72,491*	*81,243*	*90,304*	*98,988*	*107,327*
Starr County							
Agua SUD	254	295	334	370	405	437	465
County-Other	24,657	28,631	32,385	35,841	39,269	42,334	45,113
Escobares	1,188	1,380	1,561	1,728	1,893	2,040	2,174
La Grulla	1,622	1,884	2,131	2,359	2,584	2,786	2,968
Rio Grande City	13,834	16,066	18,172	20,112	22,035	23,755	25,313
Rio WSC	3,298	3,831	4,333	4,795	5,253	5,663	6,035
Roma	9,765	11,341	12,827	14,196	15,554	16,768	17,868
Union WSC	6,350	7,375	8,342	9,232	10,114	10,904	11,619
Starr County Total	*60,968*	*70,803*	*80,085*	*88,633*	*97,107*	*104,687*	*111,555*
Webb County							
County-Other	6,146	7,810	9,658	11,418	13,023	14,536	15,899
El Cenizo	3,273	4,158	5,142	6,079	6,934	7,740	8,465
Laredo	236,091	299,969	370,952	438,558	500,216	558,332	610,669
Rio Bravo	4,794	6,091	7,532	8,905	10,157	11,337	12,400
Webb County Total	*250,304*	*318,028*	*393,284*	*464,960*	*530,330*	*591,945*	*647,433*
Willacy County							
County-Other	468	530	600	666	735	800	867
East Rio Hondo WSC	31	36	40	45	49	54	58
Lyford	2,611	2,981	3,360	3,723	4,110	4,485	4,851
North Alamo WSC	5,333	6,088	6,862	7,604	8,395	9,159	9,908
Raymondville	11,284	12,880	14,519	16,089	17,762	19,379	20,964
San Perlita	573	655	738	817	902	985	1,065
Sebastian MUD	1,834	2,094	2,360	2,615	2,887	3,150	3,408
Willacy County Total	*22,134*	*25,264*	*28,479*	*31,559*	*34,840*	*38,012*	*41,121*
Zapata County							
County-Other	2,321	2,785	3,262	3,787	4,366	4,962	5,587
San Ygnacio MUD	835	1,002	1,174	1,363	1,571	1,786	2,010

County/City	Census 2010	2020	2030	2040	2050	2060	2070
Zapata County Waterworks	10,862	13,032	15,273	17,726	20,428	23,228	26,145
Zapata County Total	*14,018*	*16,819*	*19,709*	*22,876*	*26,365*	*29,976*	*33,742*

2.2.2 Municipal Water Demands

Municipal water demand projections were developed from the population projections and a per-person water use volume (gallons per capita per day, GPCD). The base year uses 2011 GPCD values for each city, water utility, and rural area (County-Other), considered an initial 'dry year' water use estimate. Over the planning horizon, a reduction is applied to the GPCD based on expected replacement rates for adoption of water-efficient fixtures and appliances, so that the projected GPCD gradually decreases from the 2011 volume. For each municipal WUG, the projected GPCD is multiplied by the projected population for each future decade to develop municipal water demand projections. The 2011 GPCD for each WUG is calculated by:

- Calculating the net water use of each water system surveyed annually by the TWDB (total intake volume minus sales to large industrial facilities and to other public water suppliers),
- Allocating all or portions of the system net use and applicable estimates of non-system municipal water use (private groundwater) to the planning WUGs (city boundaries or water utility service areas), and
- Converting annual use to daily use, and city-wide to per-capita, using the 2011 population.

When calculating the base (2011) or projected GPCD values, TWDB staff applied a minimum of 60 GPCD.[3] For city WUGs, the 2011 population estimates from the U.S. Census Bureau were used.[4] For all non-city WUGS, the population reported in the annual water use survey was used, with an alternative calculation based on the reported number of connections if necessary.

The efficiency gains that are applied to GPCD are based on new construction and gradual replacement of fixtures and appliances in existing homes. The fixtures that were included in this estimate are: toilets, showerheads, dishwashers, and clothes washers. Total water savings are based on the phased implementation of federal efficiency requirements for each of these kinds of fixtures/appliances, and assumptions about the rate at which new homes are constructed and old

---

[3] 60 GPCD minimum was based on the "Standard New Homes Retrofitted…" estimate of 39 GPCD for indoor use (Analysis of water Use in New Single Family Homes, Prepared by William B. DeOreo of Aquacraft Water Engineering & Management for the Salt Lake City Corporation and the USEPA, 2011) and an estimate that indoor use accounts for 69% of total household use (The Grass is Always Greener…Outdoor Residential Water Use in Texas, Sam Marie Hermitte and Robert Mace, TWDB Technical Note 12-01, 2012). The total of 56.5 GPCD is rounded up to account for additional local government and commercial water use.

[4] Historically the July 1st population estimates from the TSDC have been used in GPCD calculation, however because the TSDC did not release their 2011 population estimates by January 2013, TWDB staff used the available Census Bureau Estimates.

fixtures are replaced.[5] This is considered passive conservation and measures beyond those described above are included in the discussion of Advanced Water Conservation as a Water Management Strategy (WMS) in later chapters. Passive conservation savings are shown for each WUG in Table 2-4.

Table 2-4 Passive Efficiency Savings Projections for Municipal WUGs by County (Acre-feet/year)

County	Entity Name	2020	2030	2040	2050	2060	2070
Cameron	Brownsville	2,233.26	3,687.38	4,993.77	6,130.33	7,063.85	7,963.54
Cameron	Combes	38.05	62.60	84.69	103.31	117.92	131.93
Cameron	County-Other, Cameron	482.70	729.07	941.01	1,095.93	1,190.42	1,271.79
Cameron	East Rio Hondo WSC	236.63	374.11	491.74	596.26	684.51	767.31
Cameron	El Jardin WSC	139.70	223.48	296.68	360.61	413.22	462.60
Cameron	Harlingen	843.66	1,382.93	1,868.33	2,278.84	2,601.48	2,910.78
Cameron	Indian Lake	5.92	6.92	7.93	9.02	10.14	11.28
Cameron	La Feria	89.79	145.80	195.67	238.25	272.30	304.78
Cameron	Laguna Vista	31.79	50.55	66.71	80.95	92.91	104.14
Cameron	Los Fresnos	0.00	0.00	0.00	0.00	0.00	0.00
Cameron	Los Indios	15.03	24.80	33.67	41.09	46.86	52.40
Cameron	Military Highway WSC	189.45	303.84	402.25	487.04	557.23	623.68
Cameron	North Alamo WSC	4.47	6.99	9.06	10.87	12.44	13.93
Cameron	Olmito WSC	44.97	73.54	99.33	121.16	138.27	154.59
Cameron	Palm Valley	18.42	30.52	41.54	50.74	57.84	64.68
Cameron	Port Isabel	69.03	114.03	154.85	189.02	215.56	241.09
Cameron	Primera	46.50	75.24	100.57	122.40	140.09	156.76
Cameron	Rancho Viejo	25.43	39.91	52.33	63.39	72.75	81.53
Cameron	Rio Hondo	29.87	48.94	62.50	71.09	79.93	88.97
Cameron	San Benito	333.43	550.07	747.13	912.17	1,040.27	1,162.96
Cameron	Santa Rosa	39.85	65.79	89.39	109.13	124.41	139.09
Cameron	South Padre Island	35.19	57.28	76.96	93.75	107.11	119.88
Hidalgo	Agua SUD	482.90	805.54	1,089.51	1,339.61	1,554.64	1,751.44
Hidalgo	Alamo	234.74	394.36	536.78	660.27	765.03	861.39
Hidalgo	Alton	119.48	196.00	260.82	319.90	372.87	420.69
Hidalgo	County-Other, Hidalgo	584.74	800.54	986.15	1,171.40	1,356.92	1,527.78
Hidalgo	Donna	238.39	411.02	568.59	702.01	811.00	912.25
Hidalgo	Edcouch	50.75	88.14	122.62	151.54	174.90	196.68
Hidalgo	Edinburg	897.49	1,497.68	2,024.34	2,488.30	2,888.15	3,253.94
Hidalgo	Elsa	89.51	155.23	215.63	266.49	307.66	345.97
Hidalgo	Hidalgo	128.76	213.76	288.11	353.98	411.01	463.12
Hidalgo	Hidalgo County MUD #1	60.69	100.45	135.03	165.76	192.58	217.05

[5] For details regarding the way efficiency improvements were calculated, see Regional Water Planning Documentation, Projection Methodology for Draft Population and Municipal Demands, TWDB.

County	Entity Name	2020	2030	2040	2050	2060	2070
Hidalgo	La Joya	55.72	95.25	130.98	161.53	186.84	210.25
Hidalgo	La Villa	26.00	44.53	61.23	75.53	87.42	98.41
Hidalgo	McAllen	1,834.50	3,147.89	4,335.08	5,350.98	6,187.74	6,962.58
Hidalgo	Mercedes	231.19	398.50	551.52	680.81	786.66	884.93
Hidalgo	Military Highway WSC	118.19	201.47	278.19	344.69	400.16	450.58
Hidalgo	Mission	901.38	1,511.81	2,049.22	2,519.06	2,923.22	3,293.20
Hidalgo	North Alamo WSC	1,373.95	2,285.04	3,088.76	3,795.40	4,408.11	4,966.20
Hidalgo	Palmhurst	26.82	41.58	53.89	65.46	76.36	86.17
Hidalgo	Palmview	63.47	104.71	140.71	172.72	200.55	225.98
Hidalgo	Penitas	41.50	68.29	90.91	111.53	130.07	146.77
Hidalgo	Pharr	870.47	1,469.29	2,001.22	2,463.70	2,855.78	3,216.01
Hidalgo	Progreso	68.32	113.28	152.94	187.71	217.68	245.17
Hidalgo	San Juan	433.03	728.67	992.37	1,221.35	1,415.04	1,593.27
Hidalgo	Sharyland WSC	507.43	873.96	1,206.64	1,489.79	1,722.37	1,937.90
Hidalgo	Sullivan City	59.07	100.94	139.05	171.44	198.17	222.94
Hidalgo	Weslaco	482.06	823.67	1,131.22	1,394.38	1,613.61	1,816.10
Jim Hogg	County-Other, Jim Hogg	9.21	14.22	18.42	21.50	23.10	24.34
Jim Hogg	Hebbronville	57.01	88.37	114.61	133.78	143.64	151.36
Maverick	County-Other, Maverick	317.06	493.45	640.96	758.43	840.43	909.91
Maverick	Eagle Pass	342.01	558.19	743.80	894.54	1,002.19	1,097.65
Starr	Agua SUD	2.73	4.16	5.21	6.02	6.61	7.08
Starr	County-Other, Starr	337.38	542.69	719.84	847.63	926.59	990.95
Starr	Escobares	18.22	28.22	32.01	35.77	39.17	41.91
Starr	La Grulla	19.69	31.17	40.85	48.19	52.80	56.48
Starr	Rio Grande City	175.10	277.44	364.06	429.72	470.45	503.29
Starr	Rio WSC	33.47	51.01	65.10	76.32	83.99	89.91
Starr	Roma	129.70	205.75	270.64	319.53	349.54	373.88
Starr	Union WSC	65.51	99.52	126.78	148.52	163.42	174.92
Webb	County-Other, Webb	103.41	179.37	232.52	269.43	304.48	334.28
Webb	El Cenizo	43.55	72.17	96.76	116.51	131.96	144.98
Webb	Laredo	3,158.48	5,343.58	7,241.00	8,746.50	9,900.27	10,876.19
Webb	Rio Bravo	70.89	120.14	163.39	197.51	223.25	245.15
Willacy	County-Other, Willacy	3.73	5.04	5.90	6.79	7.64	8.36
Willacy	East Rio Hondo WSC	0.31	0.47	0.60	0.70	0.79	0.85
Willacy	Lyford	30.25	47.80	62.80	74.81	83.04	90.20
Willacy	North Alamo WSC	56.46	85.24	106.81	124.50	138.30	150.49
Willacy	Raymondville	137.93	218.90	288.89	344.20	381.61	414.70
Willacy	San Perlita	7.97	12.89	16.79	18.88	20.94	22.73
Willacy	Sebastian MUD	22.52	34.37	38.08	42.04	45.87	49.63
Zapata	County-Other, Zapata	39.62	52.36	62.65	73.90	85.43	96.75
Zapata	San Ygnacio MUD	11.58	19.06	26.12	32.26	37.21	42.08
Zapata	Zapata County Waterworks	139.70	227.02	308.56	380.30	439.46	497.28
		20,267.18	**33,537.99**	**45,240.77**	**55,138.97**	**63,186.23**	**70,529.83**

The Regional average GPCD for 2020 is 141.8, and in 2070 is 135.6, which is a 4% reduction in per-capita daily demand over 50 years. The base year GPCD and projected demands for all Region M municipal WUGs is shown in Table 2-5.

Table 2-5 GPCD and Projected Municipal Demands by City/County (Acre-feet/year)

County/City	Base Dry-Year GPCD	2020	2030	2040	2050	2060	2070
Cameron County							
Brownsville	162	36,092	41,913	47,986	54,797	62,040	69,520
Combes	94	322	358	397	445	498	554
County-Other	155	7,749	8,100	8,494	8,992	9,569	10,176
East Rio Hondo WSC	132	3,820	4,366	4,941	5,582	6,261	6,965
El Jardin WSC	109	1,704	1,931	2,172	2,447	2,744	3,052
Harlingen	168	13,546	15,429	17,400	19,636	22,035	24,516
Indian Lake	67	51	60	68	78	87	97
La Feria	126	1,126	1,274	1,432	1,613	1,809	2,012
Laguna Vista	599	2,435	2,831	3,236	3,676	4,130	4,597
Los Fresnos	60	440	514	589	669	752	838
Los Indios	111	144	161	179	201	226	251
Military Highway WSC	144	2,950	3,364	3,802	4,294	4,818	5,360
North Alamo WSC	153	79	90	102	115	129	144
Olmito WSC	175	732	835	941	1,063	1,192	1,327
Palm Valley	176	285	324	365	411	462	514
Port Isabel	211	1,327	1,517	1,714	1,936	2,174	2,419
Primera	87	422	472	526	590	661	735
Rancho Viejo	267	835	965	1,099	1,246	1,399	1,557
Rio Hondo	75	204	224	251	285	320	356
San Benito	123	3,607	4,053	4,529	5,088	5,705	6,346
Santa Rosa	88	295	325	358	400	448	498
South Padre Island	877	3,228	3,755	4,292	4,875	5,478	6,098
Cameron County Total	--	*81,393*	*92,861*	*104,873*	*118,439*	*132,937*	*147,932*
Hidalgo County							
Agua SUD	104	5,590	6,736	7,925	9,152	10,414	11,652
Alamo	133	3,231	3,909	4,607	5,326	6,064	6,787
Alton	125	2,071	2,524	2,990	3,464	3,943	4,413
County-Other	121	4,952	6,075	7,232	8,393	9,553	10,691
Donna	127	2,610	3,126	3,660	4,219	4,802	5,375
Edcouch	91	358	419	484	554	630	705
Edinburg	128	13,113	15,899	18,772	21,714	24,721	27,667
Elsa	112	811	963	1,121	1,289	1,466	1,641
Hidalgo	125	1,859	2,254	2,662	3,079	3,505	3,923
Hidalgo County MUD #1	82	570	682	801	923	1,049	1,174
La Joya	125	652	783	919	1,060	1,207	1,351
La Villa	108	275	328	385	443	504	564
McAllen	220	38,728	47,219	55,875	64,722	73,748	82,563

County/City	Base Dry-Year GPCD	2020	2030	2040	2050	2060	2070
Mercedes	111	2,223	2,648	3,091	3,558	4,049	4,531
Military Highway WSC	144	1,841	2,231	2,629	3,039	3,460	3,873
Mission	193	20,212	24,704	29,290	33,954	38,684	43,305
North Alamo WSC	153	24,015	29,240	34,598	40,064	45,625	51,069
Palmhurst	259	932	1,149	1,369	1,591	1,813	2,030
Palmview	104	743	897	1,056	1,220	1,388	1,554
Penitas	103	603	732	865	1,001	1,139	1,275
Pharr	108	9,923	11,933	14,021	16,183	18,415	20,607
Progreso	101	722	868	1,020	1,177	1,339	1,498
San Juan	137	6,152	7,448	8,782	10,154	11,561	12,940
Sharyland WSC	169	8,026	9,722	11,460	13,252	15,094	16,896
Sullivan City	106	544	647	755	869	989	1,107
Weslaco	165	7,873	9,551	11,271	13,040	14,852	16,625
Hidalgo County Total	--	*158,629*	*192,687*	*227,640*	*263,440*	*300,014*	*335,816*
Jim Hogg County							
County-Other	118	100	104	108	114	120	126
Hebbronville	115	592	616	638	673	709	745
Jim Hogg County Total	--	*692*	*720*	*746*	*787*	*829*	*871*
Maverick County							
County-Other	128	4,269	4,697	5,113	5,579	6,056	6,523
Eagle Pass	182	6,004	6,841	7,639	8,506	9,374	10,215
Maverick County Total	--	*10,273*	*11,538*	*12,752*	*14,085*	*15,430*	*16,738*
Starr County							
Agua SUD	104	32	35	38	42	45	48
County-Other	124	3,640	3,956	4,259	4,607	4,954	5,276
Escobares	121	169	184	203	221	238	253
La Grulla	169	337	373	406	441	475	506
Rio Grande City	223	3,839	4,262	4,660	5,075	5,464	5,820
Rio WSC	100	396	435	473	513	551	587
Roma	117	1,357	1,476	1,590	1,719	1,849	1,968
Union WSC	108	827	910	991	1,076	1,156	1,231
Starr County Total	--	*10,597*	*11,631*	*12,620*	*13,694*	*14,732*	*15,689*
Webb County							
County-Other	116	912	1,076	1,252	1,423	1,585	1,732
El Cenizo	93	390	464	537	606	675	737
Laredo	134	41,867	50,337	58,587	66,336	73,905	80,785
Rio Bravo	96	585	690	795	895	996	1,089
Webb County Total	--	*43,754*	*52,567*	*61,171*	*69,260*	*77,161*	*84,343*
Willacy County							
County-Other	118	67	75	83	91	99	107

County/City	Base Dry-Year GPCD	2020	2030	2040	2050	2060	2070
East Rio Hondo WSC	132	6	6	7	7	8	8
Lyford	96	291	314	338	368	400	432
North Alamo WSC	153	987	1,091	1,197	1,315	1,432	1,548
Raymondville	115	1,522	1,652	1,784	1,944	2,115	2,286
San Perlita	330	235	260	286	315	344	371
Sebastian MUD	73	149	159	176	195	212	230
Willacy County Total	--	*3,257*	*3,557*	*3,871*	*4,235*	*4,610*	*4,982*
Zapata County							
County-Other	138	391	452	523	601	682	767
San Ygnacio MUD	179	190	217	248	283	321	361
Zapata County Waterworks	175	2,415	2,767	3,167	3,625	4,114	4,628
Zapata County Total	--	*2,996*	*3,436*	*3,938*	*4,509*	*5,117*	*5,756*

2.2.3 Wholesale Water Providers

There are 51 Wholesale Water Providers (WWPs) or WUG-Sellers in Region M. These include Irrigation Districts, which sell raw water to irrigation and municipal users, as well as water supply corporations (WSCs), cities with customers outside of their service area, and regional water suppliers like Southmost Regional Water Authority. All of the contract demands between WWPs or WUG Sellers and WUGs are given in Appendix B.

2.3 Irrigation Demands

2.3.1 Base Year Demand

Irrigation use within Region M is largely dependent on available supply from the Amistad-Falcon reservoir system; however, it is important that regional planning irrigation estimates make a distinction between irrigation water use and irrigation water demand. Since the RWP process permits only a single demand scenario and is intended to represent a drought year, irrigation demand is best developed assuming a dry year in which regional irrigation water needs are met, rather than limiting demand to the availability of surface water supplies.

In most actual drought years, some farmers can respond to anticipated limited water supplies by selecting crops that require less water or no ‘applied’ water (dry land farming) which are often lower in value. Similarly, citrus and pecan trees can tolerate minimal water for a limited time period, but their true demand is greater than the minimum water required to survive. In order to address the long-term needs of the farmers in Region M, demands are based on the “worst-case” scenario, where there is minimal rainfall. A detailed discussion of irrigation conservation measures is included in Chapter 5.

Various methodologies have been proposed for the estimation of irrigation demand. The 2011 RWP used the portion of agricultural water rights associated with each county to estimate the base year agricultural demand. The rate of change used in the 2011 RWP projected a rapid decrease between 2020 and 2030, and a constant demand from 2030 through the remainder of the planning horizon.

The initial data proposed by the TWDB for this round of planning established a base year calculated using an average of 2005 to 2009 estimated water use, where that historical water use varied based on supply availability and climate conditions from year to year.

The Region M RWPG formed a sub-committee to research alternative methods for estimating non-population related demand within the TWDB standards. An alternate methodology was developed by the RWPG and approved by TWDB staff. Instead of using the base proposed by TWDB, the base year is established utilizing the same data set but aggregating the maximum year for each county and assembling a new representative demand year. This revised approach results in an increase of the 2011 base year estimate from 998,000 acre-ft. to 1,100,000 acre-ft., which is over 12%. A summary of the TWDB base year estimates, the average use, and the 5-year maximum use are shown in Table 2-6.

Table 2-6 Summary of TWDB Irrigation Base-Year Demand Estimates (Acre-feet/year)

County	2005	2006	2007	2008	2009	5-Year Average	5-Year Maximum
Cameron	298,503	308,571	322,976	314,353	314,597	311,800	322,976
Hidalgo	513,348	530,395	519,770	610,576	616,600	558,138	616,600
Jim Hogg	500	500	417	563	0	396	563
Maverick	53,720	69,592	33,325	30,194	40,000	45,366	69,592
Starr	7,358	9,756	14,060	17,387	17,504	13,213	17,504
Webb	7,250	9,544	6,610	3,738	4,750	6,378	9,544
Willacy	57,532	57,000	57,457	59,300	59,700	58,198	59,700
Zapata	3,414	4,033	4,349	2,780	6,300	4,175	6,300
Total	**941,625**	**989,391**	**958,964**	**1,038,891**	**1,059,451**	**997,664**	**1,102,779**

2.3.2 Rate of Change

In addition to revising the methods for estimating the base year demand, the Region M stakeholders had concerns about the methods used for estimating the rate of change. Specifically, the approach TWDB used to estimate irrigation demands is based on the 2001 Regional Water Plan, and does not reflect the data and trends of the last 15 years.

Faculty at Texas AgriLife Research recommended that, for this planning cycle, a “relatively quick and updated rate of change” be developed that considers the relationship between municipal and irrigation demands. Given that both agriculture and municipal users rely primarily on the Rio Grande for water, it follows that as municipal demands increase, the agricultural demands will decrease as land area that was farmed is developed and municipal demand pressures will lead to some irrigation water rights being converted to municipal water rights. In response, Black & Veatch created a simple model that irrigation demands decline over the planning horizon at the same rate that municipal demands increase. “This *is* better than using the 15-year old rate of change that has been used in previous plans that assumes no change over several decades" (Lacewell et. al, 2012). Municipal demands from the 2011 RWP were used because updated municipal demands were not yet available at the time.[6] The model was applied to all counties in the region except Webb County, which was omitted due to the comparatively large growth in municipal demand projected in the 2011 RWP (more than 90,000 acre-ft./year) versus a relatively small irrigation base year of 7,250 acre-ft./year.

Table 2-7 provides a detailed by county summary of the adopted revisions. Figure 2-4 compares the 2011 RWP and current irrigation projections.

Table 2-7 Irrigation Demand Projections by County (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron	355,962	339,470	322,622	305,522	288,601	288,601
Hidalgo	639,676	609,754	577,457	540,797	502,563	502,563
Jim Hogg	439	413	398	414	451	451
Maverick	52,993	51,886	50,903	49,951	49,076	49,076
Starr	13,483	11,085	8,646	6,192	3,714	3,714
Webb	7,612	7,612	7,612	7,612	7,612	7,612
Willacy	69,253	69,074	68,936	68,814	68,741	68,741
Zapata	4,717	4,455	4,215	3,981	3,800	3,800
Total	**1,144,135**	**1,093,749**	**1,040,789**	**983,283**	**924,558**	**924,558**

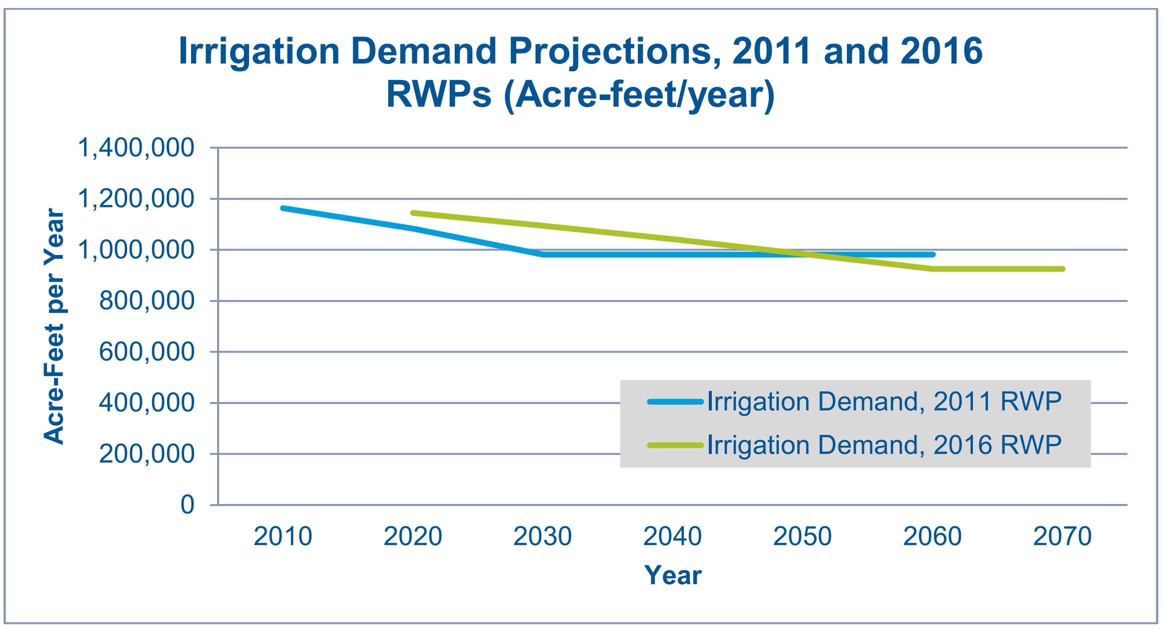

Figure 2-4 Irrigation Projections from Region M 2011 RWP and 2016 RWP (Acre-feet/year)

[6] The 2012 SWP municipal demand data only extends to 2060, so the 2060 values were used for 2070.

2.3.3 Recommendation for Future Study

The Region M Planning Group recommended that a special study be conducted in the near future to better understand historical, existing and future irrigation water demands within the planning area. Such a study would consider the impacts of urbanization and potential water rights transfers. It should also include passive irrigation conservation measures that are expected to occur as either a regulatory or legislative requirement. It is recommended that the resulting updated projections not include active irrigation conservation measures (such as canal lining or crop portfolio optimization), as these are considered to be specific water management strategies by TWDB and are addressed as part of the water management strategy evaluation task. This approach would be consistent with the municipal conservation model, with measures divided into passive and active, or 'advanced' measures.

2.4 Manufacturing Demands

TWDB projects that manufacturing will make up less than 2% of the overall non-population related water demands and less than 30% of overall industrial water demands in Region M throughout the planning horizon. The primary manufacturing water users are related to the agriculture industry and the fishing industry, including shrimp farming, and sugar and vegetable processing. Manufacturing projections show an increase in water demand from 10,400 acre-ft./year in decade 2020 to 15,000 acre-ft./year in decade 2070. The majority of the increase in demand occurs in Cameron and Hidalgo counties and represents a 25% higher projection than the adopted 2011 RWP manufacturing projections. The region-wide manufacturing projections are shown in Table 2-8 by county for the planning horizon.

Table 2-8 Manufacturing Demand Projections by County (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron	4,708	5,111	5,510	5,856	6,324	6,829
Hidalgo	5,461	5,909	6,357	6,756	7,276	7,836
Jim Hogg	0	0	0	0	0	0
Maverick	93	98	103	107	114	121
Starr	14	15	16	17	18	19
Webb	21	23	25	26	28	30
Willacy	136	136	136	136	136	136
Zapata	0	0	0	0	0	0
Total	**10,433**	**11,292**	**12,147**	**12,898**	**13,896**	**14,971**

2.4.1 Base Year

Manufacturing water demand projections utilized 2004-2008 data from TWDB's Annual Water Use Survey. In counties where reported employment from the companies returning surveys was low compared to manufacturing employment data reported by the Bureau of Economic Analysis, surveyed water use was adjusted to account for non-responses.

2.4.2 Rate of Change

The rate of change for manufacturing projections from the 2011 RWP was applied to the updated 2016 RWP base year estimate. The 2011 RWP manufacturing rate of change utilized the rate of change initially developed for the 1997 SWP, which followed increasing population trends. Because of the relatively small portion of the overall demands that manufacturing represents, and no major shifts are expected in the region, the TWDB projections were adopted by the RWPG.

2.5 Mining Demands

Mining water usage in Region M is dominated by hydraulic fracturing, with some aggregate operations in Hidalgo, Starr, and Webb Counties. One of the major hurdles in evaluating mining water usage is the lack of consistent reporting, especially for groundwater usage. In Region M, the use of surface water from the Rio Grande allowed the Region M Planning Group to further inform water demand projections for mining.

In 2011 the Bureau of Economic Geology (BEG) issued a report, "Current and Projected Water Use in the Texas Mining and Oil and Gas Industry" (June 2011, the 2011 report) and a subsequent update to the report, "Oil and Gas Water Use Report: Update to the 2011 Mining Water Use Report" (September 2012, the 2012 update) to better reflect some of the fast-moving changes to water use due to the growth of hydraulic fracturing across the state. [7] This initial report addressed traditional mining water usage and the update used new information to better estimate hydraulic fracturing water use.

The TWDB staff and Black & Veatch considered the data provided by the BEG, and additionally referenced the Texas Railroad Commission, and FracFocus, a Hydraulic Fracturing well and chemical disclosure registry, to develop estimates for both Base Year and Rate of Change. County-by-county determinations were made for the most appropriate base year demand and how that demand splits between groundwater and surface water.

2.5.1 Base Year

Statewide, a major shift from gas to oil production significantly changed the spatial distribution of production in a relatively short time. Within Region M, accelerated development of the Eagle Ford Shale reflected this trend. Adoption of operating practices that allowed for more water recycling and use of brackish water also changed patterns of water consumption and usage at the same time that overall water usage was increasing. Thus, another major objective of the 2012 update was to further differentiate between total water use and consumptive use for mining operations.

Water usage was estimated for the upstream segment of the oil and gas industry, that is, water used to extract the commodity until it leaves the wellhead. For the aggregate industry, estimates included washing but no further processing, for coal mostly pit dewatering and aquifer depressurization, or mining as defined in the SIC/NAICS codes. Therefore cement factories, in spite of large quarries, are grouped with manufacturing and not mining.

Reuse or recycling is taken into account in water-use values, as well as opportunity usages like stormwater collection for aggregate mining. Usage numbers mostly represent consumption. The

---

[7] Bureau of Economic Geology, Oil and Gas Water Use in Texas: 2011 Mining Water Use Report…and Update to the 2011 Mining Water Use Report. Bureau of Economic Geology, Scott W. Tinker, Director, Jackson School of Geosciences, The University of Texas at Austin, Austin, Texas 78713-8924

division of water between surface and groundwater sources is not well documented. Some facilities provided this information directly, but no consistent information is available due to the reporting exemption for the oil and gas industry. The BEG estimated that approximately 56% of water used in mining statewide was groundwater, and regional estimates varied from 7% in Zapata County to 86% in Maverick County.

The BEG report estimated water usage for the oil and gas, coal, aggregate, and other mineral sectors for a base year and projected through 2060. The data were linearly interpolated through 2070 by TWDB staff. The base year for the 2011 BEG report is 2008; the base year for the 2012 update is 2011. Water usage from the different sectors was calculated variously (only the oil and gas sector was considered in the 2012 report). In general, the data used was compiled from reports submitted to the state for permitting (e.g. information about wells submitted to Railroad Commission of Texas, RRC), surveys distributed by TWDB, and communication with operators and industry trade groups.

For the oil and gas sector, estimates of water use for water-flooding and drilling operations were developed through consultation with operators.[8] There is not a single directly reported source for this information. As noted, one major objective of the 2012 update was to better differentiate between total water usage, which is the volume of water needed for operations regardless of source, and water consumption or “new” water usage, i.e. the portion of demand not met by recycled or reused water. Estimates from operators regarding water sources and current and anticipated future levels of recycling were used to further quantify demand met from various sources for current and projected water use.

Oil and gas sector water usage was projected in the 2012 update using a resource-based approach. Estimates of quantity of developable resources, quantity of operations needed for extraction, and amount of water used by these operations were developed for each major production region. Concentration of future operations was distributed spatially by characteristics of each major play. Temporal distribution was accomplished by modeling production with a hyperbolic decline curve, once again parameterized by data specific to each play.

No comprehensive data set exists for aggregate mining. Surveys were distributed to operators, but despite collaboration with industry trade groups response rates were low. Some data from similar historical water-use surveys distributed by TWDB were available. Records of aggregate production coupled with water-use coefficients from previous studies were also utilized in the attempt to quantify aggregate industry water use. The product of aggregate mining is used locally, so population projections were used to predict future production and water use for this sector as well.

[8] Information from a database compiled by a private vendor (IHS) provided the basis for calculating water used for well development by hydraulic fracturing. Data explicitly reporting water use was available from this source. While a report must be submitted for each well receiving a permit, the completeness and quality of these data varies. Across the state, the percentage of wells determined to be reporting full and consistent information ranged from about 93% in the Barnett Shale to about 32% in the Cotton Valley formation. The Eagle Ford Shale had full and consistent reporting for 47% of permitted wells.

Table 2-9 Base Year Mining Demand by Resource (Acre-feet/year)

BEG Base-Year Data	Coal & Lignite	Crushed Stone	Sand & Gravel	Oil & Gas
Cameron	0	0	0	27
Hidalgo	0	898	603	46
Jim Hogg	0	0	0	33
Maverick	0	0	0	174
Starr	0	180	5	35
Webb	0	100	0	4,599
Willacy	0	0	0	17
Zapata	0	0	0	30

2.5.2 Rate of Change

Limited data was available for groundwater usage, because of the reporting exemption afforded oil and gas industries. Surface water records were available for all Rio Grande water from the TCEQ Rio Grande Watermaster (RGWM). Because all water rights are classified according to their intended use, diversions associated with mining water rights were recorded and compared with the portion of mining usage attributed to surface water by the BEG. This surface water data was not used in the development of the BEG data, and revisions were made for some counties based on these records.

Each county used one of three different projection methodologies, based on evidence of existing traditional mining users and hydraulic fracturing operations. The majority of counties retained the BEG mining projections, based on the information discussed below for each portion of the mining sector.

In order to project future demands from current usage, the general approach was stated to be: 1) Assume general trends will continue. 2) Apply correction factors, such as an estimate of increased recycling in the oil and gas sector. 3) Distribute anticipated trends spatially and temporally. For all counties, the BEG estimated rate of change was used.

For Cameron and Hidalgo counties, where there is evidence of little to no hydraulic fracturing and a significant reliance on surface water, the Rio Grande Watermaster (RGWM) mining diversion data was used to scale the BEG projections.

Table 2-10 Sources of Data for Cameron and Hidalgo County Mining Water Projections

Dataset	Cameron	Hidalgo
2011 Oil & Gas Water Use (BEG 2012)	27 acre-ft.	46 acre-ft.
2011 Water Use, All Other Sectors (BEG 2012)	0 acre-ft.	1,501 acre-ft.
2011 Well Count, FracFocus Registry	0 wells	3 wells
2011 Oil & Gas Wells, Texas Railroad Commission (TRC)	4 wells	47 wells
Operational Drilling Rigs in County (May 22, 2013 Baker Hughes Rig Count)	0 rigs	2 rigs
2012 Mining Water Charged from Rio Grande, RGWM	351 acre-ft.	3,998 acre-ft.

Although the BEG report estimated the split between ground and surface water for the base year data, the RGWM records showed a much higher use of surface water for mining. Therefore the RGWM surface water records were used in the place of the BEG surface water estimate, and the groundwater estimate from BEG increased proportionally. The BEG rate of change, based on estimates of future productivity, was applied to the revised base year.

Table 2-11 Cameron and Hidalgo County Mining Water Use Revisions (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron, BEG 2012	65	68	47	31	15	7
Cameron, Adopted	264	277	191	126	61	28
Hidalgo, BEG 2012	2,445	3,203	3,888	4,592	5,385	6,339
Hidalgo, Adopted	2,844	3,620	4,198	4,819	5,532	6,434

Two other counties, Webb and Zapata, showed some surface water usage in the RGWM data that did not agree with the BEG estimates. Webb County, in the southern Eagle Ford Shale development area, was one of the top ten counties in the state by volume of water used for hydraulic fracturing in 2011. Actual water use in Webb County in 2011 was estimated to be more than double the amount initially projected for that year from the 2008 base-year data in the 2011 report, and was further increased based on the TCEQ Rio Grande Watermaster's records.

The FracFocus Registry lists 164 wells reported with a total water use of 3,170 acre-ft., an average of 19.3 acre-ft. per well. Applying that per-well volume to the 221 wells permitted through TRC produces a 2011 water use of 4,265 acre-ft., which is similar to the BEG estimate of 4,719 acre-ft.

Comparing these estimates to the surface water diversion records shows a much larger than expected reliance on surface water, as opposed to the general assumption that hydraulic fracturing relied primarily on groundwater. Zapata County, on the other hand, shows a small volume of water used in oil and gas, but significantly more surface water than was estimated in the BEG report.

Table 2-12 Sources of Data for Webb and Zapata County Mining Water Projections

Dataset	Webb	Zapata
2011 Oil & Gas Water Use (BEG 2012)	4,599 acre-ft.	30 acre-ft.
2011 Water Use, All Other Sectors (BEG 2012)	0 acre-ft.	1,501 acre-ft.
2011 Well Count, FracFocus Registry	164 wells	3 wells
2011 Oil & Gas Wells, Texas Railroad Commission (TRC)	220 wells	23 wells
Operational Drilling Rigs in County (May 22, 2013 Baker Hughes Rig Count)	1 rig	0 rigs
2011 Mining Water Charged from Rio Grande, RGWM	7,280 acre-ft.	846 acre-ft.
2012 Mining Water Charged from Rio Grande, RGWM	6,728 acre-ft.	763 acre-ft.

The projections for Webb and Zapata Counties were revised to reflect the initial groundwater usage estimates from the BEG report and the 2011 RGWM records as a base year for surface water usage.

Table 2-13 Webb and Zapata County Mining Water Use Revisions (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Webb, BEG 2012	3,862	3,008	2,257	1,537	690	502

County	2020	2030	2040	2050	2060	2070
Webb, Adopted	10,331	8,047	6,038	4,112	1,846	1,343
Zapata, BEG 2012	85	89	66	49	31	20
Zapata, Adopted	911	956	707	525	332	214

Jim Hogg, Maverick, Starr, and Willacy Counties mining use estimates are all directly based on the 2012 BEG report.

Table 2-14 Mining Water Demand Projections (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron	264	277	191	126	61	28
Hidalgo	2,844	3,620	4,198	4,819	5,532	6,434
Jim Hogg	93	97	72	53	34	22
Maverick	1,988	2,737	2,933	2,302	1,674	1,217
Starr	571	697	775	858	961	1,091
Webb	10,331	8,047	6,038	4,112	1,846	1,343
Willacy	49	51	38	28	18	12
Zapata	911	954	707	525	332	214
Total	**17,051**	**16,480**	**14,952**	**12,823**	**10,458**	**10,361**

2.6 Steam –Electric Power Generation Demand Projections

Steam-electric power generation water demand is projected to grow from less than 2% to over 4% of the overall non-population related water demands in Region M throughout the planning horizon. Similarly, the projections show an increase from 48% to over 62% of the overall industrial water demand. The steam-electric water demands show a significant temporal increase from approximately 17,000 acre-ft./year in 2020 to nearly 39,000 acre-ft./year in 2070. The region-wide steam-electric power generation water demand projections are shown in Table 2-15 by county for the planning horizon.

Table 2-15 Steam Electric Power Generation Demands by County (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron	1,523	1,780	2,094	2,477	2,944	3,428
Hidalgo	14,151	16,545	19,462	23,018	27,354	32,507
Jim Hogg	0	0	0	0	0	0
Maverick	0	0	0	0	0	0
Starr	0	0	0	0	0	0
Webb	1,298	1,517	1,784	2,110	2,508	2,981
Willacy	0	0	0	0	0	0
Zapata	0	0	0	0	0	0
Total:	**16,972**	**19,842**	**23,340**	**27,605**	**32,806**	**38,916**

2.6.1 Base Year

The 2011 RWP adopted the same water demand projections for steam-electric generation as was presented in the 2006 Regional Water Plan. The 2008 TWDB report *Water Demand Projections for Power Generation in Texas* by Tinker et al. estimated the base year from actual water consumption and electricity generation data for 2006, which was a lower estimate than previous reports. During the 2011 planning cycle Region M stakeholders elected to continue use of the more conservative base year estimates from the 2003 report. That base year was developed from the 2003 TWDB report *Water Power Generation Water Use in Texas* by Sledge et al. which estimated the base year demand using plant electricity generation data from the year 2000.

The 2016 RWP was estimated by gathering reported power generation, by fuel type, and applying a water use factor for the generating units for each existing plant. Cameron, Hidalgo and Webb counties are the only areas with demands associated with power generation..

2.6.2 Rate of Change

Similar to the base year, the 2011 Regional Water Plan Region M utilized the projected water demands presented in the 2003 TWDB report (Sledge et al, 2003) versus the 2008 TWDB report (Tinker et al, 2008). This same rate of change is again being carried forward for the 2016 RWP.

2.6.3 Recommendation

It is recommended that further review of existing generation facilities and their water usage be undertaken. Additionally, the total demand, rather than consumptive demand, should be considered, with all treated return flows shown as a water reuse strategy.

2.7 Livestock Demands

Livestock is expected to make up less than 1% of the overall non-population related water demands in Region M throughout the planning horizon. The livestock water demand projections show a constant demand of 4,986 acre-ft./year for decade 2020 through decade 2070. This represents 14% less demand for each planning decade than was predicted in the approved 2011 RWP livestock projections for Region M. The region-wide livestock projections are shown in Table 2-16 by county for the planning horizon.

Table 2-16 Livestock Demand Projections (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron	334	334	334	334	334	334
Hidalgo	830	830	830	830	830	830
Jim Hogg	436	436	436	436	436	436
Maverick	499	499	499	499	499	499
Starr	1,018	1,018	1,018	1,018	1,018	1,018
Webb	1,129	1,129	1,129	1,129	1,129	1,129
Willacy	261	261	261	261	261	261
Zapata	479	479	479	479	479	479
Total	**4,986**	**4,986**	**4,986**	**4,986**	**4,986**	**4,986**

2.7.1 Base Year Demand

Livestock water demand projections utilized an average of TWDB's 2005 to 2009 livestock water use estimates as the base year. Water use estimates for 2005 to 2009 were calculated by applying a water use coefficient for each livestock category to county level inventory estimates from Texas Agricultural Statistics Service. Livestock categories considered include breeding cattle, dairy cattle, feed cattle, hogs, pigs, sheep, goats, hens, broilers and horses.

2.7.2 Rate of Change

The rate of change for projections from the 2011 RWP was then applied to the updated base year. During the last RWP cycle many counties, including all of those within Region M, chose to hold the base constant throughout the planning horizon.

Texas Water Development Board

RIO GRANDE
REGIONAL WATER PLANNING GROUP

2016 Region M Water Plan
Chapter 3: Water Supplies

BLACK & VEATCH
Building a world of difference.

Table of Contents

Figures

Tables

List of Abbreviations

AWR	Annual Water Rights
BRACS	Brackish Resource Aquifer Characterization System
DFC	Desired Future Conditions
DMI	Domestic, Municipal, & Industrial
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
GPCPD	Gallons per Capita per Day
IBWC	International Boundary Waters Commission
KCGCD	Kenedy County Groundwater Conservation District
KRC	Kennedy Resource Company, Inc.
MAG	Modeled Available Groundwater
MGD	Million Gallons per Day
RWPG	Regional Water Planning Group
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
WAM	Water Availability Model
WMS	Water Management Strategy
WRAP	Water Rights Analysis Package
WSC	Water Supply Corporation
WUG	Water User Group
WWTP	Wastewater Treatment Plant

Chapter 3. Water Supplies

The planning effort requires a detailed understanding of current and potential water supplies. Region M water users rely mainly on surface water from the Rio Grande although both fresh and brackish groundwater is used across the region for primary or supplementary water supplies. Increasingly, sources which require additional treatment, like brackish groundwater, are being considered in the face of increasing demands. Reuse of water for both potable and non-potable uses is expected to increase in the region as demands on existing surface and groundwater increase and the technology, permitting, and public acceptance processes become more commonplace. Figure 3-1 shows the 2020 estimates of available water resources in Region M.

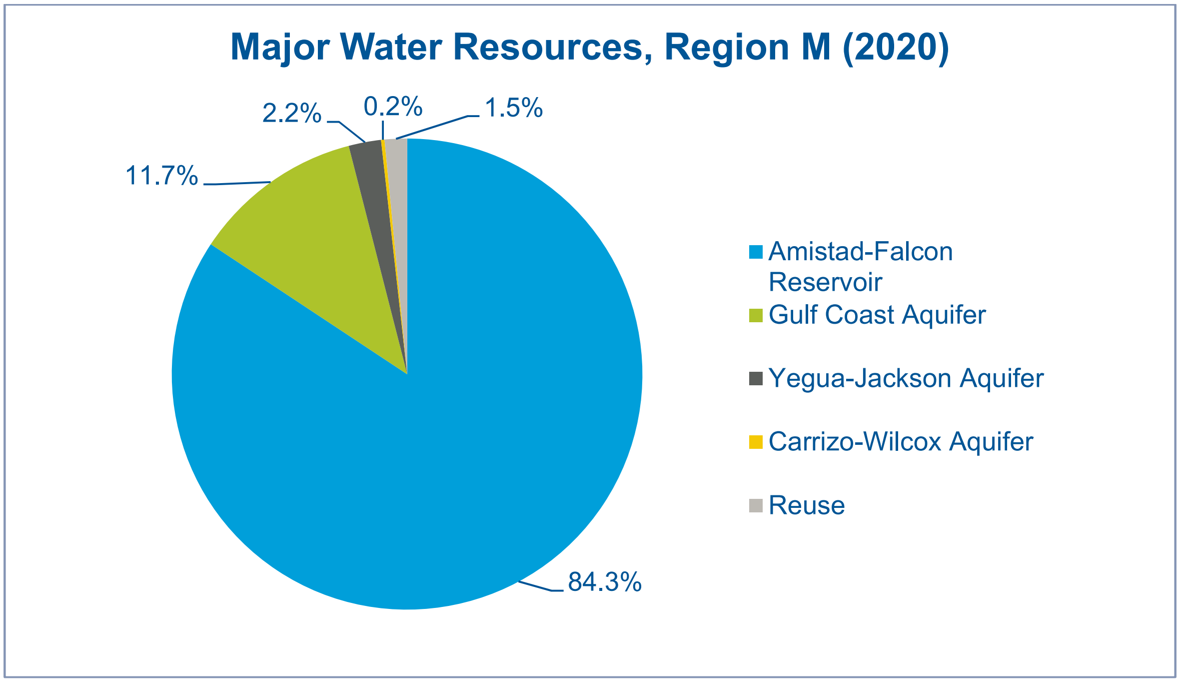

Figure 3-1 Major Groundwater, Surface Water, and Reuse Water Source Projections in Region M

3.1 Surface Water

3.1.1 Rio Grande

The Rio Grande, called the Rio Bravo in Mexico, is the fifth longest river in the United States and among the top twenty in the world. It extends from 12,000 feet above sea level in the San Juan Mountains of Colorado to the Gulf of Mexico (1,901 miles) and forms a 1,255 mile segment of the border between the United States and Mexico.

The entire Rio Grande basin covers an area approximately 336,000 square miles, with approximately half the watershed in the United States and the other half in Mexico. Approximately 182,000 square miles of the basin actually contribute flow; the remainder includes numerous endorheic, or closed basins. Roughly 54,000 square miles of the total watershed are within Texas, about 8,100 square miles of which are endorheic basins.

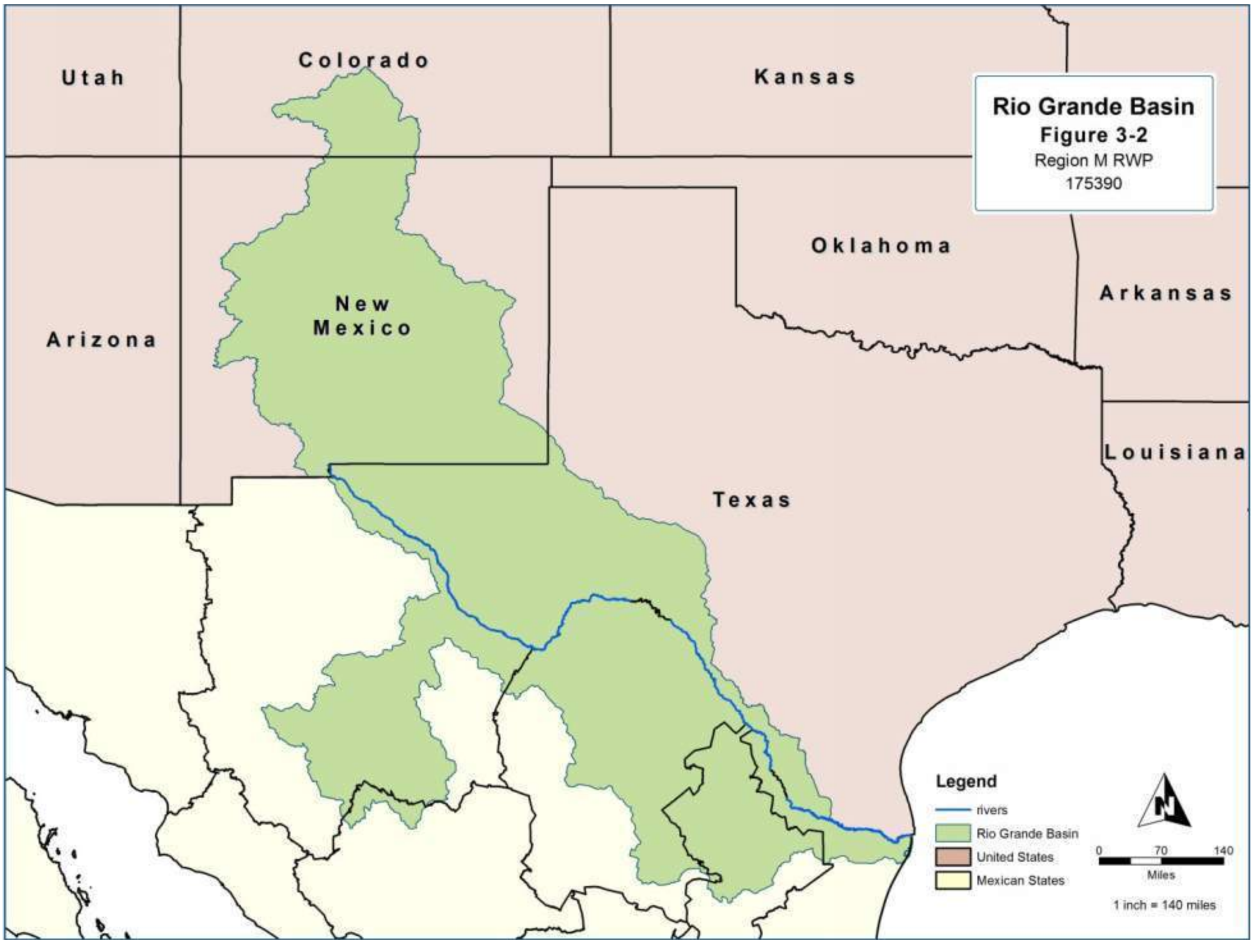

Figure 3-2 Rio Grande Basin

The two major international reservoirs on the Rio Grande, Falcon and Amistad, are operated as a system by the International Boundary and Water Commission (IBWC) for flood control and water supply purposes. Amistad Reservoir is located in Val Verde County (in Region J) at the confluence of the Devils River, 12 miles northwest of Del Rio. 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.

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 3-4 shows the location of these reservoirs.

Drought of Record

The regional water plan is based on "drought of record" conditions, which are based on worst drought known to have previously occurred in the region as documented by existing hydrologic records. Each basin’s Water Availability Model (WAM) determines the Firm Yield of the reservoir system, which is the supply modeled to be available in the drought of record.

The Rio Grande Basin and the Amistad-Falcon Reservoir System refer to the drought spanning from February 1993 to October of 2000 as the drought of record. This 7.75 year period is the most severe hydrologic drought according to the Rio Grande Water Availability Model (WAM), and is used to predict Firm Yield over the planning horizon. Historical data showing combined storage in the Amistad (green) and Falcon (blue) Reservoir system are shown in Figure 3-3.

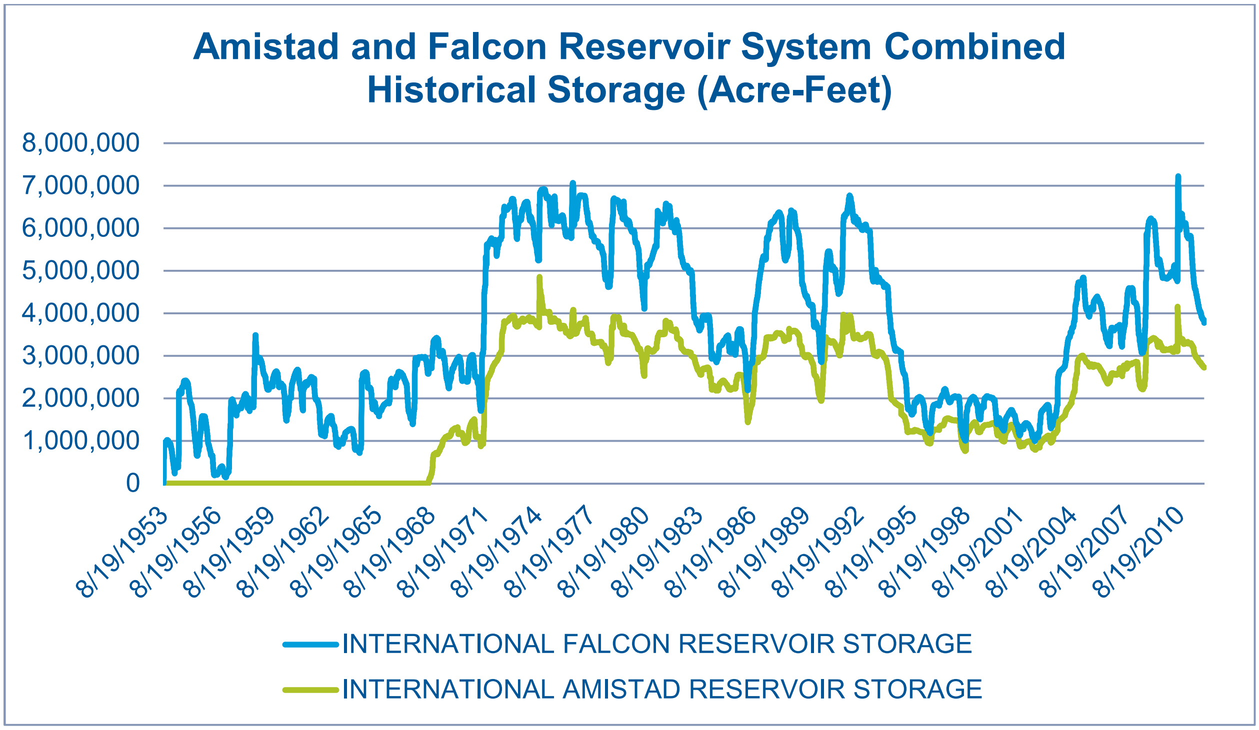

Figure 3-3 Combined U.S. and Mexican Storage in Amistad and Falcon Reservoirs, 1953 – 2011 (Acre-feet).[1]

The span of the current drought is limited by the extent of naturalized flow data in the WAM. The actual drought extended through approximately 2003, and if the WAM were updated to include those years, may impact the drought of record. Extending the span of the drought of record or reviewing recent droughts could change the drought of record, and therefore the firm yield projections. It was recommended in the 2011 Regional Water Plan, and is the opinion of the RWPG, that the Rio Grande WAM should be updated regularly.

Shared Resources with Mexico

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 Convention provides for delivery to Mexico by the United States of 60,000 acre-ft. 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. Region M interprets the 1906 Convention and 1944 Treaty so that the flows in the Rio Grande at Fort Quitman are owned 100% by the United States because Mexico waived 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. All other flows occurring in the Main

[1] USIBWC's Water Accounting Division, accessed 3/27/2015. The IBWC is the legal repository of data related to this lake for treaty purposes and official versions of the datasets should be obtained directly from them.

Channel of the Rio Grande downstream from Fort Quitman are owned 50% by the U.S. and 50% by Mexico.

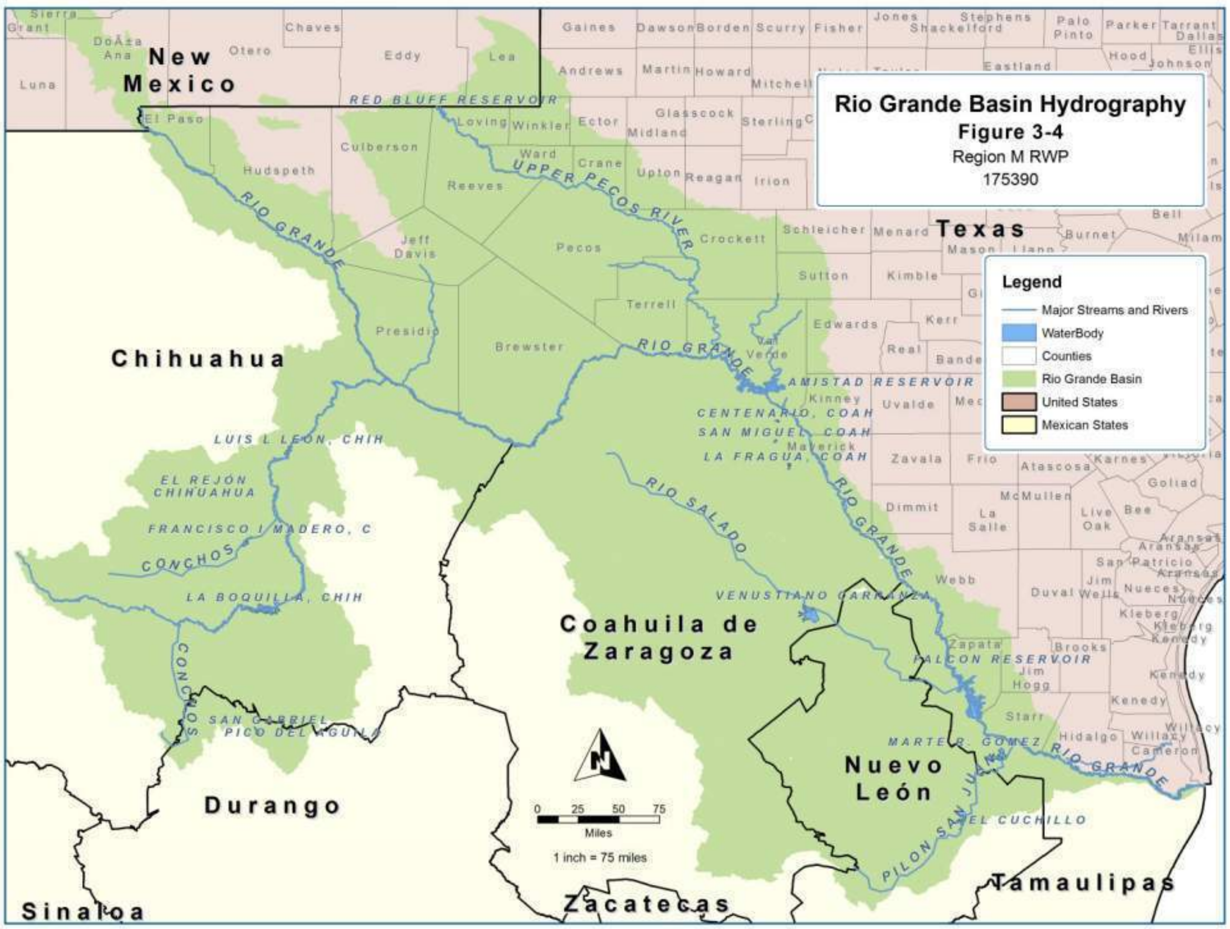

Figure 3-4 Rio Grande Basin, Showing Tributaries and Major Reservoirs in Mexico

The Treaty of February 3, 1944 for "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande" described how Mexico and the United States would divide the waters of the Rio Grande from Fort Quitman to the Gulf of Mexico, and the waters of the Colorado River. Of the waters of the Rio Grande, the Treaty allots to Mexico: (1) all of the waters reaching the main channel of the Rio Grande from the San Juan and Alamo Rivers, including the return flows from the lands irrigated from those two rivers; (2) two-thirds of the flow in the main channel of the Rio Grande from the measured Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers, and the Las Vacas Arroyo, subject to certain provisions; and (3) one-half of all other flows occurring in the main channel of the Rio Grande downstream from Fort Quitman. The Treaty allots to the United States: (1) all of the waters reaching the main channel of the Rio Grande from the Pecos and Devils Rivers, Goodenough Spring and Alamito, Terlingua, San Felipe and Pinto Creeks; (2) one-third of the flow reaching the main channel of the river from the six named measured tributaries from Mexico and provides that this third shall not be less, as an average amount in cycles of five consecutive years, than 350,000 acre-ft. annually; and (3) one-half of all other flows occurring in the main channel of the Rio Grande downstream from Fort Quitman.[2]

The Treaty makes exceptions for years of extraordinary drought or serious accident to the hydraulic systems on the Mexican tributaries, however extraordinary drought is not defined. As a result, Mexico often runs a deficit for up to four consecutive years and repays the debt in years of high precipitation. This significantly impacts the reliability of supplies, and is especially difficult for farmers whose water rights are the most vulnerable to reduced system availability.

Although the term “extraordinary drought” is not expressly defined in the Treaty, as other terms are defined in Article 1, it 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-ft. (431,721,000 cubic meters) annually.” In other words, it is a drought condition when there is less than 1,050,000 acre-ft. (350,000 U.S. share and 700,000 Mexico share) of “run-off waters in the watersheds of the named Mexican tributaries” so as to allow Mexico to deliver the required amount of 1,050,000 acre-ft. to the Rio Grande. This amount is measured at the Rio Grande, without regard to conveyance losses in Mexico, and so Mexico must assume conveyance losses in Mexico and deliver to the Rio Grande the full amount. If there is sufficient run off water in the watershed of the Mexican tributaries, an extraordinary drought does not exist.

The International Boundary and Water Commission (IBWC) tracks the deliveries of water from Mexico to the US. Figure 3-5 shows how much water that has been delivered from Mexico in each of the previous cycles since 1988. The cycles last either 5 years or until the conservation pools in the two reservoirs are full. Figure 3-6 shows the deliveries for this current cycle compared with the target delivery rate as described in the 1944 Treaty.

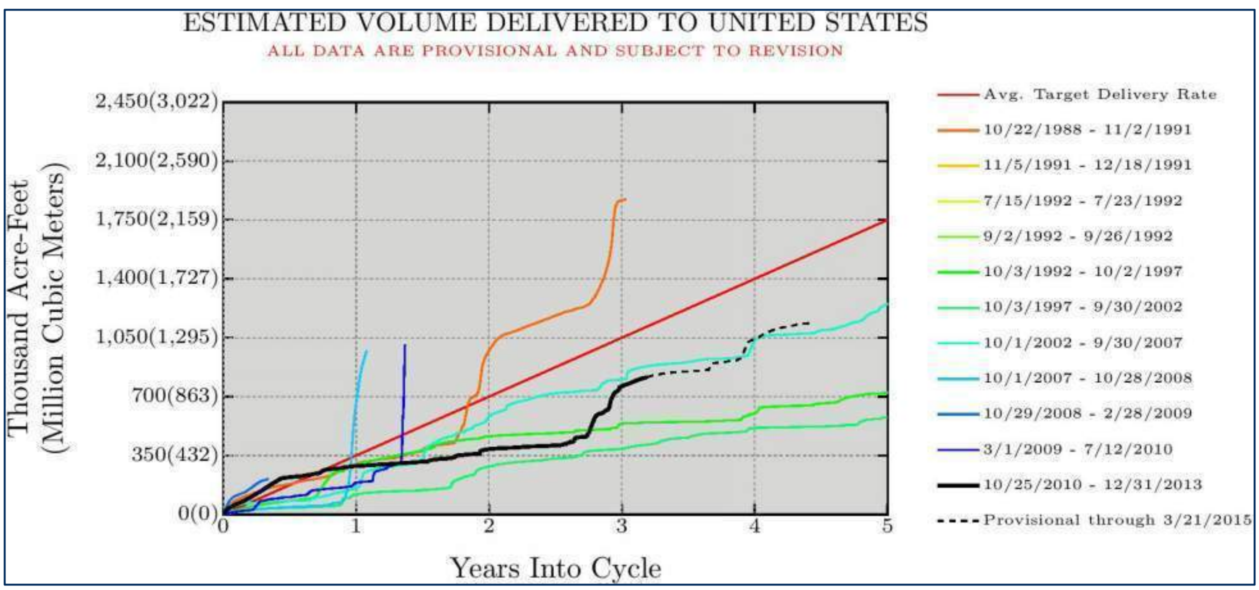

Figure 3-5 Water Delivered to the U.S. from Mexico, 1988 – 2013 (IBWC)

[2]The International Boundary and Water Commission - Its Mission, Organization and Procedures for Solution of Boundary and Water Problems, http://www.ibwc.state.gov/About_Us/About_Us.html

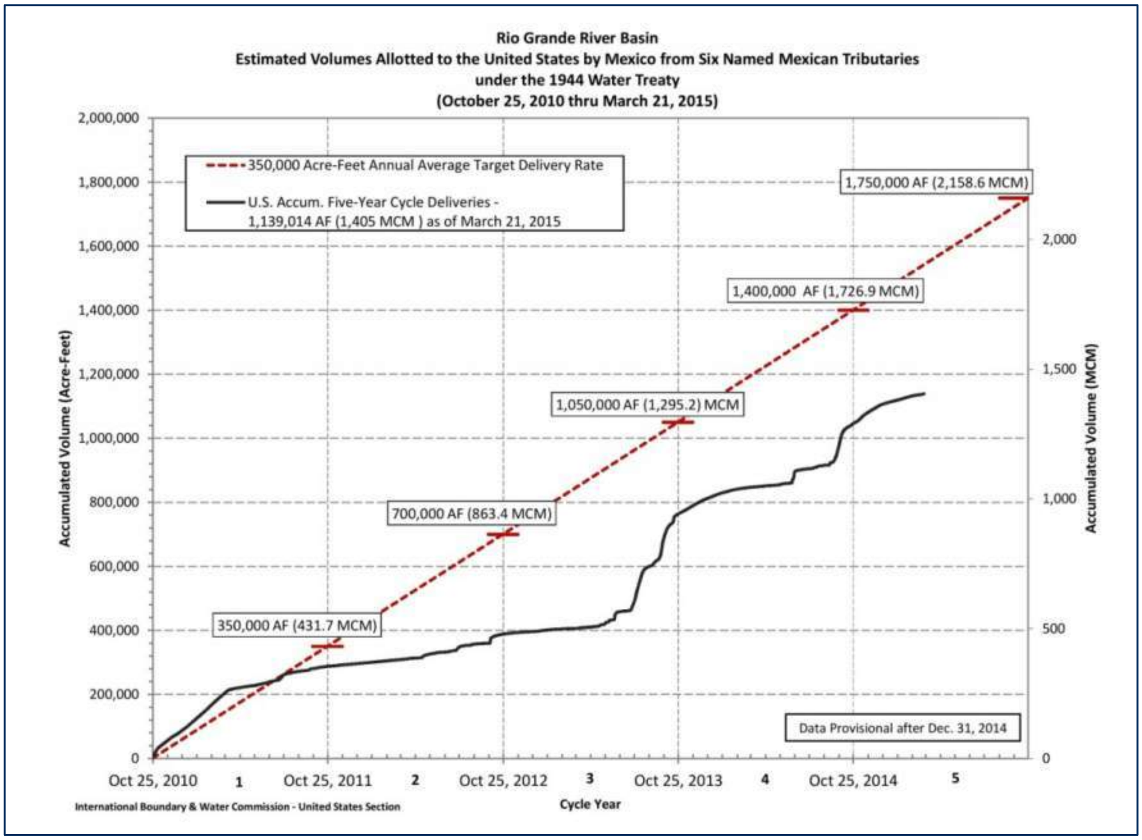

Figure 3-6 Water Delivered to U.S. from Mexico, Current Cycle (IBWC)

Rio Grande Water Availability Model

Availability in the Rio Grande for U.S. use is determined by the Rio Grande Water Availability Model (WAM), maintained by TCEQ. Estimated historical streamflow conditions are developed, including typical wet, dry, and normal flow periods, as they would be without the influence of manmade diversions, dams, and other influence on the watershed, called naturalized flows. The current Rio Grande WAM includes data from 1940 to 2000 from control points, or locations where contributing streams have gauging data, in both Texas and Mexico. The WAM extends to the New Mexico state line, and includes data from both the Rio Grande and the Pecos Rivers at the state line, according to the provisions of existing compacts between the states. The 1940-2000 historical period includes the droughts of the 1950s and 1990s, both of which represent extreme drought conditions for most of the Rio Grande Basin. The current drought of record, 1993-2000, continued beyond the year 2000, and may not be fully quantified because those data are not included in the WAM.

In order to estimate the Firm Yield, the WAM is run with particular parameters intended to best approximate a drought scenario, called Run 3. This model run assumes that all water rights are fully diverted and that there are no return flows into the Rio Grande. The Simplified Rio Grande WAM Run 3 is the current WAM Run 3, according to TCEQ.[3] Firm Yield values for 2020 and

[3] TCEQ letter, 'Region M changes to the Rio Grande WAM," dated January 14, 2014 from Dr. Kathy Alexander, Water Availability Division to Ms. Connie Townsend, TWDB.

2070 were estimated by the WAM Run 3, showing a reduction in availability over time due to sedimentation. These two projections were linearly interpolated over the intermediate decades. The annual Firm Yield, averaged for each planning decade, is shown in Table 3-1.

Table 3-1 Firm Yield Projections for the Amistad-Falcon Reservoir System 2020-2070 (Acre-feet/year)

Source	2020	2030	2040	2050	2060	2070
Amistad-Falcon Reservoir System	1,060,616	1,059,260	1,057,903	1,056,547	1,055,191	1,053,834

The WAM then simulates the monthly ability of individual water rights to meet their authorized diversions or storage quantities in accordance with the TCEQ's Rio Grande operating rules. The simulations are performed using the Water Rights Analysis Package program (WRAP).[4] The results of this simulation indicate that there is no water in the Rio Grande Basin which is not already appropriated, and estimates the reliability of each of the different types of water rights. These monthly simulations are aggregated into decadal averages for planning purposes.

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. The treaty provision requiring a minimum of 350,000 acre-ft. /year to be delivered to the U.S. from the six named Mexican tributaries has not been incorporated into the WAM, because it is not enforced on an annual basis and future compliance is uncertain. The transfer of Mexican water from the six named Mexican tributaries of the Rio Grande to the U.S. is modeled after Mexico's demands and reservoirs on these tributaries have been simulated. The U.S. is allotted one-third of the remaining flow at the mouths of each of the six named Mexican tributaries. 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.

Kennedy Resource Company, Inc. (KRC) was asked to review and revise the 2007 Rio Grande WAM as a part of this update to the Region M Plan. A hydrologic variance was requested by the Region M planning group, and approved by Mr. Jeff Walker on June 2, 2014 (Appendix EA-2). TCEQ's WAM Run 3 showed approximately 1,150 water rights associated with the United States' (U.S.) share of the Amistad-Falcon Reservoir System. KRC developed a simplified version of the WAM which represents all U.S. water rights using aggregated water right groups.

In addition to the simplified modeling of the water rights, the WAM was revised to correct certain errors and misrepresentations of specific water rights. Additionally, the sedimentation rate for Amistad Reservoir was revised based on a new sediment surveys, and the distribution of Class A and B water rights data were updated based on recent data from TCEQ. The changes made to the Rio Grande WAM are summarized in the KRC report, included in Appendix EA-2. It is recommended that the WAM be used to further evaluate the impacts of urbanization and changing water use, which is further discussed and quantified in Chapter 5.

Table 3-2 shows the results of 6 different WAM runs, represented by columns numbered 1-6 in the heading. Each model run is based on the current distribution of water rights between DMI

[4] "Water Rights Analysis Package (WRAP) Users and Reference Manual," published by the Texas Water Resources Institute at Texas A&M University, revised December 2003, by Ralph A. Wurbs (Wurbs, 2003). The version of the WRAP program dated February 2004was used for the 2004 Rio Grande WAM (Wurbs, 2004).

and Agriculture and Mining. The model is intended to show how the system will operate over the next 50 years, assuming that all other conditions stay the same.

The demand condition describes whether the WAM was run with the full authorized diversions for Class A and B water rights, or a Firm Yield diversion based on reliability. The first two results columns show the previously accepted model approach, showing each of the water rights separately. The next four columns show the simplified KRC model. This shows that the simplification does not significantly change the results.

The first four columns show reservoir storage with 2013 sedimentation conditions, and the last two show 2020 and 2070, respectively. The model conditions used in this Plan are from Column 5, 2020 Firm Yield, and column 6, 2070 Firm Yield.

3.1.2 Rio Grande Operations

Waters of the Rio Grande are treated as a 'stock resource,' and accumulated in the Amistad-Falcon reservoir system and released on demand in accordance with water rights set by law. The TCEQ administers the United States' share of water stored in Amistad and Falcon Reservoirs in compliance with the decision of the Thirteenth Court of Civil Appeals in the case, "State of Texas, et al. vs. Hidalgo County Water Control and Improvement District No. 18, et al." commonly referred to as the Valley Water Suit, and the Adjudication Decree in the Middle Rio Grande under the Water Rights Adjudication act of 1967. The TCEQ Rio Grande Watermaster program is responsible for allocating, monitoring, and controlling the use of surface water in the Rio Grande Basin from Ft. Quitman to the Gulf of Mexico.

Since the 1960s, the U.S. portion of the Rio Grande below Amistad has been fully adjudicated, such that there is no 'unclaimed' water regularly available in the system. Water rights on the river are divided into two major types: Domestic, Municipal, and Industrial (DMI) rights, and irrigation and mining rights (which are sub-divided into Class A and B). These rights represent the annual allowable maximum diverted, but because demand exceeds supply in a drought year, only the highest priority (DMI) water rights are guaranteed to receive the full amount of their water rights. Class A and B irrigation and mining accounts are allocated water on a pro-rata basis, but are not necessarily able to access their maximum authorized diversion each year.

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-ft. are deducted to re-establish the DMI storage pool. 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 to account for evaporation, seepage, conveyance losses, and emergencies; and
4. Any remaining storage is allocated to the irrigation and mining accounts.

In years of limited availability Class A and Class B mining or irrigation water accounts are only replenished as water is available. Sometimes only 30% or 40% of the face value of their water right can be diverted over the course of a year. Steps 2 through 4 listed above are iterative, and are all based on the reservoir volume. When there is insufficient water to fulfill the account balances for Irrigation and Mining, the requirement for operating reserve can be reduced.

Table 3-2 Rio Grande WAM Model Runs (Acre-feet /year)

Rio Grande WAM Model Runs - Firm Yield Of U.S. And MX Reservoir System Quantities In Acre-Ft./year Unless Specified Otherwise	(1)	(2)	(3)	(4)	(5)	(6)
Demand Condition	Authorized	Firm Yield	Authorized	Firm Yield		
Water Rights Represented	ALL WR'S		ABREVIATED 14			
Sedimentation Condition	2013				2020	2070
WAM Run	R3-FULL-AA	R3-FULL-FY	R3-ABBR-AA	FY-ABBR-2013	FY-ABBR-2020	FY-ABBR-2070
Supplies						
DMI	301,922	301,922	301,922	301,922	301,922	301,922
Class A	1,617,234	697,028	1,617,234	697,028	695,411	689,750
Class B	186,952	62,633	186,953	62,629	63,284	62,162
Total	2,106,108	1,061,582	2,106,109	1,061,579	1,060,616	1,053,834
Total For Class A and Class B	1,804,186	759,660	1,804,187	759,657	758,694	751,912
Reservoir Information (Acre-ft.)						
US Amistad Conservation Capacity	1,821,502	1,821,502	1,821,502	1,821,502	1,804,609	1,683,947
US Falcon Conservation Capacity	1,548,640	1,548,640	1,548,640	1,548,640	1,546,437	1,530,703
US Combined Conservation Capacity	3,370,142	3,370,142	3,370,142	3,370,142	3,351,046	3,214,650
Min U.S. Simulated Storage	239,989	358,248	225,980	371,711	371,853	373,824
Max Simulated U.S. Storage	3,370,142	3,370,142	3,370,142	3,370,142	3,351,046	3,214,650
U.S. ANNUAL FIRM YIELD	**NA**	**1,061,579**	**NA**	**1,061,579**	**1,060,616**	**1,053,834**
Monthly Period Reliability						
DMI	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Class A	58.9%	100.0%	56.4%	100.0%	100.0%	100.0%
Class B	32.1%	100.0%	29.5%	100.0%	100.0%	100.0%
Annual Average Demand Met						
DMI	301,922	301,922	301,922	301,922	301,922	301,922
Class A	1,132,991	697,028	1,116,796	697,028	695,411	689,750
Class B	86,017	62,632	83,098	62,629	63,284	62,162
Total	1,520,929	1,061,581	1,501,816	1,061,579	1,060,616	1,053,834
Vol Rel of PA Rights (w/o BWeir)	45.39%	45.39%	45.39%	45.39%	45.39%	45.39%
Vol Rel of BWeir	6.58%	29.11%	41.91%	47.90%	47.94%	48.83%
Drought (Feb 1993-Oct 2000)						
Releases from U.S. System	1,289,154	1,250,332	1,255,881	1,257,065	1,253,974	1,234,366
Channel Losses on Releases	363,924	309,149	333,916	290,879	289,552	282,682
System Evap Loss	49,949	231,668	42,010	230,346	229,467	222,761
MX FIRM ANNUAL YIELD	**NA**	**893,896**	**NA**	**893,896**	**893,056**	**886,546**
Max Annual MX Shortage	85,478	0	86,113	0	0	0

Water that has been designated for municipal use must be used for municipal purposes, and similarly irrigation water rights for irrigation, etc. unless it is permanently converted through TCEQ. When irrigation and mining water rights are converted to municipal water rights, the maximum diversions for Class A are reduced by 50% and Class B by 60%. The main mechanism for this conversion is urbanization.

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.

When there are substantial flows in the river due to high runoff conditions, the Rio Grande Watermaster may allow water rights holders along the lower and middle Rio Grande to divert water without it being charged to their accounts. 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. 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.

DMI water right accounts are not allowed to roll over any water each year; they are limited to diverting no more than their water right in each year. Class A and B water right accounts can accumulate up to 1.41 times the annual authorized diversion right in storage. If an allottee does not use any water for two consecutive years, its account is reduced to zero.

TCEQ records from 2013 show the annual water rights (AWR) that are held for Rio Grande water, separated into user designations for Domestic (guaranteed, similar to municipal but more commonly used for lawn watering or small accounts outside of city accounts), Municipal (most commonly raw water for municipal treatment plants), Industrial, Irrigation class A and B, Multi-Use (Multi, which refers to a water right that can be used for either mining or irrigation and is allocated in the same way as irrigation water rights), and Mining. Annual water rights are aggregated into DMI, Class A, and Class B in Table 3-3, and the full listing of Rio Grande water rights is included in Appendix EA-3.

Table 3-3 2013 Annual Water Rights, 2014 Rio Grande Water Availability Model Update (Acre-feet/year)

WAM AWR (KRC's 2014 WAM Update)	
DMI	301,992
Class A	1,617,234
Class B	186,952
Total	**2,106,178**

3.1.3 Irrigation Districts

Irrigation districts (IDs) operate under rules and regulations in the Texas Water Code, and within the TCEQ operational rules that resulted in part from the Valley Water Suit. Among other things, this judgment allocated specific amounts of water in the Lower Rio Grande Valley to individual DMI water users (typically cities) with 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. 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.

Most water in the Lower Rio Grande is diverted and delivered by IDs, although some farmers, entities, and individuals divert their own water directly, including most users in the Middle Rio Grande. Water right holders request diversion certifications from the Watermaster, and then divert water from the Rio Grande into their storage and delivery systems. Water is metered as it is pumped out of the river, according to TCEQ Watermaster rules, but most IDs do not meter any water provided to irrigators or “domestic” water usage for lawn watering and livestock.

In some cases, there are written contracts between the DMI users and the IDs 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 are often 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 ID will continue to supply DMI water to the DMI user under the district's own water right, to the extent that a district has these rights available, and then charge the DMI user for this additional water. If the District does not have available municipal water rights, the City or the District can acquire municipal use water from third parties to deliver to the City. This one-time delivery of water is referred to as "contract water,” which means that water is being delivered to a DMI user on a short-term contractual basis, governed by the Watermaster rules.

The DMI water users are guaranteed the maximum diversion of the water rights, and it is these water rights, rather than the condition of the reservoirs, that determine the extent of the overall DMI supply. There are some municipal water users that have their own water rights, and some 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 Suit.

Irrigation water rights are also generally held by the irrigation district. Farmers pay an annual flat rate assessment which entitles them to receive irrigation water based on acreage. Each district operates somewhat differently with respect to if and how water can be sold and purchased within and outside of the district. For instance, during a drought period some districts allow farmers to consolidate their allocation of water on one portion of their land, some allow for sales within the District, and some allow for sales outside of the district. When the District is not on allocation, most water will be delivered to farmers on a “first-come, first-served” basis.

The drought year projections for 2020 water rights, water diversion, and water delivered to end users are shown below in Table 3-4. Each District is listed with the associated end users, and the maximum diversion for the water rights for each end user. The diversion data shows what water expected to be diverted in a drought year, showing reduced reliability for irrigation and mining water rights, and full authorized volumes for DMI water rights. The projected delivery to the end user is the diversion amount further reduced by conveyance losses.

As the basis of our supply analysis, diversions are projected out to 2070, reflecting the gradually decreasing yield from the reservoirs due to sedimentation. The Deliveries are projected out with the combined impacts of conveyance losses and the reduction in reliability from lower reservoir yields. These supply projections are intended to show what supplies are currently available, and project what supplies would continue to be available if no water management strategies are implemented.

Table 3-4 Irrigation Districts, Water Rights, Water Diversions, and Water Deliveries (Acre-feet/year)

User	Water Right	2020 Diversion	2020 Delivery
Adams Garden			
Cameron County Irrigation	18,738	8,057	5,479
City of Harlingen (Class A Agricultural WR)	1,625	699	485
Bayview ID #11			
Cameron County Irrigation Class A (Delivered by CCID #6)	17,353	5,074	3,450
Cameron County Irrigation Class B (Delivered by CCID #6)	2,407	554	377
Cameron County-Other (Delivered by CCID #6)	183	124	85
Cameron County Industrial (Delivered by CCID #6)	30	14	9
Laguna Madre Municipal (Delivered by CCID #6, Pass-Through)	7,380	5,018	3,413
Cameron County Livestock	145	68	46
Brownsville ID			
Cameron County Irrigation Class A	33,949	14,598	9,927
Cameron County Irrigation Class B	3,633	1,230	836
Cameron County-Other	334	334	227.12
CCID #2			
Cameron County Irrigation Class A	151,617	65,195	44,333
Cameron County Irrigation Class B	1,655	560	381
Cameron County Steam Electric	192	0	0
San Benito	7,032	7,032	4,782
Rio Hondo	890	890	605.2
East Rio Hondo WSC	5,167	5,167	3,514
Cameron County-Other	850	850	578
CCID #6 - Los Fresnos			
Cameron County Irrigation Class A	50,142	21,561	14,662
Cameron County Irrigation Class B	4,707	1,593	1,083
Los Fresnos	1,051	1,051	714.68
Olmito WSC	1159.5	1159.5	788.46
Brownsville	386.5	386.5	262.82
Pass-Through: Bayview ID	27,488	16,005	10,883
Pass-Through: CC WID #10	7,988	3,435	2,336
CCWID #10			
Cameron County Irrigation (From CCID #6)	7,988	2,336	1,588
CCID #16			

Cameron County Irrigation	3,713	1,597	1,086

Delta Lake ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Willacy County Irrigation	76,828	32,951	19,771
Hidalgo County Irrigation	100,603	43,149	25,889
Lyford	980	980	588
North Alamo WSC – Manufacturing	554	554	332.4
North Alamo WSC - Municipal	8,151	8,151	4,891
Raymondville	5,670	5,670	3,402
Hidalgo County-Other (Monte Alto)	600	600	360
Willacy County Other (Port Mansfield)	250	250	150
Hidalgo County Livestock	571.56	748.44	449.064
Willacy County Livestock	748.44	571.56	342.936
Pass Through: Engleman ID	18,706	8,044	4,826
Pass Through: Valley Acres ID	16,624	7,433	4,460

Donna ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	95,135	40,908	29,045
Hidalgo County Irrigation Class B	2,233	756	537
City of Donna	4,190	4,190	2,975
North Alamo WSC	2,690	2,690	1,910
Hidalgo County Other (La Blanca)	13	13	9.23

Engleman ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation (From Delta Lake ID)	18,706	4,826	3,427

Harlingen ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Cameron County Irrigation Class A	98,233	42,240	28,723
Cameron County Irrigation Class B	99	34	23
City of Harlingen	23,692	23,692	16,111
Military Highway WSC	978	978	665
Cameron County-Other	69	69	47
East Rio Hondo WSC	345	345	235
Pass Through: La Feria	293	126	86

HCID #1			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	75,060	32,276	22,916
Hidalgo County Irrigation Class B	4,802	1,625	1,154
Edinburg	9,530	9,530	6,766
McAllen	4,000	4,000	2,840
North Alamo WSC Manufacturing	136	136	97
North Alamo WSC Municipal	1,740	1,740	1,235
Sharyland WSC	3,465	3,465	2,460
Hidalgo County Steam-Electric	250	250	178

Pass Through: Santa Cruz ID	79,700	36,904	26,202
Pass Through: Hidalgo MUD	1,605	802	569
Pass Through: HCID #13	4,357	1,874	1,330

HCID #2			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	137,978	59,331	42,125
Hidalgo County Irrigation Class B	6,472	2,191	1,555
North Alamo WSC	3,750	3,750	2,663
Manufacturing	203	203	144
Alamo	2,258	2,258	1,603
McAllen	8,111	8,111	5,759
Pharr	9,495	9,495	6,741
San Juan	3016	3,016	2,141
Edinburg	3,170	3,170	2,251
Rio Grande City	600	600	426
Falcon Rural WSC	60	60	42.6

HCID #5			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	14,408	6,195	4,399
Hidalgo County Irrigation Class B	618	209	149

HCID #6			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	36,761	15,807	11,223
Hidalgo County Irrigation Class B	1,008	341	242
Agua SUD	5,816	5,816	4,129
Hidalgo County Steam Electric	125	125	89
Hidalgo County-Other	368	368	261

HCID #13/ Baptist Seminary			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation	4,357	1,330	944

HCID #16			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	30,749	13,222	9,388
Hidalgo County Irrigation Class B	3,130	1,060	752
La Joya	559	559	396.89
Agua SUD	3,657	3,657	2,596
Hidalgo County Mining Class A	200	86	61.06
Hidalgo County Mining Class B	429	145.2165	103.103715
Hidalgo County-Other	100	100	71

H&CC ID #9			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Cameron County Irrigation	12,523	5,385	3,769
Hidalgo County Irrigation	161,405	54,636	38,245

North Alamo WSC	5,600	5,600	3,920
Edcouch	375	472	330
Elsa	1,000	1,300	910
La Villa	325	352	246
Mercedes	1,840	1,840	1,288
Weslaco	5,611	5,611	3,928
Cameron County-Other	225	225	157
Hidalgo County-Other	3,097	3,097	2,168
Cameron County Livestock	75	75	52
Hidalgo County Livestock	966	966	676

HC MUD 1			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation	1,496	281	200
Hidalgo County MUD	1,120	273	194

HC WID 3/ McAllen			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
McAllen	16,350	16,350	11,609
Hidalgo County Mining	100	100	71
Hidalgo County Irrigation Class A	8,453	3,635	2,581
Hidalgo County Irrigation Class B	293	99	70
Hidalgo County Manufacturing	600	600	426

HC WCID 18			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation	807	273	194
Hidalgo County Mining	2,421	819	582

La Feria, CCID 3			
Cameron County Irrigation Class A	86,357	37,134	25,251
Cameron County Irrigation Class B	255	86	59
Sebastian MUD	300	300	204
Santa Rosa	350	350	238
La Feria	1,500	1,500	1,020
Cameron County-Other	900	900	612
Cameron County Livestock	2,152	2,152	1,463

Maverick County ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Maverick County Irrigation	134,900	58,007	38,865
Maverick County-Other	2,690	2,690	1,802
Maverick County Mining Class A	10	4	3
Maverick County Mining Class B	114	39	26

Santa Cruz ID #15			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation (Pass through from HCID#1)	75,080	22,922	16,275
Sharyland WSC (Pass through from HCID#1)	2,000	1,420	1,008

North Alamo WSC (Pass through from HCID#1)	2,500	1,775	1,260
Hidalgo County-Other (Pass through from HCID#1)	120	85	60

Sharyland/ HCWCID 19			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	8,786	3,778	2,682
Hidalgo County Irrigation Class B	100	34	24

United ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation Class A	49,374	21,231	15,074
Hidalgo County Irrigation Class B	4,476	1,515	1,076
McAllen	11,250	11,250	7,988
Mission	17,280	17,280	12,269
Sharyland WSC	5,200	5,200	3,692

Valley Acres ID			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation (Pass through from Delta Lake)	13,947	3,598	2,540
Cameron County Irrigation (Pass through from Delta Lake)	1,963	506	358
Hidalgo County Manufacturing (Pass through from Delta Lake)	200	120	85
Hidalgo County Steam Electric (Pass through from Delta Lake)	760	180	127

Valley MUD 2			
User	**Water Right**	**2020 Diversion**	**2020 Delivery**
Hidalgo County Irrigation	5,716	1,935	1,374
Rancho Viejo	798	798	567

In Chapter 5, Irrigation District Conservation is evaluated, which will reduce the impact of conveyance losses on the Delivery projections. Also, urbanization is considered, which is expected to reduce irrigation use and make some additional water available to meet growing municipal demands through conversion of water rights.

3.1.4 Drought and Push Water

One of the results of the Rio Grande water rights system is that there are effectively two distinct supplies of surface water: the DMI pool and the irrigation and mining pool. Agricultural conservation does not directly make water available for municipal use, because the municipal use is limited by municipal water rights, which can be diverted in full. Municipal conservation may have a very small impact on overall reservoir storage levels, but it is not likely to significantly benefit farmers. Conservation triggers and incentives are very different for cities primarily reliant on Rio Grande water because the municipal use is limited entirely by water rights ownership rather than by hydraulic conditions.

Agriculture absorbs reduced availability in drought, and municipalities only experience "drought" if their water right is insufficient for their demands, regardless of the conditions in the reservoirs or meteorological conditions. To date, there has not been a drought severe enough to impact municipal water rights, and so they are considered 100% reliable.

The exception to this is the impact of reduced agricultural availabilities on the operations of Irrigation Districts, or the impact of "push water." Many of the water districts primarily deliver water for irrigation, and use this water to charge their networks of canals. When there is irrigation water being delivered, the municipal water is effectively "carried on" the irrigation water. In years of severe drought, there may not be irrigation water being delivered, so municipalities may need to purchase additional water in order to provide a minimum operational amount of water in the system. This is in addition to the regular water losses experienced by districts as a result of seepage, evaporation, and operational losses.

To date, a few cities have purchased water in anticipation of the need for push water, but none have had to use it. When an Irrigation District goes on allocation, agricultural usage slows dramatically. This reduction of usage has historically allowed for the reservoirs and irrigators' useable account balances to re-charge, and for the system to go back to normal operations with irrigation deliveries to charge the canals and make municipal water available. Although the system does have a self-righting tendency, push water is still a concern, and may be exacerbated by urbanization. The recommendations for addressing this concern include the construction or expansion of storage capacity for cities so that a city has sufficient supply between deliveries, and increasing inter-connectedness between both raw and treated water systems for increased flexibility and resilience in times of shortage.

3.1.5 Water Quality

Rio Grande water quality within Region M is evaluated in 4 segments over the Middle Rio Grande Sub-Basin, and three segments in the Lower Rio Grande Sub-Basin. From Amistad Dam south to the confluence with the Rio Salado from Mexico, the river is impaired for contact recreation due to high bacteria below, nitrates and low dissolved oxygen (DO), and concern for toxicity and bacteria near Laredo as a result of urban runoff and discharges outside of U.S. jurisdiction. Manadas Creek, an unclassified water body northwest of Laredo, has high bacteria and chlorophyll-a due to urban runoff and high metal content due to industrial activity. Falcon Reservoir is not impaired, but there is concern for toxicity near Zapata. San Felipe Creek is impaired for bacteria, but has a positive effect on the Rio Grande water quality. The Lower Rio Grande Sub-Basin is separated into the freshwater stream and the stream impacted by tidal flows. The freshwater portion, which runs from Falcon Reservoir to downstream of Brownsville, is impaired in small reaches from consistently high bacteria counts near urban areas. Additionally, there are concerns across the entire segment for fish consumption due to elevated mercury levels. The tidal stream portion has no impairments but there can be high chlorophyll-a levels.

The Arroyo Colorado is the major drainage-way for approximately two dozen cities in this area, and almost 300,000 acres of farmland. The Arroyo Colorado includes the TCEQ Classified Stream Segment 2201 and 2202, which are impaired for high bacteria, and experience high nutrient concentrations. Segment 2201 is also impaired for low DO.

Regular monitoring of water quality as a result of these programs draws attention to the need for continued assessment and evaluation of water data and integrated regional approaches to managing the watersheds to meet quality goals.

3.1.6 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. Only a small portion of the Nueces Basin in Webb and Maverick counties is located within the Rio Grande Region. The Nueces River does not pass through Region M and the Nueces Basin does not contribute significant surface water supply to the region.

3.1.7 Nueces-Rio Grande Basin

The Nueces-Rio Grande 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 Basin is 10,442 square miles, terminating at the Laguna Madre Estuary. Within the Region M 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 3-7, below).

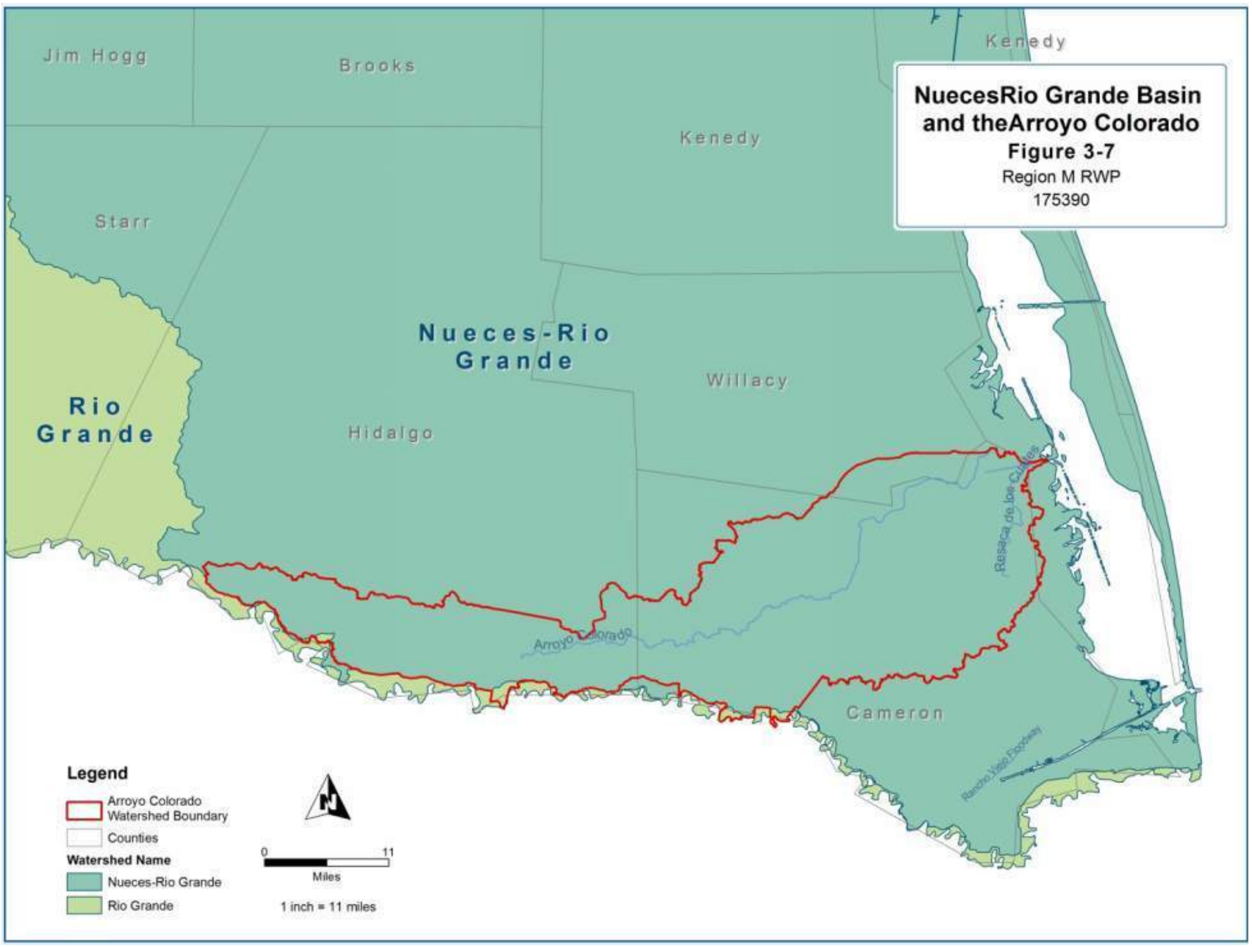

Figure 3-7 Nueces-Rio Grande Basin Including Major Drainage-Ways

There are two major drainage courses in the basin: the main floodway and the Arroyo Colorado. Inflows from the Arroyo Colorado are critical to the ecological health of the Laguna Madre estuary. In addition to natural drainage, most of the surface water diverted from the lower Rio Grande is pumped into this basin, and discharges into the Arroyo Colorado. There are no natural perennial streams and no significant water supplies from this basin.

The TWDB evaluated the Lower Laguna Madre Estuary, and found the combined freshwater inflows to the estuary between 1977 and 2010 averaged 523,602 acre-feet/year and ranged from a minimum of 234,158 acre-feet in 1990 to 2,726,325 acre-feet in 2010 [5]. The two gauging stations are on the North Floodway at the town of Sebastian and the Arroyo Colorado at Harlingen. Gauged inflow to the Lower Laguna Madre accounted for 60% of the inflows, ungauged flows (estimated using precipitation data over ungauged watershed areas) accounted for approximately 38% of the combined inflow, and the net diversions and return flows accounted for the remaining 2%.

The Arroyo Colorado traverses Willacy, Cameron, and Hidalgo counties and is the major drainage-way 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 Cameron County.

Use of the water in the Arroyo Colorado for municipal, industrial, and/or irrigation purposes is somewhat limited because of the water quality conditions that exist there. The Arroyo Colorado has two TCEQ Classified Stream Segments; a freshwater segment (Segment 2202) and a tidally influenced marine segment (Segment 2201). Segments 2201 and 2202 are listed as impaired for high bacteria levels. Segment 2201 is also listed as impaired for low dissolved oxygen. Nutrient concentrations (nitrogen and phosphorus compounds) are high in both segments.

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 few in number and small in terms of their discharge. 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.

3.1.8 Local Supplies

Livestock local supplies are disbursed supplies that are only available at the point of use and do not impact firm yield. These supplies are generally runoff collection, like livestock supply ponds, and are assumed to be fresh water. Because livestock is managed in such a way that populations will be maintained at a level that can be supported by a combination of known groundwater supplies and livestock local supplies. Livestock local supplies are shown in Table 3-5.

Table 3-5 Livestock Local Supplies (Acre-feet/year)

County	Basin	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	50	50	50	50	50	50
Hidalgo	Nueces-Rio Grande	7,522	7,522	7,522	7,522	7,522	7,522
Willacy	Nueces-Rio Grande	0	0	0	0	0	0

[5] "Coastal Hydrology for the Laguna Madre Estuary, with Emphasis on the Lower Laguna Madre." Caimee Schoenbaechler and Carla Guthrie, Bays & Estuaries Program, Surface Water Resources Division, TWDB, Austin, TX. September, 2011.

3.2 Groundwater

The major aquifer that underlies Region M is the Gulf Coast, which underlies Hidalgo, Starr, Jim Hogg, and the western portions of Willacy and Cameron Counties. The Carrizo – Wilcox extends through Webb and part of Maverick Counties, however only the outcrop has fresh water, and the subsurface water tends to be slightly too moderately saline. The minor aquifers in the region may produce significant quantities of water that supply relatively small areas, including the Rio Grande Alluvium, the Laredo Formation, and the Yegua-Jackson aquifer. The majority of groundwater is slightly or moderately saline. Table 3-6 shows the aquifers in Region M for which Managed Available Groundwater (MAG) values have been developed.

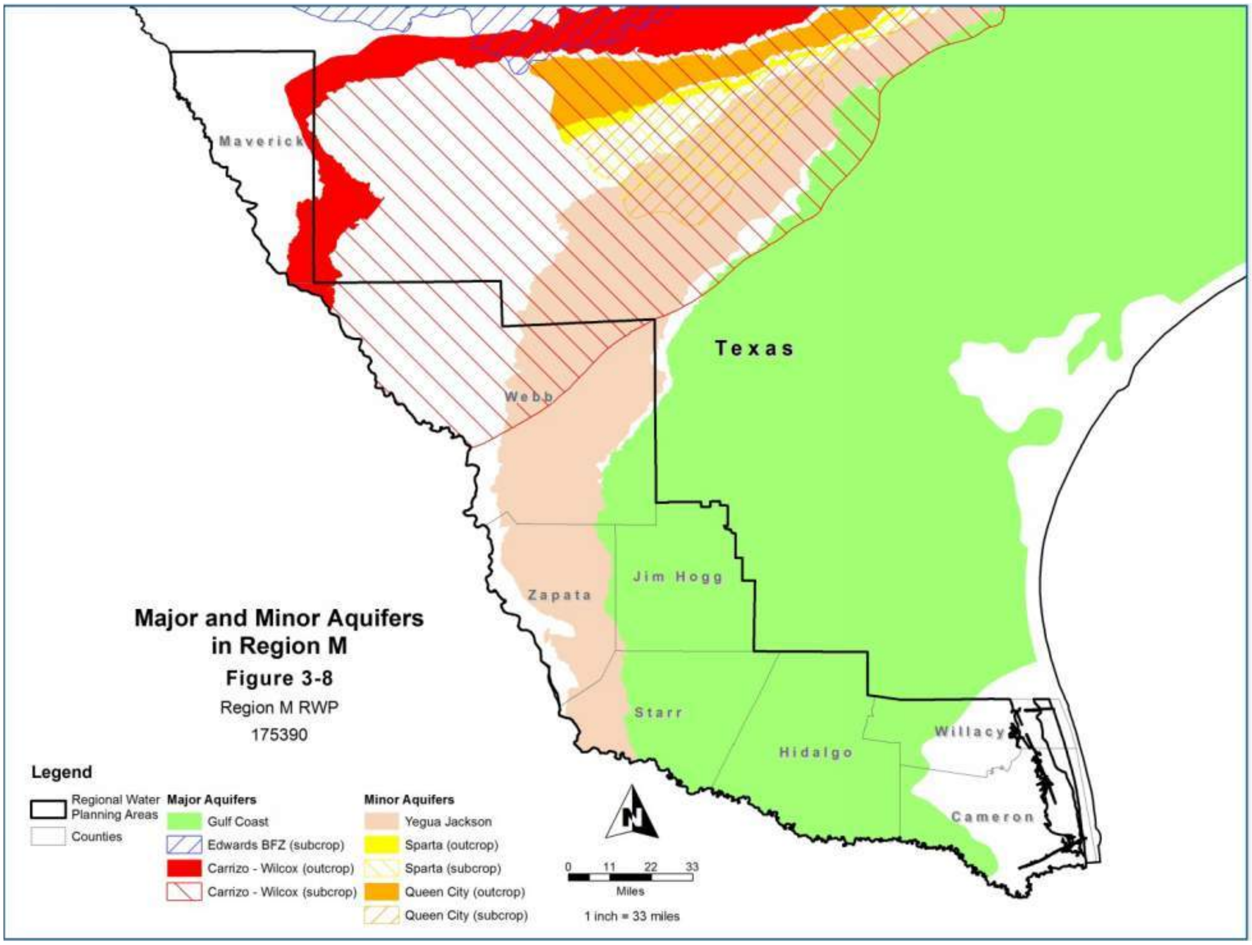

Figure 3-8 Major and Minor Aquifers in Region M

Table 3-6 Managed Available Groundwater for Significant Aquifers in Region M (Acre-feet/year)

Aquifer	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer	2,959	2,940	2,593	2,486	2,448	2,448
Gulf Coast Aquifer	147,441	147,441	147,441	147,441	147,441	147,441
Yegua-Jackson Aquifer	27,998	27,998	27,998	27,998	27,998	27,998
Total	**178,398**	**178,379**	**178,032**	**177,925**	**177,887**	**177,887**

3.2.1 Gulf Coast Aquifer

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 (Figure 3-8).

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 Catahoula; above the Catahoula 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 Region M, 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.

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 precipitation. This may be supplemented in some areas by the addition of irrigation water from the Rio Grande, which may have negative impacts on water quality in localized areas. 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, recent pumping has resulted in dropping groundwater levels in some areas. Anecdotally, northern Hidalgo and western Willacy Counties are experiencing dropping water levels in recent drought years of up to 80 feet.

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. Availability from the Gulf Coast Aquifer is based on GAM Run 10-047 MAG: Groundwater Management Area 16 Model Runs to Estimate Drawdowns under Assumed Future Pumping for the Gulf Coast Aquifer, finalized December 8, 2011.

Table 3-7 Gulf Coast Aquifer Availability Projections by County and River Basin (Acre-feet/year)

Source County	Source Basin	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	48,576	48,576	48,576	48,576	48,576	48,576
Cameron	Rio Grande	1,984	1,984	1,984	1,984	1,984	1,984
Hidalgo	Nueces-Rio Grande	38,941	38,941	38,941	38,941	38,941	38,941
Hidalgo	Rio Grande	2,985	2,985	2,985	2,985	2,985	2,985
Jim Hogg	Nueces-Rio Grande	20,836	20,836	20,836	20,836	20,836	20,836
Jim Hogg	Rio Grande	3,578	3,578	3,578	3,578	3,578	3,578
Starr	Nueces-Rio Grande	3,079	3,079	3,079	3,079	3,079	3,079

Source County	Source Basin	2020	2030	2040	2050	2060	2070
Starr	Rio Grande	4,447	4,447	4,447	4,447	4,447	4,447
Webb	Nueces	82	82	82	82	82	82
Webb	Nueces-Rio Grande	2,445	2,445	2,445	2,445	2,445	2,445
Webb	Rio Grande	475	475	475	475	475	475
Willacy	Nueces-Rio Grande	20,013	20,013	20,013	20,013	20,013	20,013
Total		**147,441**	**147,441**	**147,441**	**147,441**	**147,441**	**147,441**

The TWDB initiated a study of the groundwater resources in the lower Rio Grande Valley under the Brackish Resources Aquifer Characterization System (BRACS)[6]. Most of the groundwater in the study area (parts of Cameron, Willacy, Hidalgo, and Starr Counties) has concentrations of total dissolved solids greater than 1,000 milligrams per liter (mg/L TDS) and does not meet drinking water quality standards. The Gulf Coast Aquifer and overlying quaternary geologic units underlie an area of about 3,900 square miles in the study area, and it is the primary source of groundwater in the area.

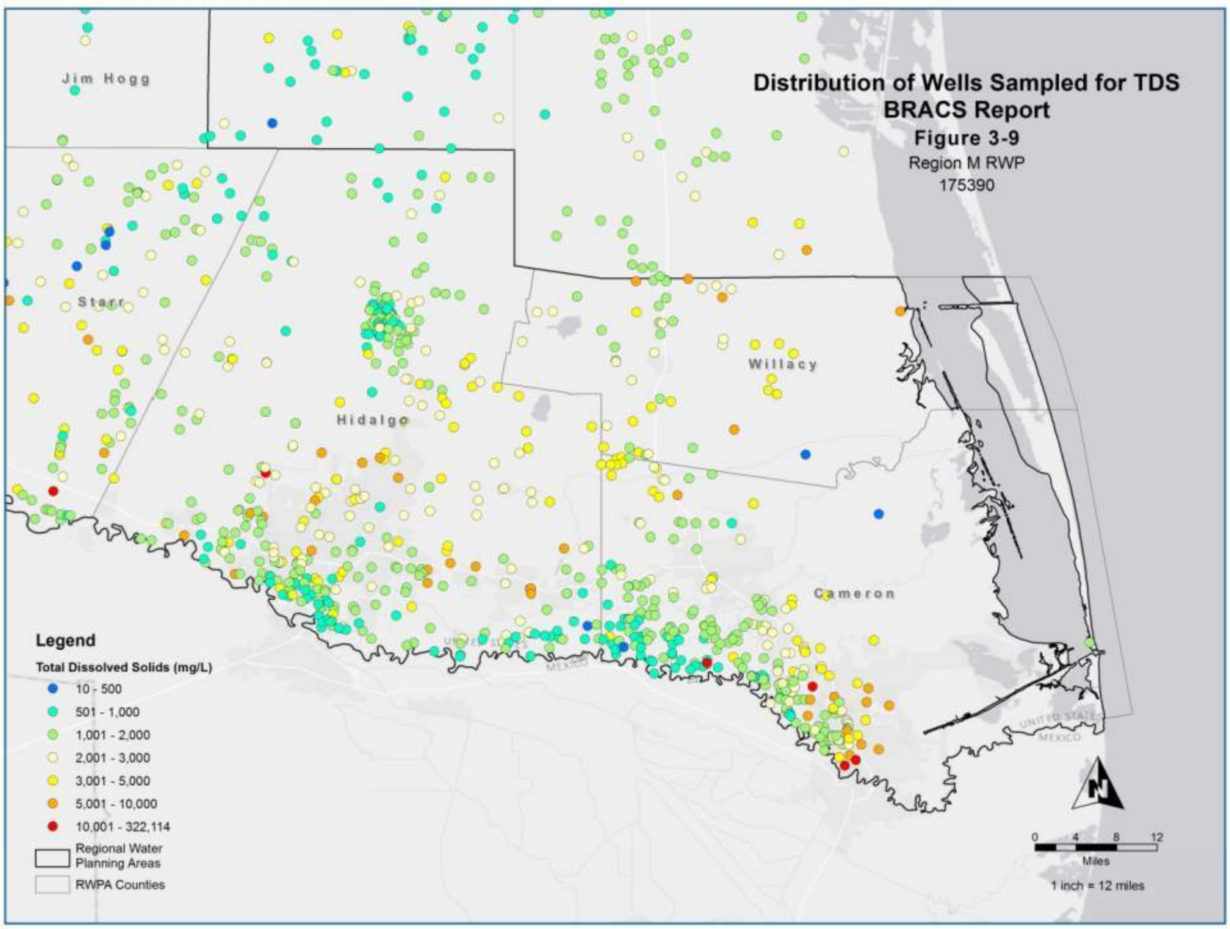

Figure 3-9 Distribution of Wells Sampled for TDS, BRACS Report

[6] Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas, September 2014. John E. Meyer, P.G., Andrea Croskrey, Matthew R. Wise, P.G., and Sanjeev Kalaswad, Ph.D., P.G. Texas Water Development Board.

Seven desalination plants treat brackish groundwater for municipal use in the area, and an additional 23 desalination projects were recommended by the 2011 Rio Grande Regional Water Plan.

The BRACS study used thousands of water well and geophysical logs for geologic, water chemistry, water level, and aquifer test data from a wide variety of sources to characterize the groundwater in the Gulf Coast Aquifer. From this information, three-dimensional salinity zones were mapped within the aquifer containing groundwater of a similar salinity range shown in Table 3-8.

Table 3-8 Salinity Ranges for Groundwater as defined in BRACS

Salinity	Range of Total Dissolved Solids (mg/L)
Fresh Water	0 – 1,000
Slightly Saline Water	1,000 – 3,000
Moderately Saline Water	3,000 – 10,000
Very Saline Water	10,000 – 35,000
Brine	greater than 35,000

TWDB estimated that the Gulf Coast aquifer in the study area contains a significant volume of brackish groundwater: more than 40 million acre-ft. of slightly saline groundwater, 112 million acre-ft. of moderately saline groundwater, and 123 million acre-ft. of very saline groundwater. Not all of the brackish groundwater can be produced or be economically extracted and treated, but the estimates provide an indication of the potential availability of this important resource.

The study delineated 21 separate geographic areas that each has a unique salinity zone profile from ground surface to the base of the Gulf Coast Aquifer. Some of the salinity zones are quite complex, with intermingled groundwater of different salinity ranges that could not be classified into unique, mapped zones. Placement of these boundaries represents best professional judgment, and can undoubtedly be refined with more data from future drilling and testing. The use is cautioned accordingly when evaluating future well fields near one of these boundaries.

3.2.2 Carrizo-Wilcox Aquifer

The Carrizo Sand outcrops in a very small area in northwest Webb County, approximately 60 miles to the north-northwest of Laredo (see Figure 3-8, above). The formation continues north into Dimmit, Zavala, and Maverick counties, roughly parallel in orientation to those formations occurring to the east and south.

The Carrizo Sand is the principal and most prolific aquifer within the northern portion of Region M. 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. Recharge occurs primarily through exposure of the Carrizo Sand to precipitation at the outcrop and where the outcrop is incised by creeks or streams.

The projected quantities of water available from the Carrizo-Wilcox aquifer are presented in Table 3-9 below. These estimates are derived by assessing GAM Run 10-012 MAG: Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, and Sparta Aquifers in Groundwater Management Area 13 from August 2, 2012.

Table 3-9 Carrizo-Wilcox Aquifer Availability Projections for Each County and River Basin by Decade (Acre-ft./year)

Source County	Source Basin	2020	2030	2040	2050	2060	2070
Maverick	Nueces	777	777	472	472	472	472
Maverick	Rio Grande	1,266	1,247	1,205	1,098	1,060	1,060
Webb	Nueces	92	92	92	92	92	92
Webb	Rio Grande	824	824	824	824	824	824
Total		**2,959**	**2,940**	**2,593**	**2,486**	**2,448**	**2,448**

3.2.3 Yegua-Jackson Aquifer

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 Region M, the Yegua-Jackson aquifer extends in a narrow band from the Rio Grande through Starr, Zapata, and Webb counties (Figure 3-8). The amount and type of use from the Yegua-Jackson aquifer vary across the region.

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 Region M planning area. 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.

Availabilities in the Yegua-Jackson Aquifer are based on GAM Run 10-041 MAG finalized December 8, 2011.

Table 3-10 Yegua-Jackson Aquifer Availability Projections for Each County and River Basin by Decade (Acre-feet/year)

Source County	Source Basin	2020	2030	2040	2050	2060	2070
Webb	Nueces	11,969	11,969	11,969	11,969	11,969	11,969
Webb	Rio Grande	8,030	8,030	8,030	8,030	8,030	8,030
Zapata	Rio Grande	7,999	7,999	7,999	7,999	7,999	7,999
Total		**27,998**	**27,998**	**27,998**	**27,998**	**27,998**	**27,998**

3.2.4 Rio Grande Alluvium

The alluvial aquifer of the lower Rio Grande Valley consists of terrace, flood-plain, and delta deposits of the Rio Grande. They are made up of unconsolidated gravel, sand, silt, and clay. The aquifer also includes some clay, silt, sand and gravel of the Goliad, Lissie, and Beaumont Formations which underlie the alluvium. The aquifer extends along the Rio Grande from below Falcon Dam in Starr County for about 100 miles to Brownsville in Cameron County. In southern Starr County and southwestern Hidalgo County, the aquifer follows a narrow strip along the river 5 to 10 miles wide. From eastern Hidalgo County, it extends northward into Willacy County where its maximum width in Texas is about 28 miles. It also covers the western half of Cameron

County. The productive area of the aquifer covers about 950 square miles, most of which is in or around the Rio Grande Basin in Hidalgo, Cameron, and Willacy Counties. This additional area adjacent to the Rio Grande Basin has been included in this discussion because of its hydrologic connection with the aquifer in the basin. The potential yield of the aquifer in the Rio Grande Basin depends on the amount of water recharged by the infiltration of precipitation and by seepage from the Rio Grande, and the amount of water withdrawn from the aquifer in the area north of the basin.

Groundwater in the upper part of the aquifer generally is under water-table conditions. However, local artesian conditions exist where the water passes under relatively impermeable clays. The maximum thickness of the aquifer is about 700 feet. Its thickness is irregular and is generally less than 500 feet. The best quality of water in the aquifer occurs near the Rio Grande at depths of less than 75 feet in southeastern Starr County, between 50 and 250 feet in southern Hidalgo County, and between 100 and 300 feet in western Cameron County.

Recharge to the aquifer is from the percolation of water from the land surface. This water is from precipitation, canals and drains, irrigation return water, and the Rio Grande. Water normally flows from the Rio Grande into the aquifer, except when the river is at its lowest level.[7]

Although there are a number of entities which pump Rio Grande Alluvial groundwater, there is not a MAG for this aquifer. The Rio Grande Alluvium intermingles with the Gulf Coast Aquifer, and in many cases it is difficult to delineate these two aquifers. The wells at Southmost Regional Water Authority and Military Highway WSC have been identified in some cases as drawing from Gulf Coast, and some cases drawing from Rio Grande Alluvium.

3.2.5 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. HB1763 includes the following: 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.

Groundwater Management Areas work with GCDs to develop Desired Future Conditions (DFC) for the aquifers in their area. 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, establishing physically compatible conditions using public process guidelines. Groundwater Availability Models (GAMs) must be used in this analysis. 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.

Currently four groundwater conservation districts exist in the region, Brush Country, Kenedy County, Red Sands, and Starr County.

---

[7] Peckham, Richard C. Summary of the Groundwater Aquifers in the Rio Grande Basin. Texas Water Commission Circular No. 63-05, June 1963.

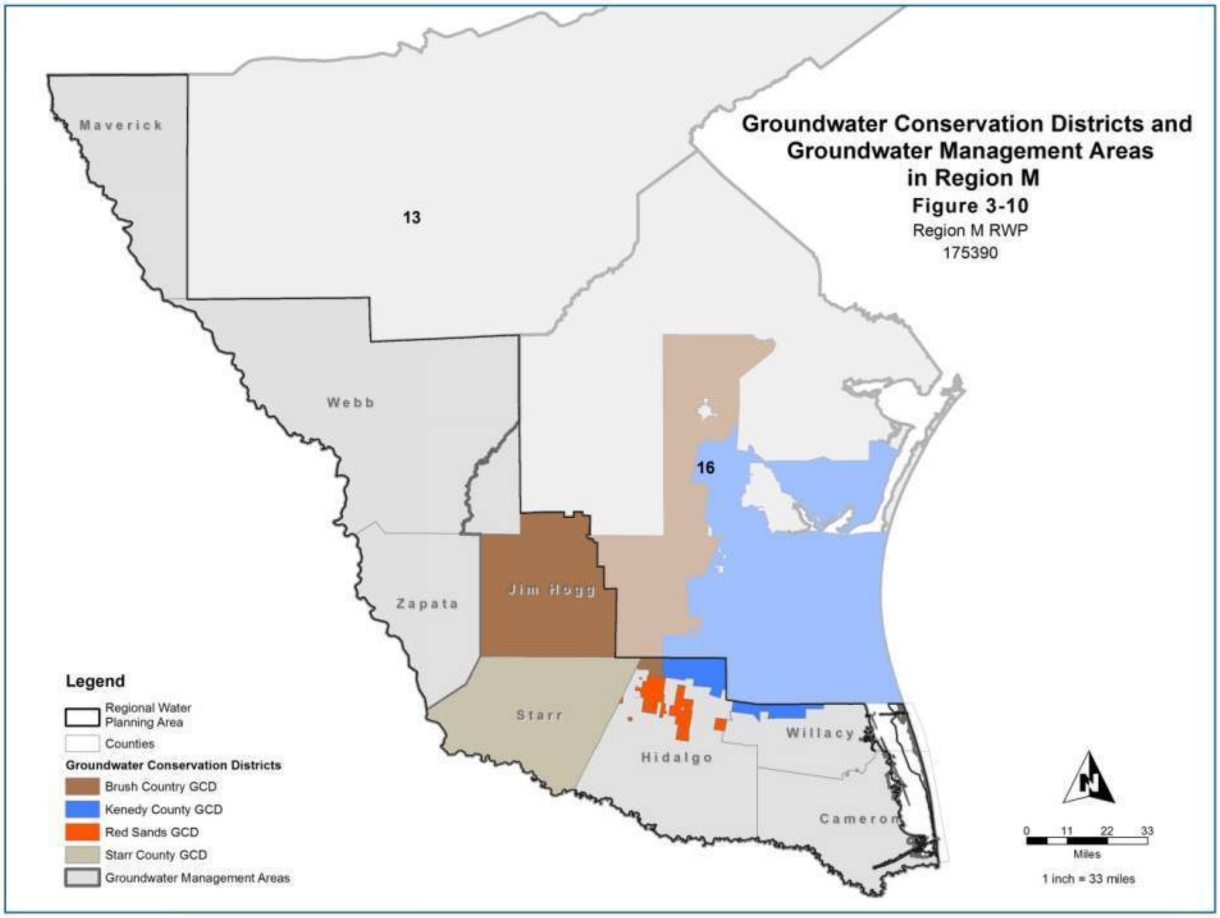

Figure 3-10 Groundwater Conservation Districts and Groundwater Management Areas in Region M

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. On August 26, 2013, the Brush Country Board of Directors adopted comprehensive rules to manage, protect, and conserve the groundwater resources within its district boundaries. The Brush Country GCD territory includes 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. The current Brush County Groundwater Conservation District Management Plan identifies the Gulf Coast aquifer as the only major aquifer within the District's boundaries, and has established a DFC, valid for the next ten years, of a GMA-wide average drawdown of approximately 94 feet. The GAM Run 09-008, Scenario 10, was used to establish this DFC.

Brush Country GCD has been actively participating in Groundwater Management Area (GMA) 16 meetings and is considered fully operational.

Kenedy County Groundwater Conservation District

The Kenedy County Groundwater Conservation District (KCGCD) covers 1,686,889 acres, including all land within Kenedy County and parts of Brooks, Hidalgo, Jim Wells, Kleberg, Nueces, and Willacy counties. The District includes 44,311 acres of northern Willacy County and 73,006 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 adopted an update to their original Groundwater Conservation Plan on July 25, 2012. This Plan outlines rules for the district, which include the following:

- Well Registration, Drilling Permits, and Operating permits for all wells, regardless of when they were drilled and whether they have been plugged;
- Well construction and completion standards, and including a requirement for a sampling port on all wells;
- Annual recordkeeping and reporting for water production from all wells with an operating permit and for all temporary rig supply wells. Well owners/water well drillers are also required to submit well drilling and completion reports, pump reports, and other reports that may be helpful to the District in fulfilling its statutory duties. Permitted wells must report all water quality data obtained for raw water from the wells. Uranium exploration companies must submit all water quality data required by statute and District Rule.
- Any deteriorated or abandoned wells shall be plugged in accordance with Texas Department of Licensing and Regulation, 16 Texas Administrative Code, Chapter 76, as amended. The rules will also address circumstances requiring the sealing and capping of wells. If a landowner becomes aware of a plugged well, or if a P-13 is filed with the Railroad Commission to convert an oil and gas well (usually a dry hole) into a water well, these are considered water wells under District Rules and must be registered with the District;
- Water well spacing requirements of the Water Well Driller's rules, 16 Texas Administrative Code Section 76.1000, as amended;
- Rules setting out its enforcement authority and policies, as authorized by Texas Water Code §§ 36.101 and 36.102. The rules authorize entry onto property as authorized by Texas Water Code §36.123. They also establish the process by which the District will undertake an enforcement action and the steps to be followed;
- Procedural rules establishing required notice and hearing for various District activities such as approval of rules, including emergency rules; actions on operating permits; permit actions requiring a contested case hearing; and enforcement matters. These rules have recently been updated to implement changes in state law applicable to the District; and
- The District prohibits waste of groundwater.

The DFC established for the Kenedy County GCD was a drawdown of 101 feet in 2060.

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. The District is comprised of an area of land in the northwestern corner of Hidalgo County, an adjacent area in north central Hidalgo County, and an area along the border between Hidalgo and Willacy Counties.

Red Sands is in the process of registering all wells in the district and issuing permits for those wells. There are many inactive wells in the District, and Red Sands is in the process of plugging those inactive wells in accordance with the goals in their Conservation Plan. There is a very limited water supply in the Red Sands Groundwater Conservation District; the Desired Future Conditions identify a target of 40 feet of average drawdown. Based on the most recent groundwater modeling, this allows for 584 acre-ft. /year of pumping.

Starr County Groundwater Conservation District

Starr County Groundwater Conservation District consists entirely of Starr County, bounded by Zapata, Jim Hogg, Brooks, and Hidalgo Counties, and the Rio Grande River. Starr County GCD is governed by a 5- member Board of Directors that was appointed at the inception of the District, all were re-elected in the county elections in November of 2012, and serve for two years. The District intends to establish and adopt a well monitoring program and has a well registration program underway.

Starr County GCD overlies parts of both the Gulf Coast Aquifer and the Yegua-Jackson Aquifer. The Portion of the Gulf Coast has low water availability, with TDS ranging from 1,000 to more than 10,000 milligrams per liter. The Yegua Jackson Aquifer has low yield with quality between 50 and 10,000 mg/L TDS. Starr county GCD has adopted the drawdown goal of 94 foot drawdown area-wide for GMA 16. This results in an estimated 127 ft. of drawdown in the Gulf coast Aquifer. The portion of the Yegua Jackson aquifer in Starr County is not included in the MAG process.

3.3 Recycled Water

The use of wastewater treatment plant effluent as reclaimed water is becoming increasingly common as an alternative water supply. Water reuse is classified as direct or indirect and potable or non-potable. Direct reuse is defined as the use of reclaimed water that is piped directly from the wastewater treatment plant to the place where it is utilized. Indirect reuse is defined as the use of reclaimed water by discharging to a water supply source, such as surface water or groundwater, where it blends with the water supply and may be further purified before being removed for non-potable or potable uses. Potable water is suitable for direct consumption, and non-potable is used to meet a range of other demands. This gives four classes of reuse:

1. Direct Potable
2. Direct Non-potable
3. Indirect Potable
4. Indirect Non-potable

The most common class is direct non-potable for irrigation or industrial type uses. Irrigation use may include turf irrigation, or in some cases crop irrigation. Many forms of indirect reuse have been implemented through the years as discharges from one water user contribute to streamflow or groundwater recharge and are then diverted by a downstream water user. In unique cases involving groundwater-based return flows or inter-basin transfers, a discharger may retain a right to its return flows. For planning purposes, indirect reuse is considered water that would require a permit to access after it has been discharged into the environment. This form of indirect reuse is limited by the legal complexity required to demonstrate that a discharge increases water availability.

The Texas Administrative Code (TAC) Chapter 210 authorizes individual producers of reclaimed water to implement water reuse in Texas. Many individual water user groups (WUGs) in Region M have 210 authorizations with water reuse in various stages of implementation. Two classes of water are authorized:

- Type I Reclaimed Water – suitable for use where contact between humans and the reclaimed water is likely.
- Type II Reclaimed Water – suitable for use where contact between humans and the reclaimed water is unlikely

There are currently six municipalities in Cameron and Hidalgo Counties that use reclaimed water to satisfy municipal demands and one entity in each of Maverick and Webb Counties, as presented in Table 3-11. All of these uses are for non-potable purposes, such as service water at WWTPs and landscape irrigation and ponds.

Table 3-11 Current Reuse Water Usage in the Lower Rio Grande Valley

Municipality	WWTP	Average Reuse (MGD)	Maximum reuse Capacity (MGD)	Intended Use
City of Eagle Pass	Eagle Pass WWTP	0.58	6	Dust Control and Golf Course: Irrigation, Ponds
City of Edinburg	Edinburg WWTP	3.5	6	Power Plant Process Water
City of Harlingen	Harlingen WWTP No. 2	1	3	Irrigation; Watering Ponds
Laguna Madre Water District	Isla Blanca Park WWTP	0.06	0.4	Irrigation; Plant Water
Laguna Madre Water District	Laguna Vista WWTP	0.3	0.4	Golf Course Irrigation and Lagoons
Valley MUD No. 2	Rancho Viejo WWTP	0.1	0.21	Golf Course Pond
City of McAllen	McAllen North WWTP	0.01	0.02	Plant Water
City of McAllen	McAllen South WWTP	2	6	Plant Water; Golf Course Irrigation
Laredo	North Laredo WWTP	0.53	0.53	Plant Water, Golf Course Irrigation
Laredo	United Water Laredo Southside WWTP	0.08	0.08	Plant Water, Irrigation, Belt Press
Laredo	Zacate Creek WWTP	0.08	0.08	Plant Water, Irrigation, Process Water
City of Pharr	Pharr WWTP	5	8	Plant Water; Golf Course Irrigation
City of Weslaco	Weslaco South WWTP	0.94	1	Plant Water; Golf Course Irrigation

Availability of reuse water is limited by the treatment capacity and actual flow of the wastewater treatment plants that supply the effluent. It is assumed that half of a wastewater treatment plant's average effluent is available on a consistent basis to be used for reuse water.

Reuse water has the potential to supply 34.29 MGD to satisfy the municipal demand in Region M. Currently the area uses reclaimed water for non-potable purposes, however there is likely to be increased focus on potential Potable Reuse water. Ten municipalities have been identified as feasible candidates to implement Potable Reuse systems, discussed further in Chapter 5.

3.4 Allocation of Supplies

A survey was sent to entities in the region in 2012 asking for information about current supplies and entities have been contacted individually and through the Irrigation District and Utility managers associations. Other resources documenting the allocation of groundwater and surface water resources from TCEQ and TWDB have been used to estimate current reliable supplies. A table showing all of the contractual demands for WUG and WWP is included in Appendix B-3.

3.4.1 Surface Water

Water from the Amistad-Falcon Reservoir system is the primary surface water supply. The intent is to show established supplies that can be considered reliable within the context of the Rio Grande operations. TCEQ annual water rights records were used to establish most supplies. Short term contracts for water were not considered to be reliable supplies, although longer term contracts and those anticipated to be renewed, were considered reliable.

Class A and B water rights were reduced according to the volume reliability anticipated in a drought year, which decreases over the planning horizon due to sedimentation in the reservoirs. DMI water rights were expected to be 100% reliable.

In the supply data, Irrigation Districts are shown as directly accessing the Rio Grande, and as delivering the water that they divert to end users. This shows the physical relationships between the Districts and the users that they serve. The delivery losses in the Districts are estimated and tracked, and Irrigation District Conservation is recommended as a Water Management Strategy to access the water that is currently lost in these systems. Delivery losses, based on estimated conveyance efficiency, were applied to all water supplied by each district. Those water rights that are not diverted by Irrigation Districts are shown to directly supply the end user, in some cases public supply utilities and in other cases individuals. Based on the use designation, this water was counted as supplying county-other demand, irrigation, mining, livestock, or industrial demand. Where the TCEQ data was insufficient to understand the supplies associated with the Rio Grande, entities were contacted individually.

Livestock local surface water supplies were assumed for all counties with livestock demand. Because the demands are based on a drought year scenario, it was assumed that ranchers will manage their livestock so that reliable water sources will be sufficient. These supplies were assumed to be used only for livestock, and independent of other surface water sources listed.

3.4.2 Groundwater

Groundwater usage records were gathered from the TWDB groundwater database, from the Water User Group Entity Detailed GPCD Report (2011), from the Municipal and Industrial Water Uses Surveys, and from entities themselves. Municipal groundwater supplies were based on information from the municipalities/utilities, and considered to be consistent over the planning horizon.

For county-wide WUGs, like irrigation, mining, and county-other, the TWDB groundwater database was used. For each type of user, an average horsepower and well depth were used to estimate the yield from each well. These values were compared against the stated demands. For each type of user, a well yield and a percentage of wells reporting was assumed, and extrapolated over the data for each county. For instance, a domestic well was assumed to yield 0.4 acre-ft., based on 140 GPCD, 2.5 people per household, and these wells were assumed to be reported 50% of the time. The 2017 Database includes notes indicating the well count for each county and river basin split, as well as the assumptions used to develop pumping estimates.

In each of these resources, the aquifers identified were checked against availability information including, but not limited to, the MAG values.

3.4.3 Recycled Water

Existing recycled water supplies were evaluated and projected to continue through the planning horizon. Non-potable reuse supplies were limited to 1/3 of a municipal demand, because in many cases the volume of water that can be recycled is significantly larger than the limited demands that can be met with non-potable water.

Future supplies are based on the capacities of existing wastewater treatment plants. This methodology is discussed further in Chapter 5 under the Reuse WMS.

Texas Water Development Board

RIO GRANDE
REGIONAL WATER PLANNING GROUP

2016 Region M Water Plan
Chapter 4: Water Needs

BLACK & VEATCH
Building a world of difference.

Table of Contents

Figures

Tables

List of Abbreviations

MAG	Managed Available Groundwater
RO	Reverse Osmosis
SB1	Senate Bill #1
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
WMS	Water Management Strategy
WSC	Water Supply Corporation
WUG	Water User Group
WWP	Wholesale Water Provider

Chapter 4. Water Needs

4.1 Introduction

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 describes the projected needs, based on the demands described in Chapter 2 and supplies discussed in Chapter 3.

The objective is to identify which Water User Groups will have a Need, defined here as a shortage between projected demands and supplies. Drought year needs may be the result of any combination of the following scenarios, among others:

- high drought year demand,
- long-term demand growth,
- limited source availability, either
  - contractually, as in municipal water rights, or
  - hydraulically, as with irrigation water rights,
- limitations of existing infrastructure, as with well-field or treatment plan capacity, or
- use of short-term supplies.

Water Management Strategies and specific projects are discussed in Chapter 5 as the recommended methods to meet these shortages.

4.1.1 Approach

Needs were identified for each of the six types of WMS: municipal, irrigation, livestock, manufacturing, steam-electric power generation, and mining. Chapter 2 describes the methodology for demand projections for each WUG type, and Chapter 3 discusses the approach for determining existing supplies. For each WUG (each municipal WUG and each county-wide aggregate for the other 5 types of users), the supplies and the demands are compared to estimate the needs. Surpluses, where the currently available supplies exceed demands, are shown as a zero in the needs evaluations. This ensures that a surplus for one location does not automatically cancel out a shortage for another entity. For any surplus that is moved from one entity/geographical area to another, a water management strategy is identified in Chapter 5.

For Wholesale Water Providers (WWPs) that are also WUGs, their needs are shown here based on the supplies or portions of supplies that have been identified to meet their WUG needs. WWP supplies to other WUG are included as a supply for that WUG. WWPs that do not have a demand associated to them independent of the WUG they supply are not shown here.

4.2 Regional Needs Summary

4.2.1 Regional Needs by WUG

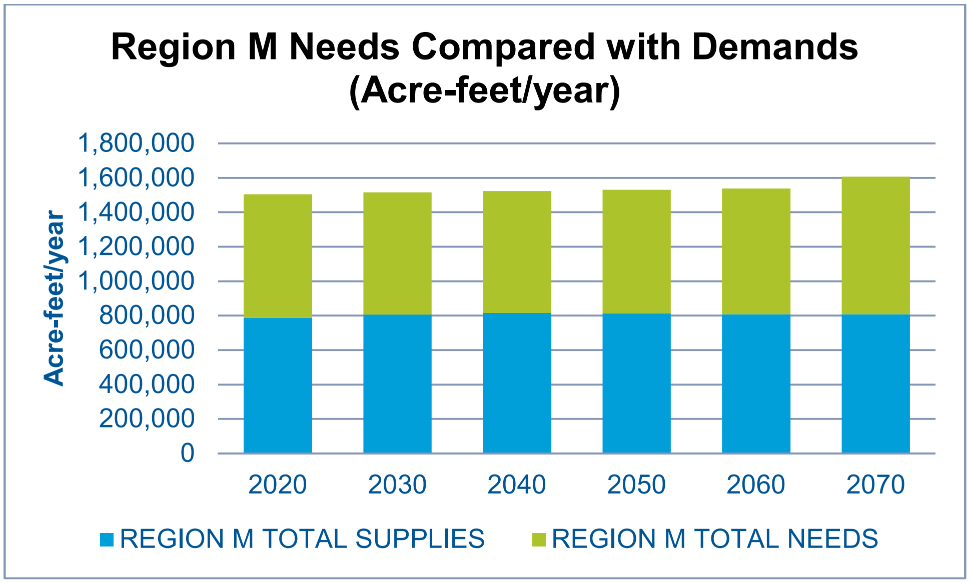

Figure 4-1 Total Regional Needs, Shown as a Portion of Total Demands (Acre-feet/year)

The vast majority of needs in Region M come from irrigation. This is to be expected, as the irrigation demand projections are based on estimated use in a year where supplies are not limited from the reservoirs and there is little rainfall, or the highest demand scenario, whereas the supplies are based on the drought of record. This shortage will be partially addressed both with supply increase, through improvements to the conveyance systems, and is managed through on-farm conservation measures, both discussed in detail in Chapter 5.

Table 4-1 Water Needs by WUG Type (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
Irrigation Needs	658,049	608,580	557,158	502,526	447,439	448,029
Municipal Needs	48,534	86,393	132,173	190,834	251,976	312,410
Mining Needs	5,290	4,641	5,488	5,565	5,758	6,337
Steam Electric Power Needs	2,984	5,635	8,866	12,805	17,608	23,501
Manufacturing Needs	2,529	3,388	4,243	4,994	5,992	7,067
Livestock Needs	0	0	0	0	0	0
Total Needs	**717,386**	**708,637**	**707,928**	**716,724**	**728,773**	**797,344**

Municipal needs are also significant, and increase rapidly over the planning horizon. One consideration when evaluating municipal needs is that some entities may have sufficient water for a year with normal precipitation, but show a need for a drought year. While one-time purchases of water, rather than contractual agreements or purchase of water rights, is often used as a stopgap measure, it is not a reliable drought year supply strategy. Chapter 5 recommends the purchase of water rights, as well as development of new sources, conservation, and other strategies, in order to address current and future needs of municipal WUG and WWPs.

Industrial users (mining, steam-electric, and manufacturing) supplies were evaluated based on data provided to TWDB and TCEQ regarding groundwater wells, surface water use, and purchase of water from public water supplies. Needs in these categories will likely also require increased cooperation with municipalities for reuse of wastewater effluent as well as conservation and water efficiency measures.

4.2.2 Regional Needs by County

The needs in Region M follow a similar distribution as the demands, focused heavily in Cameron and Hidalgo Counties, as shown in Table 4-2. There are some needs anticipated in each county in 2020, which will be evaluated individually in following sections.

Table 4-2 Needs by County (Acre-feet/year)

County	2020	2030	2040	2050	2060	2070
Cameron County	206,026	193,330	187,351	183,864	182,476	198,668
Hidalgo County	431,898	439,406	446,258	450,263	454,524	497,403
Jim Hogg County	239	237	244	295	368	404
Maverick County	15,775	15,488	14,771	13,816	13,253	13,709
Starr County	7,992	6,579	5,199	6,176	7,140	8,127
Webb County	4,294	2,204	2,387	10,181	17,998	25,450
Willacy County	49,376	49,445	49,529	49,627	50,075	49,994
Zapata County	1,786	1,948	2,189	2,502	2,939	3,589
Total Needs	**717,386**	**708,637**	**707,928**	**716,724**	**728,773**	**797,344**

4.3 Municipal Needs

The rate of population growth in Region M is similar to the growth rate across Texas. The Demand distribution is heavily concentrated in Cameron and Hidalgo Counties, and in the Laredo area in Webb County. Current supplies are estimated to be slightly less than 2020 demands for municipalities. In some cases a need shown here indicates that drought-year demands exceed reliable supplies, although that need may be regularly met by short-term contracts for water. Other municipalities may experience persistent shortage, especially those communities that rely solely on groundwater or utilities with infrastructure limitations.

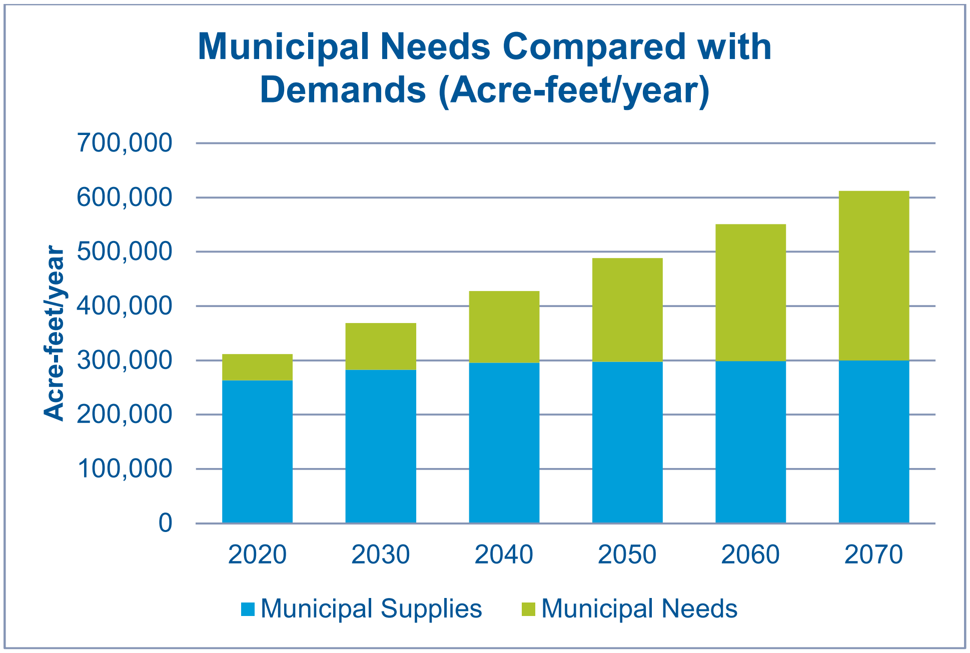

Figure 4-2 **Municipal Needs, Shown as a Portion of Municipal Demands (Acre-feet/year)**

The need for municipal water is shown in green in Figure 4-2 and increases to 45% of the total demand by 2070. Figure 4-3 shows each county's portion of the total regional municipal needs. The population centers are shown in Figure 4-4. Municipal demands for each county are discussed in the following sections.

Chapter 5 describes water management strategies that have been identified to address projected municipal needs.

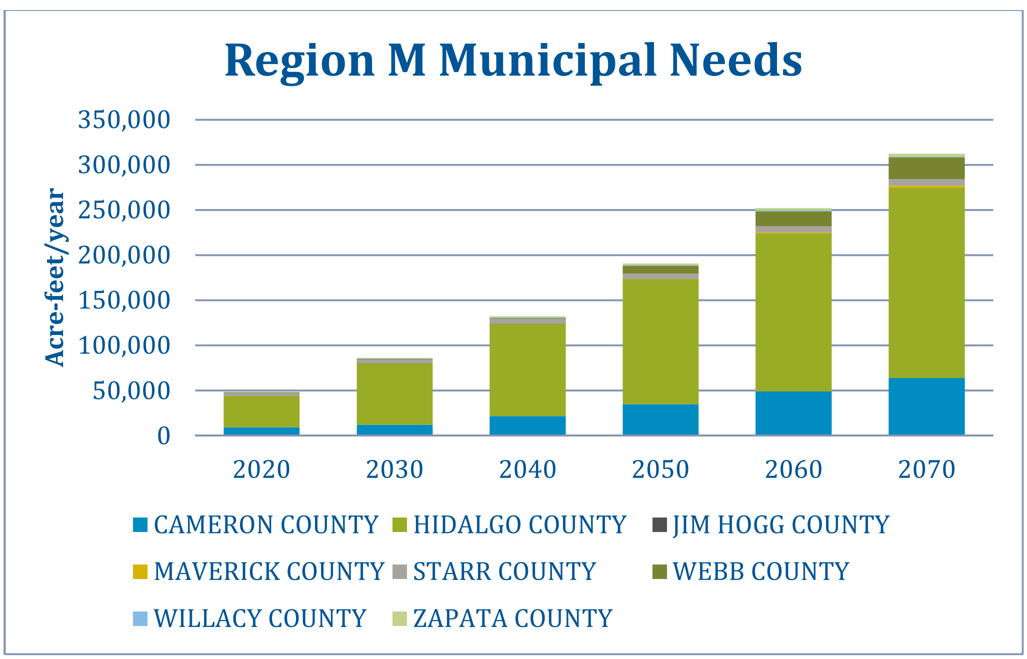

Figure 4-3 **Regional Municipal Needs, Shown by County (Acre-feet/year)**

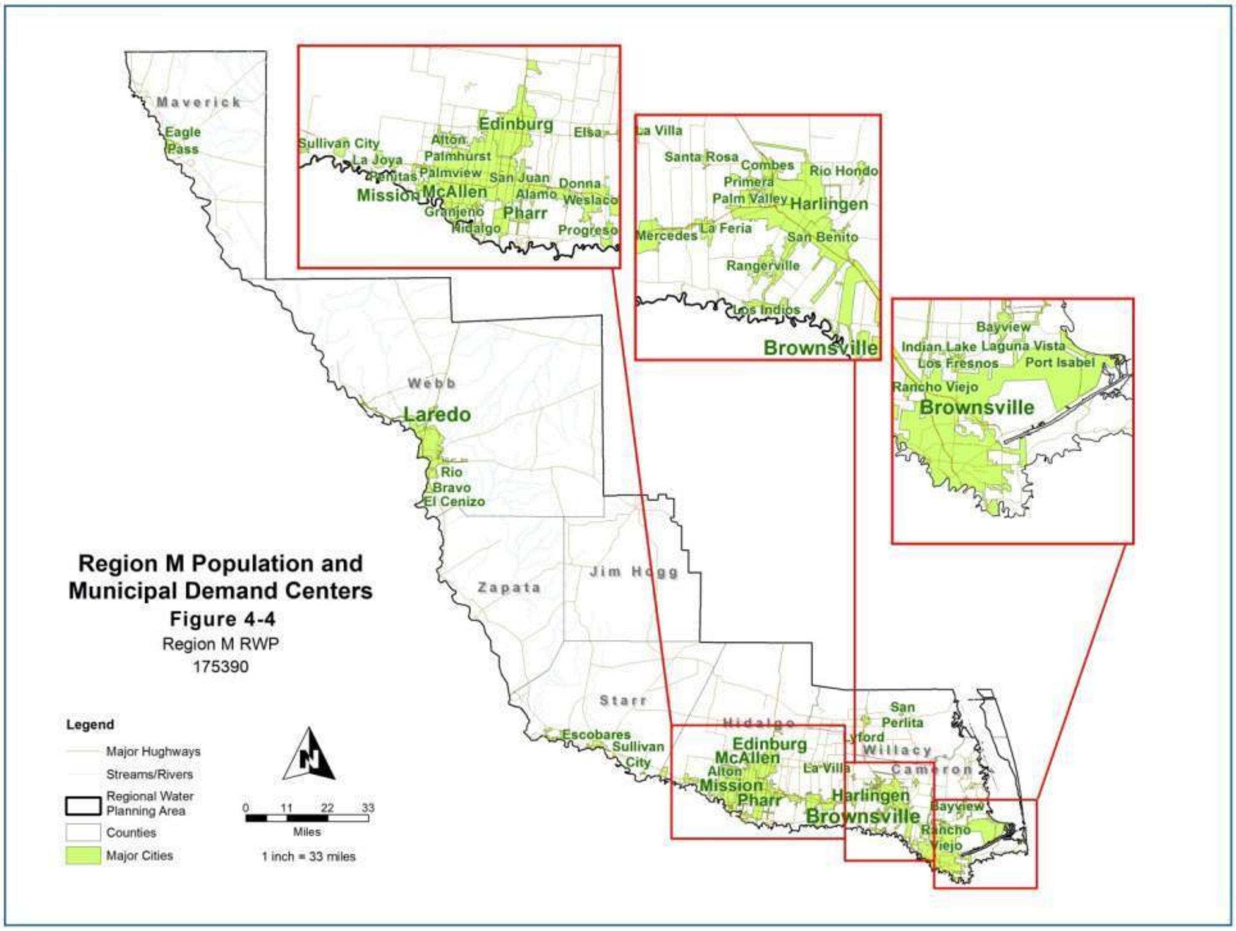

Figure 4-4 Region M Population and Municipal Demand Centers

4.3.1 Regional Water Supply Corporations

Needs for Water Supply Corporations (WSC) that serve multiple counties are shown as aggregated in Table 4-3 and listed separately in each County section below. If supply and demand centers are not fully connected across the WSCs, new interconnections across their service areas may allow for these WSCs to meet future needs as one system. In other cases strategies may be better supplied near the location of the demand, requiring separate strategies in each area. (Sharyland WSC is a large Regional WSC, but is only in Hidalgo County and therefore not listed here.)

Table 4-3 Regional Water Supply Corporation Needs (Acre-feet/year)

WSC	2020	2030	2040	2050	2060	2070
AGUA SUD	1,080	2,615	4,207	5,852	7,543	9,204
EAST RIO HONDO WSC	268	801	1,385	2,036	2,734	3,458
MILITARY HIGHWAY WSC	1,253	2,220	3,226	4,307	5,439	6,578
NORTH ALAMO WSC	1,603	6,943	12,419	18,016	23,708	29,283

4.3.2 Cameron County Municipal Needs

Cameron County is projected to have the second-largest share of municipal needs, behind Hidalgo County, as shown in Table 4-4. The largest individual need comes from County-Other, which may be indicative of the lack of reliable drought year supplies to individuals that live outside of a city or the service area of a Water Supply Corporation (WSC).

Most of the entities within Cameron County are at least in part served by irrigation districts and surface water. For this source, the most common limiting factor is water rights and the efficiency of conveyance infrastructure. There has been increased groundwater development in Cameron County, which in many cases requires advanced treatment like Reverse Osmosis (RO). In these cases, the cost of extraction and treatment of groundwater can be a limiting factor, which impacts the rate of development of new well fields and treatment facilities.

Table 4-4 Cameron County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
Brownsville	0	0	4,385	11,196	18,439	25,919
Combes	0	36	75	123	176	232
County-Other	5,117	5,468	5,862	6,360	6,937	7,544
East Rio Hondo WSC	0	319	895	1,535	2,214	2,917
El Jardin WSC	204	431	672	947	1,244	1,552
Harlingen	0	0	1,697	3,933	6,332	8,813
Indian Lake	14	1	9	19	28	38
La Feria	106	254	412	593	789	992
Laguna Vista	1,106	1,502	1,907	2,347	2,801	3,268
Los Fresnos	0	0	0	0	0	45
Los Indios	59	76	94	116	141	166
Military Highway WSC	632	1,097	1,576	2,088	2,625	3,174
North Alamo WSC	4	20	33	49	64	79
Olmito WSC	0	82	188	310	439	574
Palm Valley	0	39	80	126	177	229
Port Isabel	603	793	990	1,212	1,450	1,695
Primera	0	26	80	144	215	289
Rancho Viejo	0	0	0	0	104	262
Rio Hondo	0	0	0	0	0	0
San Benito	0	0	0	306	923	1,564
Santa Rosa	57	87	120	162	210	260
South Padre Island	1,466	1,993	2,530	3,113	3,716	4,336
Total	**9,368**	**12,224**	**21,605**	**34,679**	**49,024**	**63,948**

4.3.3 Hidalgo County Municipal Needs

Hidalgo County has the largest share of municipal needs in the region, shown in Table 4-5. Within the county, almost all of the municipalities are served by irrigation districts, with some groundwater. Therefore, the majority of the supplies are limited by the water rights that are held by each entity, as well as the efficiency of the conveyance infrastructure.

Table 4-5 Hidalgo County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
Agua SUD	774	1,917	3,104	4,331	5,591	6,828
Alamo	1,004	1,682	2,380	3,099	3,837	4,560
Alton	785	1,238	1,704	2,178	2,657	3,127
County-Other	1,365	2,488	3,645	4,806	5,966	7,104
Donna	0	151	685	1,244	1,827	2,400
Edcouch	28	89	154	224	300	375
Edinburg	4,016	6,802	9,675	12,617	15,624	18,570
Elsa	0	54	212	380	558	733
Hidalgo	360	755	1,163	1,580	2,006	2,424
Hidalgo County MUD #1	298	410	529	651	777	902
La Joya	0	0	0	0	56	200
La Villa	29	82	139	197	258	318
McAllen	7,297	15,788	24,444	33,291	42,317	51,132
Mercedes	281	706	1,149	1,616	2,107	2,589
Military Highway WSC	388	727	1,084	1,474	1,882	2,288
Mission	8,022	12,514	17,100	21,764	26,494	31,115
North Alamo WSC	1,060	6,197	11,494	16,918	22,445	27,865
Palmhurst	354	571	791	1,013	1,235	1,452
Palmview	103	257	416	580	748	914
Penitas	83	212	345	481	619	755
Pharr	106	2,116	4,204	6,366	8,598	10,790
Progreso	157	303	455	612	774	933
San Juan	1,897	3,193	4,527	5,899	7,306	8,685
Sharyland WSC	75	178	286	400	520	638
Sullivan City	3,041	4,737	6,475	8,267	10,109	11,911
Weslaco	3,076	4,754	6,474	8,243	10,055	11,828
Total	**34,599**	**67,921**	**102,634**	**138,231**	**174,666**	**210,436**

4.3.4 Jim Hogg County Municipal Needs

Jim Hogg County has very little municipal demand and shows a small municipal need in Table 4-6. WUGs in Jim Hogg County do not have direct access to Rio Grande water with current infrastructure. Hebbronville is the only town that meets the criteria to be listed as a WUG, but small towns and villages that comprise County-Other include Guerra, Agua Nueva, Las Lomitas, Randado, South Fork Estates, and Thompsonville. The limiting factor for groundwater supplies can be both the existing well-field capacities as well as the characteristics of the aquifer(s).

Table 4-6 Jim Hogg County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
County-Other	0	0	0	0	0	0
Hebbronville	0	24	46	81	117	153
Total	**0**	**24**	**46**	**81**	**117**	**153**

4.3.5 Maverick County Municipal Needs

Maverick County does not have a significant municipal need until 2050, as shown in Table 4-7. Eagle Pass is the only incorporated city in Maverick County, but there are eight census-designated places that are included in the County-Other projections (Edison Road, Elm Creek, El Indio, Las Quintas Fronterizas, Rosita North, and Rosita South). The total county's population, according to the 2010 census, was 54,258. Maverick County Water Control and Improvement District No. 1 serves some of these unincorporated areas. Maverick County's population is concentrated along the Rio Grande, so the limiting factor on supplies is likely to be water rights.

Table 4-7 Maverick County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
County-Other	0	0	0	0	0	0
Eagle Pass	0	0	0	559	1,427	2,268
Total	**0**	**0**	**0**	**559**	**1,427**	**2,268**

4.3.6 Starr County Municipal Needs

Municipal needs in Starr County are primarily in the County-Other category, shown in Table 4-8. Starr County's population is concentrated along the Rio Grande, so the limiting factor on supplies is likely to be water rights. However, the primary need is County-Other, which includes many areas that are not served by surface water, and are therefore limited by access to groundwater. Some areas in northeastern Starr County are experiencing dropping water levels, which require new or deepened wells.

Table 4-8 Starr County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
Agua SUD	4	10	15	19	24	28
County-Other	2,702	3,018	3,321	3,669	4,016	4,338
Escobares	0	0	0	0	0	0
La Grulla	0	0	0	0	0	0
Rio Grande City	136	559	957	1,372	1,761	2,117
Rio WSC	66	105	143	183	221	257
Roma	0	0	0	0	0	63
Union WSC	381	464	545	630	710	785
Total	**3,289**	**4,156**	**4,981**	**5,873**	**6,732**	**7,588**

4.3.7 Webb County Municipal Needs

Webb County is the largest county in Region M, but is relatively sparsely populated outside of Laredo and the cities south of Laredo along the Rio Grande. The population of the county, at the time of the 2010 census was 250,304, 94% of which was in Laredo. Limitations on access to water in this county are both related to surface water rights and availability of groundwater and existing infrastructure with which to access groundwater. Table 4-9 shows municipal need projections in Webb County.

Table 4-9 Webb County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
County-Other	721	885	1,061	1,232	1,394	1,541
El Cenizo	0	0	0	0	36	98
Laredo	0	0	0	7,610	15,179	22,059
Rio Bravo	0	0	0	0	37	130
Total	**721**	**885**	**1,061**	**8,842**	**16,646**	**23,828**

4.3.8 Willacy County Municipal Needs

Willacy County, although not on the Rio Grande, is primarily supplied by water diverted from the river in Cameron and Hidalgo Counties and delivered to users in Willacy County via Irrigation Districts. North Alamo WSC and East Rio Hondo WSC have also developed groundwater resources to supplement their surface water supplies, including brackish groundwater desalination. Need projections for Willacy County are shown in Table 4-10.

Table 4-10 Willacy County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
County-Other	0	0	0	0	0	0
East Rio Hondo WSC	0	1	1	2	3	4
Lyford	0	0	0	0	0	0
North Alamo WSC	44	231	397	554	704	844
Raymondville	0	0	0	0	0	0
San Perlita	12	37	63	92	121	148
Sebastian Mud	0	0	0	0	8	26
Total	**56**	**269**	**461**	**648**	**836**	**1,022**

4.3.9 Zapata County Municipal Needs

Zapata County accounts for a small portion of the Region's municipal needs, shown in Table 4-11. There is very little groundwater pumping documented in Zapata County.

Table 4-11 Zapata County Municipal Needs Projections (Acre-feet/year)

WUG	2020	2030	2040	2050	2060	2070
County-Other	204	265	336	414	495	580
San Ygnacio MUD	0	0	0	0	37	77
Zapata County Waterworks	297	649	1,049	1,507	1,996	2,510
Total	**501**	**914**	**1,385**	**1,921**	**2,528**	**3,167**

4.4 Irrigation Needs

Irrigation is the largest water user in Region M, and has the largest need. This is because the needs are calculated based on the maximum demand estimate and a minimum supply. Because irrigation surface water rights are filled only after all domestic, municipal, and industrial water is set aside, supplies are vulnerable to drought. The portion of demand that is met (supplies) and the resulting needs are shown in Figure 4-5 for each decade. There is a detailed discussion on how Irrigation demands are estimated in Chapter 2, and more information about how water is allocated on the Rio Grande in Chapter 3.

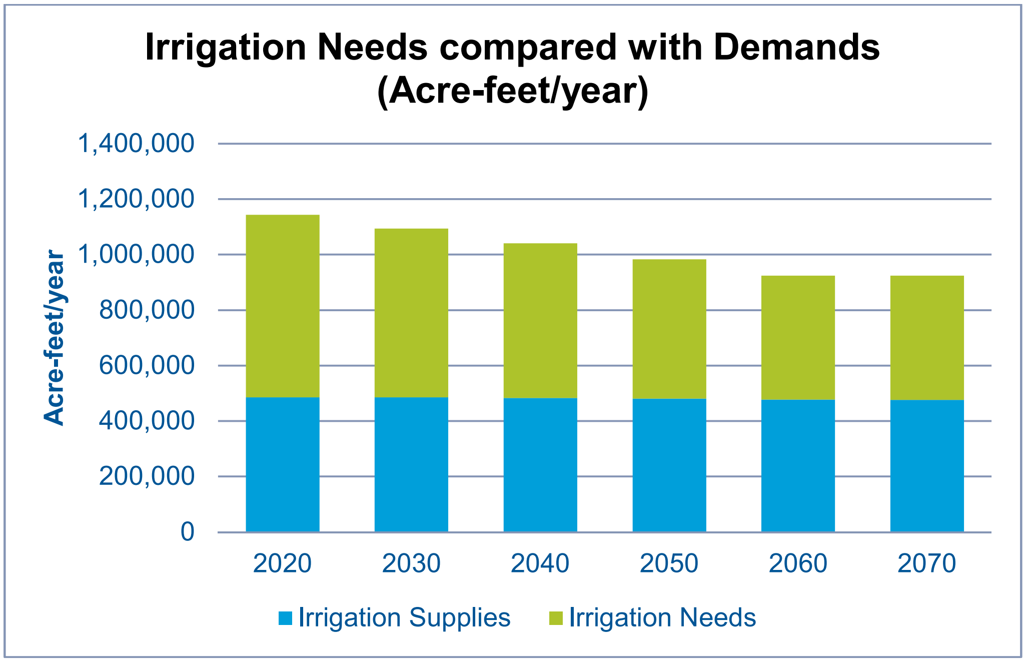

Figure 4-5 Irrigation Needs, Shown as a Portion of Irrigation Demands (Acre-feet/year)

Irrigation needs are the highest in Cameron and Hidalgo Counties, where there is the most farmland irrigated with surface water. Needs are projected to decrease slightly as a result of decreasing demand. Increased Irrigation District efficiency and on-farm conservation may alleviate some of the impacts of drought on productivity for farmers. The needs shown in Table 4-12 represent the extent of shortage anticipated by farmers in years of limited supply.

Table 4-12 Irrigation Needs Projection by County and River Basin (Acre-feet/year)

County	Basin	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	83,512	168,272	153,163	136,911	121,245	121,505
Cameron	Rio Grande	11,423	10,451	9,487	8,449	7,447	7,466
Hidalgo	Nueces-Rio Grande	376,535	348,278	317,742	283,018	246,784	247,253
Hidalgo	Rio Grande	15,687	14,510	13,239	11,793	10,281	10,303
Jim Hogg	Nueces-Rio Grande	211	190	178	191	221	221
Jim Hogg	Rio Grande	28	23	20	23	30	30
Maverick	Nueces	0	0	0	0	0	0
Maverick	Rio Grande	14,112	13,070	12,151	11,263	10,452	10,516
Starr	Rio Grande	4,654	2,284	0	0	0	0
Webb	Rio Grande	1,298	1,310	1,322	1,334	1,345	1,357
Willacy	Nueces-Rio Grande	49,304	49,158	49,052	48,963	49,223	48,956
Zapata	Rio Grande	1,285	1,034	804	581	411	422
Total		558,049	608,580	557,158	502,526	447,439	448,029

4.5 Steam Electric Power Generation Needs

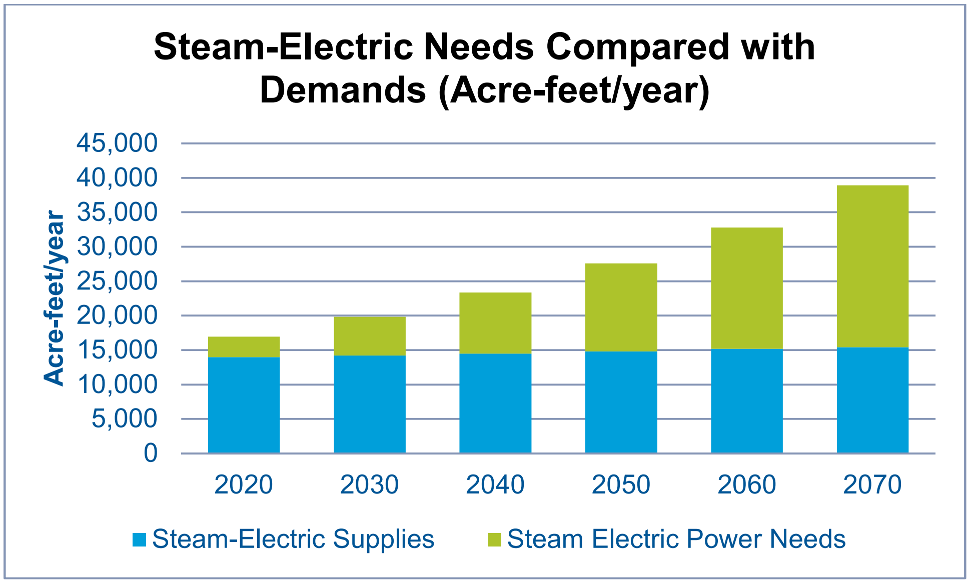

Figure 4-6 Steam-Electric Needs, Shown as a Portion of Steam Electric Demands (Acre-feet/year)

The current supplies for Steam Electric power generation meet about 91% of the 2020 demands (Figure 4-6). This stems, in part, from the anticipated near-term growth of power generation demands, the likelihood of some short-term contractual water, and from increasingly efficient power generation in terms of consumptive water use. This will be discussed in Chapter 5 as a strategy for addressing the needs of steam-electric power generation. Table 4-13 shows Steam Electric needs projections.

Table 4-13 Steam-Electric Needs Projection by County and River Basin (Acre-feet/year)

County	Basin	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	1,036	1,293	1,607	1,990	2,457	2,941
Hidalgo	Nueces-Rio Grande	1,948	4,342	7,259	10,815	15,151	20,304
Webb	Rio Grande	0	0	0	0	0	256
Total		**2,984**	**5,635**	**8,866**	**12,805**	**17,608**	**23,501**

4.6 Mining Needs

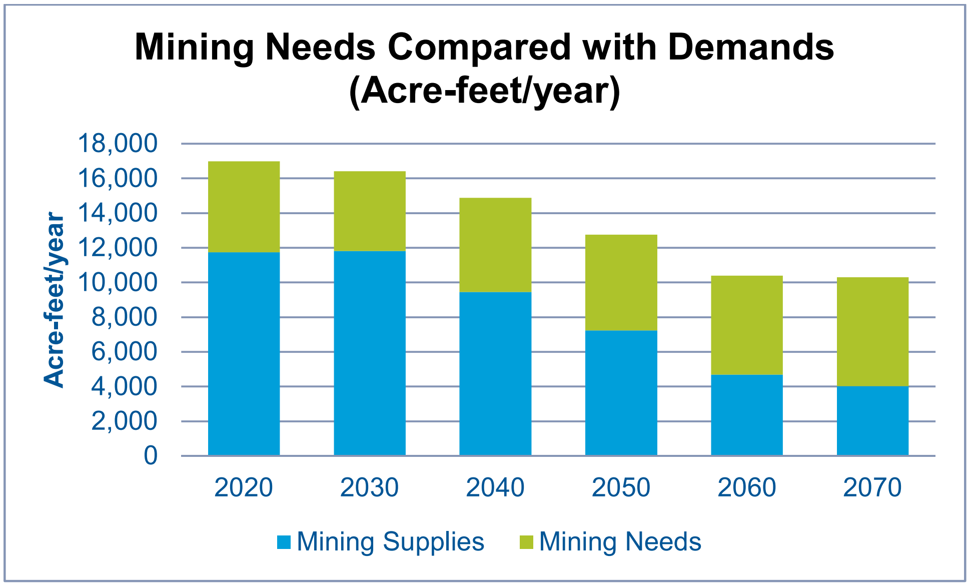

Figure 4-7 Mining Needs, Shown as a Portion of Mining Demands (Acre-feet/year)

Current mining supplies appear to meet about 71% of the 2020 demands for mining water (Figure 4-7). The apparent shortage is in part due to low reliability for Rio Grande mining water rights to in drought years, so the estimates of availability are significantly lower than what is available in a normal year. Increased use of recycled water at oil and gas wells is discussed as a water management strategy in Chapter 5, and accounts for a projected reduction in mining demands. Because of reporting limitations, there may be additional mining supplies from groundwater that would exceed the Managed Available Groundwater (MAG) values for some aquifer/county/river basin areas. Mining needs are shown in Table 4-14.

Table 4-14 Mining Needs Projection by County and River Basin (Acre-feet/year)

County	Basin	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	0	0	0	0	0	0
Hidalgo	Nueces-Rio Grande	1,235	1,956	2,495	3,072	3,736	4,575
Hidalgo	Rio Grande	147	204	246	292	344	410
Jim Hogg	Nueces-Rio Grande	0	0	0	0	0	0
Jim Hogg	Rio Grande	0	0	0	0	0	0
Maverick	Nueces	323	472	512	385	261	169
Maverick	Rio Grande	1,261	1,862	2,019	1,516	1,013	649
Starr	Nueces-Rio Grande	49	78	96	115	139	169
Starr	Rio Grande	0	60	120	185	265	365
Webb	Nueces	688	2	0	0	0	0
Webb	Nueces-Rio Grande	120	5	0	0	0	0
Webb	Rio Grande	1,467	0	0	0	0	0
Willacy	Nueces-Rio Grande	0	2	0	0	0	0
Zapata	Rio Grande	0	0	0	0	0	0
Total		**5,290**	**4,641**	**5,488**	**5,565**	**5,758**	**6,337**

As discussed in Chapter 2, the mining, oil and gas industry has very few requirements for reporting the volumes of groundwater used. Additionally, some Class A and B water rights have been reclassified as 'Multi-Use' which allows both irrigation and mining use. This is an impediment to evaluating current and future availabilities, and may result in over-allocation of some aquifers or mis-allocation of supplies.

4.7 Manufacturing Needs

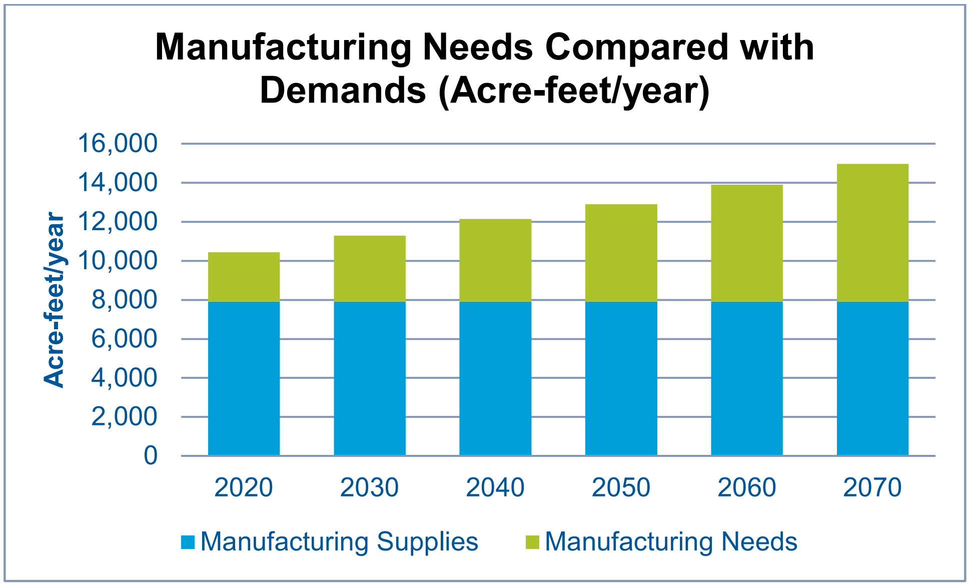

Figure 4-8 Manufacturing Needs, Shown as a Portion of Manufacturing Demands (Acre-feet/year)

Manufacturing needs are shown in Figure 4-8 and Table 4-15. Water demand associated with manufacturing is met by both groundwater and surface water, and comprises a relatively small portion of the regional demand and need. Current supplies meet 51% of 2020 projected demands. The need likely results in part from the date of most recent supply data (2013) being seven years from the first date of demand data (2020), and due to some portion of supplies from short-term contracts for water.

Table 4-15 Manufacturing Needs Projection by County and River Basin (Acre-feet/year)

County	Basin	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	687	1,090	1,489	1,835	2,303	2,808
Hidalgo	Nueces-Rio Grande	1,747	2,195	2,643	3,042	3,562	4,122
Maverick	Rio Grande	79	84	89	93	100	107
Starr	Rio Grande	0	1	2	3	4	5
Webb	Nueces	0	2	4	4	6	8
Webb	Rio Grande	0	0	0	1	1	1
Willacy	Nueces-Rio Grande	16	16	16	16	16	16
Total		**2,529**	**3,388**	**4,243**	**4,994**	**5,992**	**7,067**

4.8 Livestock Needs

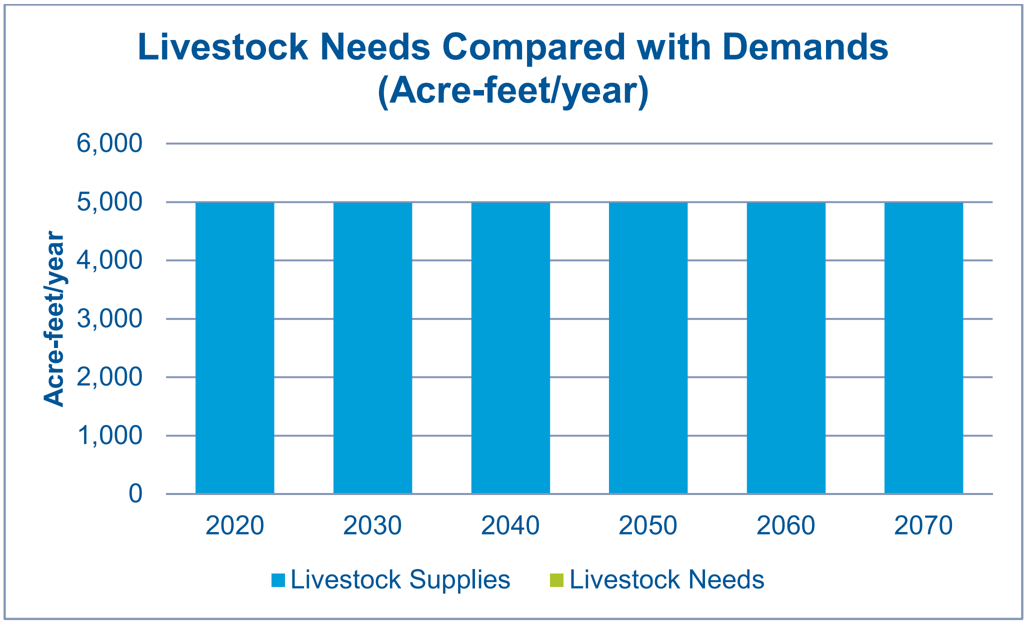

Figure 4-9 Livestock Needs, Shown as a Portion of Livestock Demands (Acre-feet/year)

Livestock demands are met by numerous groundwater wells, ephemeral streams and ponds, as well as surface water diversions, often classified together with lawn watering contracts or referred to here as Livestock Local Supplies. These supplies are expected to be sufficient to meet the needs of the (stable) livestock demand, and therefore there is not a Need for livestock. In particular areas there may be some difficulty providing sufficient water in a drought year, but overall ranchers are expected to manage their livestock within the available supplies.

4.9 Unmet Needs

Unmet needs after WMS include the needs that remain after the demand reduction and/or supply from all conservation and WMS are applied to an entity's initial need. For Region M there are no unmet needs for Municipal, Steam Electric, Manufacturing, or Livestock WUG. The remaining unmet needs for Irrigation and Mining are presented in Table 4-16.

Table 4-16 Summary of Unmet Needs for Region M (Acre-feet/year)

County	Basin	WUG	2020	2030	2040	2050	2060	2070
Cameron	Nueces-Rio Grande	Irrigation	163,370	150,607	138,749	126,068	114,058	109,605
Cameron	Nueces-Rio Grande	Manufacturing	65	391	544	542	541	537
Cameron	Rio Grande	Irrigation	10,137	9,324	8,567	7,757	6,990	6,707
Hidalgo	Nueces-Rio Grande	Irrigation	271,498	243,145	214,381	183,363	151,750	141,441
Hidalgo	Nueces-Rio Grande	Manufacturing	0	0	566	736	738	743
Hidalgo	Nueces-Rio Grande	Mining	865	1,495	1,956	2,458	3,040	3,779
Hidalgo	Rio Grande	Irrigation	11,460	10,281	9,081	7,790	6,474	6,045
Hidalgo	Rio Grande	Mining	117	169	204	244	290	348
Maverick	Nueces	Mining	270	403	437	322	208	125

County	Basin	WUG	2020	2030	2040	2050	2060	2070
Maverick	Rio Grande	Mining	1,052	1,587	1,722	1,264	805	472
Starr	Nueces-Rio Grande	Mining	36	62	78	95	117	144
Starr	Rio Grande	Irrigation	3,714	2,624	1,601	662	0	0
Starr	Rio Grande	Mining	0	6	60	119	191	281
Webb	Nueces	Mining	378	0	0	0	0	0
Webb	Nueces-Rio Grande	Mining	68	0	0	0	0	0
Webb	Rio Grande	Irrigation	343	351	359	366	372	381
Webb	Rio Grande	Mining	795	0	0	0	0	0
Willacy	Nueces-Rio Grande	Irrigation	38,842	36,918	35,114	33,346	31,936	29,899
Zapata	Rio Grande	Irrigation	774	655	554	458	390	399
Total			**503,784**	**458,018**	**413,973**	**365,590**	**317,900**	**300,906**

In a drought year Irrigation and Mining surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, which is one of the reasons why these WUG have a large need. Conservation strategies were recommended for Irrigation and Mining WUG as On-Farm Conservation and Implementation of Best Management Practices and savings from those WMS were applied to their initial needs. However, there is not sufficient water available within conservation limits to meet needs in an economically feasible way. Both irrigation and mining are industries that are able to adjust to utilize variable amounts of water, and in a drought year the demands for these industries are not feasibly met.

A social and economic impacts evaluation of projected water shortages if no WMS are implemented provided by TWDB can be found in Chapter 6.

Texas Water Development Board

2016 Region M Water Plan

Chapter 5: Water Management Strategies

Table of Contents

Figures

Tables

List of Abbreviations

Acre-ft.	Acre-feet
Acre-ft./year	Acre-feet per year
AgriLife	Texas A&M AgriLife Research
ASR	Aquifer Storage and Recovery
AWSC	Arroyo Water Supply Corporation
AWWA	American Waterworks Association
BMP	Best Management Practice
CCID	Cameron County Irrigation District
cfs	Cubic feet per second
DMI	Domestic, Municipal, or Industrial
ERHWSC	East Rio Hondo Water Supply Corporation
FM	Farm to Market
GPM	Gallons per Minute
HCDD	Hidalgo County Drainage District
HCID	Hidalgo County Irrigation District
HP	Horsepower
IBWC	International Boundary and Water Commission
kWh	Kilowatt-hour
LF	Linear Feet
MAG	Managed Available Groundwater
MF	Microfiltration
MG	Million Gallons
Mg/L	Milligrams per Liter
MGD	Million Gallons per Day
MUD	Municipal Utility District
NAWSC	North Alamo Water Supply Corporation
O&M	Operations and Maintenance
PUB	Public Utilities Board
PVC	Polyvinyl Chloride

RGRWA	Rio Grande Regional Water Authority
RO	Reverse Osmosis
RWP	Regional Water Plan
SCADA	Supervisory Control and Data Acquisition
SUD	Special Utility District
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TWDB	Texas Water Development Board
TX	Texas
TXDOT	Texas Department of Transportation
UCM	Unified Costing Model
UF	Ultrafiltration
US	United States
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UTPA	University of Texas Pan America
UV	Ultraviolet
WAM	Water Availability Model
WCID	Water Control and Improvements District
WID	Water Improvements District
WMS	Water Management Strategy
WR	Water Right
WSC	Water Supply Corporation
WSOC	Water Supply Option Contract
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider
WWTP	Wastewater Treatment Plant

Chapter 5 Water Management Strategies

5.1 Introduction

Water Management Strategies (WMS) were evaluated and updated in this Region M Regional Water Plan. The following chapter describes the process of gathering all of the WMS that were considered, the evaluation of the potentially feasible WMS, and selecting recommended WMS to meet future needs. Section 5.1.1 describes this process in detail, Section 5.2 discusses how each type of WMS was evaluated (e.g. desalination or advanced municipal conservation). Section 5.3 describes all of the WMS that were recommended for each water user group (WUG), by county, listing the Irrigation Districts and WWP strategies first, municipal WUG second, and non-municipal WUG third. Section 5.4 describes alternative strategies, which are also considered feasible and should be considered alternative recommendations. Section 5.5 includes those strategies that were evaluated but not recommended.

5.1.1 Process

The Regional Water Planning Group is tasked with evaluating all potentially feasible Water Management Strategies (WMS) and recommending selected strategies to meet current and future needs in the region. The potentially feasible water management strategies came from three major sources:

1. The recommended WMS from the 2011 Region M Water Plan,
2. Responses to a request sent to all water providers and stakeholders for project and strategy descriptions in 2013, and
3. The list of WMS for consideration listed in the water planning guidance documents provided by the TWDB, which includes:
    a. Improved conservation;
    b. Reuse;
    c. Management of existing water supplies;
    d. Conjunctive use;
    e. Acquisition of available existing water supplies;
    f. Development of new water supplies;
    g. Drought Management WMS;
    h. Development of regional water supply facilities or regional management of water supply facilities;
    i. Voluntary transfer of water within the region using, but no limited to, regional water banks, sales, leases, options, subordination agreements, and financing agreements; and
    j. Emergency transfer of water.

The 2011 Regional Water Plan (RWP) strategies for Irrigation District Conservation and Municipal Water Conservation were considered and re-developed with additional conservation measures and updated cost estimates and yield projections. Most of the specific projects that were re-evaluated from the 2011 RWP were infrastructure, brackish groundwater desalination facilities, and expansion of existing groundwater supplies. Drought Management WMS, the implementation of permanent drought restrictions, was considered and not recommended.

The request for WMS from stakeholders took place over 2 months in 2013, with follow-up taking place over the next 18 months. Forty-six entities submitted 180 projects and strategies to be evaluated. Municipal utilities and irrigation districts submitted most of the projects and strategies, and some additional conservation measures were submitted by Texas A&M AgriLife Extension services and the USDA. The submitted costs, projected yield, feasibility, and impacts were evaluated for accuracy, consistency, and compliance with TWDB rules and guidance where that information was available, and where information was not available assumptions were made and documented.

The WMS components that are included in this RWP are limited to the infrastructure and costs that are required to develop and convey increased water supplies from water supply sources and to treat the water for end WUG requirements. Conservation WMS that reduce demands or measurably reduce water losses are also included. Infrastructure components associated with internal water distribution networks that do not convey an additional water supply volume or address current losses are not included in the RWP.

Those potentially feasible WMS were updated or completed with any new information, associated costs were either updated to 2013 US dollars or re-evaluated using the Unified Cost Model (UCM), and checked for accuracy, consistency, and compliance with source availability limitations. Each WMS was evaluated within the context of the WUG(s)/WWP(s) impacted and the needs projected for the entity/entities. For each entity, different approaches to meet needs may be feasible depending on what volume of need is anticipated and what other WMS may be available to meet that need.

Irrigation District Conservation and Advanced Municipal Conservation were recommended across the region. The projected water saved through Irrigation District improvements and Advanced Municipal Conservation was first subtracted from each WUG's need to obtain a revised need after conservation. If a need still existed, additional WMS were considered for the WUG. In cases where two or more alternatives were available without significant negative impacts, an evaluation process was used to select the most appropriate WMS. The evaluation process ranked each potential WMS in order based on the following criteria:

1. Projects considered regular maintenance or internal distribution (not providing new or supplemented supplies), and WMS without sufficient information to evaluate were not considered.
2. Projects requiring changes to existing law or policy for implementation were ranked lower. (yes/no)
3. Projects with significant risk with permitting or implementation, including environmental impacts were ranked lower. (yes/no)
4. Projects using sources with limited availability such that implementation of one project excludes another WMS by using a limited source. This has been indicated as a "yes" for WMS that rely on fully appropriated sources, or are competing with other strategies for the same water source as other current and future supplies, and ranked lower. (yes/no)
5. Unit costs were ranked from lowest to highest.
6. Yield was ranked from largest to smallest.

The highest ranked WMS or portfolio of strategies with sufficient yield to meet the needs after conservation were recommended for each WUG and any additional viable WMS were listed as alternative recommended strategies. Only WMS with insufficient information or major feasibility concerns were evaluated but not recommended.

The Water Management Strategy Committee of the Region M Water Planning Group evaluated special cases, including brush control as a WMS, and Irrigation Conservation as a WMS. This Committee made recommendations to the Planning Group for the action taken in each special case.

5.2 WMS Evaluation Assumptions and Methodology

5.2.1 Water Infrastructure and Distribution Systems

Irrigation District Improvements

Irrigation Districts (IDs) carry over 85% of the water that is used from the Rio Grande system in Region M. These districts deliver water for agricultural, municipal, and industrial users. Most ID have similar components: initial pump stations to divert water from the river, some storage in either off-channel reservoirs or in the main canals, and canal and/or pipeline networks that deliver water to farmland and municipal utilities for treatment and distribution. Most systems measure the water supplied to farmers using a flow rate estimate from delivery pipe rather than metering, which makes accurate volumetric pricing difficult.

The ID systems require significant regular maintenance just to mitigate losses, and can benefit from more proactive improvements like gate and meter automation. Districts currently experience losses in the range of 25-40% of the water that they divert, estimated at over 300,000 acre-feet per year. While some districts have been able to maintain their networks and introduce more advanced systems, others are further behind, and all would benefit from improvements. ID Improvements include conservation measures, which directly reduce measurable losses, and operational improvements like automated gates and increased off-channel storage.

As per TWDB rules, ID Conservation is recommended here based on savings predicted in a drought year. Operational improvements continue to be critical for districts, and an increased effort to quantify water savings from these measures is recommended by the RWPG. New reservoirs and reservoir improvements or expansions, including dredging, are included as WMS improvements that are not classified as ‘conservation.’ Where drought year water losses from insufficient or malfunctioning storage are measurably reduced, these projects have been included with an associated firm yield. ID improvements represent some of the best WMS for Region M by both decreasing losses and improving service to customers.

Black and Veatch worked with Texas A&M AgriLife Research (AgriLife) to develop Irrigation District Conservation WMS for all Districts. Sixty-four projects were submitted by 15 IDs, representing a fairly consistent approach to improving operations and reducing losses. The ID Conservation projects that were submitted were used to form the basis of a generic ID Conservation WMS for those ID that did not submit any project information. ID Conservation strategies include:

1. Canal lining (new linings and replacement of damaged linings),
2. Installation or replacement of pipeline,
3. General repairs and improvements including new metering installation,

4. Metering and controls including installation of automated system controls, meters and SCADA systems where implementation leads to measurable efficiency gains, and
5. Interconnects between IDs where IDs are capable of serving new WUG or measurable efficiency gains are achieved.

All of the submitted projects were assumed to apply to the first decade of planning, 2020, unless noted otherwise. The annual estimated potential water savings in 2020 for all of the WMS submitted was approximately 80,000 acre-ft. The number of WMS submitted by each ID is shown in Table 5-1.

Table 5-1 Number and Type of Projects Submitted by Irrigation Districts

ID	Canal Lining	Pipeline	Inter-connects	Operations and Controls	Reservoirs and Storage	Number of WMS
Adams Garden				1		1
Cameron County ID No. 2	7	11				18
Delta Lake ID	4	1				5
Donna ID		1				1
Engleman ID		1				1
Harlingen ID		4				4
Hidalgo & Cameron County ID No. 9	1			1	2	4
Hidalgo County Drainage District No. 1		3			1	4
Hidalgo County ID No. 1		4	1			5
Hidalgo County ID No. 16	1			1		2
Hidalgo County ID No. 2	1	1		2		4
Hidalgo County ID No. 5				2		2
Hidalgo County Water Improvement District No. 3	1			2		3
La Feria ID	3					3
Santa Cruz ID No. 15	1	2		1	1	5
United ID	1					1

Stakeholder meetings were held with representatives from the IDs and agricultural producers to discuss strategies, estimated costs, water savings and implementation feasibility.

Submitted ID Conservation projects were evaluated for consistency and accuracy, and used as the basis for the generalized project components of the ID Conservation WMS. For those districts that did not submit any projects, generalized components were selected for each ID based on information about each district's existing infrastructure from Texas A&M AgriLife Extension Irrigation Technology Program and Drought Contingency Plans.

The amount of water that can be conserved per ID was calculated based on estimates of current conveyance efficiency, and a maximum efficiency of 90%.[1] The amount of water currently lost was calculated by multiplying each ID projected 2020 diversion volume by its current efficiency.

[1] For comparison, the public water supply systems in Region M average approximately 86% efficiency, with about 14% losses due to leaks and breakage in their systems.

The Maximum Water Conserved was obtained by subtracting the Minimum Losses (at 90% efficiency) from the current water lost. Of the total potential savings of 211,056 acre-ft., the ID Conservation WMS are projected to conserve 85,973 acre-ft. in 2020. The ID that submitted WMS accounted for 71,001 acre-ft. of potential water saved and strategies developed for non-responding ID account for 22,494 acre-feet of savings.

Table 5-2 Estimated Cost per Acre-Foot of Water Conserved by WMS

	Canal Lining	Pipeline Installation	General Repairs & Improvements
O&M Cost/ acre-ft.	-$7.20	-$18.91	-$5.21
Total Cost/ acre-ft.	$457	$274	$508

For all Irrigation District Conservation WMS, cost metrics were developed based on capital costs and O&M. Many strategies result in a negative O&M cost, relative to the cost of current O&M. Recommended reservoir project cost estimates were developed using the UCM. The loan period used for a reservoir was 40 years and 20 years was used for all other types of strategies. The annual interest rate for project financing was assumed to be 5.5 percent, per TWDB guidance. Electronic Appendix EA-6.ii includes the workbooks used to make these calculations.

Although costs are based on specific components submitted or some combination of lining, pipeline, and general maintenance, it is intended that ID should implement any water conservation strategies appropriate to their system. Components of ID Improvements and Conservation are discussed in more detail below.

METERING AND CONTROLS

Most Irrigation Districts in Region M meter the water from the Rio Grande as it is pumped out of the river according to TCEQ Watermaster rules, but do not meter water provided to irrigators or “domestic” water usage for lawn watering and livestock. Instead, there are Canal Riders, employees of the District, who drive along the canals to verify that only users who requested water are withdrawing from the canals and estimate the amount of water delivered. In many cases the Canal Riders are also responsible for manually opening and closing headgates, and turning pumps on and off.

In most districts agricultural water deliveries are measured in ‘irrigations,’ which are considered to be between 4-8 inches of water over each irrigated acre depending on the district, and are monitored by canal riders based on the estimated flowrate and time that a headgate is open and/or measured water depths at some point in the field. There are significant losses associated with manual operations of District conveyance systems and the inaccuracies associated with visual observations of how much water is diverted.

Farmers have little incentive to conserve water per irrigation when they are charged a flat rate for each irrigation. More accurate flow or volume measurements would allow Districts to charge irrigators more accurately by volume, and would create an incentive for farmers to reduce their use. More accurate flow data would allow both the farmer and the District to improve their water management practices.

One analysis of water conservation implications of meters was conducted as part of the Rio Grande Initiative in cooperation with the Harlingen Irrigation District.[2] This project consisted of installing meters at farm irrigation delivery site locations serving 50% of the irrigated acreage in the District. The information generated by the meters provided flow data used for volumetric pricing and to improve the management of water delivery to end users. Installation and applications of meters at farm gate suggested annual water savings of 27% of the average annual water delivered to the affected area at a cost per acre-ft. of $25.87. Implementation of volumetric pricing enabled the District not only to manage the system and charge end users more accurately, but also creates an incentive for farmers to reduce their water use.

Another component of this analysis focused on the installation and use of meters and Telemetry equipment in the District canals. The information generated by the meters and telemetry system provided flow data required to balance the distribution of water within the delivery canals. The resulting improved management sought to minimize the over-delivery of water, which has been estimated as high as 40%. Reducing the amount of water pumped also reduces the energy required and associated costs. This strategy was projected to save 3% of water diverted annually with associated cost of $93.10 per acre-ft. Table 5-3 presents the water conservation and economic implications of meter installation.

Table 5-3 Water Conservation and Economic Implications of Installation of Meters

Meter Location	Characteristics
Farm Gate	
Water Saved	27%
Cost per acre-ft.	$25.87
Canal	
Water Saved	3%
Cost per acre-ft.	$93.10

CANAL LINING AND INSTALLATION OR REPLACEMENT OF PIPELINE

Most District conveyance systems are predominantly earthen or lined canals, which can vary significantly in their efficiency depending on how well they are maintained and the type of soil or lining. Buried pipelines may also vary in efficiency depending on their condition. Many of the WMS that were submitted cited recent studies by Dr. Guy Fipps and Dr. Rister at AgriLife, which attempted to measure seepage losses in a number of the ID in the Lower Rio Grande Valley. As a part of our evaluation, the submitted WMS were compared to AgriLife research where available, and checked for accuracy.

In order to determine a unit amount of water conserved per mile for canal lining and pipeline replacement strategies, results from seepage tests performed in the region were used. Seepage

---

[2] TWRI Report TR-202, October 2002. *Efficient Irrigation for Water Conservation in the Rio Grande Basin*, (also known as the Rio Grande Basin Initiative, or RGBI), 2001. The initiative is administered through the U.S. Department of Agriculture's National Institute of Food and Agriculture under Agreement No. 2010-34461-20677 and Agreement No. 2010-45049-20713, and the Texas Water Resources Institute, which is part of the Texas A&M AgriLife Extension Service, Texas A&M AgriLife Research, and the College of Agriculture and Life Sciences at Texas A&M University.

rates were obtained from Texas Water Resources Institute Technical Reports that described seepage tests performed on canals for each of the ID that submitted a canal lining or pipeline replacement strategy. Seepage results for both concrete lined canals and earthen canals were averaged and used as the annual water conserved per mile for ID that did not have any applicable seepage tests performed. It was assumed that the amount of water loss due to evaporation is negligible; therefore the same values for water conserved per mile were used for both canal lining and pipeline replacement strategies.

Texas Water Resources Institute Technical Report (220 R)[3], ID managers, and data from Cameron County ID No. 2 provided the basis for a standard unit O&M costs per mile of canal lining or pipeline. Lining canals and installing pipeline reduces the expected annual O&M, based on an anticipated reduction in costs associated with maintaining leaky canals or earthen canals. The reduction in O&M for canal lining is an estimated $325 per mile and for a pipeline it is $3,976. In several cases, the ID provided a reduction in energy for pumping and this was applied as a reduction in O&M using the rate of 7.6 cents per kWh based on information provided by the ID.

GENERAL REPAIRS AND IMPROVEMENTS

All repairs that result in increased supplies available to end users, reduced losses, or improved operations are recommended for all Irrigation Districts.

NEW RESERVOIR OR RESERVOIR IMPROVEMENTS

Storage capacity is critical to efficient operations of Irrigation Districts. Between the time that an end user requests water from the Amistad-Falcon Reservoir System and when it becomes available to divert can be up to seven days. If there is any significant precipitation between the time water is requested and when it is available to be diverted, the District may not have sufficient storage capacity to pump the requested water for delivery, but the end user's account is still charged 90% of the requested amount. Also, when there is a significant rainfall in the watershed and the Watermaster designates a period of no-charge pumping, a District's ability to divert water for later use is limited by storage. Environmental flow requirements were considered for all potentially feasible reservoirs.

Increased storage is recommended for some districts that have documented their water losses as a result of insufficient storage. These loss rates were applied to drought year conditions to estimate increased supply. Costs for reservoirs were estimated using the UCM.

EDUCATION AND EVALUATION

The process of evaluating existing infrastructure for efficiency is ongoing in the Irrigation Districts. There is not an agreed-upon methodology for estimating losses, and there is a need for

---

[3] *Economic and Conservation Evaluation of Capital Renovation Projects: Hidalgo County Irrigation District No. 2 (San Juan) - 48" Pipeline Replacing Wisconsin Canal Preliminary.* M. Edward Rister, Ronald D. Lacewell, Allen W. Sturdivant, John R. C. Robinson, Michael C. Popp, Texas Water Resource Institute, May 2003.

a more consistent approach across districts for comparison purposes. There is a significant opportunity for increased education of the management and leadership of each District.

Some gains could be made by reviewing the existing policies, procedures, and rules that pertain to irrigation district. There are various institutional barriers to improving and maintaining these systems in such a ways as to best meet the needs of water users in the region. A comprehensive review of existing policies, rules, funding mechanisms, and programs that can or do address Irrigation Districts may show the best way to eliminate or minimize these barriers.

Although water savings as a result of education and evaluation programs has not been quantified, and is therefore not included as a Recommended WMS, the Region M Planning Group recognizes the importance of education for all parties operating and depending on irrigation districts, and continued efforts to evaluate the existing infrastructure. Education and evaluation are further discussed in Chapter 8.

Municipal Infrastructure Improvements

Operational, treatment, and distribution projects that allow a WUG to either access a new supply, eliminate known losses, or develop new supplies are included as Municipal Infrastructure Improvements. Municipal Infrastructure Improvements focus on problem-specific water management strategies that relate to treatment, storage, or distribution and transmission. Insufficient treatment capacity or capability can be a supply limitation, inadequate storage can disrupt operations, and transmission and distribution projects may be required for entities that are experiencing significant water losses due to eroded pipelines, or leaking water tanks. Because these projects are particular to the municipal utility systems, these projects were evaluated individually based on the available information.

The following Municipal Infrastructure Improvement projects were submitted to the RWPG.

DISTRIBUTION AND TRANSMISSION

1. East Rio Hondo WSC – Bean Road Transmission Line
2. East Rio Hondo WSC – FM 2925 Transmission Line
3. East Rio Hondo WSC – Harlingen Waterworks Interconnect
4. El Jardin WSC – Upgrade Existing Distribution System
5. McAllen - Raw Water Line Project
6. North Alamo WSC – 1 MG Water Tower, Edinburg/Pharr
7. North Alamo WSC - 1 MG Water Tower, Mid Valley
8. North Alamo WSC - Plant No. 5, 16 inch Waterline Expansion
9. Rio Hondo – Emergency Interconnect
10. Union WSC - Water Line Replacement and Meter Reading System
11. Weslaco - Emergency Transfers of Surface Water or Interconnects Between Systems

STORAGE

1. Brownsville PUB – Banco Morales Reservoir
2. Brownsville PUB – Brownsville-Matamoros Weir and Reservoir
3. Brownsville PUB – Resaca Restoration

4. Donna - New Raw Water Reservoir and Raw Water Pump Station
5. Hidalgo County Drainage District No. 1 - Delta Watershed and Reclamation Project
6. San Juan - Raw Water Reservoir Improvements
7. Sharyland WSC - Reservoir at WTP #1 for Additional Storage Capacity

SURFACE WATER TREATMENT

1. Donna WTP Expansion & Urbanized Water Rights
2. East Rio Hondo WSC – Municipal UV Disinfection for FM 510 WTP
3. East Rio Hondo WSC - Surface Water and WTP & Water Rights through Urbanization (Phase I)
4. East Rio Hondo WSC - Surface Water and WTP & Water Rights through Urbanization (Phase II)
5. Elsa – WTP Expansion and Interconnect to Engleman ID
6. Laredo – Expansion of El Pico WTP
7. North Alamo WSC - Expansion of Delta WTP - 4MGD
8. North Alamo WSC - Expansion of Water Treatment Plant No. 5
9. Roma - Regional Water Treatment plant
10. San Juan - WTP No. 1 Upgrade and Expansion & Urbanized Water Rights

Environmental Impacts

Potential environment impacts for water infrastructure and distribution systems strategies have been identified and categorized as described below. The letters identifying each section correspond to the headings in Table 5-4, Environmental Impacts of Irrigation District Improvement Strategies, and Table 5-5, Environmental Impacts of Municipal Infrastructure Strategies.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known.
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity.
- Irrigation District Conservation impacted acreage assumes that all improvements are done within existing conveyance systems, so no acreage is impacted permanently.
- Reservoir projects for IDs are shown to permanently impact an area equivalent to 110% of the inundation area.

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Inundation Acreage

The Inundation Acreage applies to reservoirs only and it equal to the amount of land that will be inundated by the construction of the reservoir.

D. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a '1' if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect any wetlands.

E. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. Acreage that is impacted by a strategy was considered to be a reasonable estimate of potentially impacted habitat.

F. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy listed in the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

G. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative irrigation district improvements projects is presented in Table 5-4.

Table 5-4 Environmental Impacts of Irrigation District Improvement Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Adam Gardens ID	ID Conservation	500	0	4	0	1	0	17	0
Bayview ID No. 11	ID Conservation	1,810	0	105	0	1	0	17	0
Brownsville ID	ID Conservation	2,616	0	156	0	1	0	17	0
Cameron County ID No. 16	ID Conservation	270	0	17	0	1	0	17	0
Cameron County ID No. 2	ID Conservation	4,754	0	765	0	1	0	17	0
Cameron County ID No. 6	ID Conservation	7,402	0	298	0	1	0	17	0

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Cameron County Water Improvement District No. 10	ID Conservation	395	0	24	0	1	0	17	0
Delta Lake ID	ID Conservation	6,166	0	635	0	1	0	14	0
Donna ID	ID Conservation	532	0	77	0	1	0	9	0
Engleman ID	ID Conservation	831	0	55	0	1	0	9	0
Harlingen ID	ID Conservation	1,137	0	40	0	1	0	17	0
Hidalgo County Drainage District 1	Edinburg Lake	3,739	471	518	428	1	428	9	0
Hidalgo County Drainage District 1	New Reservoir	2,278	426	468	387	0	387	9	0
Hidalgo and Cameron Counties ID No. 9	ID Conservation	2,948	0	655	0	1	0	17	0
Hidalgo County ID No. 1	ID Conservation	13,111	0	666	0	1	0	9	0
Hidalgo County ID No. 13	ID Conservation	194	0	8	0	1	0	9	0
Hidalgo County ID No. 16	ID Conservation	485	0	43	0	1	0	9	0
Hidalgo County ID No. 2	ID Conservation	4,077	0	178	0	1	0	9	0
Hidalgo County ID No. 5	ID Conservation	1,215	0	63	0	1	0	9	0
Hidalgo County ID No. 6	ID Conservation	3,237	0	168	0	1	0	9	0
Hidalgo County Water Control and Improvement District No. 18	ID Conservation	119	0	7	0	1	0	9	0
Hidalgo County Water Improvement District No. 3	ID Conservation	2,284	0	110	0	1	0	9	0
Hidalgo Municipal Utility District No. 1	ID Conservation	180	0	10	0	1	0	9	0
La Feria ID No. 3	ID Conservation	2,064	0	622	0	1	0	17	0
Maverick County Water Control and Improvements District	ID Conservation	10,780	0	520	0	1	0	5	0
Santa Cruz ID No. 15	ID Conservation	2,899	0	56	0	1	0	9	0
Sharyland/ Hidalgo County Improvement District No. 19	ID Conservation	554	0	32	0	1	0	9	0
United ID	ID Conservation	7,093	0	145	0	1	0	9	0
United ID	Off-Channel Reservoir	2,000	50	55	45	1	50	9	0
Valley Acres ID	ID Conservation	510	0	30	0	1	0	17	0

*First decade of implementation yield (acre-ft./year)

A summary of the identified and quantified environmental impacts for recommended and alternative municipal infrastructure is presented in Table 5-5.

Table 5-5 Environmental Impacts of Municipal Infrastructure Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
East Rio Hondo WSC	Harlingen WW Interconnect	112	56	62	0	0	56	17	0
McAllen	Raw Water Line Project	800	15	17	0	0	15	9	0
Rio Hondo	Emergency Interconnects	70	30	33	0	0	30	17	0
Brownsville PUB	Banco Morales Reservoir	3,835	60	75	60	0	60	17	0
Brownsville PUB	Resaca Restoration	877	40	50	40	0	40	17	0
Brownsville PUB	Brownsville/Matamoros Weir and Reservoir	19,176	300	375	300	0	300	17	0
RGRWA	Regional Facility Project - Groundwater, Surface Water, and Reuse	20,000	216	324	216	0	216	17	0
Donna	WTP Expansion & Urbanized Water Rights	950	25	28	0	0	25	9	0
East Rio Hondo	Surface Water Treatment Plant (Phase	11,200	67	74	0	0	67	17	0

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
WSC	I)								
Elsa	WTP Expansion and Interconnect to Engleman ID	2,240	35	39	0	0	35	9	0
Laredo	Expansion of El Pico WTP (Phases 1-4)	28,000	13	14	0	0	13	5	0
North Alamo WSC	NAWSC Converted WR and Water Treatment Plant No. 5 Expansion	1,120	5	6	0	0	5	9	0
North Alamo WSC	NAWSC Converted WR and Delta WTP Expansion	4,480	5	6	0	0	5	9	0
Roma	Water Right Purchase and Regional Water Treatment Plant	1,500	5	6	0	1	5	8	0

*First decade of implementation yield (acre-ft./year)

5.2.2 Wastewater Reuse

Wastewater reuse is defined as the types of projects that utilize treated wastewater effluent as a replacement for water supply, reducing the overall demand for fresh water supply. Wastewater reuse can be classified into two major types, defined by how the reuse water is handled. Direct Reuse involves introducing treated wastewater directly from a wastewater plant to the place of use. For example, piping treated wastewater from a wastewater treatment plant to a golf course for use would be considered direct reuse. Indirect Reuse involves discharging treated wastewater to a river, stream, or lake for subsequent diversion downstream. Virtually any water supply entity with a wastewater treatment plant could pursue a reuse alternative, provided that downstream water rights do not have a claim for the entire return flow. Both direct and indirect wastewater reuse can be applied to potable and non-potable uses.

Non-Potable Reuse

Wastewater reuse 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.

This WMS is feasible if several factors are taken into consideration: 1) the location of wastewater treatment facilities relative to the location 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 (i.e., 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.

Wastewater reuse quality and system design requirements are regulated by TCEQ by 30 TAC §210. TCEQ allows two types of non-potable reuse as defined by the use of the water and the required water quality:

1. Type I – Use of reclaimed water where contact between humans or food crops and the reclaimed water is likely; and
2. Type II – Use of reclaimed water where contact between humans or food crops and the reclaimed water is unlikely.

Current TCEQ criteria for non-potable reuse water are shown in Table 5-6.

Table 5-6 Quality Standards for Reclaimed Water on a 30-Day Average

Parameter	Allowable Level
Type I Reuse	
BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal coliform	20 CFU/100 mL* 75 CFU/100 mL**
Enterococci	4 CFU/100 mL* 9 CFU/100 mL**
Type II Reuse – For a system other than a pond	
BOD_5	20 mg/L
Or $CBOD_5$	15 mg/L
Fecal Coliform	200 CFU/100 mL* 800 CFU/100 mL**
Enterococci	35 CFU/100 mL* 89 CFU/100 mL**
Type II Reuse – For a pond	
BOD_5	30 mg/L
Fecal coliform	200 CFU/100 mL* 800 CFU/100 mL**
Enterococci	35 CFU/100 mL* 89 CFU/100 mL**

* 30-day geometric mean

** maximum single grab sample

Non-potable Reuse was evaluated for those entities that identified it as a desired WMS. In each case, the end user's demands were evaluated to verify that the supply was only considered where a demand would have otherwise been filled by municipal water, either raw or treated. In the cases where a non-potable reuse WMS was evaluated but there was no specific end user associated with the strategy, that WMS was categorized as having an possible implementation risk in the ranking matrix during the evaluation process because of the possibility that customers could not be identified. For these WMS the yield was estimated as 5% of the WUG's 2020 demand.

The following seven potential wastewater non-potable reuse projects were submitted and evaluated as specific water management strategies:

1. Agua SUD – Non-Potable Reuse
2. Brownsville Public Utilities Board – Non-Potable Water Reuse Pipeline
3. City of Edinburg – Reuse Water for Cooling Tower and Landscaping Usage

4. City of La Feria – Non-Potable Wastewater Effluent Reuse
5. City of Mission – Use of Treated Sewer Effluent to Irrigate City Parks
6. City of San Benito – Reuse of Treated Effluent from City's WWTP
7. City of Weslaco – Scalping Plants

Potable Reuse

Potable reuse of reclaimed water refers to the intentional reuse of highly treated wastewater effluent as a supplemental source of water supply for potable use. Indirect potable reuse is practiced in Texas where surface water supplies are deliberately augmented with wastewater effluent. The general steps in indirect potable reuse are as follows:

1. Wastewater is treated at a conventional Wastewater Treatment Plant.
2. The water is again treated through Microfiltration (MF), Ultrafiltration (UF) and/or Reverse Osmosis (RO).
3. The treated water is returned to the natural environment and mixes with other waters for an extended period of time.
4. The blended water is sent to a Water Treatment Plant for conventional water treatment.
5. The water is stored and pumped to distribution.

The TCEQ is currently in the process of establishing the requirements for both indirect and direct potable reuse. In 2012, TWDB funded a study to assess the potential for direct potable reuse in Texas and develop a resource document that provides scientific and technical information for the implementation of direct potable reuse.[4] The final version of the report was released in April 2015. There are two direct potable reuse projects to date in Texas. The City of Wichita Falls and the City of Big Spring have both implemented direct potable reuse projects. Both of the cities were issued permits from the TCEQ following extensive testing of the drinking water. The general steps in direct potable reuse are as follows:

1. Wastewater is treated at a conventional Wastewater Treatment Plant.
2. The water is again treated through Microfiltration (MF) or Ultrafiltration (UF).
3. The water is treated again through Reverse Osmosis (RO).
4. The MFRO or UFRO treated reuse water is blended with surface water.
5. The blended water is sent to a Water Treatment Plant for conventional water treatment.
6. The water is stored and pumped to distribution.

Until official requirements are set by the TCEQ, indirect and direct potable reuse projects are being approved on a case-by-case basis pending testing and confirmation of the drinking water quality.

All of the potable reuse strategies recommended in this Regional Water Plan are considered direct reuse, because none of them have sufficient evidence that the reuse water would be retained in a natural environmental buffer for what would be considered an extended amount of

---

[4] http://www.twdb.texas.gov/innovativewater/reuse/projects/directpotable/index.asp

time. By TWDB definition, indirect reuse refers to water that is returned to a natural water body such that an additional permit is required to access that water after buffering.

This WMS is feasible if several factors are taken into consideration: 1) the location of wastewater treatment facilities relative to the location of potential surface waters and water treatment facilities, 2) the level of treatment and quality of the reclaimed water, 3) the water quality requirements for potable water, and 4) the public acceptance of reuse.

The following four potential wastewater potable reuse projects were submitted and evaluated as specific water management strategies:

1. Agua Special Utilities District – Potable Reuse
2. City of Pharr – Raw Water Reservoir Augmentation
3. City of San Benito – Reuse of Treated Effluent from City's WWTP
4. Laguna Madre Water District – Port Isabel Water Reclamation Facility Potable Reuse

In addition to the submitted potable reuse water management strategies, an evaluation of wastewater treatment plants in the Region was performed in order to determine other entities that could benefit from potable reuse. Wastewater treatment plants with an average effluent flow greater than 2.0 MGD that were not included in submitted reuse WMS were considered suitable to potentially provide a cost effective yield of reuse water. It was assumed that half of the average effluent flow could be produced as reuse yield on a consistent basis. The wastewater treatment plants that had at least 1.0 MGD of water available after the amount of reclaimed water currently being used and are within reasonable distances to water treatment plants have been further evaluated for potable reuse strategies. The wastewater treatment plants that were recommended for potable reuse include:

1. Brownsville PUB – Southside WWTP
2. City of Harlingen – Harlingen WWTP 2
3. City of Laredo – South WWTP
4. City of McAllen – McAllen North WWTP
5. City of McAllen – McAllen South WWTP
6. City of Mercedes – Mercedes WWTP
7. City of Mission – Mission WWTP
8. City of Weslaco – City of Weslaco North WWTP

Environmental Impacts

Potential environment impacts for recommended and alternative reuse strategies have been identified and categorized as described below. The letters identifying each section correspond to the headings in Table 5-7.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known

- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect any wetlands.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. Acreage that is impacted by a strategy was considered to be a reasonable estimate of potentially impacted habitat.

E. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy listed in the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

F. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

G. Reduction in WWTP Effluent (Acre-Ft./Year)

Environmental impacts may be seen due to lower WWTP effluent flows to the discharge streams for wastewater effluent reuse strategies. These impacts could include:

- Decreases to the stream flow/level
- Change in the water quality by reducing the organic levels
- Effects to fish and wildlife that inhabit the streams

A summary of the identified and quantified environmental impacts for reuse projects is presented in Table 5-7.

Table 5-7 Environmental Impacts of Reuse Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Brownsville	Non-Potable Water Reuse Pipeline	6,721	116	128	0	116	17	0	6,721
Brownsville	Brownsville Southside WWTP Potable Reuse	4,000	41	45	0	41	17	0	4,000
Harlingen	Harlingen Wastewater Treatment Plant 2 Potable Reuse	1,825	57	63	0	57	17	0	1,825
Harlingen	Non-potable Reuse Project	677	42	46	0	42	17	0	677
La Feria	Non-Potable Wastewater Reuse	174	13	14	0	13	17	0	174
Laguna Madre	Port Isabel Water Reclamation Facility Potable Reuse	820	87	96	1	87	17	0	820
Laguna Madre	Non-potable Reuse	350	14	15	0	14	17	0	350
San Benito	Potable Reuse	1,120	44	48	0	44	17	0	1,120
San Benito	Non-Potable Reuse	1,120	32	35	0	32	17	0	1,120
Agua SUD	East WWTP Direct Potable Reuse - Phase 1	1,050	44	48	0	44	9	0	1,050
Agua SUD	West WWTP Direct Potable Reuse - Phase 1	784	143	157	0	143	9	0	784
Agua SUD	East WWTP Direct Potable Reuse - Phase 2	1,260	0	5	0	0	9	0	1,260
Agua SUD	West WWTP Direct Potable Reuse - Phase 2	1,680	0	15	0	0	9	0	1,680
Agua SUD	Non-Potable Reuse	280	0	2	0	0	9	0	280
Edinburg	Reuse Water for Cooling Tower and Landscaping Usage	3,920	43	47	0	43	9	0	3,920
McAllen	South WWTP Potable Reuse	2,000	46	51	0	46	9	0	2,000
McAllen	North WWTP Potable Reuse	1,120	50	55	0	50	9	0	1,120
McAllen	Non-potable Reuse Project	1,950	49	54	0	49	9	0	1,950
Mercedes	Potable Reuse	1,670	32	35	0	32	9	0	1,670
Mission	WWTP Potable Reuse Phase 1	3,920	22	24	0	22	9	0	3,920
Mission	WWTP Potable Reuse Phase 2	7,840	0	2	0	0	9	0	7,840
Pharr	Potable Reuse	6,721	38	42	0	38	9	0	6,721
Pharr	Non-potable Reuse Project	500	34	37	0	34	9	0	500
Weslaco	North WWTP Potable Reuse	1,120	26	29	0	26	9	0	1,120
Weslaco	Scalping Plants	0	1	1	0	1	9	0	0
Laredo	South Laredo WWTP Potable Reuse	5,725	54	59	1	54	5	0	5,725
Laredo	Non-potable Reuse Project	2,100	21	23	1	21	5	0	2,100

*First decade of implementation yield (acre-ft./year)

5.2.3 Desalination

There are several types of desalination methods to treat brackish and saline groundwater and seawater. Such methods include thermal processes such as multistage flash distillation, multiple-effect distillation, and vapor compression. These energy intense processes are more common in the Middle East where fuels are more abundant. The most common method of treatment is membrane technology.

Membrane technologies are prevalent today using reverse osmosis (RO). Brackish or saline water is highly pressurized and pushed through semi-permeable membranes, which separate the brackish or saline water into fresh water and a concentrated by-product. For higher total dissolved solids (TDS) found in seawater, RO becomes significantly more energy intensive and has a lower yield of permeate, or fresh water. 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, which generally requires disposal and can add significant costs to a project. This compares to approximately 80% with the lower salinity brackish water facilities. Surface water intakes will require additional pretreatment of suspended solids prior to the RO treatment.

The TWDB recommends that feasibility studies for these projects be completed. Other TWDB recommendations include: consideration of regional-scale projects, 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.

Local Brackish Groundwater Development and Treatment

Texas currently has more than 40 municipal brackish desalination plants, with a combined capacity of about 123 million gallons per day. That includes 73 million gallons per day of BGD and 50 million gallons per day of brackish surface water desalination.[5] The average cost to produce desalinated water from brackish groundwater ranges from approximately $350 to $780 per acre-ft.

The following potential BGD projects were submitted and evaluated as specific water management strategies:

1. City of Alamo – Additional Groundwater
2. East Rio Hondo WSC – New Water Supply Development-Groundwater
3. City of La Feria – Water Well with RO Unit Providing a Backup Drinking Water Supply
4. City of Lyford – Water Facilities to Provide An Alternative Source of Water
5. North Alamo WSC – La Sara Water Well Expansion
6. North Alamo WSC – Delta Area RO Water Treatment Plant

---

[5] TWDB Desalination Plant Database, http://www2.twdb.texas.gov/apps/desal/default.aspx updated in 2011, accessed 4/14/2015. Only public water supply plants with a capacity greater than 0.025 MGD are reported in the database.

7. Town of Primera – RO Water Treatment Plant with Ground Storage and Water Well
8. Rio Grande Regional Water Authority – Strategic Water Management Program: BGD
9. Sharyland WSC – Water Well and RO Unit at WTP #2
10. Sharyland WSC – Water Well and RO Unit at WTP #3
11. Willacy County – BGD Planning

Seawater Desalination

Texas does not yet have a seawater desalination plant. Charged with developing the first seawater desalination plant in Texas, the TWDB has completed three feasibility studies and two pilot-plant studies. To this date two desalination plants have been proposed – one by the Brownsville Public Utilities Board and the other by the Laguna Madre Water District.

Seawater desalination still remains one of the higher cost water management strategies, but costs have declined over the years as technology advances. The average cost to produce desalinated water from seawater ranges from $820 to over $1,300 per acre-ft. 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 following two potential seawater desalination projects were submitted and evaluated as specific water management strategies:

1. Brownsville Public Utilities Board – Seawater Desalination
2. Willacy County – Seawater Desalination Planning

Environmental Impacts

Potential environment impacts for recommended and alternative brackish groundwater and seawater desalination strategies have been identified and categorized as described below. The letters identifying each section correspond to the headings in Table 5-8.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity
- The impact of wells and wellfields are given by the UCM, which includes 0.5 acres per well

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect any wetlands.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. Acreage that is impacted by a strategy was considered to be a reasonable estimate of potentially impacted habitat.

E. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy listed in the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

F. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

G. Volume of Brine (Acre-ft.)

The Volume of Brine quantifies the amount of brine concentrate from the desalination process that is released as surface water discharge. It is assumed that BGD plants are 80% efficient, so 20% of the amount of water pumped from the aquifer is discharged as brine concentrate. An efficiency of 50% was assumed for seawater desalination.

H. TDS of Brine (mg/L)

The Total Dissolved Solids (TDS) of Brine provides the concentrate of the brine discharge. This number was calculated by assuming that the raw brackish groundwater has a TDS of 3,500 mg/L and the TDS of the seawater is 35,000 mg/L. A TDS of 500 mg/L was used for the finished water for both types of desalination.

A summary of the identified and quantified environmental impacts for desalination projects is presented in Table 5-8.

Table 5-8 Environmental Impacts of Desalination Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G	H
Agua SUD	New Brackish Water Treatment Plant	1,344	3	4	0	3	9	0	269	19,375
Alamo	BGD Plant	896	2	3	0	2	9	0	179	19,375
Brownsville	Seawater Desalination Demonstration - Pilot	2,800	8	9	1	8	17	0	1,400	86,500
Brownsville	Seawater Desalination Demonstration - Build-Out	28,000	31	34	1	31	17	0	14,000	86,500
Combes	BGD Plant	125	1	2	0	1	17	0	25	19,375
Donna	BGD Plant	700	1	2	0	1	9	0	140	19,375
Eagle Pass	BGD Plant	560	1	2	0	1	5	0	112	19,375
East Rio Hondo WSC	North Cameron Regional WTP Wellfield Expansion	400	1	2	0	1	17	0	80	19,375
El Jardin WSC	Brackish Desalination Plant	560	1	2	0	1	17	0	112	19,375
Elsa	New Brackish Water Treatment Plant	560	1	2	0	1	9	0	112	19,375
Harlingen	BGD Plant	1,000	1	2	0	1	17	0	200	19,375
Hebbronville	New Brackish Water Treatment Plant	560	1	2	0	1	2	0	112	19,375
La Feria	Water Well with R.O. Unit	1,120	1	2	0	1	17	0	224	19,375
La Villa	New Brackish Water Treatment Plant	560	1	2	0	1	9	0	112	19,375
Laguna Madre	BGD Plant	2,240	3	4	0	3	17	0	448	19,375
Laguna Madre	Seawater Desalination Plant	1,120	8	9	0	8	17	0	560	86,500
Laredo	BGD Plant	5,000	6	7	0	6	5	0	1,000	19,375
Lyford	Brackish Groundwater Well and Desalination	1,120	1	2	0	1	14	0	224	19,375
McAllen	BGD Treatment	2,688	5	6	0	5	9	0	538	19,375
Mercedes	BGD Plant	435	1	2	0	1	9	0	87	19,375
Mission	BGD Plant	2,688	5	6	0	5	9	0	538	19,375
North Alamo WSC	North Cameron Regional WTP Wellfield Expansion	800	1	2	0	1	17	0	160	19,375
North Alamo WSC	Delta Area RO Plant 2 MGD	2,250	3	4	0	3	14	0	450	19,375
North Alamo WSC	La Sara RO Plant, expand well field	1,120	2	3	0	2	14	0	224	19,375
Olmito WSC	Brackish Desalination Plant	560	1	2	0	1	17	0	112	19,375
Primera	RO WTP with Groundwater Well	1,120	4	5	0	4	17	0	224	19,375
RGRWA	Regional Facility Project - Seawater Desal	5,470	41	45	0	41	17	0	2,735	86,500
Rio Grande City	BGD Plant	560	1	2	0	1	8	0	112	19,375
San Juan	WTP No. 1 Upgrade and Expansion to include BGD	1,792	3	4	0	3	9	0	358	19,375
Santa Rosa	Brackish Desalination Plant	560	1	2	0	1	17	0	112	19,375
Sharyland WSC	Water Well and R.O. Unit at WTP #2	900	2	3	0	2	9	0	180	19,375
Sharyland WSC	Water Well and R.O. Unit at WTP #3	900	2	3	0	2	9	0	180	19,375
Union WSC	BGD Plant	560	1	2	0	1	8	0	112	19,375
Valley MUD #2	BGD Plant	100	1	2	0	1	17	0	20	19,375
Weslaco	BGD Plant	1,630	2	3	0	2	9	0	326	19,375

*First decade of implementation yield (acre-ft./year)

5.2.4 Fresh Groundwater

While there is not abundant fresh groundwater available in Region M, there are numerous entities and individuals that rely on minimally treated groundwater to meet their needs. Cities that are farther from the Rio Grande and surface water distribution networks have few alternative sources, and have identified portions of the aquifer(s) that produce acceptable water for municipal use without advanced treatment technology.

In some cases, where there appears to be additional available fresh groundwater, further development of that source is recommended, within the MAG values for the applicable aquifer. In many cases this is the recommendation for County-Other entities, where domestic wells are distributed over a large area and pump small amounts for a single household.

Environmental Impacts

Potential environment impacts for fresh groundwater strategies have been identified and categorized as described below. The letters identifying each section correspond to the headings in Table 5-9.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity
- The impact of wells and wellfields are given by the UCM, which includes 0.5 acres per well

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect any wetlands.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. Acreage that is impacted by a strategy was considered to be a reasonable estimate of potentially impacted habitat.

E. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy listed in the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

F. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative fresh groundwater projects is presented in Table 5-9.

Table 5-9 Environmental Impacts of Fresh Groundwater Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F
Alamo	Groundwater Well	1,100	1	1	0	1	9	0
County-Other	Expand Groundwater Supply	3,000	0	10	0	0	17	0
County-Other	Additional Groundwater Wells	400	3	6	0	3	8	0
County-Other	Additional Groundwater Wells	1,400	11	22	0	11	5	0
Eagle Pass	New Groundwater Supply	700	1	1	0	1	5	0
Edcouch	New Groundwater Supply	500	1	1	0	1	9	0
Hidalgo	Expand Existing Groundwater Wells	300	1	1	0	1	9	0
Hidalgo Steam Elec - NRG	Additional Groundwater Wells	100	2	4	0	2	9	0
Irrigation	Additional Groundwater Wells	300	3	6	0	3	2	0
Maverick Manufacturing - RG	New Groundwater Supply	100	2	4	0	2	5	0
McAllen	Expand Existing Groundwater Wells	500	1	1	0	1	9	0
Mercedes	Expand Existing Groundwater Wells	560	1	1	0	1	9	0
Military Highway WSC	Expand Groundwater Supply (Cameron Co.)	625	1	1	0	1	17	0
Military Highway WSC	Expand Groundwater Supply (Hidalgo Co.)	250	1	1	0	1	9	0
San Benito	Groundwater Supply	1,120	1	1	0	1	17	0
Webb County Water Utility	Expand Existing Groundwater Supply	100	1	1	0	1	5	0
Weslaco	Groundwater Blending	560	1	1	0	1	9	0
Zapata County Waterworks	New Groundwater Supply	1,680	2	2	0	2	7	0

*First decade of implementation yield (acre-ft./year)

5.2.5 Advanced Municipal Water Conservation

Water conservation is defined as those methods and practices that reduce demand for water supply, increase the efficiency of supply, or use facilities so that available supply is conserved and made available for future use. Water conservation is typically a non-capital intensive alternative that any water supply entity can and should pursue. All public water suppliers are required by the Texas Administrative Code Rule §288.2 to submit a Drought Contingency and Water Conservation Plan to the TCEQ for approval. These plans must include a utility profile including population and water use data (total gallons per capita per day (GPCD) and residential), specific water savings goals and conservation strategies to meet those goals.

In 2001, the Texas Legislature amended the Texas Water Code to require Regional Water Planning Groups to consider water conservation and drought management strategies for every entity with a projected water shortage (need). The Water Conservation Implementation Task Force was created by Senate Bill 1094 to identify Water Conservation Best Management Practices (BMPs) and develop a BMP Guide for use by Regional Water Planning Groups and utilities. Best Management Practices contained in the BMP Guide are voluntary efficiency measures that save a quantifiable amount of water, either directly or indirectly, and can be implemented within a specific timeframe.[6]

The current TWDB municipal water demand projections account for expected water savings due to implementation of the 1991 State Water Efficient Plumping Act. Any additional projected water savings from conservation programs must be listed as a separate water management strategy. The savings projected by the TWDB include complete replacement of existing plumbing fixtures to water-efficient fixtures by the year 2045. The projections also assume that all new construction includes water-efficient plumbing fixtures. It is important when including a retrofit program as a water management strategy to not double-count water savings, as savings due to retrofits are already included in the base water demand projections.

Municipal utilities implementing advanced conservation measures may face reduced revenue as a result of decreasing demand for water from municipal customers. This can be a barrier to implementation of significant conservation measures. However, it is recommended that the costs associated with increasing capacity should be considered in the conservation cost evaluation, such that reduced demands may reduce what expansion is required.

A variety of conservation measures are recommended as described in the TWDB Best Management Practices, any combination of which can be used to meet the specific goals for a municipality or utility.[7] Conservation can be achieved using a variety of strategies, including the following:

1. System Operations
    a. Metering of All New Connections and Retrofit of Existing Connections
    b. System Water Audit and Water Loss Control

---

[6] *The Complete Guide: Best Management Practices for Municipal Water Users*. Water Conservation Best Management Practices, TWDB November, 2013.
[7] Water Conservation Implementation Task Force, “Water Conservation Best Management Practices Guide,” November 2004.

2. Landscaping
    a. Athletic Field Conservation
    b. Golf Course Conservation
    c. Landscape Irrigation Conservation and Incentives
    d. Park Conservation
    e. Residential Landscape Irrigation Evaluations
3. Education and Public Awareness
    a. Public Information
    b. School Education
    c. Small Utility Outreach and Education
    d. Partnerships with Nonprofit Organizations
4. Rebate, Retrofit, and Incentive Programs
    a. Conservation Programs for Industrial, Commercial, and Institutional Accounts
    b. Residential Clothes Washer Incentive Program
    c. Showerhead, Aerator, and Toilet Flapper Retrofit Program
    d. Water Wise Landscape Design and Conversion Programs
5. Conservation Technology
    a. New Construction Graywater
    b. Rainwater Harvesting and Condensate Reuse
    c. Water Reuse
6. Regulatory Enforcement
    a. Prohibition on Wasting Water
    b. Conservation Ordinance Planning and Development

The following specific water management strategies were submitted to the RWPG that fall within Advanced Municipal Conservation, and are discussed in more detail in section 0.0.0 :

1. Hidalgo County Water Improvement District No. 3 – Renewal of Lawn Irrigation Systems,
2. City of La Feria – Rainwater Harvesting, and
3. Rio Grande City – Water Meter Replacement.

In addition to the specific WMS submitted, Advanced Municipal Conservation is recommended for every municipal WUG in Region M. For every municipal WUG with a projected need or a per capita water use rate greater than 140 gallons per capita per day (GPCD), municipal conservation yield and costs were estimated.

For entities that have projected needs, the usage reduction rate was based on the current GPCD. Entities with needs and a GPPCD greater than 140 GPCD were assigned a 1% usage reduction per year. After the 140 GPCD goal was achieved, or for entities with a need and a GPCD below 140, the annual reduction was set to 0.5%. A minimum value of 60 GPCD was fixed based on the "Projection Methodology – Draft Population and Municipal Water Demands" memo from the

TWDB referencing the *Analysis of Water Use in New Single-Family Homes*[8] study and internal report, *The Grass Is Always Greener…Outdoor Residential Water Use In Texas*[9]. Once the minimum value was reached, entities were projected to stop reducing their GPCD. For municipal entities that have needs starting later than 2020 and base year GPCD below 140, the Advanced Water Conservation strategy is projected to begin in the first decade with needs.

Entities that are not projected to have a need, but have per capita usage above 140 GPCD in 2011 are recommended to implement Advanced Conservation at a rate of 1% reduction per year beginning in 2020. Once these entities reach a GPCD of 140, it was assumed that Advanced Conservations would continue to yield a steady volume without an additional cost, but that additional reductions in use are not anticipated.

It is recommended that entities without needs that have a 2011 per capita water use rate under 140 GPCD implement Advanced Water Conservation, but they were not recommended a specific advanced conservation water management strategy, as goals were not assigned to them and no yield or costs were determined.

The calculations use the GPCD estimated for each municipality, based on projected population and water demands, which can be found in Section 2.2 Municipal Demands. For every decade, the Base GPCD was calculated from the projected water demands before reductions due to Advanced Water Conservation strategies are implemented. A Base Per Capita Goal was determined by reducing the Per Capita Water Use in the decade of implementation annually by the reduction rates discussed above. The yield of Advanced Water Conservation, or the amount of water conserved in each decade, is the difference between the Per Capita Water Use and the Base Per Capita Goal, converted to acre-ft./year.

The initial GPCD projections do include reductions due passive conservation, and in some instances the Per Capita Water Use may be lower than the Base per Capita Day. In this case, the Advanced Water Conservation is shown as zero. This may occur if the base GPCD rates projected by the TWDB decreases at a greater rate than the rates assumed for Advanced Municipal Conservation. One possible reason may be that if a municipality is projected to have high growth rates, then the GPCD would lower due to an increase in more efficient appliances that come with new construction.

The amount of water that can be conserved by implementing Advanced Municipal Conservation measures and associated costs were estimated with the assistance of the Unified Costing Model (UCM) tool. The methodology is based on the "Quantifying the Effectiveness of Various Water Conservation Techniques in Texas"[10] study conducted for the TWDB. The cost to implement Advanced Water Conservation was calculated by multiplying a unit cost of $681/acre-ft. by the

---

[8] Analysis of Water Use in New Single Family Homes, Prepared by William B. DeOreo of Aquacraft Water Engineering & Management for The Salt Lake City Corporation and the U.S. Environmental Protection Agency, 2011.

[9] The Grass Is Always Greener…Outdoor Residential Water Use In Texas, Sam Marie hermitte and Robert Mace, Technical Note 12-01, 2012.

[10] GDS Associates, "Quantifying the Effectiveness of Various Water Conservation Techniques in Texas; Appendix VI, Region L," Texas Water Development Board, Austin, Texas, July 2003.

amount of water conserved. The annual unit cost for Advanced Water Conservation is $2/1,000 gallons. Specific conservation measure used to determine the unit cost in the study include toilet, showerheads, and aerator retrofit, clothes washer rebate, irrigation audit, rainwater harvesting, rain barrels, and commercial general rebate.

Environmental Impacts

Potential environment impacts for advanced municipal conservation strategies have been identified and categorized as described below. The letters identifying each section correspond to the headings in Table 5-10.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acreage impacted by pipelines is equivalent to the right of way easements required, assumed to be 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on plant capacity

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect any wetlands.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. Acreage that is impacted by a strategy was considered to be a reasonable estimate of potentially impacted habitat.

E. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative advanced municipal conservation projects is presented in Table 5-10. Additionally, it should be noted that because conservation reduces demand, this type of strategy decreases the amount of water that is discharged from a WWTP.

Table 5-10 Environmental Impacts for Advanced Municipal Conservation Strategies

Entity	WMS Name	Yield*	A	B	C	D	E
Agua SUD	Advanced Municipal Water Conservation	131	0	0	0	0	0
Alamo	Advanced Municipal Water Conservation	159	0	0	0	0	0
Alton	Advanced Municipal Water Conservation	70	0	0	0	0	0
Brownsville	Advanced Municipal Water Conservation	1,081	0	0	0	0	0
Combes	Advanced Municipal Water Conservation	5	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	230	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	52	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	309	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	121	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	31	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	17	0	0	0	0	0
Donna	Advanced Municipal Water Conservation	4	0	0	0	0	0
Eagle Pass	Advanced Municipal Water Conservation	208	0	0	0	0	0
East Rio Hondo WSC	FM 2925 Water Transmission Line	30	142	178	0	142	0
East Rio Hondo WSC	Municipal (UV Disinfection FM 510 WTP)	11	0	0	0	0	0
East Rio Hondo WSC	Advanced Municipal Water Conservation	1	0	0	0	0	0
Edcouch	Advanced Municipal Water Conservation	1	0	0	0	0	0
Edinburg	Advanced Municipal Water Conservation	8	0	0	0	0	0
El Cenizo	Advanced Municipal Water Conservation	29	0	0	0	0	0
El Jardin WSC	Distribution Pipeline Replacement	11	0	394	0	0	0
El Jardin WSC	Advanced Municipal Water Conservation	37	0	0	0	0	0
Elsa	Advanced Municipal Water Conservation	11	0	0	0	0	0
Harlingen	Advanced Municipal Water Conservation	401	0	0	0	0	0
Hebbronville	Advanced Municipal Water Conservation	1	0	0	0	0	0
Hidalgo	Advanced Municipal Water Conservation	11	0	0	0	0	0
Hidalgo MUD No. 1	Advanced Municipal Water Conservation	56	0	0	0	0	0
La Feria	Rainwater Harvesting	24	0	0	0	0	0
La Feria	Advanced Municipal Water Conservation	25	0	0	0	0	0
La Grulla	Advanced Municipal Water Conservation	11	0	0	0	0	0
La Joya	Advanced Municipal Water Conservation	56	0	0	0	0	0
La Villa	Advanced Municipal Water Conservation	17	0	0	0	0	0
Laguna Vista	Advanced Municipal Water Conservation	182	0	0	0	0	0
Laredo	Advanced Municipal Water Conservation	2,600	0	0	0	0	0
Los Indios	Advanced Municipal Water Conservation	2	0	0	0	0	0

Entity	WMS Name	Yield*	A	B	C	D	E
McAllen	Advanced Municipal Water Conservation	1,674	0	0	0	0	0
Mercedes	Advanced Municipal Water Conservation	80	0	0	0	0	0
Military Highway WSC	Advanced Municipal Water Conservation	133	0	0	0	0	0
Mission	Advanced Municipal Water Conservation	925	0	0	0	0	0
North Alamo WSC	Advanced Municipal Water Conservation	860	0	0	0	0	0
Olmito WSC	Advanced Municipal Water Conservation	22	0	0	0	0	0
Palm Valley	Advanced Municipal Water Conservation	8	0	0	0	0	0
Palmhurst	Advanced Municipal Water Conservation	57	0	0	0	0	0
Palmview	Advanced Municipal Water Conservation	21	0	0	0	0	0
Penitas	Advanced Municipal Water Conservation	5	0	0	0	0	0
Pharr	Advanced Municipal Water Conservation	167	0	0	0	0	0
Port Isabel	Advanced Municipal Water Conservation	52	0	0	0	0	0
Primera	Advanced Municipal Water Conservation	9	0	0	0	0	0
Progreso	Advanced Municipal Water Conservation	7	0	0	0	0	0
Rancho Viejo	Advanced Municipal Water Conservation	50	0	0	0	0	0
Raymondville	Advanced Municipal Water Conservation	34	0	0	0	0	0
Rio Bravo	Advanced Municipal Water Conservation	41	0	0	0	0	0
Rio Grande City	Advanced Municipal Water Conservation	173	0	0	0	0	0
Rio Grande City	Rio Grande City Water Meter Replacement	370	0	1	0	0	0
Rio WSC	Advanced Municipal Water Conservation	29	0	0	0	0	0
Roma	Advanced Municipal Water Conservation	93	0	0	0	0	0
San Benito	Advanced Municipal Water Conservation	146	0	0	0	0	0
San Juan	Advanced Municipal Water Conservation	15	0	0	0	0	0
San Perlita	Advanced Municipal Water Conservation	14	0	0	0	0	0
San Ygnacio MUD	Advanced Municipal Water Conservation	6	0	0	0	0	0
Santa Rosa	Advanced Municipal Water Conservation	1	0	0	0	0	0
Sharyland WSC	Advanced Municipal Water Conservation	231	0	0	0	0	0
South Padre Island	Advanced Municipal Water Conservation	248	0	0	0	0	0
Sullivan City	Advanced Municipal Water Conservation	13	0	0	0	0	0
Union WSC	Automatic Meter Reading System	88	0	1	0	0	0
Union WSC	Advanced Municipal Water Conservation	25	0	0	0	0	0
Weslaco	Advanced Municipal Water Conservation	241	0	0	0	0	0
Zapata County Waterworks	Advanced Municipal Water Conservation	81	0	0	0	0	0

*First decade of implementation yield (acre-ft./year)

5.2.6 Implementation of Best Management Practices for Industrial Users

Implementation of Best Management Practices (BMPs) for Industrial Users is recommended for every Manufacturing, Mining, and Steam Electric Power user in Region M. The TWDB Water Implementation Task Force recommended strategies for industrial users to conserve water in the "Best Management Practices for Industrial Water Users" guidance.[11] The guide provides BMPs for specific industries, as well as general BMPs that are recommended for any type of industrial user. The BMPs provided include:

1. Industrial Site Specific Conservation
2. Industrial Water Audit
3. Management and Employee Programs (Educational Practices)
4. Boiler and Stream Systems
5. Industrial Alternative Sources and Reuse of Process Water
6. Industrial Sub-metering
7. Industrial Water Waste Reduction
8. Refrigeration
9. Rinsing/Cleaning
10. Water Treatment
11. Cooling Systems (Other than Cooling Towers)
12. Cooling Towers
13. Once-Through Cooling
14. Industrial Facility Landscaping

The BMP guidance describes Water Audits as the initial way for industrial water users to increase water efficiency. It is assumed that all of the users for which this strategy is recommended will at the minimum perform a Water Audit. On average, the range of water savings from implementing water audits is between 10-35%[12]. Therefore, 10% of the water demand of each Manufacturing, Mining, and Steam Electric Power WUG is used to estimate the amount of water conserved per decade by implementing BMPs.

The unit cost for this strategy has been estimated at $2,500/acre-ft. to match the cost of purchasing a water right for one acre-ft. This unit cost was chosen because it is assumed that an industrial user would only implement BMP if they cost less than or equal to purchasing additional surface water.

Environmental Impacts

Potential environment impacts for industrial conservation strategies have been identified and categorized as described below. The letters identifying each section correspond to the headings in Table 5-11.

---

[11] Water Conservation Implementation Task Force, "Water Conservation Best Management Practices: Best Management Practices for Industrial Water Users," February 2013.

[12] Ibid.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. No permanent acres are impacted for industrial conservation because the strategy will occur on land already used for industrial purposes

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities which are typical of any construction project. The Construction Impacted Acreage was estimated as one acre.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect any wetlands.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. Acreage that is impacted by a strategy was considered to be a reasonable estimate of potentially impacted habitat.

E. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative industrial conservation projects is presented in Table 5-11.

Table 5-11 Environmental Impacts for Advanced Municipal Conservation Strategies

Entity	WMS Name	Yield*	A	B	C	D	E
Manufacturing - Nueces-Rio Grande	Implementation of BMP	471	0	1	0	0	0
Steam Elec - Nueces-Rio Grande	Implementation of BMP	152	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	26	0	1	0	0	0
Steam Elec - Nueces-Rio Grande	Implementation of BMP	1,415	0	1	0	0	0
Manufacturing - Nueces-Rio Grande	Implementation of BMP	546	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	264	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	21	0	1	0	0	0

Entity	WMS Name	Yield*	A	B	C	D	E
Mining - Nueces-Rio Grande	Implementation of BMP	8	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	1	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	159	0	1	0	0	0
Mining - Nueces	Implementation of BMP	40	0	1	0	0	0
Manufacturing - Rio Grande	Implementation of BMP	9	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	44	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	13	0	1	0	0	0
Manufacturing - Rio Grande	Implementation of BMP	1	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	672	0	1	0	0	0
Mining - Nueces	Implementation of BMP	310	0	1	0	0	0
Steam Elec - Rio Grande	Implementation of BMP	130	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	52	0	1	0	0	0
Manufacturing - Nueces	Implementation of BMP	2	0	1	0	0	0
Manufacturing - Nueces-Rio Grande	Implementation of BMP	14	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	5	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	91	0	1	0	0	0

*First decade of implementation yield (acre-ft./year)

5.2.7 Conversion of Surface Water Rights through Urbanization

Over the planning horizon it is expected that there will be increased urban and suburban development and increased pressure on the existing water supplies. Irrigation demands are expected to decrease as a result of these pressures and associated urbanization of land. In some cases, where water is owned by an individual farmer, there may be a point at which the conversion of irrigated farmland to dry-land farming will make economic sense, based on the price of water.

According to the TCEQ rules, when an irrigation water right is converted to a DMI water right, the maximum authorized diversion is reduced to 50% for Class A and 40% for Class B.

For the purpose of this plan, it was assumed that the increase in Municipal Water Demand is proportional to the decrease in Irrigation Demand. The urbanization rate was calculated for each county based on the rate at which Irrigation Demand decreases. The reduction in agricultural supplies, called 'exclusion' was estimated at 75% of the projected urbanization rate. The water rights made available through exclusion were assumed to be converted for DMI use.

The 2020 urbanization rate is 0.7 times the 2030 rate to account for the seven years between when the numbers were projected (in 2013) and 2020. Table 5-12 shows the projected agricultural demands, the rate at which water rights are converted in each county, the reduction in irrigation supplies, and the reduction in irrigated acreage, assuming that each acre of land that is irrigated has an associated 2.5 acre-feet of water rights. Although there is measured historical urbanization for Jim Hogg and Webb Counties, these measurements were not considered statistically reliable based on the amount of total urbanization water rights. No urbanization was projected for Webb County.

Table 5-12 Urbanization Rates and Available Converted Water Rights per County

	2020	2030	2040	2050	2060	2070
Cameron County						
Agricultural Demands	355,962	339,470	322,622	305,522	288,601	288,601
Exclusion Rate	1.82%	3.47%	3.72%	3.98%	4.15%	0.00%
Reduction in Agricultural Supplies (Cumulative)	4,852	12,633	21,149	29,929	38,756	38,757
Reduction in Irrigated Acreage (Cumulative)	4,039	11,593	19,403	27,434	35,492	35,492
Hidalgo County						
Agricultural Demands	639,676	609,754	577,457	540,797	502,563	502,563
Exclusion Rate	1.84%	3.51%	3.97%	4.76%	5.30%	0.00%
Reduction in Agricultural Supplies (Cumulative)	7,015	18,280	31,272	46,184	61,968	61,955
Reduction in Irrigated Acreage (Cumulative)	5,815	16,687	28,566	42,238	56,739	56,739
Jim Hogg County						
Agricultural Demands	439	413	398	414	451	451
Exclusion Rate	2.33%	4.44%	2.72%	-3.02%	-6.70%	0.00%
Reduction in Agricultural Supplies (Cumulative)	0	0	0	0	0	0
Reduction in Irrigated Acreage (Cumulative)	0	0	0	0	0	0
Maverick County						
Agricultural Demands	52,993	51,886	50,903	49,951	49,076	49,076
Exclusion Rate	0.82%	1.57%	1.42%	1.40%	1.31%	0.00%
Reduction in Agricultural Supplies (Cumulative)	627	1,490	2,381	3,270	4,117	4,129
Reduction in Irrigated Acreage (Cumulative)	444	1,282	2,031	2,759	3,432	3,432
Starr County						
Agricultural Demands	13,483	11,085	8,646	6,192	3,714	3,714
Exclusion Rate	7.00%	13.34%	16.50%	21.29%	30.01%	0.00%
Reduction in Agricultural Supplies (Cumulative)	753	2,031	3,415	4,896	6,529	6,519
Reduction in Irrigated Acreage (Cumulative)	291	806	1,358	1,950	2,607	2,607
Webb County						
Agricultural Demands	7,612	7,612	7,612	7,612	7,612	7,612
Exclusion Rate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Reduction in Agricultural Supplies (Cumulative)	0	0	0	0	0	0
Reduction in Irrigated Acreage (Cumulative)	0	0	0	0	0	0
Willacy County						
Agricultural Demands	69,253	69,074	68,936	68,814	68,741	68,741
Exclusion Rate	0.10%	0.19%	0.15%	0.13%	0.08%	0.00%
Reduction in Agricultural Supplies (Cumulative)	309	422	690	980	1,262	1,290
Reduction in Irrigated Acreage (Cumulative)	81	236	356	461	524	524
Zapata County						
Agricultural Demands	4,717	4,455	4,215	3,981	3,800	3,800
Exclusion Rate	2.19%	4.17%	4.04%	4.16%	3.41%	0.00%
Reduction in Agricultural Supplies (Cumulative)	81	215	345	474	577	577
Reduction in Irrigated Acreage (Cumulative)	83	238	383	525	637	637
Total Reduction in Agricultural Supplies (Cumulative)	**13,638**	**35,071**	**59,252**	**85,734**	**113,210**	**113,227**
Total Reduction in Irrigated Acreage (Cumulative)	**10,754**	**30,843**	**52,096**	**75,368**	**99,431**	**99,431**

All Municipal WUG with recommended strategies that required additional water rights in order to be feasible (such as expansion of a surface water treatment plant) were allocated urbanized water rights to accompany those strategies. Additionally, the strategy for Acquisition of Water Rights through Urbanization was evaluated for all Municipal, Manufacturing, and Steam Electric Power WUG with needs prior to 2070. In situations where a municipality is currently served by an Irrigation District (ID) that is expected to be urbanized, water rights from the specific ID were identified to be sold, if sufficient water rights were available.

A unit capital cost of $2,500 per acre-ft. has been estimated as the market value for water rights. However, under Subchapter O of Chapter 49 Texas Water Code, a municipal supplier can buy water rights to the net irrigable acres in a subdivision at 68% of the market value. Therefore, if a strategy calls for a municipal water provider to purchase water rights from an ID that serves them, it is assumed that the urbanized land is within the provider's jurisdiction and this reduced rate would apply. In those cases, a unit capital cost of $1,700 per acre-ft. is used to estimate the capital costs. Any costs associated with the delivery of water rates are assumed to be insignificant and are not included.

Each converted water right sold to an entity through a recommended WMS has been identified as either being sold through an ID from urbanized land within their service area or through converted water rights from land within a part of a county that is not served by an ID (unaffiliated). It should be noted that these are possible methods for entities to receive urbanized water rights, however there are multiple ways each user could purchase them. Table 5-13 through Table 5-17 present the recommended distribution of converted water rights through WMS.

Table 5-13 Cameron County Irrigation Districts Converted Water Rights Distribution (Acre-feet/year)

Irrigation District		Converted WR					
		2020	2030	2040	2050	2060	2070
Adams Garden	DMI Supplies from Conversion	126	378	660	971	1,306	1,355
	Purchased DMI Supplies:						
	Roma	100	0	0	0	0	0
	Manufacturing, Hidalgo (Nueces-Rio Grande)	26	51	130	160	210	250
	Remaining Unassigned DMI Supplies	*0*	*327*	*530*	*811*	*1,096*	*1,105*
Bayview ID	DMI Supplies from Conversion	149	432	733	1,049	1,374	1,391
	Purchased DMI Supplies:						
	Cameron County-Other	5	5	5	5	5	5
	Steam-Electric, Hidalgo (Nueces-Rio Grande)	144	427	728	1,044	1,369	1,386
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
Brownsville ID	DMI Supplies from Conversion	284	826	1,400	2,004	2,626	2,658
	Purchased DMI Supplies:						
	Hidalgo	200	200	200	200	200	200
	Manufacturing, Hidalgo (Nueces-Rio Grande)	84	300	400	600	800	1100
	Remaining Unassigned DMI Supplies	*0*	*325*	*800*	*1,204*	*1,626*	*1,358*
CCID#2	DMI Supplies from Conversion	1,091	3,226	5,558	8,081	10,743	11,032
	Purchased DMI Supplies:						
	Roma	237	0	0	0	0	0

Irrigation District		Converted WR 2020	2030	2040	2050	2060	2070
	East Rio Hondo WSC	800	800	800	800	800	800
	Cameron County-Other	54	1,772	278	278	278	278
	North Alamo WSC - Delta WTP	0	0	4,480	6,160	6,160	6,160
	Remaining Unassigned DMI Supplies	*0*	*654*	*0*	*843*	*3,505*	*3,794*
CCID#6 (Los Fresnos)	DMI Supplies from Conversion	416	1,208	2,048	2,932	3,841	3,888
	Purchased DMI Supplies:						
	Olmito WSC	200	200	200	300	300	300
	Hidalgo	200	200	750	750	1,200	1,200
	Remaining Unassigned DMI Supplies	*16*	*808*	*1,098*	*1,882*	*2,341*	*2,388*
Harlingen ID	DMI Supplies from Conversion	897	2,574	4,308	6,090	7,879	7,879
	Efficiency with ID Conservation WMS	70%	74%	78%	82%	86%	90%
	DMI Supplies from Conversion	624	1,897	3,350	4,985	6,770	7,091
	Purchased DMI Supplies:						
	Roma	324	636	130	80	30	5
	Military Highway WSC	300	1,100	1,800	2,550	3,650	4,550
	Remaining Unassigned DMI Supplies	*0*	*161*	*1,420*	*2,355*	*3,090*	*2,536*
La Feria ID (CCID#3)	DMI Supplies from Conversion	699	2,014	3,384	4,804	6,240	6,265
	Purchased DMI Supplies:						
	Santa Rosa	0	25	50	100	150	175
	City of Roma	699	699	699	699	699	699
	Remaining Unassigned DMI Supplies	*0*	*1,290*	*2,635*	*4,005*	*5,391*	*5,391*
Valley Acres	DMI Supplies from Conversion	129	375	634	907	1,186	1,199
	Purchased DMI Supplies:						
	Steam-Electric, Hidalgo (Nueces-Rio Grande)	129	375	634	907	1,186	1,199
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
CCID16	DMI Supplies from Conversion	30	88	150	215	281	285
	Purchased DMI Supplies:						
	Manufacturing, Hidalgo (Nueces-Rio Grande)	30	50	129	162	210	250
	Remaining Unassigned DMI Supplies	*0*	*38*	*21*	*53*	*71*	*35*
CCWID10	DMI Supplies from Conversion	62	180	304	435	570	576
	Purchased DMI Supplies:						
	Manufacturing, Hidalgo (Nueces-Rio Grande)	65	150	250	300	425	500
	Remaining Unassigned DMI Supplies	*0*	*30*	*54*	*135*	*145*	*76*

Table 5-14 Hidalgo County Irrigation Districts Converted Water Rights Distribution (Acre-feet/year)

Irrigation District		Converted WR 2020	2030	2040	2050	2060	2070
Donna ID/Hidalgo Co. No. 1	DMI Supplies from Conversion	527	1,672	3,133	5,033	7,300	7,838
	Purchased DMI Supplies:						
	North Alamo WSC - WTP 5	0	1,150	700	700	700	700
	City of Donna	500	500	1,790	1,790	1,790	1,790
	Steam-Electric, Hidalgo (Nueces-Rio Grande)	27	22	643	2,543	4,810	5,348
	Remaining Unassigned DMI Supplies	*0 0*		*0*	*0*	*0*	*0*

Irrigation District		Converted WR 2020	2030	2040	2050	2060	2070
Hidalgo and Cameron Co. ID No. 9	DMI Supplies from Conversion	1,210	3,606	6,400	9,799	13,615	14,066
	Purchased DMI Supplies:						
	North Alamo WSC - WTP 5 - Cameron	34	158	208	208	208	208
	North Alamo WSC - WTP 5 - Hidalgo	407	1,983	2,483	2,483	2,483	2,483
	Elsa	0	0	0	0	100	150
	Edcouch	40	40	40	100	100	100
	La Villa	50	50	50	50	100	100
	Weslaco	679	1,375	3,000	3,500	3,500	3,500
	Mission	0	0	600	1,000	1,000	1,000
	Steam-Electric, Hidalgo (Nueces-Rio Grande)	0	0	0	0	0	3,000
	Remaining Unassigned DMI Supplies	*0*	*0*	*19*	*2,458*	*6,124*	*3,525*
Hidalgo Co. ID No.1 (Edinburg)	DMI Supplies from Conversion	614	1,785	3,095	4,634	6,303	6,381
	Purchased DMI Supplies:						
	Edinburg	100	1,000	1,500	2,500	4,000	4,000
	Sharyland	200	500	1,200	1,200	1,200	1,200
	HC MUD	285	285	285	785	785	785
	Hidalgo County-Other	29	0	0	0	0	0
	Remaining Unassigned DMI Supplies	*0*	*0*	*110*	*149*	*318*	*396*
Hidalgo Co. ID No. 2 (San Juan)	DMI Supplies from Conversion	995	2,957	5,253	8,051	11,196	11,577
	Purchased DMI Supplies:						
	Alamo	0	0	0	1,000	1,000	1,000
	McAllen	0	0	800	800	1,511	4,011
	San Juan	200	800	1,600	1,600	1,600	1,600
	Edinburg	100	1,100	2,000	3,000	4,000	4,000
	North Alamo WSC - WTP 5	395	742	282	282	282	282
	City of Roma	300	300	300	300	300	300
	Remaining Unassigned DMI Supplies	*0*	*15*	*271*	*1,069*	*2,503*	*384*
Hidalgo Co. ID No. 6 (Mission No. 6)	DMI Supplies from Conversion	295	856	1,481	2,214	3,006	3,038
	Purchased DMI Supplies:						
	HC MUD	215	215	215	715	715	715
	Hidalgo	0	100	100	100	100	100
	Hidalgo County-Other	80	541	1,166	1,399	2,191	2,223
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
Hidalgo Co. ID No. 16 (Mission No. 16)	DMI Supplies from Conversion:	241	712	1,252	1,902	2,622	2,689
	Purchased DMI Supplies:						
	Agua SUD	200	400	1,000	1,800	2,600	2,600
	Hidalgo County-Other	41	312	252	102	22	89
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
Hidalgo Co. Water Control and Improvement District No. 18	DMI Supplies from Conversion	5	15	25	38	52	52
	Purchased DMI Supplies:						
	Remaining Unassigned DMI Supplies	*5*	*15*	*25*	*38*	*52*	*52*
Hidalgo Co. Water Improvement District No. 3 (McAllen No. 3)	DMI Supplies from Conversion:	65	191	334	503	689	703
	Purchased DMI Supplies:						
	McAllen	0	0	0	0	689	689
	Hidalgo County-Other	65	0	0	0	0	0
	Remaining Unassigned DMI Supplies	*0*	*191*	*334*	*503*	*0*	*14*
Santa Cruz Irrigation District	DMI Supplies from Conversion:	584	1,698	2,945	4,409	5,997	6,072
	Purchased DMI Supplies:						

Irrigation District		Converted WR 2020	2030	2040	2050	2060	2070
No. 15	Sharyland WSC	350	1,300	2,000	3,500	4,800	4,800
	Hidalgo County-Other	34	198	385	349	637	712
	NAWSC - WTP 5	200	200	560	560	560	560
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
United ID	DMI Supplies from Conversion	404	1,180	2,053	3,087	4,215	4,283
	Purchased DMI Supplies:						
	Mission	0	600	1500	2500	2500	2500
	Sharyland WSC	140	250	250	250	1,400	1,500
	City of Roma	264	264	264	264	264	264
	Remaining Unassigned DMI Supplies	*0*	*66*	*39*	*73*	*51*	*19*
Engleman ID	DMI Supplies from Conversion	152	438	753	1,117	1,507	1,513
	Purchased DMI Supplies:						
	City of Roma	152	152	152	152	152	152
	Hidalgo County-Other	0	286	148	765	383	913
	Remaining Unassigned DMI Supplies	*0*	*0*	*453*	*200*	*972*	*448*
HCID5	DMI Supplies from Conversion	123	354	607	897	1,205	1,205
	Purchased DMI Supplies:						
	City of Roma	123	123	604	604	604	604
	Remaining Unassigned DMI Supplies	*0*	*231*	*3*	*293*	*601*	*601*
HCID13	DMI Supplies from Conversion	32	93	164	249	343	352
	Purchased DMI Supplies:						
	Hidalgo County-Other	32	32	32	32	32	32
	Remaining Unassigned DMI Supplies	*0*	*61*	*132*	*217*	*311*	*320*
Hidalgo Co. Water Improvement District No. 19, Sharyland	DMI Supplies from Conversion	70	202	350	523	710	717
	Purchased DMI Supplies:						
	Hidalgo County-Other	70	202	350	523	710	717
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*

Table 5-15 Maverick County Irrigation District Converted Water Rights Distribution (Acre-feet/year)

Irrigation District		Converted WR 2020	2030	2040	2050	2060	2070
Maverick County ID	DMI Supplies from Conversion	468	1,369	2,198	3,025	3,812	3,861
	Purchased DMI Supplies:						
	City of Donna	450	450	450	450	450	450
	Steam-Electric, Hidalgo (Nueces-Rio Grande)	18	919	1,748	2,493	3,273	3,316
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*82*	*89*	*95*

Table 5-16 Willacy County Irrigation District Converted Water Rights Distribution (Acre-feet/year)

Irrigation District		Converted WR 2020	2030	2040	2050	2060	2070
Delta Lake ID	DMI Supplies from Conversion	84	247	377	495	570	578
	Purchased DMI Supplies:						
	North Alamo WSC - WTP 5 - Willacy	36	106	106	106	106	106
	North Alamo WSC - WTP 5 - Hidalgo	48	141	141	141	141	141
	Remaining Unassigned DMI Supplies	*0*	*0*	*130*	*248*	*323*	*331*

Table 5-17 Unaffiliated Converted Water Rights Distribution (Acre-feet/year)

County		Converted WR					
		2020	2030	2040	2050	2060	2070
Cameron	DMI Supplies from Conversion	435	1248	2089	2953	3821	3821
	Purchased DMI Supplies:						
	Hidalgo County-Other	435	435	435	435	435	435
	Manufacturing, Cameron (Nueces-Rio Grande)	0	0	170	470	365	808
	Steam-Electric, Hidalgo (Nueces-Rio Grande)	0	813	1,484	2,048	3,021	2,578
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
Hidalgo	DMI Supplies from Conversion	270	776	1,328	1,963	2,637	2,637
	Purchased DMI Supplies:						
	Hidalgo County-Other	270	776	1,328	1,963	2,637	2,637
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
Willacy	DMI Supplies from Conversion	2	4	7	9	10	10
	Purchased DMI Supplies:						
	Manufacturing, Willacy	2	4	7	9	10	10
	Remaining Unassigned DMI Supplies	0	0	0	0	0	0
Starr	DMI Supplies from Conversion	863	2,391	4,030	5,795	7,754	7,754
	Purchased DMI Supplies:						
	Starr County-Other	863	2,391	4,030	5,794	7,752	7,751
	Manufacturing, Starr (Rio Grande)	0	0	0	1	2	3
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*
Zapata	DMI Supplies from Conversion	86	247	397	545	661	661
	Purchased DMI Supplies:						
	Zapata County-Other	86	247	397	545	661	661
	Remaining Unassigned DMI Supplies	*0*	*0*	*0*	*0*	*0*	*0*

Environmental Impacts

Potential environment impacts for voluntary conversion and purchase of surface water rights strategies have been identified. The largest impact from urbanization of irrigation water rights is the land that is no longer irrigated. Table 5-12 quantifies the amount of acreage per county. The reduction of irrigated acreage was estimated as the amount of urbanized water rights divided by 2.5, based on the standard authorization per acre. It was assumed that the permanent acreage impacted is the same as would impact habitats in the local area.

The development of farmland has implications for the operations of irrigation and districts, including the frequency and volume of deliveries and tailwaters. Whereas tailwaters from irrigation are drained across farmland, wastewater effluent will be concentrated at wastewater treatment plants. However, the majority of both farmland and municipal wastewater plants are located in the Nueces-Rio Grande basin and therefore ultimately drain into the Laguna Madre.

5.2.8 On-Farm Irrigation Conservation

On-Farm conservation measures can be grouped into the following categories: water use management practices, land management systems, on-farm water delivery systems, water district delivery systems, and tailwater recovery systems. Water District delivery system improvements, including conveyance infrastructure, metering, and telemetry, are discussed in detail in Section 5.2.1 and addressed as a separate WMS. However, for farmland in Irrigation Districts, the operational effectiveness and efficiency of the Irrigation Districts (ID) are necessary to reap the full benefits of on-farm measures. On-farm efficiency depends on timely delivery of water and adequate head to push water across a field. For these farmers, the incentive to conserve water is largely based on the irrigation district, and their ability to volumetrically price water.

Water use management practices include scheduling irrigations and measuring water used or soil moisture, including on-farm audits. For irrigators relying on Rio Grande water, scheduling irrigations based on soil moisture metering is difficult because of the delay between when a farmer requests water and the time that it is actually available to use, which can be up to 5 to 7 days. However, metering of irrigation water, either short-term as a part of an on-farm water audit or long-term as a management strategy, is recommended where physically and economically feasible. Common practice currently is for Districts to send an employee to monitor diversions, estimating the amount of water used based on how long a headgate is open or measuring water depth at certain locations. Where metering is implemented by the Irrigation District so that water can be volumetrically priced, farmers have an incentive for reducing their use of water and both the Districts and the farmer can manage water more carefully.

Land management systems include laser leveling, brush control, conversion of irrigated farmland to dry-land farmland, and furrow dikes or narrow-border citrus, which is discussed in more detail below. Each of these strategies addresses how to manage farmland so that available water is used to maximum effect. Conversion of irrigated farmland to dry land farming generally equates to lower value and/or yield, but can be a valuable tool if drought is anticipated and the water available to a farm is consolidated on a high-value crop. Crop selection based on market values, water demand, and acreage can be made so that farmers are best able to respond to drought.

On-farm water delivery system improvements limit losses in the conveyance of water to the crop and apply water precisely where it is needed for each type of plant. This includes surge valves, which can increase the uniformity of water application across a field, lining on-farm canals or use of poly-pipe, and drip or sprinkler systems. For irrigators using surface water in Region M, the lack of pressure head on irrigation water is a significant barrier to implementing many water delivery system improvements. Soil type can be a limitation for the use of surge valves, as well as limited pressure head or storage at or near the point of use. Research and demonstration projects on drip irrigation have shown significant increases in yield for some vegetables.

Tailwater recovery systems allow for excess water applied to farmland to be put to beneficial use. In place in much of the Lower Rio Grande Valley, tailwaters are collected in the drainage canals like the Arroyo Colorado, which may be utilized by other users downstream. Although this water tends to have high dissolved solids content, it is used for crops that can withstand high salinity and for other uses, including aquaculture. Treatment of tailwaters to potable standards is generally costly but may be appropriate where there are few alternatives. The Delta Watershed Project, sponsored by Hidalgo County Drainage District, describes capture and use of tailwaters.

These measures are considered on-farm conservation measures, but in most cases implementation of these measures in a drought year increases the potential yield of a crop per acre-foot of water but may not reduce irrigator's overall demand for water. When water is available in a drought year, farmers are likely to use it. Making better use of the water that is available is critical to helping farmers through drought, and the Region M Planning Group recommends continued research, education, demonstration, and large-scale implementation of these and any other irrigation conservation measures that farmers find to be appropriate.

A select subset of on-farm water conservation strategies which were developed based on input from stakeholders and ID are discussed in detail below. These are strategies that are of particular interest to the region, although the full range of BMP described in TWDB literature are recommended where appropriate.[13] On-Farm Conservation is recommended for all irrigators in the planning area.

Using the an estimated cost of $1,392 per acre-foot, an On-Farm Conservation WMS was developed based on the above described categories.

- Water use Management Practices (e.g. scheduling, moisture metering, and on-farm audits) were assumed to be implemented across the region such that 25% of potential water savings have already been made. 5% efficiency gains were estimated for the remaining 75% for 2020.
- Land management systems (e.g. laser leveling, narrow border citrus, and furrow dikes) were assumed to be 25% implemented, and the strategy estimates a10% efficiency gain over the remaining 75% of irrigation water use for the decade of 2020.
- On-Farm water delivery systems (e.g. poly-pipe, surge valves, drip, sprinkler) were estimated to impart a 10% efficiency gain on 10% of irrigation water usage in 2020, for which that technology is appropriate and not already in place.

Capture of tailwaters and Irrigation District conveyance improvements were not included in the general On-Farm Conservation WMS, but are addressed elsewhere in this chapter.

Table 5-18 Narrow Border Citrus Water Savings

County	Basin	2020 Demand Projections	Management Practices	Land Management Systems	On-Farm Water Delivery Systems	Total Savings
Cameron	Nueces-Rio Grande	334,604	12,548	25,095	3,346	40,989
Cameron	Rio Grande	21,358	801	1,602	214	2,616
Hidalgo	Nueces-Rio Grande	614,089	23,028	46,057	6,141	75,226
Hidalgo	Rio Grande	25,587	960	1,919	256	3,134
Jim Hogg	Nueces-Rio Grande	351	13	26	4	43
Jim Hogg	Rio Grande	88	3	7	1	11
Maverick	Nueces	61	2	3	1	5
Maverick	Rio Grande	52,932	1,323	2,647	529	4,499
Starr	Rio Grande	13,483	506	1,011	135	1,652
Webb	Rio Grande	7,612	285	571	76	932
Willacy	Nueces-Rio Grande	69,253	2,597	5,194	693	8,483
Zapata	Rio Grande	4,717	177	354	47	578

Narrow-Border Citrus Irrigation

Narrow border flood irrigation provides an alternative to the traditional pan flooding method of irrigation commonly used by citrus growers in the Lower Rio Grande Valley. This method is a cost effective and easy to implement alternative that involves erecting narrow berms of soil between existing rows of citrus trees in order to direct and contain irrigation water directly in the

[13] Texas Water Development Board, Best Management Practices for Agricultural Water users http://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp accessed 4/21/2015

root-zone of trees. This method can save about 35% of the water required for traditional flood irrigation and is estimated to potentially conserve 49,000 acre-ft. of water per year if implemented on all South Texas citrus groves. Currently, it is estimated that 10% of citrus growers in the Lower Rio Grande Valley have implemented the narrow border flood irrigation practice. If narrow border flood irrigation is implemented these 23,800 acres of citrus could save approximately 21 inches per acre per year, saving an additional 41,650 acre-ft.

This practice has many benefits in addition to water and cost savings; including faster water channeling rates, higher water use efficiency in trees, reduced water in areas prone to weed growth, and fertilizer retention in the root-zone. The potential economic benefits also exceed that of traditional flood irrigation, with higher average net cash farm projected income of $1,730 per acre compared to $820 per acre with traditional flood (Nelson et al., 2013). The narrow border flood method can also be used in conjunction with other practices such as raised beds, denser plantings, and mesh groundcover than can enhance water use efficiency and water savings.

Based on TWDB irrigation water use records by crop, between 2009 and 2013, the overall orchard acreage (assumed to be all citrus in Region M) decreased by 500 acres, and water use averaged 3.7 feet per acre. Assuming 10% increase in implementation per decade, the following on-farm conservation gains could be made in the counties where citrus is a prevalent crop (Table 5-19). Because these gains are more easily quantifiable, they were used as a component in the estimates for the general on-farm WMS in Table 5-18.

Table 5-19 Narrow Border Citrus Water Savings

	5-Year Average of AC	5-Year Average of ft./AC	First Decade Implementation Acreage	Implementation Acreage Current Water Use	Water Conserved in 2020
Cameron	4,420	3.8	398	1,512	983
Hidalgo	5,200	3.8	468	1,794	1,166
Maverick	4,900	3.5	441	1,521	989
Webb	300	3.0	27	80	52
Willacy	340	3.5	31	108	70
Total	**15,160**	**3.5**	**1,364**	**5,015**	**3,260**

Drip Irrigation

Drip irrigation can be difficult to implement in the Lower Rio Grande Valley, where almost all irrigation is done with surface water by way of irrigation districts. The IDs are set up to deliver water for flood irrigation on an infrequent basis, whereas drip irrigation systems require a constant supply. When sufficient storage and pressure are available, either through separate storage or access to a main canal which is regularly charged, drip irrigation can use significantly less water for equivalent or even greater crop yields. The low cost of water and inadequate volumetric pricing among irrigation districts impedes the implementation of drip and other water saving technologies. In spite of these challenges, a number of farmers are successfully using drip irrigation on several crops including various vegetables and citrus.

Dry Year Option

An approach to water marketing known as "dry year options" or "water supply option contracts" (WSOC) may reduce the impact on agricultural production while providing drought supplies for other uses. This concept involves temporary transfers of irrigation water to provide secure water supplies to non-agricultural users during droughts. This option would transfer water to other users when needed while preserving the water for agriculture during normal water supply situations. In Texas WSOC is a practice in the Edwards Aquifer area to provide water for endangered species and San Antonio water users during drought.

A WSOC as defined here is a formal contract or agreement between a farmer or a group of farmers and an urban water provider or authority to transfer water temporarily from agriculture to urban or another use, during occasional critical drought periods so that the purchaser secures a source of drought water supply. The farmer or irrigation district does not relinquish ownership of the water right and retains access to the water supply during normal supply situations. In financial exchange market terminology, the holder of an option contract has the right to buy the commodity or stock (in this case water) at a specified price, termed the striking or exercise price, from the seller of the option. The seller of the option is guaranteeing future delivery under specified conditions and price. In exchange for guaranteeing future delivery of the commodity at a set price, a further premium above the exercise price, called the option price, may be paid to the seller. [14]

WSOC Requirements:

1. The water supply must be reliable enough to provide sufficient water for the option use in drought years and plentiful enough in average years to supply the agricultural use.
2. Property rights must be definable and transferrable for market exchange. As with water right purchases, the amount of water transferred must be adjusted for conveyance and field losses to protect third parties (return flow water users).
3. Agricultural operations must be capable of being temporarily suspended or crop production under dryland conditions. This requirement limits option contracts primarily

---

[14] Contract Terms and Provisions: Contract terms and provisions are important to identify and protect the rights of both parties. The exercise price is the cost each time (season/year) the option is exercised. This represents the payment to the farmer or the irrigation district for the net value of foregone agricultural production or loss in district revenue. The present value cost of a water-option contract is the sum of the costs to exercise the option (take the water) multiplied by the expected number of times of option exercise plus any cost appreciation/depreciation of the value of the alternative source plus any payments to the seller to hold the option (option price), each discounted to present value.

Agricultural enterprise and water valuation models can be used to estimate foregone benefits to the farmer or irrigation district. Actual exercise payments need to be negotiated based on both party's perceptions of transfer losses and benefits. Advance notification that the option is to be exercised should be given to the seller for planning purposes so that certain variable production costs can be avoided. Shorter advance notice raises seller costs with an associated higher level of reimbursement required. A flexible quantity provision may be required because of variations in drought water allocation, but the minimum acceptable delivery should be specified. Escalator clauses can be used to adjust contract prices protecting sellers from the effects of inflation.

Option exercise cost is the farmer's offering price for water delivery/foregoing delivery and would be site-specific, depending on the types of crops grown, quantity and cost of irrigation water, production costs, yields, and crop prices on the specific farms. The exercise cost also needs to be sufficient to cover any fixed production costs that might be incurred because the water supply was temporarily relinquished and irrigated crop production ceased. These additional costs include the opportunity costs of family labor and management, taxes, depreciation on durable equipment and cash overhead.

to annual crop operations and will exclude most livestock operations, perennial crops such as orchards and contract crops such as sugar cane.

4. Both buyer and seller must have realistic knowledge of water use values and alternative water supply costs.
5. The probability and severity of drought (the expected frequency of exercising the option) must be able to be estimated within acceptable limits of risk for both parties.
6. Total option contract costs, including both transaction costs of negotiating and adjudicating the temporary transfer of water, and the costs of transporting the water to the purchaser's point of intake must be less than the costs of the purchaser's next most costly water supply alternative.

The Lower Rio Grande Valley and Region M have some unique institutional, hydrologic and economic conditions that would need to be address to provide seller and buyer incentives to enter into WSOC. Unlike many other areas of the Western U.S., water rights are held by the irrigation districts rather than farmers. Given this and the generally low price of agricultural water farmers have little incentive to conserve water except in drought and lack the ability to sell water conserved by more efficient irrigation methods or fallowing land such as for WSOC payments. While there is the potential for irrigation districts to enter into a WSOC with another user, irrigation districts would need to work with farmers and pass through exercise payments in order to make WSOCs feasible from the farmer’s point of view. Also with the generally low cost of irrigation district water the purchase of this water may be the lowest cost to urban providers and other users compared to alternative sources such as desalination or reuse.

Urban demand has the highest priority in drought conditions and therefore urban communities may feel little need to have WSOCs unless there is concern about the agricultural community and/or irrigation district welfare.

The program involves a target time early enough that a farmer can make cropping decisions for the growing season and an option price is offered to secure that if needed water can be called. Then during the year, if the drought is sufficient that the farmer’s water is needed then a preset price for delivery is paid and the farmer forgoes irrigation. In the event the water is not needed then it is available to the farmer. This suggests a cropping decision which can be irrigated but also can be produced dryland (rain-fed) in case the option is exercised.

Environmental Impacts

Potential environment impacts of on-farm conservation are expected to be minimal. The impact on overall demands and supplies is negligible in a drought year because these strategies will only reduce unmet needs. When water is available to irrigators in a drought year, it is expected that they will use it. The particular water management, land management, and water delivery system strategies discussed may have minor or temporary impacts, i.e. soil disturbance and dust from laser leveling or narrow border citrus, which are typical for farmland.

5.2.9 Biological Control of Arundo Donax

Arundo donax (Carrizo cane/giant reed) is an invasive water-using weed that infests the riparian areas of the Lower Rio Grande Basin. It grows up to 30 feet tall (typically 18 to 24 feet) and at a rate of up to four inches per day. This invasive weed is native to Mediterranean Europe, where various insect species naturally control the reed's growth. *A. donax* is a heavy water user, with estimates of up to 5.0 acre-ft. of water per acre per year.

Most control measures, including fire and mechanical, accelerated the spread of the plant. Chemicals can be temporarily effective but are very costly ($5000 per acre) and may impact water quality for both U.S. and Mexican supplies. *A. donax*- specific insects have been imported by USDA, evaluated, permitted and released in the U.S. and Mexico for biological control: *Tetramesa romana* (gall wasp), *Rhizaspidiotus donacis* (scale), *Cryptoevra* (fly), and *Lasioptera donacis* (leafminer). Research studies conducted by USDA and Texas A&M University showed that moderate levels of attack by the biocontrol agents should reduce water use of *A. donax*.

Research conducted in 2009 by Emily Seawright was based on a 50 year program of biological releases of insects targeting the Arundo and thus reducing the water consumption of the plant. The analysis was based on increasing levels of biological control agents over time reaching an equilibrium much as exists in Spain today. The details of the study are available in the thesis of Ms. Seawright (2009). The agents were expected to achieve 67% control of size and acreage of Arundo over the 50 year period. The reduction in water consumption by *A. donax* was offset somewhat by water use of emerging native riparian vegetation, and the additional water would be shared equally between the US and Mexico. For cost analysis, it was assumed that the saved water would be used for irrigation purposes based on the Rio Grande Watermaster rules.

Five years post release of the *A. donax* gall wasp, *Tetramesa romana*, into the riparian habitats of the lower Rio Grande River changes in the health of Arundo donax have been documented. These changes in plant attributes are fairly consistent along the study area of 558 river miles between Del Rio and Brownsville, TX, and support the hypothesis that the *A. donax* wasp has had a significant impact as a biological control agent. Plant attributes were measured prior to release in ten quadrats at each of ten field sites in 2007, and measured again at the same undisturbed sites, 5 years after the release of *T. romana*, in 2014. Above ground biomass of *A. donax* decreased on average by 22% across the ten sites. This decline in biomass was negatively correlated to increased total numbers of *T. romana* exit holes in main and lateral shoots per site in 2014 compared to 2007. Changes in biomass, live shoot density and shoot lengths, especially the positive effect of galling on main and lateral shoot mortality, appear to be leading to a consistent decline of A. donax. Economically, this reduction in A. donax biomass is estimated to be saving 4.4 million dollars per year in agricultural water. Additional impacts are expected as populations of the wasp increase and as other biological control agents such as the *A. donax* scale, *Rhizaspidiotus donacis*, become more widespread.

Potential water conservation benefits were estimated at the start of the program by Seawright et al. (2009). A current estimate was calculated using the Seawright model for water conservation and value attributable to the 22 percent reduction in biomass. This suggests a water savings of 6,593 acre feet due reduced consumptive use by *A. donax*, accounting for water used by regrowth of native riparian plants. Since the U.S. receives about 2/9 of this water, availability to the U.S. would be 2,183 acre feet. This water, available annually, will increase over time, as will the effectiveness and expansion of the biological control agents. It is assumed that 80% of the total water saved through biological control will be above the Amistad or Falcon Reservoirs in the Rio Grande Watershed, thus making that water available as a supply for irrigators (Table 5-20).

Table 5-20 Firm Yield of Biological Control of A. Donax, and Resulting Supplies (Acre-feet/year)

Firm Yield	2020	2030	2040	2050	2060	2070
Total Region M	*4,366*	*4,822*	*5,279*	*5,735*	*6,192*	*6,648*
Upstream of Reservoirs	*3,491*	*3,857*	*4,222*	*4,588*	*4,951*	*5,315*
Cameron	1,087	1,197	1,309	1,426	1,546	1,660
Hidalgo	1,953	2,151	2,343	2,524	2,693	2,891
Maverick	162	183	207	233	263	282
Starr	41	39	35	29	20	21
Webb	23	27	31	36	41	44
Willacy	211	244	280	321	368	395
Zapata	14	16	17	19	20	22

The annual value of the water in agriculture for the Bi-National Rio Grande Valley is an estimated $917,808, where the U.S. portion is $303,848 and one acre foot is valued at $139. Given increasing water issues in the region, and a current market price of $2,000 per acre foot, the value of the water savings for the U.S. would be $4.4 million per year. Impacts from the *A. donax* wasp and other biological control agents are expected to increase the environmental, political and economic benefits realized by the biological control program. The costs for operating and monitoring the biological controls program are estimated in Table 5-21.

Table 5-21 Costs of Biological Control of A. Donax

	2020	2030	2040	2050	2060	2070
Water Saved (acre-ft./year)	3,493	3,858	4,223	4,588	4,953	5,319
Cost per acre-ft. ($)	49	45	12	11	10	10
Total Cost (2020)	$172,000	$172,000	$52,000	$52,000	$52,000	$52,000

Environmental Impacts

The establishment of *A. donax* wasp in the lower Rio Grande River is producing multiple environmental, political and water conservation benefits. The reduction in *A. donax* biomass will likely allow native flora and fauna to return, which has many multi-trophic benefits environmentally (Racelis 2012a). Reduction in biomass increases within stand visibility, which allows for safer and more effective law enforcement activities along the international border. The targeted use of the biological control agents allows native vegetation to be preserved and reestablished, and avoids the negative environmental impacts of herbicides or mechanical removal that are typical of brush control efforts.

5.2.10 Brush Control

In addition to biological control of Arundo Donax, other brush control measures were considered and recommended for Region M. Brush control is the process of removing non-native brush from the banks along rivers and streams and upland areas in order to reduce water consumption by vegetation and increase stream flows and groundwater availability. Studies and pilot projects on brush control in West Texas show promising results. The first large-scale projects are currently underway through the State Water Supply Enhancement Program. Undertaking and maintaining brush control can be expensive and requires landowner participation. However, given the amount of non-native vegetation and the potential water quality and security gains that can be made along the border with Mexico, the RWPG has recommended Brush Control as a zero-supply firm yield water management strategy for all irrigation water users in Region M. Based on the Salt cedar Control Project conducted on the Colorado River, E.V. Spence Reservoir, and the Pecos River, and the estimates for the Carrizo Cane Eradication Program, the total program costs were estimated at $4.5 million/year.

Brush control may have negative impacts on the environment associated with the mechanism of removal, but ideally brush control has an overall beneficial impact on the environment by allowing native vegetation to take hold and increasing surface water and shallow groundwater availability. Temporary environmental impacts may be seen with mechanical removal of brush, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The use of herbicides must be carefully controlled and monitored so as not to impact water supplies and other species of plants or animals.

5.2.11 Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) is an effective way to assist a water user in management of its water resources and to access a reliable water supply during times of drought. The concept is a water storage system located in an underground aquifer. Water can be pumped into the aquifer when there is excess available and recovered through the same wellfield when it is needed. ASR has benefits over surface water storage because there are no evaporative losses, it does not lose storage capacity due to sedimentation, it requires a smaller footprint, and environmental issues associated with land inundation are minimized. The Texas Administrative Code requires water to meet primary drinking water standards prior to injection and continue to meet the standards while in storage. Therefore, in many circumstances, the water can be pumped straight to the distribution system in order to meet peak demands and cost savings can be realized by sizing other water facilities to meet average demands.

Determination of the specific ASR location is important because an aquifer with suitable storage conditions must be identified and permitted. Geologic assessments must be performed for the proposed wellfield site in order to determine its suitability. Also, it is preferable to locate the ASR near the water source and/or distribution system to minimize conveyance costs.

Although there are no specific ASR strategies recommended in the 2016 Regional Water Plan, the RWPG does recommended that municipalities consider ASR in the future. Studies on groundwater in Region M, including the Brackish Water in the Gulf Coast Aquifer; Lower Rio Grande Valley, Texas (BRACS) report, should be used to determine the feasibility of ASR for entities that are considering the strategy[15]. The BRACS study contains preliminary evaluations of hydraulic characteristics of the Gulf Coast Aquifer at certain locations in the Lower Rio Grande Valley. TWDB has funded preliminary ASR feasibility studies for the Brownsville Public Utilities Board (1997) and the City of Laredo (1999)[16]. Although the studies indicated that ASR is feasible and recommended further investigation, the municipalities chose not to continue evaluation of the technology. The RWPG encourages Brownsville and Laredo to continue to assess ASR and other municipalities to consider the strategy.

---

[15] John E. Meyer, P.G., Andrea Croskrey, Matthew R. Wise, P.G., Sanjeev Kalaswad, Ph.D., P.G.; "Brackish Water in the Gulf Coast Aquifer; Lower Rio Grande Valley, Texas" Texas Water Development Board; 2013
[16] Matthew Webb; "Aquifer Storage and Recover in Texas: 2015"; TWDB Technical Note 15-04; 2015

5.3 Recommended WMS

5.3.1 Cameron County

Irrigation Districts/WWP

All of the Irrigation Districts in Cameron County are recommended to implement Irrigation District Conservation Water Management Strategies. Figure 5-1 shows a map of the Cameron County ID.

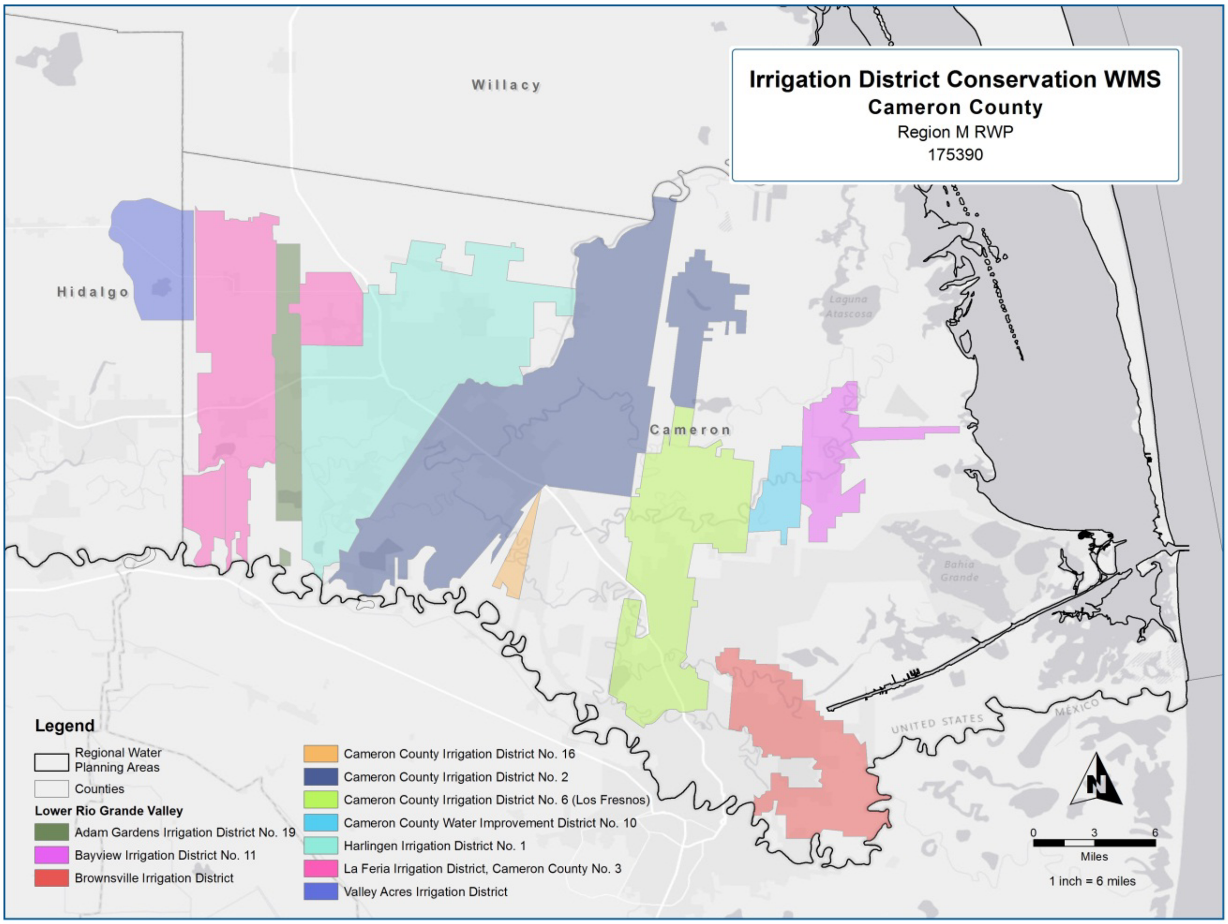

Figure 5-1 Cameron Irrigation District Conservation WMS

ADAMS GARDEN IRRIGATION DISTRICT NO. 19

Adams Gardens Irrigation District, Cameron County No. 19 is located in Cameron County, Texas. The south end of the District is 2.5 miles north of the Rio Grande near· Los Indios, Texas. The District is 1.11 miles wide by 13.6 miles long encompassing about 7,600 acres, the northern end terminating just northeast of Combes, Texas. The District was created in 1931 as Cameron County Water Control and Improvement District Number Nineteen. The water delivery system was originally constructed in 1931 with many modifications and revisions since construction.

The District converted to an irrigation district in 1979 and changed the name to "Adams Gardens Irrigation District". The name is often further clarified as Adams Gardens Irrigation District, Cameron County No. 19. The District is an irrigation district operating under Chapters 49 and 58 of the Texas Water Code. The District primarily supplies irrigation water to agriculture as well as to a few residential customers' within the District. The service area boundaries consist of 15.5 sq. miles, all in Cameron County, Texas. The District is approximately 300 feet wide at the diversion point on the Rio Grande and continues at this width for approximately 2.26 miles, then becomes approximately 6,000 feet wide for about 13.5 miles to the north end of the District.

Adams Garden only provides water to irrigators, and the distribution system is primarily open canals. The estimated diversion for this district, in a drought year, is 8,944 acre-ft., which results

in an estimated 1,968 acre-ft. maximum volume conserved. Adams Garden submitted a WMS for Canal Automation, with an estimated 500 acre-ft./year of savings for a capital cost of $424,495.This submitted WMS was used as the basis for a complete ID Conservation WMS. The cost projections for the strategy submitted by Adams Garden ID No. 19 to the RWPG are shown in Table 5-22.

Table 5-22 Adams Garden Irrigation District Conservation WMS

Cost Estimate Summary ***Adams Gardens Irrigation District No. 19*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Sluice Gates (15)	$105,000
SCADA for Sluice Gates (15)	$105,000
Miscellaneous Supplies	$6,750
TOTAL COST OF FACILITIES	**$216,750**
Site Security	$37,500
Installation Costs	$150,000
Reporting	$3,000
Indirect Costs	$17,245
TOTAL COST OF PROJECT	**$424,495**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$33,670
O&M Cost (based on reduced pumping and canal rider costs)	-$13,015
TOTAL ANNUAL COST	$20,655
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft)	$41.31
Annual Cost of Water ($ per 1,000 gallons)	$0.13

The District maintains 15 miles of main canal and pipelines along its original western boundary line. Approximately 3 miles of the main canal consist of pipelines while the remainder is earthen. From there, the District has approximately 70 miles of lateral canal and pipelines to serve its customers. The oldest facilities are concrete lined canals and mortar joint pipeline. The newer laterals are rubber joint concrete and PVC pipeline.

The District canals are regulated by a set of numerous locks or gate structures that maintain water levels as the water moves from a high of 63' above sea level at the river to approximately 45' above sea level on the north end of the District.

BAYVIEW IRRIGATION DISTRICT NO. 11

Bayview Irrigation District serves only irrigators directly, but passes water through to Laguna Madre Water District. The conveyance system is primarily open canals, estimated at 68% efficiency.

Table 5-23 Bayview Irrigation District No. 11 Conservation WMS

Cost Estimate Summary *Bayview Irrigation District* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$4,591,314
Installation of Pipeline	$2,902,080
General Repairs and Improvements	$1,165,305
TOTAL COST OF PROJECT	**$8,658,699**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$686,781
O&M Cost (based on reduced pumping and canal rider costs)	-$21,436
TOTAL ANNUAL COST	$665,345
Available Project Yield (acft/yr)	1750
Annual Cost of Water ($ per acft)	$380
Annual Cost of Water ($ per 1,000 gallons)	$1.17

BROWNSVILLE IRRIGATION DISTRICT

Brownsville Irrigation District only delivers water to irrigators, but the district holds 3,500 municipal water rights, which are sold to El Jardin and McAllen and diverted by Brownsville Public Utility and Hidalgo County Water Improvement District No. 3, respectively. The conveyance system in this district is primarily pipeline. In 2020, this district is expected to divert approximately 15,874 acre-ft., for an estimated potential conservation of 3,492 acre-ft.

The District is approximately 20,000 acres (31.25 square miles) with off channel storage of 2,000 acre-ft. in resacas. The conveyance system has 162 miles of underground pipeline that delivers water to the field by 14 inch alfalfa valves. There are three pumps at the river, two 40 cubic feet per second (cfs) and one 80 cfs, that deliver water to the resacas. The water is delivered to the fields through pipeline by 9 pump stations located on the Resaca banks throughout the district. The District's efficiency is estimated at 68%.

Table 5-24 Brownsville Irrigation District Conservation WMS

Cost Estimate Summary *Brownsville Irrigation District* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Installation/Improvement of Pipeline	$2,387,531
General Repairs and Improvements	$10,475,983
TOTAL COST OF PROJECT	**$12,863,514**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,020,294
O&M Cost (based on reduced pumping and canal rider costs)	-$20,647

Cost Estimate Summary ***Brownsville Irrigation District*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
TOTAL ANNUAL COST	**$999,647**
Available Project Yield (acft/yr)	2264
Annual Cost of Water ($ per acft)	$442
Annual Cost of Water ($ per 1,000 gallons)	$1.36
Installation/Improvement of Pipeline	$2,387,531

CAMERON COUNTY IRRIGATION DISTRICT NO. 2

The District is in the central portion of Cameron County, and has a network of 312 miles of main canals and pipelines, 241 total miles of lateral canals and pipelines. Unlined canals comprise 120 miles, lined canals account for 17 miles, enclosed pipelines for 104 miles. Current reservoir capacity is approximately 5,000 acre-ft. The earthen canals experience water losses through both seepage and evaporation. Since the District's 2009 Water Conservation Plan, 10.3 miles of canal were converted to pipeline. Strategies submitted by Cameron County ID No. 2 to the RWPG include 11 pipeline installations, one pipeline replacement, and lining of six canals.

CCID No. 2 delivers water to irrigators in Cameron County and raw water to East Rio Hondo WSC and the cities of San Benito and Rio Hondo.

Table 5-25 Cameron County ID No. 2 Conservation WMS

Cost Estimate Summary ***Cameron County Irrigation District No. 2, San Benito*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Canal Lining 13-A1 North Pipeline	$17,043
Canal 13-A1 South Pipeline	$125,880
Canal 13-B Pipeline	$65,647
Canal 13-B1 Pipeline	$282,180
Canal 13-BR Pipeline	$152,456
Canal 23 Pipeline	$377,174
Canal 25 Pipeline	$399,794
Canal 27 Pipeline	$433,152
Canal 52B North Pipeline	$14,607
Canal B North Lining	$258,651
Canal B South Lining	$2,380,125
Canal B North-North Pipeline	$206,884
Canal B North-South Pipeline	$53,298
Upper Canal C lining	$349,018
Canal 13-A1 Lining	$971,534
Resaca By-Pass Pipeline	$54,478,230
Canal Lining for 13-A	$2,230,216
Canal D lining	$349,018
TOTAL COST OF PROJECT	**$63,144,906**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$5,601,602
O&M Cost (based on reduced pumping and canal rider costs)	-$85,557

Cost Estimate Summary *Cameron County Irrigation District No. 2, San Benito* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
TOTAL ANNUAL COST	**$5,516,045**
Available Project Yield (acft/yr)	8,264
Annual Cost of Water ($ per acft)	$668
Annual Cost of Water ($ per 1,000 gallons)	$2.05

CAMERON COUNTY IRRIGATION DISTRICT NO. 6 (LOS FRESNOS)

Cameron County ID No. 6 is predominantly open canal. This district provides water to irrigation users in Cameron County and to the cities of Los Fresnos, Olmito, and Brownsville PUB.

Table 5-26 Cameron County ID No. 6 Conservation WMS

Cost Estimate Summary *Cameron County Irrigation District No. 6, Los Fresnos* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$12,288,345
Installation of Pipeline	$7,767,224
General Repairs and Improvements	$4,531,741
TOTAL COST OF PROJECT	**$24,587,310**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,950,189
O&M Cost (based on reduced pumping and canal rider costs)	-$58,510
TOTAL ANNUAL COST	**$1,891,679**
Available Project Yield (acft/yr)	4902
Annual Cost of Water ($ per acft)	$385.90
Annual Cost of Water ($ per 1,000 gallons)	$1.18

CAMERON COUNTY IRRIGATION DISTRICT NO. 16

Cameron County ID No. 16 is predominantly open canal. This district provides water to irrigation users in Cameron County.

Table 5-27 Cameron County ID No. 16 Conservation WMS

Cost Estimate Summary *Cameron County Irrigation District No. 16* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$631,671
Installation of Pipeline	$399,267
General Repairs and Improvements	$362,759
TOTAL COST OF PROJECT	**$1,393,698**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$110,544
O&M Cost (based on reduced pumping and canal rider costs)	-$3,112
TOTAL ANNUAL COST	**$107,432**

Cost Estimate Summary ***Cameron County Irrigation District No. 16*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Available Project Yield (acft/yr)	272
Annual Cost of Water ($ per acft)	$395
Annual Cost of Water ($ per 1,000 gallons)	$1.21

CAMERON COUNTY WATER IMPROVEMENT DISTRICT NO. 10

Cameron County WID No. 10 is predominantly open canal. This district provides water to irrigation users in Cameron County.

Table 5-28 Cameron County ID No. 10 Conservation WMS

Cost Estimate Summary ***Cameron Co W.I.D No. 10, Rutherford Harding*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Canal Lining	$924,112
Installation of Pipeline	$584,113
General Repairs and Improvements	$511,439
TOTAL COST OF PROJECT	**$2,019,664**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$160,193
O&M Cost (based on reduced pumping and canal rider costs)	-$4,538
TOTAL ANNUAL COST	**$155,656**
Available Project Yield (acft/yr)	395
Annual Cost of Water ($ per acft)	$394.07
Annual Cost of Water ($ per 1,000 gallons)	$1.21

HARLINGEN IRRIGATION DISTRICT NO. 1

Harlingen ID's conveyance system is both pipeline and canal, with slightly more canals. This system serves both irrigators in Cameron County and the cities of Harlingen and the Military Highway WSC. Harlingen ID No. 1 submitted two strategies converting earthen canal into pipeline, one strategy converting a concrete lined canal into pipeline, and improvements to Simmons Spur area. These are components of the Irrigation District Conservation strategy cost and yield estimates shown in Table 5-29.

Table 5-29 Harlingen ID No. 1 Conservation WMS

Cost Estimate Summary ***Harlingen Irrigation District*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Earthen canal into pipeline-Canal No. 4	$810,908
Earthen canal into pipeline-Canal No. 5	$331,904
Concrete lined canal into pipeline-Canal No. 1	$1,769,466
Simmons Spur Improvements	$350,000
TOTAL COST OF PROJECT	**$3,262,278**

Cost Estimate Summary *Harlingen Irrigation District* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$258,754
O&M Cost (based on reduced pumping and canal rider costs)	-$16,352
TOTAL ANNUAL COST	**$242,402**
Available Project Yield (acft/yr)	1137
Annual Cost of Water ($ per acft)	$213
Annual Cost of Water ($ per 1,000 gallons)	$0.65

LA FERIA IRRIGATION DISTRICT, CAMERON COUNTY NO. 3

La Feria Irrigation District has a 2,000 acre-ft. storage capacity reservoir that is supplied by a 5.3-mile long unlined main canal from the primary pump station. A secondary pump station transfers the water from the reservoir through a network of canals, laterals, and pipelines. The conveyance system includes approximately 22.5 miles of lined canals, 21.3 miles of unlined canals, and 120 miles of pipeline. La Feria ID delivers water to irrigators in Cameron County, Sebastian MUD, Santa Rosa, La Feria, other Cameron County users, and Domestic users.

Water Management Strategies were submitted by La Feria ID to the RWPG, including lining of the Main Canal and replacement of the Wilson Canal lateral.

Table 5-30 La Feria ID Conservation WMS

Cost Estimate Summary *La Feria Irrigation District 3* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Lining of La Feria Main Canal from the La Feria Reservoir to High Canal Rd	$26,000,000
Lining of La Feria Main Canal from the River Pump to La Feria Reservoir	$22,500,000
Replacement of the 6.0 Lateral Lining (Wilson Canal)	$2,800,000
TOTAL COST OF PROJECT	**$51,300,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,068,957
O&M Cost (based on reduced pumping and canal rider costs)	-$46,563
TOTAL ANNUAL COST	**$4,022,394**
Available Project Yield (acft/yr)	8750
Annual Cost of Water ($ per acft)	$460
Annual Cost of Water ($ per 1,000 gallons)	$1.41

VALLEY ACRES IRRIGATION DISTRICT

Valley Acres ID is located primarily in Cameron County, with 12% of the total District area in Hidalgo County. Valley Acres delivers water to irrigators in both counties and industrial users in Hidalgo County. This conveyance system is primarily pipelines and has a number of resacas and reservoirs that constitute a significant source of evaporative losses.

Table 5-31 Valley Acres ID Conservation WMS

Cost Estimate Summary ***Valley Acres Irrigation District*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Canal Lining	$1,491,446
Installation of Pipeline	$942,714
TOTAL COST OF PROJECT	**$2,434,160**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$193,070
O&M Cost (based on reduced pumping and canal rider costs)	-$6,659
TOTAL ANNUAL COST	**$186,412**
Available Project Yield (acft/yr)	510
Annual Cost of Water ($ per acft)	$366
Annual Cost of Water ($ per 1,000 gallons)	$1.12

WUG and WUG/WWP

Cameron County WUG and WUG/WWP that have recommended strategies with capital costs which do not have individual maps associated with them are represented in Figure 5-2. A list of these WMS and their map numbers is given in Table 5-32.

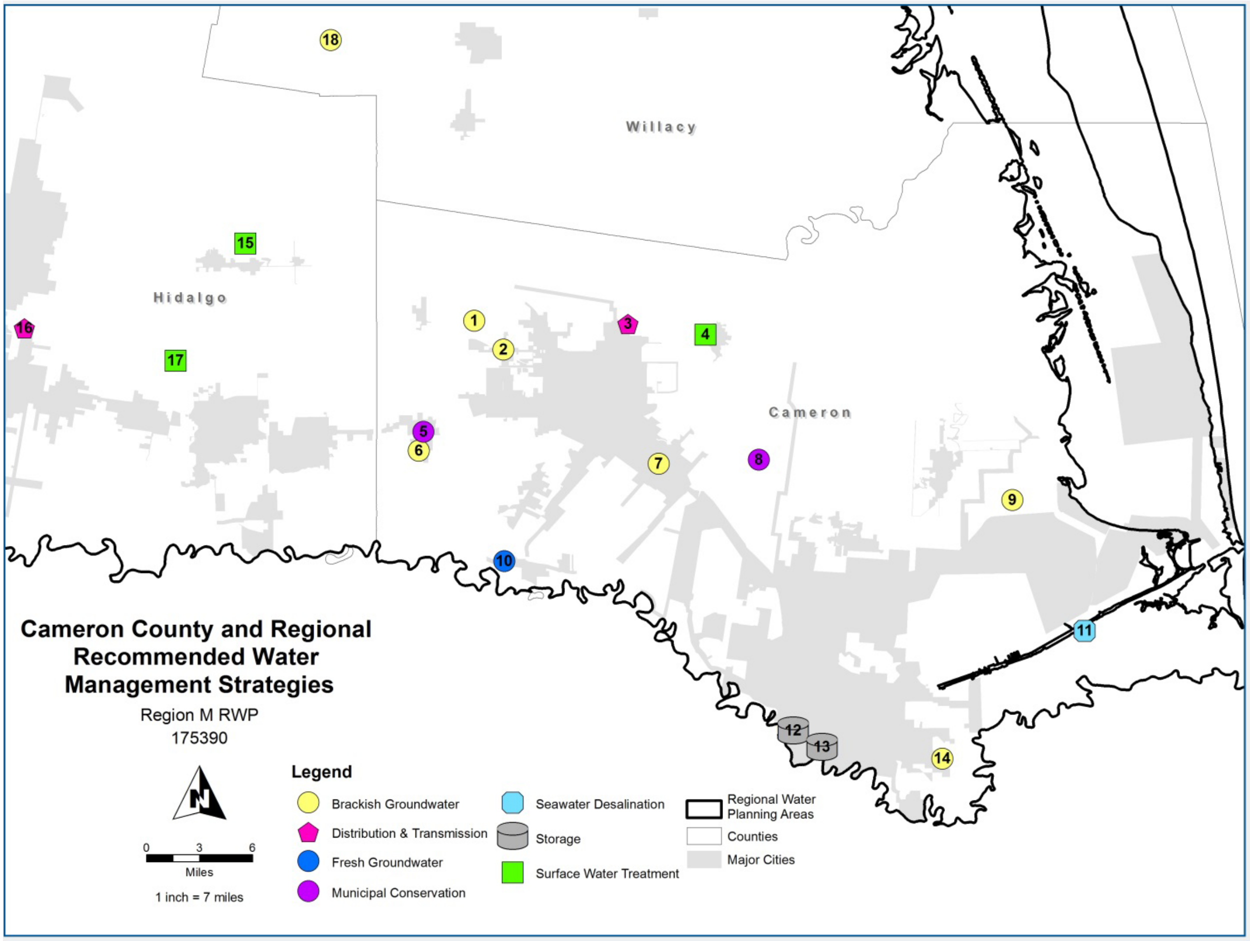

Figure 5-2 Cameron County and Regional Recommended WMS

Table 5-32 Map Legend: Cameron County and Regional Recommended Water Management Strategies

Map Number	Entity	Water Management Strategy Name	Water Management Strategy Category
1	East Rio Hondo WSC & North Alamo WSC	North Cameron Regional WTP Wellfield Expansion	Brackish Groundwater
2	Primera	Brackish Groundwater Desalination	Brackish Groundwater
3	East Rio Hondo WSC	Harlingen Waterworks Interconnect	Distribution & Transmission
4	East Rio Hondo WSC	Surface Water Treatment Plant	Surface Water Treatment
5	La Feria	Rainwater Harvesting	Municipal Conservation
6	La Feria	Water Well with R.O. Unit	Brackish Groundwater
7	San Benito	New Brackish Groundwater Supply	Brackish Groundwater
8	East Rio Hondo WSC	UV Disinfection – FM 510 WTP	Municipal Conservation
9	Laguna Madre Water District	New Brackish Water Treatment Plant	Brackish Groundwater

Map Number	Entity	Water Management Strategy Name	Water Management Strategy Category
10	Military Highway WSC	Expand Existing Groundwater Wells	Fresh Groundwater
11	Brownsville Public Utilities Board	Seawater Desalination Plant	Seawater Desalination
12	Brownsville Public Utilities Board	Banco Morales Reservoir	Storage
13	Brownsville Public Utilities Board	Resaca Restoration	Storage
14	El Jardin WSC	New Brackish Groundwater Treatment Plant	Brackish Groundwater
15	North Alamo WSC	Expansion of Delta Water Treatment Plant	Surface Water Treatment
16	North Alamo WSC	NAWSC Delta Area Brackish Groundwater Desalination Plant	Brackish Groundwater
17	North Alamo WSC	Expansion of Water Treatment Plant No. 5	Surface Water Treatment
18	North Alamo WSC	NAWSC La Sara Desalination Plant Expansion	Brackish Groundwater

BROWNSVILLE

Table 5-33 Brownsville Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supplier**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Demand	Yes		36,092	41,913	47,986	54,797	62,040	69,520
El Jardin	Yes		1,704	1,931	2,172	2,447	2,744	3,052
Manufacturing, Cameron			220	220	220	220	220	220
Steam-Electric, Cameron			125	125	125	125	125	125
Total Demands			**38,141**	**44,189**	**50,503**	**57,589**	**65,129**	**72,917**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			43,601	43,601	43,601	43,601	43,601	43,601
El Jardin			1,500	1,500	1,500	1,500	1,500	1,500
Manufacturing, Cameron			220	220	220	220	220	220
Steam-Electric, Cameron			125	125	125	125	125	125
Total			**45,446**	**45,446**	**45,446**	**45,446**	**45,446**	**45,446**
WWP Needs (Surplus +/ Need -)			7,305	1,257	-5,057	-12,143	-19,683	-27,471
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: CCID #6*		$386	84	101	119	136	153	170
Brownsville Advanced Municipal Conservation*		$652	1081	2695	2421	2396	2608	2880
El Jardin Advanced Municipal Conservation**		$652	0	0	37	138	275	438
Need after Conservation			**1,291**	**2,921**	**2,701**	**2,795**	**3,160**	**3,613**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville Resaca Restoration	$12,396,000	$1,182	877	877	877	877	877	877
Brownsville Banco Morales Reservoir	$8,853,000	$168	3,835	3,850	3,864	3,878	3,891	3,906
Non-Potable Water Reuse Pipeline***	$32,271,000	$1,094	6,721	6,721	6,721	6,721	6,721	6,721

Brownsville Southside WWTP Potable Reuse - Phase I	$36,282,000	$1,651	0	4,000	4,000	4,000	0	0
Brownsville Southside WWTP Potable Reuse - Phase II	$9,822,000	$1,153	0	0	0	0	5,000	5,000
Brownsville Seawater Desalination Demonstration (Phase I)	$56,002,000	$5,522	2,800	2,800	2,800	2,800	0	0
Brownsville Seawater Desalination Demonstration (Phase II)	$309,531,000	$3,646	0	0	0	0	28,000	28,000
Surplus/Deficit after WMS			**15,524**	**21,169**	**20,963**	**21,071**	**47,649**	**48,117**
Total Supplies with WMS			**60,845**	**66,490**	**66,284**	**66,392**	**92,970**	**93,438**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			51,761	56,816	56,573	56,579	81,542	81,845
El Jardin			1,790	2,308	2,345	2,447	3,236	3,400
Manufacturing, Cameron			358	382	382	382	897	898
Steam-Electric, Cameron			6,936	6,984	6,984	6,984	7,295	7,295
Total WWP Surplus/Deficit			**22,704**	**22,301**	**15,781**	**8,803**	**27,841**	**20,521**
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total WUG Surplus/Deficit			15,669	14,903	8,587	1,782	19,502	12,325
El Jardin			86	377	173	0	492	348
Manufacturing, Cameron			138	162	162	162	677	678
Steam-Electric, Cameron			6,811	6,859	6,859	6,859	7,170	7,170
Alternative Strategies - WUG Supply	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville/Matamoros Weir and Reservoir	$20,508,000	$77	17,821	17,887	17,953	18,020	18,086	18,152
Valley MUD #2 New BGD Plant		$6,430	0	0	0	0	10	10
RGRWA Regional Facility Project		$3,237	0	0	500	7,600	15,150	22,950

* Full WMS supply to Brownsville
** Full WMS supply to El Jardin
*** Full WMS supply to Steam-Elec, Cameron

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Brownsville's 2011 GPCD was estimated at 162, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Resaca Restoration

Project Source

This strategy was submitted by the City of Brownsville to the RWPG.

Description

This strategy is to restore resacas within the boundaries of the City of Brownsville. The three main systems to be restored are the Town Resaca, Resaca de la Guerra, and Resaca Del Rancho Viejo. Restoring the resacas will increase raw water storage and storm water capacity, improved water quality, habitat restoration, bank stabilization, and improved aesthetics.

Available Supply

This strategy is estimated to save 877 acre-ft./year.

Environmental Issues

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. 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.

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.

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.

Engineering and Costing

Total construction costs for the project are estimated at $8,871,000 per the submitted strategy. This construction cost was entered into the UCM to determine other cost metrics.

Table 5-34 outlines the estimate project costs.

Table 5-34 Brownsville Resaca Restoration Project Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville Public Utility Board - Resaca Restoration***	
Item	***Estimated Costs for Facilities***
Resaca Restoration	$8,871,000
TOTAL COST OF FACILITIES	**$8,871,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,105,000
Interest During Construction (4% for 1 years with a 1% ROI)	$420,000
TOTAL COST OF PROJECT	**$12,396,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,037,000
Operation and Maintenance	

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville Public Utility Board - Resaca Restoration***	
Item	***Estimated Costs for Facilities***
TOTAL ANNUAL COST	**$1,037,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	877
Annual Cost of Water ($ per acft)	$1,182
Annual Cost of Water ($ per 1,000 gallons)	$3.63

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 must also be considered to minimize the chances of offensive odors and stormwater runoff of the solids.

Banco Morales Reservoir

Project Source

This strategy was submitted by the City of Brownsville to the RWPG.

Description

This strategy is for the construction of an off-channel raw water reservoir to capture excess water from the lower Rio Grande that currently flows into the Gulf of Mexico. Water is currently released from the Falcon Dam with no opportunity to capture water at a downstream location in the event of rain or changed conditions. The Reservoir would be located between the existing International Boundary and Water Commission (IBWC) levee system and the City of Brownsville's levee along the Rio Grande, adjacent to Brownsville PUB's Water Treatment Plant No. 1.

Available supply

In addition to other water rights, Brownsville PUB currently has authorization to divert up to 40,000 acre-ft./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. This proposed strategy would add an additional 400 million gallons of storage capacity for the excess flows. The Rio Grande Water Availability Model (WAM) includes an evaluation of the drought year reliability for the Permit No. 1838. The estimated firm yield is based on the proportional capacity of the Banco Morales Reservoir compared with the capacity of the Brownsville Weir.

Environmental Issues

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. However, many of the environmental issues that have been raised regarding the Banco Morales Reservoir may be addressed through the Section 404/10 Federal permitting process and preparation of an Emergency Action Plan (EAP) through the TCEQ.

Engineering and Costing

The UCM was used to determine estimate costs for construction and maintenance of the reservoir. It is assumed that the construction period for this strategy is one year. Table 5-35 outlines the project requirements and estimated costs.

Table 5-35 Banco Morales Reservoir Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville Public Utility Board - Banco Morales Reservoir***	
Item	***Estimated Costs for Facilities***
Off-Channel Storage/Ring Dike (Conservation Pool 1228 acft, 60 acres)	$6,067,000
TOTAL COST OF FACILITIES	**$6,067,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,123,000
Environmental & Archaeology Studies and Mitigation	$180,000
Land Acquisition and Surveying (60 acres)	$183,000
Interest During Construction (4% for 1 years with a 1% ROI)	$300,000
TOTAL COST OF PROJECT	**$8,853,000**
ANNUAL COST	
Reservoir Debt Service (5.5 percent, 40 years)	$552,000
Operation and Maintenance	
Dam and Reservoir (1.5% of Cost of Facilities)	$91,000
TOTAL ANNUAL COST	**$643,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	3,835
Annual Cost of Water ($ per acft)	$168
Annual Cost of Water ($ per 1,000 gallons)	$0.51

Implementation Issues

Brownsville PUB will need complete the Environmental Compliance Requirements and obtain a federal 404 permit authorization. Brownsville PUB would operate this project in conjunction with their existing flows diversion Permit No. 1838, which authorizes diversions of excess flows from the Rio Grande of 40,000 acre-ft./year.

Seawater Desalination Demonstration and Implementation

Project Source

This strategy was submitted by the City of Brownsville to the RWPG.

Description

This strategy is for the construction of a 2.5 MGD seawater desalination facility on the south shore of the Brownsville Ship Channel. In anticipation of a future expansion to a 25 MGD facility, this strategy includes some full-scale components like the intake system, concentrate disposal system, and land acquisition.

Available Supply

This strategy would start with a desalination demonstration in 2020, supplying 2.5 MGD of drinking water. It is assumed that the full-scale, 25 MGD desalination facility will be constructed by 2060 when Brownsville's drinking water demand exceeds their current water treatment capacity.

Engineering and Costing

This strategy includes two separate costs. One cost is for the initial 2.5 MGD demonstration, including an intake structure, piping, land acquisition, and treatment. The second cost includes the facility expansion to 25 MGD, including expanded intake structure and pipeline.

This strategy proposes construction and implementation of alternative energy generation facilities, including wind generation and landfill gas reclamation. These alternatives could not be incorporated into the UCM and are not included in the costs presented.

Table 5-36 and Table 5-37 outline the estimated costs and project requirements used to develop the cost estimate in the UCM.

Table 5-36 Brownsville PUB Seawater Desalination Demonstration Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option Brownsville Public Utilities Board - Seawater Desalination Demonstration	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (2.6 MGD)	$1,111,000
Transmission Pipeline (12 in dia., 300 feet)	$14,000
Two Water Treatment Plants (2.5 MGD and 2.5 MGD)	$38,251,000
TOTAL COST OF FACILITIES	**$39,376,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$13,781,000
Environmental & Archaeology Studies and Mitigation	$24,000
Land Acquisition and Surveying (8 acres)	$27,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$2,794,000
TOTAL COST OF PROJECT	**$56,002,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,686,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$28,000
Water Treatment Plant (2.5% of Cost of Facilities)	$10,717,000
Pumping Energy Costs (335533 kW-hr @ 0.09 $/kW-hr)	$30,000
TOTAL ANNUAL COST	**$15,461,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,800
Annual Cost of Water ($ per acft)	$5,522
Annual Cost of Water ($ per 1,000 gallons)	$16.94

Table 5-37 Brownsville PUB Seawater Desalination Implementation Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option Brownsville Public Utilities Board - Seawater Desalination Implementation	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$3,999,000
Transmission Pipeline (36 in dia., 300 feet)	$71,000
Two Water Treatment Plants (25 MGD and 25 MGD)	$272,729,000
TOTAL COST OF FACILITIES	**$276,799,000**

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville Public Utilities Board - Seawater Desalination Implementation***	
Item	***Estimated Costs for Facilities***
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$96,876,000
Environmental & Archaeology Studies and Mitigation	$92,000
Land Acquisition and Surveying (31 acres)	$101,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$19,629,000
TOTAL COST OF PROJECT	**$393,497,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$32,928,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$101,000
Water Treatment Plant (2.5% of Cost of Facilities)	$75,576,000
Pumping Energy Costs (3300293 kW-hr @ 0.09 $/kW-hr)	$297,000
TOTAL ANNUAL COST	**$108,902,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	28,000
Annual Cost of Water ($ per acft)	$3,889
Annual Cost of Water ($ per 1,000 gallons)	$11.93

Implementation Issues

Financing a full-scale seawater desalination facility is a major implementation issue. The Brownsville Public Utilities Board is in the process of researching potential federal, state, and local funding sources to help finance this strategy.

Brownsville PUB Non-Potable Water Reuse Pipeline

Project Source

This strategy was submitted by the City of Brownsville to the RWPG.

Description

The Brownsville Generating Station power plant requires cooling water in order to operate. This direct non-potable reuse strategy involves Brownsville Public Utilities Board (BPUB) sending the power plant treated wastewater effluent, in lieu of providing potable water to be used for cooling water demand. The Brownsville PUB Robindale Wastewater Treatment Plant is located near the Brownville Generating Station and has sufficient capacity to provide reuse water.

A map of the proposed non-potable reuse line is shown in Figure 5-3.

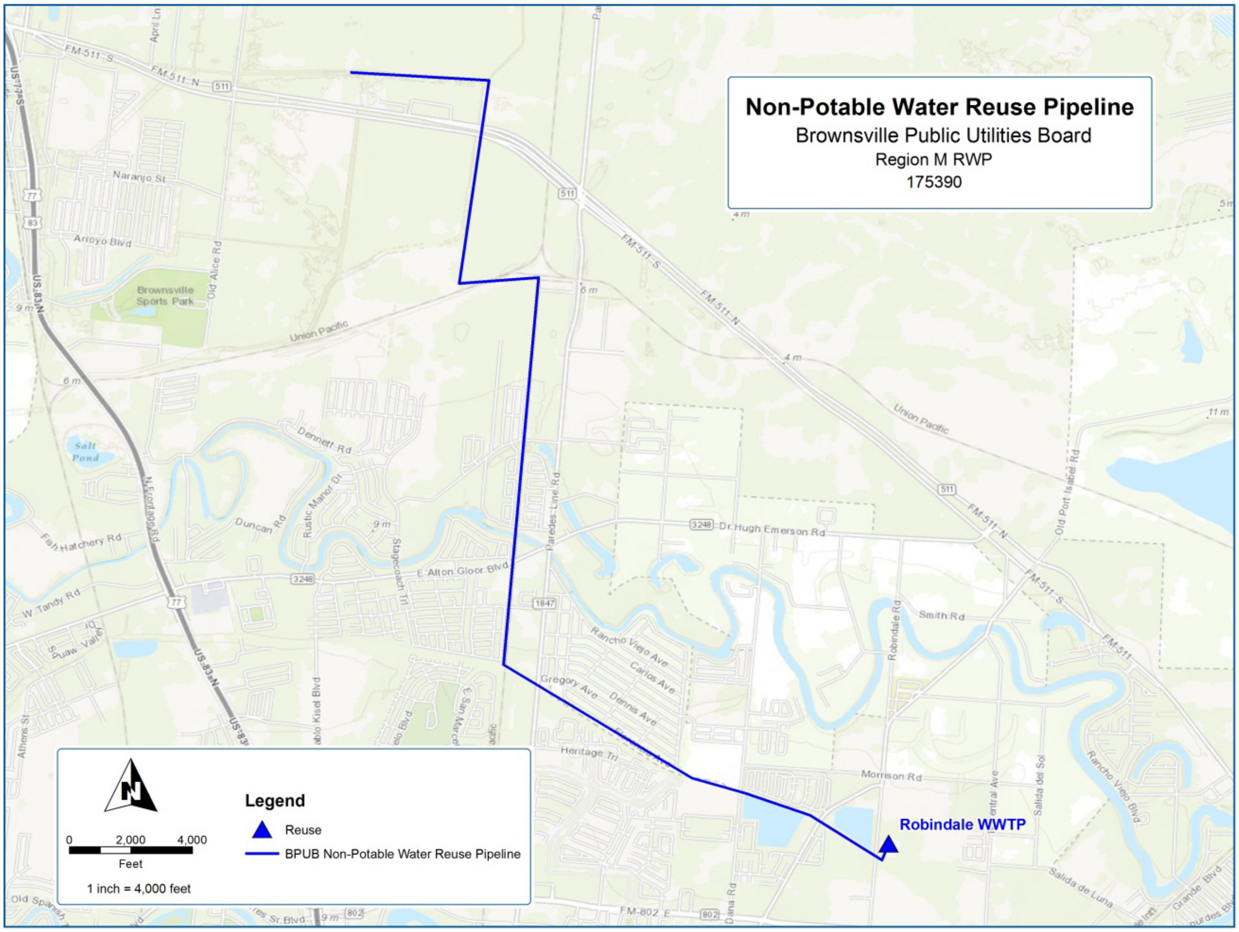

Figure 5-3 Brownsville PUB Non-Potable Water Reuse Pipeline Location

Available Supply

In a drought year, 6 MGD of reclaimed wastewater will be sent to the Brownsville Generating Station, however the project will be sized for a peak flow of 12 MGD, or 13,442 acre-ft./year.

Engineering and Costing

The Brownsville PUB Non-potable Reuse project would consist of pumping and pipeline infrastructure to transfer the reclaimed water to the power plant, a storage tank, and additional treatment facilities to treat the wastewater effluent to the water quality needed for cooling water. It is assumed that the construction period would be 1.5 years.

Table 5-38 summarizes the project requirements and costs estimated in UCM.. It was assumed that additional filtration at the wastewater treatment plants will be needed; therefore Treatment Level 2, Simple Filtration, was used in UCM.

Table 5-38 Brownsville PUB Non-Potable Reuse Pipeline Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Brownsville Public Utilities Board - Non-Potable Water Reuse Pipeline*	
Item	***Estimated Costs for Facilities***
Pump Station (12 MGD)	$3,658,000
Transmission Pipeline (30 in dia., 9 miles)	$11,371,000
Storage Tanks (Other Than at Booster Pump Stations)	$699,000
Water Treatment Plant (12 MGD)	$7,000,000
TOTAL COST OF FACILITIES	**$22,728,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$7,386,000
Environmental & Archaeology Studies and Mitigation	$213,000
Land Acquisition and Surveying (116 acres)	$334,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$1,610,000
TOTAL COST OF PROJECT	**$32,271,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,700,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$212,000
Water Treatment Plant (2.5% of Cost of Facilities)	$4,344,000
Pumping Energy Costs (1085723 kW-hr @ 0.09 $/kW-hr)	$98,000
TOTAL ANNUAL COST	**$7,354,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 2	6,721
Annual Cost of Water ($ per acft)	$1,094
Annual Cost of Water ($ per 1,000 gallons)	$3.36

Implementation Issues

Approval for a reclaimed water system is needed from TCEQ; however, Brownsville PUB has already submitted an application for this project and does not anticipate any issues with receiving it. Construction of the new pipeline may also include any of the following permits: U.S. Army Corps of Engineers Section 404 permit, TPWD Sand, Shell, Gravel and Marl permit, TPDES Storm Water Pollution Prevention Plan, TXDOT right-of-way permit.

Brownsville PUB Southside WWTP Potable Reuse

Project Source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the Brownville Southside Wastewater Treatment Facility to the Brownsville Water Treatment Plant No. 2.

A map of the recommended potable reuse strategy is shown in Figure 5-4.

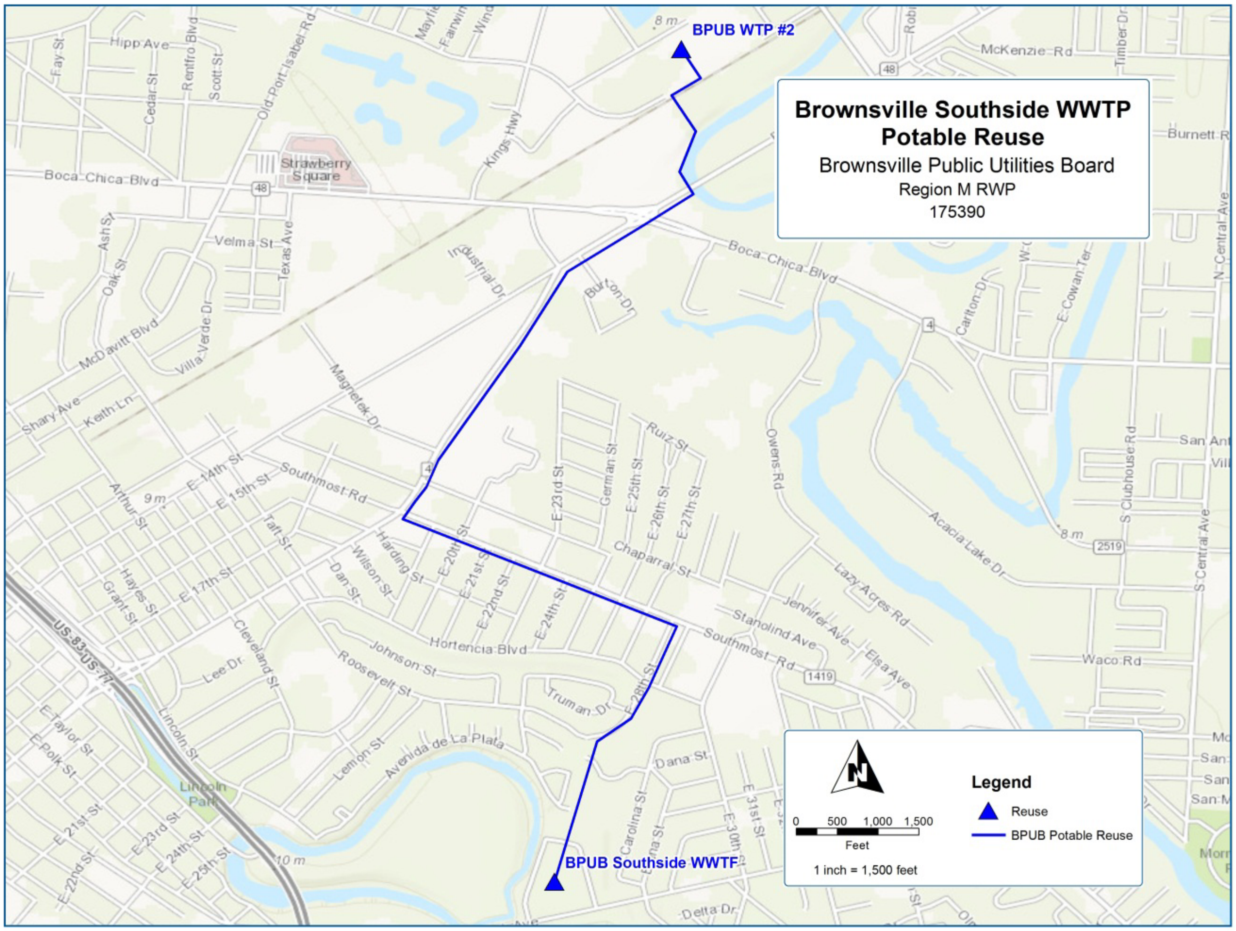

Figure 5-4 Brownsville Southside WWTP Potable Reuse Pipeline Location

Available Supply

Based on recorded wastewater treatment plant flows, the annual average flow for Brownsville Southside WWTP is 7.13 MGD. Approximately half of that flow is assumed to be available on a consistent basis therefore 3.57 MGD, or 4,000 acre-ft./year, would be produced for potable reuse in 2030. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 4,800 acre-ft./year of wastewater effluent would be used. The plant will be expanded to produce 5,000 acre-ft./year of potable reuse in 2060.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to Brownsville WTP No. 2 would be constructed. The pipeline and pump station would be built to handle the full build out flow during the first phase, but the treatment facilities would be expanded during Phase II construction. It is assumed that the construction period would be 2 years.

Table 5-39 and Table 5-40 outline the estimated costs and project requirements used to develop the cost estimate. Treatment Levels 2 and 4 were used in the UCM to estimate the costs for addition of the advanced treatment facilities.

Table 5-39 Brownsville PUB Potable Reuse Phase I Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville PUB - Southside WWTP Potable Reuse -Phase I***	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (5.4 MGD)	$2,100,000
Transmission Pipeline (18 in dia., 3 miles)	$3,222,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,958,000
Two Water Treatment Plants (3.6 MGD and 3.6 MGD)	$17,837,000
TOTAL COST OF FACILITIES	**$25,117,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$8,630,000
Environmental & Archaeology Studies and Mitigation	$63,000
Land Acquisition and Surveying (41 acres)	$98,000
Interest During Construction (4% for 2 years with a 1% ROI)	$2,374,000
TOTAL COST OF PROJECT	**$36,282,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,036,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$104,000
Water Treatment Plant (2.5% of Cost of Facilities)	$3,390,000
Pumping Energy Costs (796264 kW-hr @ 0.09 $/kW-hr)	$72,000
TOTAL ANNUAL COST	**$6,602,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	4,000
Annual Cost of Water ($ per acft)	$1,651
Annual Cost of Water ($ per 1,000 gallons)	$5.06

Table 5-40 Brownsville PUB Potable Reuse Phase II Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville PUB - Brownsville Southside WWTP Potable Reuse -Phase II***	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (0.9 MGD and 0.9 MGD)	$6,680,000
TOTAL COST OF FACILITIES	**$6,680,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,338,000
Environmental & Archaeology Studies and Mitigation	$63,000
Land Acquisition and Surveying (38 acres)	$98,000
Interest During Construction (4% for 2 years with a 1% ROI)	$643,000
TOTAL COST OF PROJECT	**$9,822,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$822,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Total Facilities)	$104,000

Cost Estimate Summary ***Water Supply Project Option*** ***Brownsville PUB - Brownsville Southside WWTP Potable Reuse -Phase II***	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (2.5% of Cost of Total Facilities)	$4,665,000
Pumping Energy Costs (1941895kW-hr @ 0.09 $/kW-hr)	$175,000
TOTAL ANNUAL COST	**$5,766,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	5,000
Annual Cost of Water ($ per acft)	$1,153
Annual Cost of Water ($ per 1,000 gallons)	$3.54

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

COMBES

Table 5-41 Combes Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			322	358	397	445	498	554
Total Supply			322	322	322	322	322	322
Projected Supply Surplus/Deficit			**0**	**-36**	**-75**	**-123**	**-176**	**-232**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Harlingen ID via Harlingen		$213	9	36	51	73	94	115
Advanced Municipal Conservation		$652	0	0	5	21	45	74
Need after Conservation			**9**	**0**	**-19**	**-29**	**-37**	**-43**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen WWTP 2 Potable Reuse		$1,957	0	0	39	39	39	43
Surplus/Deficit after WMS			**9**	**0**	**20**	**9**	**1**	**0**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BGD Plant	$3,891,000	$5,320	0	0	0	125	125	125
Harlingen New BGD Plant		$2,180	0	0	21	21	21	21

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Combes' 2011 GPCD was estimated at 94, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

EAST RIO HONDO WATER SUPPLY CORPORATION

Table 5-42 East Rio Hondo WSC Water Supply and Demand Analysis (Acre-feet/year)

Demands (AF/yr)	Sole Supplier		2020	2030	2040	2050	2060	2070
WUG Water Demand	Yes		3,826	4,372	4,948	5,589	6,269	6,973
Indian Lake****			51	38	46	56	74	94
County-Other (Immigration and Customs Enforcement)			182	182	182	182	182	182
Military Highway WSC (from water use survey)			513	513	513	513	513	513
Total Demands			**4,572**	**5,105**	**5,689**	**6,340**	**7,038**	**7,762**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			4,052	4,052	4,052	4,052	4,052	4,052
Indian Lake			37	37	37	37	37	37
County-Other (Immigration and Customs Enforcement)			182	182	182	182	182	182
Military Highway WSC			33	33	33	33	33	33
Total			**4,304**	**4,304**	**4,304**	**4,304**	**4,304**	**4,304**
WWP Needs (Surplus +/ Need -)			**-268**	**-801**	**-1,385**	**-2,036**	**-2,734**	**-3,458**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: CCID #2		$668	537	657	777	897	1,017	1,137
ID Conservation: Harlingen ID		$213	6	20	34	48	62	76
ID Conservation: Harlingen ID via Harlingen		$213	6	36	45	82	117	156
Advanced Municipal Conservation*		$652	1	58	245	502	830	1,214
Need after Conservation			**401**	**89**	**-164**	**-388**	**-588**	**-755**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
FM 2925 Water Transmission Line*	$5,089,000	$16,000	30	30	30	30	30	30
UV Disinfection - FM 510 WTP*	$687,000	$24,282	11	11	11	11	11	11
North Cameron Regional WTP Wellfield Expansion**	$1,881,000	$843	400	400	400	400	400	400
Harlingen WW Interconnect*	$3,268,000	$1,766	112	112	112	0	0	0
Bean Road Water Transmission Pipeline	$4,000,000		0	0	0	0	0	0
Surface Water Treatment Plant and WR Purchase***	$34,794,000	$5,963	800	800	800	800	800	800
Acquisition of Water Rights through Urbanization (WTP)	$26,448,000	N/A	0	0	0	0	0	0
Harlingen WWTP 2 Potable Reuse*		$1,957	0	0	26	26	26	26
Surplus/Deficit after WMS			1,754	1,442	1,215	880	679	512

Total Supplies with WMS			6,326	6,547	6,904	7,220	7,717	8,274
WUG Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			5,304	5,578	6,119	6,688	7,510	8,447
Indian Lake			162	163	164	166	167	169
County-Other (Immigration and Customs Enforcement)			182	182	182	182	182	182
Military Highway WSC			560	562	564	566	569	571
Total WWP Surplus/Deficit			1,635	1,380	1,340	1,262	1,389	1,606
WUG Needs after WMS (+ Surplus / - Need)			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ERHWSC			1,478	1,206	1,171	1,099	1,241	1,474
Indian Lake			111	125	118	110	93	75
County-Other (Immigration and Customs Enforcement)			0	0	0	0	0	0
Military Highway WSC			47	49	51	53	56	58
Total			**1,635**	**1,380**	**1,340**	**1,262**	**1,389**	**1,606**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Surface Water TP (Phase II)	$14,540,000	$774	0	0	0	2,500	2,500	2,500
Harlingen New BGD Plant		$2,180	0	0	14	14	14	14
RGRWA Regional Facility Project		$3,237	0	50	650	1,300	2,000	2,700

* Full WMS supply to ERHWSC
** New capacity is split 1/3 to ERHWSC, 2/3 to NAWSC, requires Bean Road and Harlingen WW Interconnect to deliver
*** May include new WR or existing supplies from the 3,214 AF currently supplied by CCID
****Total demand minus 22 AF from Southmost

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. East Rio Hondo WSC's 2011 GPCD was estimated at 132, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Surface Water Treatment Plant</u>

Project Source

This strategy was submitted by East Rio Hondo WSC to the RWPG.

Description

This strategy is to construct a new surface water treatment plant just west of Rio Hondo and pipeline so that raw water would be pumped from Harlingen Irrigation District. The pipeline would reduce losses currently experienced in conveyance to treatment, and treatment capacity will be sufficient to handle current and future surface water rights.

Available Supply

The pump station and treatment plant would be designed for 5 MGD capacity. The plant will treat approximately 3,200 acre-ft./year of water rights currently owned by ERHWSC, and an estimated 800 acre-ft. of additional water rights available through conversion of irrigation water rights.

Engineering and Costing

Costs for this strategy from the UCM include a pump station, pipeline, land acquisition, and pipeline right-of-way and water treatment for Phase I of the strategy. Costs for Phase II of the strategy from the UCM only include a pump station expansion and treatment plant expansion. It is assumed that the construction period for this strategy is one year for Phase I, and six months for Phase II.

Due to the needs of East Rio Hondo, Phase I is considered a recommended strategy and Phase II is an alternative strategy.

Table 5-43 outlines the project requirements and cost estimate developed in UCM.

Table 5-43 ERHWSC Surface Water Treatment Plant, Phase I Project Requirements

Cost Estimate Summary Water Supply Project Option East Rio Hondo WSC - Surface Water Treatment Plant	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (3.8 MGD)	$1,362,000
Transmission Pipeline (36 in dia., 5 miles)	$4,736,000
Water Treatment Plant (5 MGD)	$17,349,000
TOTAL COST OF FACILITIES	**$24,807,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$8,446,000
Environmental & Archaeology Studies and Mitigation	$146,000
Land Acquisition and Surveying (67 acres)	$218,000
Interest During Construction (4% for 1 years with a 1% ROI)	$1,177,000
TOTAL COST OF PROJECT	**$34,794,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,911,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$81,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,735,000
Pumping Energy Costs (476916 kW-hr @ 0.09 $/kW-hr)	$43,000
TOTAL ANNUAL COST	**$4,770,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	800
Annual Cost of Water ($ per acft)	$5,963
Annual Cost of Water ($ per 1,000 gallons)	$18.30

Implementation Issues

The availability of surface water rights required to supply the treatment plant is a potential implementation issue.

<u>UV Disinfection – FM 510 WTP</u>

Project Source

This strategy was submitted by East Rio Hondo WSC to the RWPG.

Description

This strategy is for the addition of a UV disinfection system at the Martha A. Simpson Water Treatment Plant to decrease the usage of chloramines, resulting in less makeup water being used at the water treatment plant.

Available Supply

Approximately 11.2 acre-ft./year of water could be conserved with this strategy.

Engineering and Costing

An estimate capital cost was provided by Eat Rio Hondo WSC and it was put into the UCM to estimate other associated and unit costs. Table 5-47 outlines the estimated project costs.

Table 5-44 ERHWSC FM 510 WTP UV Disinfection System Estimated Costs

Cost Estimate Summary ***Water Supply Project Option*** ***East Rio Hondo WSC - FM 510 WTP UV Disinfection System***	
Item	***Estimated Costs for Facilities***
Water Treatment Plant Upgrade	$500,000
TOTAL COST OF FACILITIES	**$500,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$175,000
Interest During Construction (4% for 0.5 years with a 1% ROI)	<u>$12,000</u>
TOTAL COST OF PROJECT	**$687,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$57,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$215,000
TOTAL ANNUAL COST	**$272,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	11
Annual Cost of Water ($ per acft)	$24,286
Annual Cost of Water ($ per 1,000 gallons)	$74.52

Implementation Issues

No implementation issues have been identified yet.

<u>FM 2925 Water Transmission Line</u>

Project Source

This strategy was submitted by East Rio Hondo WSC to the RWPG.

Description

This strategy is for the installation of a potable water line from the East Rio Hondo WSC (ERHWSC) distribution system to Arroyo City. The existing Arroyo Water Supply Corporation (AWSC) WTP has been decommissioned due to cryptosporidium BIN2 categorization. Construction of this water line would provide treated water to Arroyo City, replacing the supply from the decommissioned WTP. This strategy was identified in the ERHWSC Master Plan to decommission the AWSC WTP and provide a potable water source to Arroyo City.

The approximate location of the FM 2825 Transmission Main is shown in Figure 5-5.

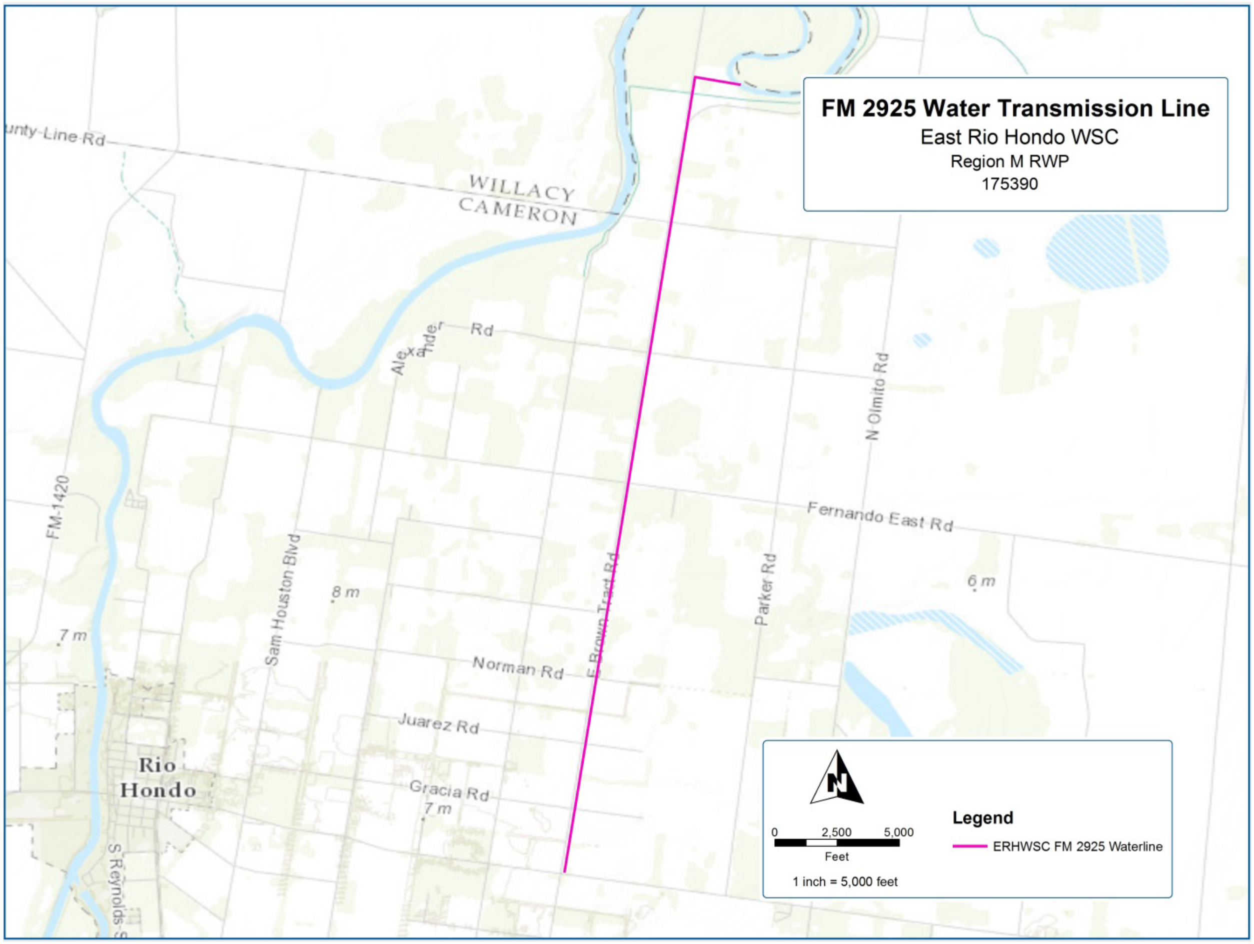

Figure 5-5 ERHWSC FM 2925 Transmission Line

Available Supply

This strategy will eliminate the losses associated with the current conveyance of supplies to Arroyo City. The drought year water savings is estimated at 30 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include a pump station, pipeline, land acquisition, and pipeline right-of-way. It is assumed that the construction period for this strategy is one year.

Table 5-45 outlines the estimated project requirements and costs.

Table 5-45 ERHWSC FM 2925 Water Transmission Line Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *East Rio Hondo WSC - FM 2925 Water Transmission Line*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0 MGD)	$726,000
Transmission Pipeline (12 in dia., 11 miles)	$2,447,000
TOTAL COST OF FACILITIES	**$3,173,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$988,000
Environmental & Archaeology Studies and Mitigation	$297,000
Land Acquisition and Surveying (142 acres)	$458,000
Interest During Construction (4% for 1 years with a 1% ROI)	$173,000
TOTAL COST OF PROJECT	**$5,089,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$426,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$43,000
Pumping Energy Costs (119356 kW-hr @ 0.09 $/kW-hr)	$11,000
TOTAL ANNUAL COST	**$480,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	30
Annual Cost of Water ($ per acft)	$16,000
Annual Cost of Water ($ per 1,000 gallons)	$49.09

Implementation Issues

No major implementation issues are anticipated for this strategy. Utility crossing permits and easements would be required for several entities including TX DOT, Cameron County, Cameron County Drainage District, and Cameron County Irrigation District.

North Cameron Regional WTP Wellfield Expansion

Project Source

This strategy was submitted by East Rio Hondo WSC to the RWPG on behalf of ERHWSC and NAWSC.

Description

This strategy is for the addition of a groundwater well to increase the brackish water supply to the existing North Cameron Regional Reverse Osmosis WTP (NCRWTP). The water treatment plant is located between the cities of Santa Rosa and Combes, increasing supplies to both the North Alamo WSC and East Rio Hondo WSC systems. ERHWSC's share of the supply would be delivered by the Bean Road Transmission Line.

Available Supply

The NCRWSC desalination plant currently treats 1.15 MGD of brackish water supplied by one groundwater well. The WTP has the capacity to treat 2.30 MGD raw water and this strategy would supply the additional 1.15 MGD of brackish water needed to bring the plant to full capacity. No additional treatment is necessary. ERHWSC would receive 400 acre-ft./year from the expansion.

Engineering and Costing

Capital costs from the UCM for this strategy include groundwater well pumping, well field piping, land acquisition, and permitting. Operations and Maintenance costs were estimated for the well and operating the desalination facility at capacity. It is assumed that the construction period would be no longer than one year.

Table 5-46 outlines the project requirements and cost estimate developed in UCM.

Table 5-46 North Cameron Regional WTP Wellfield Expansion Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***North Cameron Regional WTP Wellfield Expansion***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,040,000
Integration, Relocations, & Other	$300,000
TOTAL COST OF FACILITIES	**$1,340,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$469,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$64,000
TOTAL COST OF PROJECT	**$1,881,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$157,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$13,000
Water Treatment Plant (2.5% of Cost of Facilities)	$816,000
Pumping Energy Costs (283407 kW-hr @ 0.09 $/kW-hr)	$26,000
TOTAL ANNUAL COST	**$1,012,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,200
Annual Cost of Water ($ per acft)	$843
Annual Cost of Water ($ per 1,000 gallons)	$2.588

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

Harlingen Waterworks Interconnect

Project Source

This strategy was submitted by East Rio Hondo WSC to the RWPG.

Description

This strategy is to construct a treated water delivery source to East Rio Hondo WSC. Treated water would be pumped from Harlingen Water Works System to East Rio Hondo WSC.

Available Supply

The emergency interconnect would have the capacity to provide 2.5 MGD of treated water to East Rio Hondo WSC. However, Harlingen Water Works is only expected to use the emergency interconnect for a portion of each drought year and so supplies are based on a reliable annual supply.

Engineering and Costing

Costs for this strategy from the UCM include a pump station, pipeline, land acquisition, and pipeline right-of-way. It is assumed that the construction period for this strategy is one year.

Table 5-47 outlines the estimated project requirements and costs.

Table 5-47 ERHWSC Harlingen Waterworks Interconnect Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
East Rio Hondo WSC - Harlingen Waterworks Interconnect

Item	***Estimated Costs for Facilities***
Intake Pump Stations (0.2 MGD)	$645,000
Transmission Pipeline (6 in dia., 4 miles)	$624,000
TOTAL COST OF FACILITIES	**$1,269,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$413,000
Environmental & Archaeology Studies and Mitigation	$119,000
Land Acquisition and Surveying (56 acres)	$180,000
Interest During Construction (4% for 1 years with a 1% ROI)	$70,000
TOTAL COST OF PROJECT	**$2,051,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$172,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$22,000
Pumping Energy Costs (39474 kW-hr @ 0.09 $/kW-hr)	$4,000
TOTAL ANNUAL COST	**$198,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	112
Annual Cost of Water ($ per acft)	$1,768
Annual Cost of Water ($ per 1,000 gallons)	$5.42

Implementation Issues

No implementation issues have been identified.

Bean Road Water Transmission Line

Project Source

This strategy was submitted by East Rio Hondo WSC to the RWPG.

Description

East Rio Hondo WSC's distribution system is bisected by the Arroyo Colorado with only one small diameter water line connecting the east and west portions of the system. This project is for the installation of a large water line to transport water produced from the North Cameron Regional Water Plant from the distribution system on the west side of the Arroyo Colorado to the east side of the distribution system. This project is required in order to access the additional supplies made available by the expansion of North Cameron R.O. Plant and supplies from Harlingen Waterworks. This project was identified in the ERHWSC Master Plan as a source of potable water for the eastern portion of the ERHWSC distribution system.

Available Supply

This project would provide water to the eastern distribution system, however this is a supply within the water supply corporation and no new water is supplied therefore this project has a firm yield of zero.

Environmental Issues

Temporary impacts to residential yards, farm crops, and brush areas during construction are likely, but no major environmental impacts are expected.

Engineering and Costing

Costs for this strategy from the UCM include a pump station, pipeline, land acquisition, and pipeline right-of-way. It is assumed that the construction period for this strategy is one year. Table 5-48 outlines the project requirements and the cost estimate.

Table 5-48 ERHWSC Bean Road Water Transmission Line Project Requirements

Cost Estimate Summary ***Water Supply Project Option*** ***East Rio Hondo WSC - Bean Rd Water Transmission Line***	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0.6 MGD)	$737,000
Transmission Pipeline (16 in dia., 4 miles)	$2,005,000
TOTAL COST OF FACILITIES	**$2,742,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$859,000
Environmental & Archaeology Studies and Mitigation	$105,000
Land Acquisition and Surveying (49 acres)	$158,000
Interest During Construction (4% for 1 years with a 1% ROI)	$136,000
TOTAL COST OF PROJECT	**$4,000,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	**$335,000**
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$38,000
Pumping Energy Costs (74191 kW-hr @ 0.09 $/kW-hr)	$7,000
TOTAL ANNUAL COST	$380,000

Implementation Issues

No major implementation issues are anticipated for this strategy. Utility crossing permits and easements would be required for several entities including TX DOT, Cameron County, Cameron County Drainage District, and Cameron County Irrigation District.

EL JARDIN

Table 5-49 El Jardin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			1,704	1,931	2,172	2,447	2,744	3,052
Total Supply			1,500	1,500	1,500	1,500	1,500	1,500
Projected Supply Surplus/Deficit			-204	-431	-672	-947	-1,244	-1,552
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade (AF/yr)**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	37	138	275	438
Need after Conservation			-204	-431	-635	-809	-969	-1,114
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Jardin Brackish Desalination Plant	$8,272,000	$2,557	560	560	560	560	560	560
El Jardin Distribution Pipeline Replacement	$23,421,000	$192,909	11	11	11	11	11	11
Brownsville Resaca Restoration		$1,182	34	34	34	34	34	34
Brownsville Banco Morales Reservoir		$168	148	149	149	150	150	151
Brownsville Southside WWTP Potable Reuse -Phase I		$1,651	0	517	517	517	0	0
Brownsville Southside WWTP Potable Reuse -Phase II		$1,153	0	0	0	0	196	196
Brownsville Seawater Desalination Demonstration (Phase I)		$5,522	108	108	108	108	0	0
Brownsville Seawater Desalination Demonstration (Phase II)		$3,646	0	0	0	0	1081	1081
Surplus/Deficit after WMS			**657**	**948**	**744**	**571**	**1,063**	**919**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville/Matamoros Weir		$77	741	743	746	749	752	754

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. El Jardin's 2011 GPCD was estimated at 109, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Distribution Pipeline Replacement</u>

Project Source

This strategy was submitted by El Jardin WSC to the RWPG.

Description

This strategy is to replace approximately 313,910 linear feet of substandard water mains within the existing distribution system. The Corporation's distribution system was constructed in the mid 1960's and many of the original pipes are still being used today. This strategy would replace many of the 2, 3, 4, and 6-inch pipes that are leaking and possibly broken with 8-inch PVC pipe.

Available Supply

El Jardin WSC estimates that at least 3.6 million gallons of treated water could be saved each year with this strategy.

Engineering and Costing

Costs for this strategy from the UCM only include the cost of pipeline. It is assumed that the construction period for this strategy is one year.

Table 5-50 outlines the project requirements and cost estimate developed in UCM.

Table 5-50 El Jardin WSC Distribution Pipeline Replacement Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
El Jardin WSC - Upgrade Existing Distribution System

Item	***Estimated Costs for Facilities***
Transmission Pipeline (8 in dia., 65 miles)	$16,161,000
TOTAL COST OF FACILITIES	**$16,161,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,848,000
Environmental & Archaeology Studies and Mitigation	$1,619,000
Interest During Construction (4% for 1 years with a 1% ROI)	<u>$793,000</u>
TOTAL COST OF PROJECT	**$23,421,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,960,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$162,000
TOTAL ANNUAL COST	**$2,122,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	11
Annual Cost of Water ($ per acft)	$192,909
Annual Cost of Water ($ per 1,000 gallons)	**$591.93**

Implementation Issues

No significant implementation issues are associated with this strategy. Permits would be required by Cameron County and TX DOT.

<u>El Jardin Brackish Groundwater Desalination Plant</u>

Project Source

This strategy was identified by the RWPG.

Description

This strategy is for drilling a new brackish groundwater well and constructing a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates for El Jardin, the new brackish groundwater plant is sized to supply 560 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. Membrane treatment efficiency is assumed to be 80%, so the wells and wellfield piping are designed to 700 acre-ft./year. It is assumed that the construction period for this strategy is one and a half years.

Table 5-51 outlines the project requirements and cost estimate developed in UCM.

Table 5-51 El Jardin BGD Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***El Jardin - Brackish Groundwater Desalination***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$670,000
Water Treatment Plant (0.5 MGD)	$5,145,000
TOTAL COST OF FACILITIES	**$5,815,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,035,000
Environmental & Archaeology Studies and Mitigation	$7,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	<u>$413,000</u>
TOTAL COST OF PROJECT	**$8,272,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$692,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$726,000
Pumping Energy Costs (77322 kW-hr @ 0.09 $/kW-hr)	$7,000
TOTAL ANNUAL COST	**$1,432,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	560
Annual Cost of Water ($ per acft)	$2,557
Annual Cost of Water ($ per 1,000 gallons)	$7.846

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

HARLINGEN

Table 5-52 Harlingen Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supplier**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Demand	Yes		13,546	15,429	17,400	19,636	22,035	24,516
Combes	Yes		322	358	397	445	498	554
Palm Valley	Yes		285	324	365	411	462	514
ERHWSC			221	257	293	329	365	403
Military Highway WSC			144	144	144	144	144	144
Primera			400	400	400	400	400	400
County-Other, Cameron			153	153	153	153	153	153
Manufacturing, Cameron			185	185	185	185	185	185
Total Demands			**15,256**	**17,250**	**19,337**	**21,703**	**24,242**	**26,869**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			15,703	15,703	15,703	15,703	15,703	15,703
Combes			322	322	322	322	322	322
Palm Valley			285	285	285	285	285	285
ERHWSC			221	221	221	221	221	221
Military Highway WSC			144	144	144	144	144	144
Primera			400	400	400	400	400	400
County-Other, Cameron			153	153	153	153	153	153
Manufacturing, Cameron			185	185	185	185	185	185
Total			**17,413**	**17,413**	**17,413**	**17,413**	**17,413**	**17,413**
WWP Needs (Surplus +/ Need -)			**2,157**	**163**	**-1,924**	**-4,290**	**-6,829**	**-9,456**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Harlingen ID		$213	408	1418	2427	3437	4447	5457
Harlingen Advanced Municipal Conservation*		$652	401	1,540	2,260	3,258	4,523	5,974
Combes Advanced Municipal Conservation**		$652	0	0	5	21	45	74
Palm Valley Advanced Municipal Conservation***		$652	8	31	52	73	100	131
Need after Conservation			**2,974**	**3,152**	**2,820**	**2,499**	**2,286**	**2,180**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen Wastewater Treatment Plant 2 Potable Reuse - Harlingen Supply	$19,164,000	$1,957	0	0	1,825	1,825	1,825	1,825
Surplus/Deficit after WMS			2,974	3,152	4,645	4,324	4,111	4,005
Total Supplies with WMS			18,121	20,293	23,873	25,918	28,244	30,765

Water Supplies with WMS			2020	2030	2040	2050	2060	2070
WUG Water Supply			16,466	18,481	21,729	23,602	25,743	28,062
Combes			331	358	417	454	499	554
Palm Valley			301	342	416	456	502	552
ERHWSC			227	257	293	329	365	403
Military Highway WSC			148	157	184	194	203	213
Primera			411	437	511	538	564	591
County-Other, Cameron			157	167	196	206	216	226
Manufacturing, Cameron			190	202	237	249	261	273
Total WWP Surplus/Deficit			**2,974**	**3,152**	**4,646**	**4,325**	**4,112**	**4,005**
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total WUG Surplus/Deficit			2,920	3,052	4,329	3,966	3,708	3,546
Combes			9	0	20	9	1	0
Palm Valley			16	18	51	45	40	38
ERHWSC			6	0	0	0	0	0
Military Highway WSC			4	13	40	50	59	69
Primera			11	37	111	138	164	191
County-Other, Cameron			4	14	43	53	63	73
Manufacturing, Cameron			5	17	52	64	76	88
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen New BGD Plant	$12,327,000	$2,180	0	0	888	888	888	888
Non-potable Reuse Project	$6,898,000	$1,678	677	677	677	677	677	677
RGRWA Regional Facility Project		$3,237	0	0	1,100	3,500	6,050	8,700

* Full WMS supply to Harlingen
** Full WMS supply to Combes
*** Full WMS supply to Palm Valley

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Harlingen's 2011 GPCD was estimated at 168, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Harlingen Wastewater Treatment Plant 2 Potable Reuse

Project Source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the Harlingen Wastewater Treatment Plant 2 to the Harlingen Downtown Water Treatment Plant.

The approximate alignment of the Harlingen Watewater Treatment Plant 2 Reuse Pipeline is shown in Figure 5-6.

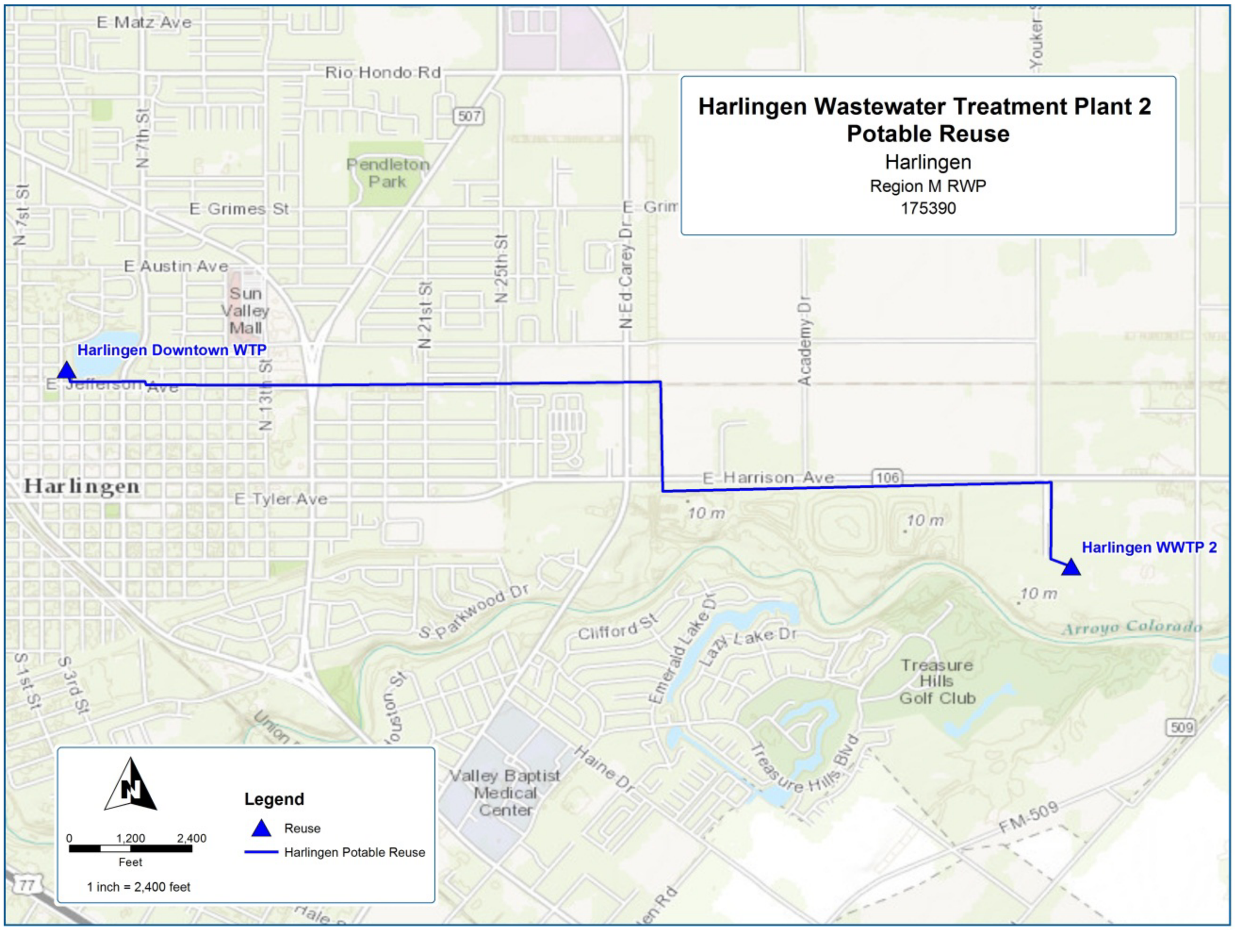

Figure 5-6 Harlingen Wastewater Treatment Plant 2 Potable Reuse Pipeline Location

Available Supply

Based on recorded wastewater treatment plant flows, the annual average flow for Harlingen WWTP 2 is 5.26 MGD. Approximately half of that flow is assumed to be available on a consistent basis and the WWTP already provides 1.0 MGD of non-potable reuse therefore 1.63 MGD, or 1,825 acre-ft./year, would be produced for potable reuse. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 2,190 acre-ft./year of wastewater effluent would be used.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to Harlingen WTP 2 would be constructed. It is assumed that the construction period would be 2 years.

Table 5-53 outlines the project requirements and cost estimate developed in UCM. Treatment Levels 2 and 4 were used to estimate the costs for addition of the advanced treatment facilities.

Table 5-53 Harlingen WWTP 2 Potable Reuse Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Harlingen - Harlingen WWTP 2 Potable Reuse*	
Item	***Estimated Costs for Facilities***
Pump Station (1.7 MGD)	$1,649,000
Transmission Pipeline (10 in dia., 4 miles)	$724,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,022,000
Two Water Treatment Plants (1.6 MGD and 1.6 MGD)	$9,710,000
TOTAL COST OF FACILITIES	**$13,105,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,550,000
Environmental & Archaeology Studies and Mitigation	$99,000
Land Acquisition and Surveying (57 acres)	$156,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,254,000
TOTAL COST OF PROJECT	**$19,164,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,604,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$59,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,850,000
Pumping Energy Costs (646364 kW-hr @ 0.09 $/kW-hr)	$58,000
TOTAL ANNUAL COST	**$3,571,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,825
Annual Cost of Water ($ per acft)	$1,957
Annual Cost of Water ($ per 1,000 gallons)	$6.00

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

INDIAN LAKE

Table 5-54 Indian Lake Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			51	60	68	78	87	97
Total Supply)			39	61	61	61	61	61
Projected Supply Surplus/Deficit			-12	1	-7	-17	-26	-36
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Need after Conservation			**-12**	**1**	**-7**	**-17**	**-26**	**-36**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ERHWSC North Cameron Regional WTP Supply		$5,963	40	40	40	40	40	40
ERHWSC Surface Water Treatment Plant and WR Purchase		$736	80	80	80	80	80	80
Surplus/Deficit after WMS			**108**	**121**	**113**	**103**	**94**	**84**

LA FERIA

Table 5-55 La Feria Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			1,126	1,274	1,432	1,613	1,809	2,012
Total Supply			1,070	1,070	1,070	1,070	1,070	1,070
Projected Supply Surplus/Deficit			-56	-204	-362	-543	-739	-942
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: La Feria, CCID No. 3		$460	309	313	317	321	326	330
Advanced Municipal Conservation		$652	0	0	25	91	181	289
Need after Conservation			**253**	**109**	**-20**	**-131**	**-232**	**-323**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rainwater Harvesting	$204,000	$831	24	24	24	24	24	24
Water Well with R.O. Unit	$6,260,000	$1,163	1120	1120	1120	1120	1120	1120
Surplus/Deficit after WMS			**1,397**	**1,253**	**1,124**	**1,013**	**912**	**821**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Non-Potable Wastewater Reuse	$2,830,000	$2,834	174	174	174	174	174	174
RGRWA Regional Facility Project		$3,237	0	50	200	400	600	800

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. La Feria's 2011 GPCD was estimated at 126, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use.

Rainwater Harvesting

Project Source

This strategy was submitted by the City of La Feria to the RWPG.

Description

This strategy involves retrofitting existing municipal buildings, businesses, and homes with a rainwater harvesting system. This strategy also includes providing information about home rainwater collection systems for individual home sites to the public. The rainwater collection systems will allow home owners and businesses to water lawns and shrubs during times of water rationing. A public information program will be developed including pamphlets explaining rainwater harvesting and information about low cost 55-gallon rainwater harvesting barrels. The rainwater barrels will be available to the public for purchase and homeowners could receive credit on their future water bills.

Available Supply

The City estimates it can capture and save approximately 9,100,000 gallons of water yearly if the rainwater collection systems are installed at City Hall and 300 homes.

For an estimation of the savings in a drought year, the historical precipitation during the Drought of Record (February, 1993 – October 2000) was averaged for an annual drought-year rainfall estimate in Cameron County[17]. The City Hall, based on measurements taken with Google Earth Pro, is an estimated 6,250 square feet, or 0.14 Acres. The average home size is assumed to be 2,000 square feet, but assuming ¾ of the roof is adaptable to rainwater harvesting, the total roof area for homes would be 10.33 Acres. The grand total rooftop area for the project is estimated at 10.44 Acres.

The rainfall over the 7.75 year drought of record in Cameron County averaged 28.01 inches per year. The total drought year yield is therefore estimated at 24 acre-ft./year.

Environmental Issues

Potential environmental impacts include reduced runoff, impacting area drainage-ways.

Engineering and Costing

The City estimates the cost of gutters and downspouts, rainwater collection tanks, pumps and controls, informational pamphlets, and rainwater collection barrels to total about $200,000. That capital cost was put into the UCM to determine additional cost metrics. Table 5-56 presents the estimated costs for this strategy.

Table 5-56 La Feria Rainwater Harvesting Estimated Costs

Cost Estimate Summary Water Supply Project Option City of La Feria - Rain Water Harvesting	
Item	***Estimated Costs for Facilities***
Rainwater Harvesting	$200,000
TOTAL COST OF FACILITIES	**$200,000**
Interest During Construction (4% for 0.5 years with a 1% ROI)	$4,000
TOTAL COST OF PROJECT	**$204,000**
ANNUAL COST	

17 Historical rainfall data from the NOAA National Climactic Data Center

Cost Estimate Summary ***Water Supply Project Option*** ***City of La Feria - Rain Water Harvesting***	
Item	***Estimated Costs for Facilities***
Debt Service (5.5 percent, 20 years)	$17,000
Operation and Maintenance	
Rainwater Harvesting	$3,000
TOTAL ANNUAL COST	**$20,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	24
Annual Cost of Water ($ per acft)	$831
Annual Cost of Water ($ per 1,000 gallons)	$2.56

Implementation Issues

No implementation issues have been identified.

La Feria Brackish Groundwater Desalination

Project Source

This strategy was submitted by the City of La Feria to the RWPG.

Description

This strategy is to provide additional drinking water supply to the City of La Feria water treatment plant with the installation of a groundwater well and high pressure RO system. Water produced from the RO system will then go to the City's water treatment plant for conventional treatment. A location adjacent to the water treatment plant is proposed for the well to limit the well field piping that is needed. The City has already drilled a pilot well and confirmed that there is water supply available at approximately 500 ft. below ground surface.

Available Supply

Based on the pilot well information, the City believes the groundwater well can pump 1.25 MGD to produce 1.0 MGD of water from the RO unit.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. It is assumed that the construction period for this strategy is one year.

Table 5-57 outlines the project requirements and cost estimate developed in UCM.

Table 5-57 La Feria BGD Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of La Feria - Brackish Groundwater Well with R.O. Treatment***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$654,000
Water Treatment Plant (1 MGD)	$3,820,000
TOTAL COST OF FACILITIES	**$4,474,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,566,000

Cost Estimate Summary ***Water Supply Project Option*** ***City of La Feria - Brackish Groundwater Well with R.O. Treatment***	
Item	***Estimated Costs for Facilities***
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acre)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$212,000
TOTAL COST OF PROJECT	**$6,260,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$524,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$744,000
Pumping Energy Costs (297597 kW-hr @ 0.09 $/kW-hr)	$27,000
TOTAL ANNUAL COST	**$1,302,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$1,163
Annual Cost of Water ($ per 1,000 gallons)	$3.57

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

LAGUNA MADRE WATER DISTRICT

Table 5-58 Laguna Madre Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supplier**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Laguna Vista	Yes		2,435	2,831	3,236	3,676	4,130	4,597
Port Isabel	Yes		1,327	1,517	1,714	1,936	2,174	2,419
South Padre Island	Yes		3,228	3,755	4,292	4,875	5,478	6,098
Manufacturing, Cameron			1	1	1	1	1	1
Total Demands			**6,990**	**8,103**	**9,242**	**10,487**	**11,782**	**13,114**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Laguna Vista			1,329	1,329	1,329	1,329	1,329	1,329
Port Isabel			724	724	724	724	724	724
South Padre Island			1,762	1,762	1,762	1,762	1,762	1,762
Manufacturing, Cameron			1	1	1	1	1	1
Total			**3,816**	**3,816**	**3,816**	**3,816**	**3,816**	**3,816**
WWP Needs (Surplus +/ Need -)			**-3,174**	**-4,287**	**-5,426**	**-6,671**	**-7,966**	**-9,298**
Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**			
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Bayview ID Conservation		$380	946	1,042	1,141	1,244	1,351	1,461
CCID No. 6 Conservation		$386	803	968	1,132	1,296	1,460	1,624

Laguna Vista Advanced Municipal Conservation*		$652	182	451	768	1138	1550	1999
Port Isabel Advanced Municipal Conservation**		$652	52	170	318	500	654	810
South Padre Island Advanced Municipal Conservation***		$652	248	606	1,028	1,518	2,065	2,662
Need after Conservation			**-942**	**-1,051**	**-1,039**	**-975**	**-887**	**-743**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Brackish Desalination Plant	$22,443,000	$1,773	2,240	2,240	2,240	2,240	2,240	2,240
LMWD Potable Reuse	$13,613,000	$2,865	820	820	820	820	820	820
Surplus/Deficit after WMS			**2,118**	**2,009**	**2,021**	**2,085**	**2,173**	**2,317**
Total Supplies with WMS			**9,108**	**10,112**	**11,263**	**12,572**	**13,955**	**15,431**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Laguna Vista			3,185	3,539	3,954	4,417	4,923	5,468
Port Isabel			1,690	1,863	2,055	2,287	2,493	2,700
South Padre Island			4,231	4,709	5,252	5,866	6,538	7,261
Manufacturing, Cameron			2	2	2	2	2	2
Total WWP Surplus/Deficit			**2,118**	**2,009**	**2,021**	**2,085**	**2,174**	**2,318**
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Laguna Vista			750	708	718	741	793	871
Port Isabel			363	346	341	351	319	281
South Padre Island			1,003	954	960	991	1,060	1,163
Manufacturing, Cameron			1	1	1	1	1	1
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Seawater Desalination Plant	$29,609,000	$7,175	1,120	1,120	1,120	1,120	1,120	1,120
LMWD Non-potable Reuse Project	$3,931,000	$1,929	350	350	350	350	350	350

* Full WMS supply to Laguna Vista
** Full WMS supply to Port Isabel
*** Full WMS supply to South Padre Island

Laguna Madre WD Brackish Groundwater Desalination Plant

Project Source

This strategy was recommended in the 2011 RWP for Port Isabel, however it was moved to Laguna Madre Water District because Laguna Madre has the Certificate of Conveyance and Necessity for Port Isabel.

Description

This strategy is for drilling a new brackish groundwater well and constructing a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates for Port Isabel, the new brackish groundwater plant is sized for 2,240 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. Membrane treatment efficiency is assumed to be 80%, so the wells and wellfield piping are designed to 2,800 acre-ft./year. It is assumed that the construction period for this strategy is one and a half years.

Table 5-59 outlines the project requirements and cost estimate developed in UCM.

Table 5-59 Laguna Madre Water District BGD Plant Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option Laguna Madre WD - Brackish Water Desalination	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,628,000
Water Treatment Plant (2 MGD)	$14,236,000
TOTAL COST OF FACILITIES	**$15,864,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,552,000
Environmental & Archaeology Studies and Mitigation	$15,000
Land Acquisition and Surveying (3 acres)	$7,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$1,126,000
TOTAL COST OF PROJECT	**$22,564,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,888,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$16,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,017,000
Pumping Energy Costs (566790 kW-hr @ 0.09 $/kW-hr)	$51,000
TOTAL ANNUAL COST	**$3,972,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,240
Annual Cost of Water ($ per acft)	$1,773
Annual Cost of Water ($ per 1,000 gallons)	$5.44

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

Port Isabel Water Reclamation Facility Potable Reuse

Project Source

This strategy was submitted by Laguna Madre Water District to the RWPG.

Description

This direct potable reuse strategy involves supplementing Laguna Madre Water District's raw water Reservoir No. 3 with treated effluent from the Port Isabel Wastewater Treatment Plant. This project would allow the reclaimed water to mix with raw water from the Rio Grande for over 10 days before being treated at the District's existing water treatment plant.

The Proposed alignment of the Port Isabel Water Reclamation Facility Reuse Line is shown in Figure 5-7.

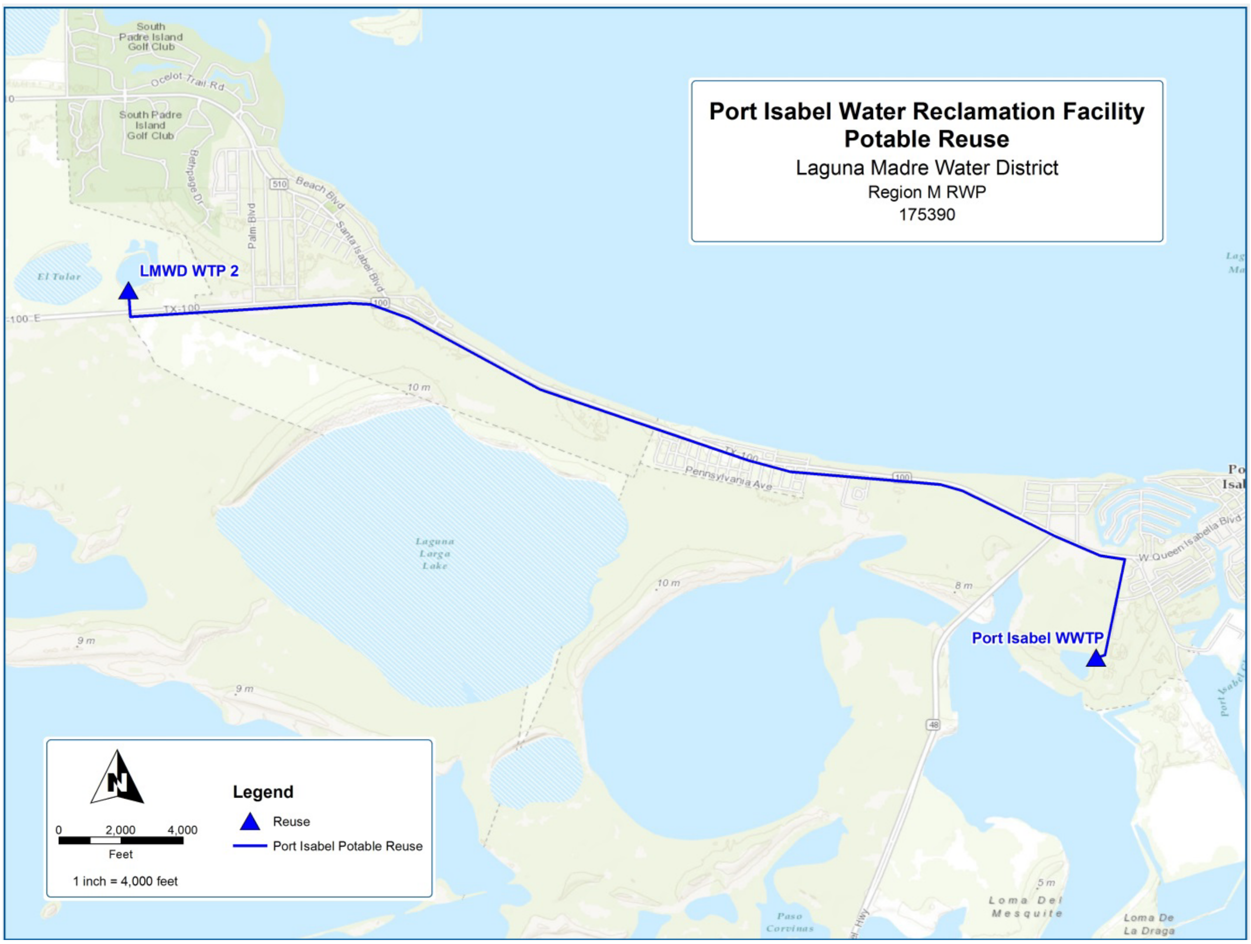

Figure 5-7 Port Isabel Water Reclamation Facility Potable Reuse

Available Supply

Based on recorded wastewater treatment plant flows and future projects, it is estimated that the available reuse water will be 0.7 MGD, or 820 acre-ft./year, at ultimate build out.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is sent to the Brownsville Ship Channel which is a seawater waterway. Existing raw water pipelines would convey the treated water to Reservoir No. 3 and a new pump station and ground storage tank at the wastewater treatment plant site would be constructed. It is assumed that the construction period would be 2 years.

Table 5-60 outlines the project requirements and cost estimate developed in UCM. Treatment Levels 2 and 4 were used to estimate the costs for addition of the advanced treatment facilities.

Table 5-60 Laguna Madre WD Port Isabel Potable Water Reclamation Facility Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option Laguna Madre Water District - Port Isabel Water Reclamation Facility Potable Reuse	
Item	***Estimated Costs for Facilities***
Pump Station (8 MGD)	$1,117,000
Transmission Pump Station(s) & Storage Tank(s)	$1,972,000
Storage Tanks (Other Than at Booster Pump Stations)	$527,000
Two Water Treatment Plants (0.7 MGD and 0.7 MGD)	$5,497,000
TOTAL COST OF FACILITIES	**$9,113,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,190,000
Environmental & Archaeology Studies and Mitigation	$163,000
Land Acquisition and Surveying (87 acres)	$256,000
Interest During Construction (4% for 2 years with a 1% ROI)	$891,000
TOTAL COST OF PROJECT	**$13,613,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,139,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$77,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,049,000
Pumping Energy Costs (935410 kW-hr @ 0.09 $/kW-hr)	$84,000
TOTAL ANNUAL COST	**$2,349,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	820
Annual Cost of Water ($ per acft)	$2,865
Annual Cost of Water ($ per 1,000 gallons)	$8.79

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

LAGUNA VISTA

Table 5-61 Laguna Vista Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			2,435	2,831	3,236	3,676	4,130	4,597
Total Supply			1,329	1,329	1,329	1,329	1,329	1,329
Projected Supply Surplus/Deficit			**-1,106**	**-1,502**	**-1,907**	**-2,347**	**-2,801**	**-3,268**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Bayview via LMWD		$380	330	357	397	433	471	509
ID Conservation: CCID#6 via LMWD		$386	280	337	394	451	508	566
Advanced Municipal Conservation		$652	182	451	768	1138	1550	1999
Need after Conservation			**-315**	**-357**	**-347**	**-324**	**-272**	**-194**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Brackish Desalination Plant		$1,773	780	780	780	780	780	780
LMWD Potable Reuse		$2,865	286	286	286	286	286	286
Surplus/Deficit after WMS			**751**	**709**	**719**	**742**	**794**	**872**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Non-potable Reuse Project		$1,929	122	122	122	122	122	122
LMWD Seawater Desalination Plant		$7,175	390	390	390	390	390	390
RGRWA Regional Facility Project		$3,237	850	1,250	1,650	2,100	2,550	3,000

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Laguna Vista's 2011 GPCD was estimated at 599, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

LOS FRESNOS

Table 5-62 Los Fresnos Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			440	514	589	669	752	838
Total Supply			815	793	793	793	793	793
Projected Supply Surplus/Deficit			**375**	**279**	**204**	**124**	**41**	**-45**

Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: CCID No. 6		$386	114	138	161	185	208	231
Need after Conservation			**489**	**417**	**365**	**309**	**249**	**186**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Surplus/Deficit after WMS			**489**	**417**	**365**	**309**	**249**	**186**

LOS INDIOS

Table 5-63 Los Indios Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			144	161	179	201	226	251
Total Supply			85	85	85	85	85	85
Projected Supply Surplus/Deficit			**-31**	**-48**	**-66**	**-88**	**-113**	**-138**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	0	2	13	26
Need after Conservation			**-59**	**-76**	**-94**	**-114**	**-128**	**-140**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Cameron Co.)		$1,254	50	50	50	50	50	50
MHWSC Acquisition of Water Rights through Urbanization		$143	8	28	45	64	92	114
ERHWSC New Surface WTP via MHWSC		$736	10	10	10	10	10	10
Surplus/Deficit after WMS			**9**	**12**	**11**	**10**	**24**	**24**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase I)		$316	6	6	6	0	0	0
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase II)		$195	0	0	0	16	16	16

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Los Indios' 2011 GPCD was estimated at 111, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

MILITARY HIGHWAY WATER SUPPLY CORPORATION

Table 5-64 Military Highway WSC Water Supply and Demand Analysis (Acre-feet/year)

Demands	Sole Supplier		2020	2030	2040	2050	2060	2070
WUG Water Demand			4,791	5,595	6,431	7,333	8,278	9,233
Los Indios	Yes		144	161	179	201	226	251
Progreso	Yes		722	868	1,020	1,177	1,339	1,498
San Juan			45	45	45	45	45	45
County-Other, Hidalgo			30	30	30	30	30	30
Total Demand			**5,732**	**6,699**	**7,705**	**8,786**	**9,918**	**11,057**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			3,771	3,771	3,771	3,771	3,771	3,771
Los Indios			85	85	85	85	85	85
Progreso			565	565	565	565	565	565
San Juan			35	35	35	35	35	35
County-Other, Hidalgo			23	23	23	23	23	23
Total			**4,479**	**4,479**	**4,479**	**4,479**	**4,479**	**4,479**
WWP Needs (Surplus +/ Need -)			**-1,253**	**-2,220**	**-3,226**	**-4,307**	**-5,439**	**-6,578**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Harlingen ID*		$213	16	56	96	135	175	215
ID Conservation: Harlingen ID via ERHWSC*		$213	0	0	0	1	1	1
ID Conservation: Harlingen ID via Harlingen*		$213	4	13	23	32	42	52
ID Conservation: Harlingen ID via Harlingen via ERHWSC*		$213	0	0	1	1	2	2
ID Conservation: CCID2 via ERHWSC*		$668	7	9	10	12	13	15
ID Conservation: Delta Lake ID via NAWSC*		$671	0	1	1	1	1	2
ID Conservation: Donna ID via NAWSC*		$468	0	0	0	0	0	1
ID Conservation: HCCID9 via NAWSC*		$1,069	0	0	0	1	1	1
ID Conservation: HCID1 via NAWSC*		$330	0	0	0	0	0	1
MHWSC Advanced Municipal Conservation*		$652	0	133	375	719	1,163	1,681
Los Indios Advanced Municipal Conservation**		$652	0	0	0	2	13	26
Progreso Advanced Municipal Conservation***		$652	0	0	7	55	122	202
Need after Conservation			**-1,226**	**-2,008**	**-2,714**	**-3,347**	**-3,906**	**-4,381**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Cameron Co.)	$5,373,000	$1,254	625	625	625	625	625	625

MHWSC Acquisition of Water Rights through Urbanization	$510,000	$143	300	1,100	1,800	2,550	3,650	4,550
North Cameron Regional WTP Wellfield Expansion*		$843	121	121	121	121	121	121
ERHWSC New Surface WTP		$5,963	400	400	400	400	400	400
Harlingen WWTP 2 Potable Reuse*		$1,957	0	0	17	17	17	17
NAWSC Delta Area Brackish Groundwater Desalination Plant*		$1,781	0	0	0	0	1	1
NAWSC La Sara Desalination Plant Expansion*		$2,104	0	0	0	0	0	1
NAWSC Expansion of Water Treatment Plant No. 5*		$654	0	2	2	2	2	2
NAWSC Expansion of Delta WTP*		$748	0	0	2	3	3	3
Surplus/Deficit after WMS			220	240	253	371	913	1,340
Total Supply with WMS			5,952	6,939	7,958	9,157	10,831	12,397
WUG Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC WUG			4,855	5,707	6,604	7,629	8,724	10,056
Los Indios			153	173	190	211	250	285
Progreso			849	954	1,048	1,191	1,397	1,590
San Juan			47	54	59	65	395	395
County-Other, Hidalgo			33	37	40	44	50	55
Total WWP Surplus/Deficit			**204**	**224**	**237**	**355**	**898**	**1,324**
WUG Needs after WMS (+ Surplus / - Need)			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC WUG			64	112	173	296	446	823
Los Indios			9	12	11	10	24	34
Progreso			127	86	28	14	58	92
San Juan			2	9	14	20	350	350
County-Other, Hidalgo			3	7	10	14	20	25
Total Surplus/Deficit			**204**	**224**	**237**	**355**	**898**	**1,324**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase I)	$668,000	$316	209	209	209	0	0	0
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase II)	$810,000	$195	0	0	0	522	522	522
Harlingen New BGD Plant		$2,180	0	0	9	9	9	9
RGRWA Regional Facility Project		$3,237	1,100	2,050	3,050	4,150	5,250	6,400

* Full WMS supply to MHWSC
** Full WMS supply to Los Indios
*** Full WMS supply to Progreso

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide

discussed in section 5.2.5 Advanced Municipal Water Conservation. Military Highway WSC's 2011 GPCD was estimated at 144, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Groundwater Supply Expansion (Cameron County)

Project Source

This strategy was recommended in the 2011 RWP and updated by the Regional Water Planning Group.

Description

This strategy is to provide additional supply to Military Highway WSC in Cameron County with the installation of additional groundwater wells.

In Cameron County, Military Highway WSC currently has fresh groundwater wells that are under the influence of surface water, which is treated at Las Rusias WTP. Therefore, this strategy also includes expansion of the treatment plant.

Available Supply

The proposed groundwater wells would provide a total of 625 acre-ft./year in 2020.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. It is assumed that the construction period for this strategy is one year.

Table 5-65 outlines the project requirements and cost estimate developed in UCM.

Table 5-65 Military Highway WSC Groundwater Supply Expansion (Cameron County) Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
Military Highway WSC - Expand Existing Groundwater Supply (Cameron)

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$691,000
Water Treatment Plant (0.6 MGD)	$3,147,000
TOTAL COST OF FACILITIES	**$3,838,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,343,000
Environmental & Archaeology Studies and Mitigation	$7,000
Land Acquisition and Surveying (1 acres)	$3,000
Interest During Construction (4% for 1 years with a 1% ROI)	**$182,000**
TOTAL COST OF PROJECT	$5,373,000
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$450,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$315,000
Pumping Energy Costs (131395 kW-hr @ 0.09 $/kW-hr)	$12,000

Cost Estimate Summary ***Water Supply Project Option*** ***Military Highway WSC - Expand Existing Groundwater Supply (Cameron)***	
Item	***Estimated Costs for Facilities***
TOTAL ANNUAL COST	**$784,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	625
Annual Cost of Water ($ per acft)	$1,254
Annual Cost of Water ($ per 1,000 gallons)	$3.85

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

NORTH ALAMO WATER SUPPLY CORPORATION

Table 5-66 North Alamo WSC Water Supply and Demand Analysis (Acre-feet/year)

Demands			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Demand			25,081	30,421	35,897	41,494	47,186	52,761
Edinburg			253	253	253	253	253	253
Military Highway			19	19	19	19	19	19
Primera			50	50	50	50	50	50
San Juan			1,682	1,682	1,682	1,682	1,682	1,682
San Perlita			235	235	235	235	235	235
County-Other, Hidalgo			29	29	29	29	29	29
Manufacturing, Cameron			19	19	19	19	19	19
Manufacturing, Hidalgo			554	554	554	554	554	554
Manufacturing, Willacy			212	212	212	212	212	212
Total Demand			**28,134**	**33,474**	**38,950**	**44,547**	**50,239**	**55,814**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			23,973	23,973	23,973	23,973	23,973	23,973
Edinburg			48	48	48	48	48	48
Military Highway			18	18	18	18	18	18
Primera			48	48	48	48	48	48
San Juan			1,687	1,687	1,687	1,687	1,687	1,687
San Perlita			225	225	225	225	225	225
County-Other, Hidalgo			29	29	29	29	29	29
Manufacturing, Cameron			19	19	19	19	19	19
Manufacturing, Hidalgo			366	366	366	366	366	366
Manufacturing, Willacy			120	120	120	120	120	120
Total			**26,533**	**26,533**	**26,533**	**26,533**	**26,533**	**26,533**
WWP Needs (Surplus +/ Need -)			**-1,601**	**-6,941**	**-12,417**	**-18,014**	**-23,706**	**-29,281**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	455	887	1,318	1,749	2,180	2,612
ID Conservation: Donna ID		$468	55	216	377	538	700	861
ID Conservation: HCID No. 1		$330	254	275	295	316	336	356

ID Conservation: HCID No. 1 via Santa Cruz ID*		$330	366	395	425	454	484	513
ID Conservation: HCID No. 2		$288	175	290	405	521	636	751
ID Conservation: H&CCID No. 9		$1,069	266	437	608	779	949	1,120
ID Conservation: Santa Cruz ID No. 15		$89	290	317	343	371	399	428
NAWSC Advanced Municipal Conservation*		$652	860	1,925	3,586	5,792	8,505	11,601
Need after Conservation			**1,121**	**-2,200**	**-5,060**	**-7,495**	**-9,518**	**-11,039**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NAWSC Delta Area Brackish Groundwater Desalination Plant	$22,709,000	$1,781	0	0	0	0	2,240	2,240
NAWSC La Sara Desalination Plant Expansion	$13,260,000	$2,104	0	0	0	0	0	1,120
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion**	$23,794,000	$654	1,120	4,480	4,480	4,480	4,480	4,480
NAWSC Converted WR and Delta WTP Expansion	$23,794,000	$748	0	0	4,480	6,160	6,160	6,160
North Cameron Regional WTP Wellfield Expansion	$1,881,000	$843	800	800	800	800	800	800
Total Supply with WMS			**31,175**	**36,554**	**43,650**	**48,492**	**54,401**	**59,575**
WUG Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NAWSC WUG			27,418	32,498	38,774	42,988	47,976	52,932
Edinburg			256	259	273	282	288	291
Military Highway			19	22	24	26	27	31
Primera			51	60	64	66	72	75
San Juan			1,845	2,120	2,405	2,972	3,829	3,958
San Perlita			247	283	320	343	368	385
County-Other, Hidalgo			30	35	139	143	145	183
Manufacturing, Cameron			19	19	19	19	19	19
Manufacturing, Hidalgo			555	573	591	609	627	646
Manufacturing, Willacy			212	217	221	225	230	235
Alamo***			200	560	560	560	560	560
Donna***			0	180	180	180	180	180
Weslaco***			370	370	370	370	370	370
Edcouch***			0	0	100	100	100	100
Elsa***			0	0	200	200	200	200
La Villa***			0	0	100	100	100	100
Total			**31,222**	**37,196**	**44,340**	**49,183**	**55,091**	**60,265**
WUG Needs after WMS (+ Surplus / - Need)			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NAWSC WUG			2,337	2,077	2,877	1,494	790	171
Edinburg			3	6	20	29	35	38
Military Highway			0	3	5	7	8	12
Primera			1	10	14	16	22	25
San Juan			163	438	723	1,290	2,147	2,276
San Perlita			12	48	85	108	133	150
County-Other, Hidalgo			1	6	110	114	116	154

Manufacturing, Cameron			0	0	0	0	0	0
Manufacturing, Hidalgo			1	19	37	55	73	92
Manufacturing, Willacy			0	5	9	13	18	23
Total Surplus/Deficit			**2,518**	**2,612**	**3,880**	**3,126**	**3,342**	**2,941**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RGRWA Regional Facility Proj.		$3,237	0	1,750	3,100	8,750	12,350	16,950
Delta Watershed - Edinburg Lake		$1,271	2,000	2,000	2,000	2,000	2,000	2,000

* Full WMS supply to NAWSC
**Although WTP will be expanded by 4,480 AFY in 2020, yield is shown as 1120 for WR acquisition limitations
*** Not an existing NAWSC customer, so no demand from NAWSC

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. North Alamo WSC's 2011 GPCD was estimated at 153, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

<u>Delta Area Brackish Groundwater Desalination Plant</u>

Project Source

This strategy was submitted by North Alamo WSC to the RWPG.

Description

This strategy is to supply 2 MGD of brackish groundwater to the Delta Area with the construction of groundwater wells and RO membrane treatment.

Available Supply

The Delta Area BGD will pump 2,800 acre-ft./year from the Gulf Coast Aquifer in Willacy County, and assuming an 80% membrane recovery rate, will supply 2,240 acre-ft. /year to residents of Hargill, Monte Alto, La Sara, and surrounding areas in North Alamo's service area, starting in 2060.

Engineering and Costing

Costs for this strategy include well field pumping, well field piping, and water treatment. Table 5-67 outlines the project requirements and cost estimate developed in UCM.

Table 5-67 Delta Area BGD Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option North Alamo WSC - Delta Area Brackish Groundwater Desalination	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,730,000
Water Treatment Plant(2 MGD)	$14,236,000
TOTAL COST OF FACILITIES	**$15,966,000**

Cost Estimate Summary *Water Supply Project Option* *North Alamo WSC - Delta Area Brackish Groundwater Desalination*	
Item	***Estimated Costs for Facilities***
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,588,000
Environmental & Archaeology Studies and Mitigation	$15,000
Land Acquisition and Surveying (3 acres)	$7,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$1,133,000
TOTAL COST OF PROJECT	**$22,709,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,900,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$17,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,017,000
Pumping Energy Costs (623544 kW-hr @ 0.09 $/kW-hr)	$56,000
TOTAL ANNUAL COST	**$3,990,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,240
Annual Cost of Water ($ per acft)	$1,781
Annual Cost of Water ($ per 1,000 gallons)	$5.47

Implementation Issues

No major implementation issues are expected for this strategy. Approval for concentrate disposal will be needed from TCEQ. Construction of groundwater well(s) and piping may also include purchase of land and a TXDOT right-of-way permit.

La Sara Desalination Plant Expansion

Project Source

This strategy was submitted by North Alamo WSC to the RWPG.

Description

This strategy is to provide an additional 1 MGD of brackish groundwater to the La Sara desalination plant with the construction of a groundwater well and expansion of existing R.O. treatment facilities.

Available Supply

The La Sara plant currently treats 1 MGD of water, supplied by a groundwater well. This strategy would add another 1 MGD of supply to the plant, starting in 2070.

Engineering and Costing

Costs from the Unified Costing Mode for this strategy include groundwater well pumping, well field piping, land acquisition, and treatment. Table 5-68 outlines the project requirements and cost estimate developed in UCM.

Table 5-68 La Sara Desalination Plant Expansion Project Requirements and Cost

Cost Estimate Summary
Water Supply Project Option
North Alamo WSC - La Sara RO WTP Expansion

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$509,000
Water Treatment Plant (1 MGD)	$8,664,000
TOTAL COST OF FACILITIES	**$9,173,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,211,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (4% for 2 years with a 1% ROI)	$868,000
TOTAL COST OF PROJECT	**$13,260,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,110,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$5,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,228,000
Pumping Energy Costs (158811 kW-hr @ 0.09 $/kW-hr)	$14,000
TOTAL ANNUAL COST	**$2,357,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$2,104
Annual Cost of Water ($ per 1,000 gallons)	$6.46

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

Water Treatment Plant No. 5 Expansion

Project Source

This strategy was submitted by North Alamo WSC to the RWPG.

Description

This strategy is for the expansion of Water Treatment Plant No. 5. The expansion would serve residents within the Weslaco, Donna, Alamo, and surrounding areas. It would also provide the North Alamo WSC the ability to utilize other water districts as a source of push water for delivery of water in times of drought. Acquisition of water rights through urbanization is required for this strategy.

Available Supply

The expansion of WTP No. 5 would provide North Alamo WSC with capacity to treat an additional 4 MGD of drinking water. In the first decade, only 1,120 acre-ft./year of converted water rights are assumed to be available, which limits the new supply in the first decade. In 2030 it is assumed the remaining water rights are available for the plant to supply the full treatment capacity of 4,480 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include water treatment plant expansion and purchase of water rights, which are separated out into the initial decade and following decades as water rights become available through urbanization. It is assumed that the construction period for this strategy is one year.

A unit capital cost of $2,500 per acre-ft. has been estimated as the market value for water rights. However, under Subchapter O of Chapter 49 Texas Water Code, a municipal supplier can buy water rights to the net irrigable acres in a subdivision at 68% of the market value. It is assumed that water rights will be urbanized within NAWSC's jurisdiction and this reduced rate would apply. Therefore, a unit capital cost of $1,700 per acre-ft. is used to estimate the capital costs. Table 5-69 outlines the project requirements and cost estimate developed in UCM.

Table 5-69 Water Treatment Plant No. 5 Expansion Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *North Alamo WSC - Water Treatment Plant No. 5 Expansion*	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (4 MGD)	$9,413,000
TOTAL COST OF FACILITIES	**$17,029,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,960,000
Interest During Construction (4% for 1 years with a 1% ROI)	$805,000
TOTAL COST OF PROJECT	**$23,794,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,991,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$941,000
TOTAL ANNUAL COST	**$2,932,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	4,480
Annual Cost of Water ($ per acft)	$654
Annual Cost of Water ($ per 1,000 gallons)	$2.01

Implementation Issues

Project would be constructed within existing easements and right-of-ways however as with any project, necessary state and federal permits must be obtained before construction can begin.

<u>Delta Water Treatment Plant Expansion</u>

Project Source

This strategy was submitted by North Alamo WSC to the RWPG.

Description

This strategy is for the expansion of Delta Water Treatment Plant. The expansion would serve residents within the Edcouch, Elsa, la Villa, Monte Alto, and surrounding areas. It would also provide the North Alamo WSC the ability to utilize other water districts as a source of push water for delivery of water in times of drought.

Available Supply

The expansion of Delta WTP would provide North Alamo WSC with the ability to treat an additional 4,480 acre-ft./year of drinking water in Phase I, and 6,160 are-ft./year in Phase II. Phase I would be constructed in 2040 and Phase II would occur in 2050. Acquisition of water rights is required for this supply.

Engineering and Costing

Costs for this strategy from the UCM include the water treatment plant expansion and purchase of water rights. It is assumed that the construction period for each phase is one year. A unit capital cost of $2,500 per acre-ft. has been estimated as the market value for water rights.

Table 5-70 outlines the project requirements and cost estimate developed in UCM for Phase I, and Phase II is presented in Table 5-71.

Table 5-70 NAWSC Delta WTP Expansion Phase I Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *North Alamo WSC - Delta Water Treatment Plant Expansion - Phase I*	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (4 MGD)	$9,413,000
TOTAL COST OF FACILITIES	**$20,613,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$7,215,000
Interest During Construction (4% for 1 years with a 1% ROI)	$974,000
TOTAL COST OF PROJECT	**$28,802,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,410,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$941,000
TOTAL ANNUAL COST	**$3,351,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	4,480
Annual Cost of Water ($ per acft)	$748
Annual Cost of Water ($ per 1,000 gallons)	$2.30

Table 5-71 NAWSC Delta Area WTP Expansion Phase II Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *North Alamo WSC - Delta Water Treatment Plant Expansion - Phase II*	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (1.5 MGD)	$5,606,000
TOTAL COST OF FACILITIES	**$9,806,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,432,000
Interest During Construction (4% for 1 years with a 1% ROI)	$464,000
TOTAL COST OF PROJECT	**$13,702,000**

Cost Estimate Summary ***Water Supply Project Option*** ***North Alamo WSC - Delta Water Treatment Plant Expansion - Phase II***	
Item	***Estimated Costs for Facilities***
ANNUAL COST	
Total Debt Service (5.5 percent, 20 years)	$3,557,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Total Facilities)	$1,502,000
TOTAL ANNUAL COST	**$5,059,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	6,160
Annual Cost of Water ($ per acft)	$821
Annual Cost of Water ($ per 1,000 gallons)	$2.52

Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin.

North Cameron Regional WTP Wellfield Expansion

This strategy was submitted by East Rio Hondo WSC to the RWPG on behalf of ERHWSC and NAWSC. NAWSC would receive 800 acre-ft./year from the expansion. See North Cameron Regional WTP Wellfield Expansion, page 5-73.

OLMITO WATER SUPPLY CORPORATION

Table 5-72 Olmito WSC Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			732	835	941	1,063	1,192	1,327
Total Supply			526	526	526	526	526	526
Projected Supply Surplus/Deficit			**-206**	**-309**	**-415**	**-537**	**-666**	**-801**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Cameron Co. ID #6		$386	84	101	119	136	153	170
Advanced Municipal Conservation		$652	22	85	140	196	265	346
Need after Conservation			**-100**	**-123**	**-156**	**-205**	**-248**	**-285**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization	$340,000	$143	200	200	200	300	300	300
Surplus/Deficit after WMS			**100**	**77**	**44**	**95**	**52**	**15**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brackish Desalination Plant	$8,400,000	$2,582	560	560	560	560	560	560
RGRWA Regional Facility Project		$3,237	0	0	0	100	250	400

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Olmito WSC's 2011 GPCD was estimated at 175, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

PALM VALLEY

Table 5-73 Palm Valley Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			285	324	365	411	462	514
Total Supply			285	285	285	285	285	285
Projected Supply Surplus/Deficit			**0**	**-39**	**-80**	**-126**	**-177**	**-229**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Harlingen ID via Harlingen		$213	8	26	45	64	83	102
Advanced Municipal Conservation		$652	8	31	52	73	100	131
Need after Conservation			**16**	**18**	**17**	**11**	**6**	**4**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen Wastewater Treatment Plant 2 Potable Reuse		$1,957	0	0	34	34	34	34
Surplus/Deficit after WMS			**16**	**18**	**51**	**45**	**40**	**38**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen New BGD Plant		$2,180	0	0	19	19	19	19

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Palm Valley's 2011 GPCD was estimated at 176, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

PORT ISABEL

Table 5-74 Port Isabel Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			1,327	1,517	1,714	1,936	2,174	2,419
Total Supply			724	724	724	724	724	724
Projected Supply Surplus/Deficit			**-603**	**-793**	**-990**	**-1,212**	**-1,450**	**-1,695**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

ID Conservation: Bayview via LMWD		$380	180	204	217	236	256	277
ID Conservation: CCID#6 via LMWD		$386	153	184	215	246	277	308
Advanced Municipal Conservation		$652	52	170	318	500	654	810
Need after Conservation			**-218**	**-235**	**-240**	**-230**	**-262**	**-300**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Brackish Desalination Plant		$1,773	425	425	425	425	425	425
LMWD Potable Reuse		$2,865	156	156	156	156	156	156
Surplus/Deficit after WMS			**363**	**346**	**341**	**351**	**319**	**281**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Non-potable Reuse Project		$1,929	66	66	66	66	66	66
LMWD Seawater Desalination Plant		$7,175	213	213	213	213	213	213
RGRWA Regional Facility Project		$3,237	450	650	850	1,100	1,300	1,550

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Port Isabel's 2011 GPCD was estimated at 211, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

PRIMERA

Table 5-75 Primera Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			422	472	526	590	661	735
Total Supply			448	448	448	448	448	448
Projected Supply Surplus/Deficit			**26**	**-24**	**-78**	**-142**	**-213**	**-287**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID via NAWSC		$671	1	2	2	3	4	4
ID Conservation: Donna ID via NAWSC		$468	0	0	1	1	1	2
ID Conservation: Harlingen ID via Harlingen		$213	11	37	64	90	117	143
ID Conservation: HCCID9 via NAWSC		$1,069	0	1	1	1	2	2
ID Conservation: HCID1 via NAWSC		$330	0	0	1	1	1	1
ID Conservation: HCID2 via NAWSC		$288	0	1	1	1	1	1

ID Conservation: Santa Cruz ID via NAWSC		$89	1	1	1	1	1	1
Advanced Municipal Conservation		$652	0	0	9	31	63	102
Need after Conservation			**39**	**18**	**2**	**-13**	**-23**	**-31**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brackish Groundwater Desalination	$14,318,000	$2,190	1,120	1,120	1,120	1,120	1,120	1,120
Harlingen WWTP 2 Potable Reuse		$1,957	0	0	48	48	48	48
NAWSC Expansion of Water Treatment Plant No. 5		$654	0	6	6	6	6	6
NAWSC Expansion of Delta WTP		$748	0	0	2	3	3	3
NAWSC Delta Area Brackish Groundwater Desalination Plant		$1,781	0	0	0	0	4	4
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	2
Surplus/Deficit after WMS			**1,159**	**1,144**	**1,177**	**1,164**	**1,157**	**1,152**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen New BGD Plant		$2,180	0	0	26	26	26	26

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Primera's 2011 GPCD was estimated at 87, and therefore the conservation WMS includes a 0.5% annual reduction.

Primera Brackish Groundwater Desalination

Project Source

This strategy was submitted by the City of Primera to the RWPG.

Description

This strategy is for the construction of a new reverse osmosis water treatment plant with ground storage and a ground water well. The Town of Primera is currently supplied with drinking water from the North Cameron Regional Water Project Water Treatment Plant and the City of Harlingen. This strategy would allow the Town of Primera to have its own drinking water source.

Available Supply

This strategy would yield the Town of Primera with 1,120 acre-ft./year of drinking water.

Engineering and Costing

Costs for this strategy from the UCM include well field pumping, well field piping, water treatment, and land acquisition. More information of the proposed location of the plant and existing distribution system is needed to include costs for pipelines. Membrane treatment efficiency is assumed to be 80%, so the wells and wellfield piping are designed to 1,400 acre-ft./year. It is assumed that the construction period would be one and half years. Table 5-76 outlines the project requirements and cost estimate developed in UCM.

Table 5-76 Primera BGD Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *City of Primera – Brackish Groundwater Desalination*	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$703,000
Storage Tanks (Other Than at Booster Pump Stations)	$699,000
Two Water Treatment Plants (1 MGD and 1 MGD)	$8,664,000
TOTAL COST OF FACILITIES	**$10,066,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,523,000
Environmental & Archaeology Studies and Mitigation	$9,000
Land Acquisition and Surveying (4 acres)	$5,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$715,000
TOTAL COST OF PROJECT	**$14,318,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,198,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$14,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,228,000
Pumping Energy Costs (147910 kW-hr @ 0.09 $/kW-hr)	$13,000
TOTAL ANNUAL COST	**$2,453,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$2,190
Annual Cost of Water ($ per 1,000 gallons)	$6.72

Implementation Issues

A pilot well and water quality study will be needed.

RANCHO VIEJO

Table 5-77 Rancho Viejo Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			835	965	1,099	1,246	1,399	1,557
Total Supply			1,295	1,295	1,295	1,295	1,295	1,295
Projected Supply Surplus/Deficit			**460**	**330**	**196**	**49**	**-104**	**-262**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	50	135	239	361	500	652
Need after Conservation			**510**	**465**	**435**	**410**	**396**	**390**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-

Surplus/Deficit after WMS			**510**	**465**	**435**	**410**	**396**	**390**
Alternate Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Valley MUD #2 New BGD Plant		$6,430	0	0	0	0	87	87
RGRWA Regional Facility Project		$3,237	0	0	0	0	100	250

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Rancho Viejo's 2011 GPCD was estimated at 267, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

RIO HONDO

Table 5-78 Rio Hondo Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			204	224	251	285	320	356
Total Supply			605	605	605	605	605	605
Projected Supply Surplus/Deficit			**401**	**381**	**354**	**320**	**285**	**249**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: CCID #2		$668	92	113	134	154	175	196
Need after Conservation			**493**	**494**	**488**	**474**	**460**	**445**
Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Emergency Interconnects	$2,470,000	$3,167	70	70	70	70	70	70
Surplus/Deficit after WMS			**563**	**564**	**558**	**544**	**530**	**515**

Emergency Interconnects

Project Source

This strategy was submitted by City of Rio Hondo to the RWPG.

Description

This strategy is to construct a treated water delivery source to East Rio Hondo WSC and a raw water pipeline to Harlingen Irrigation District in order to alleviate shortages in dry months due to push water issues.

The approximate locations of the Rio Hondo Interconnects are shown in Figure 5-8.

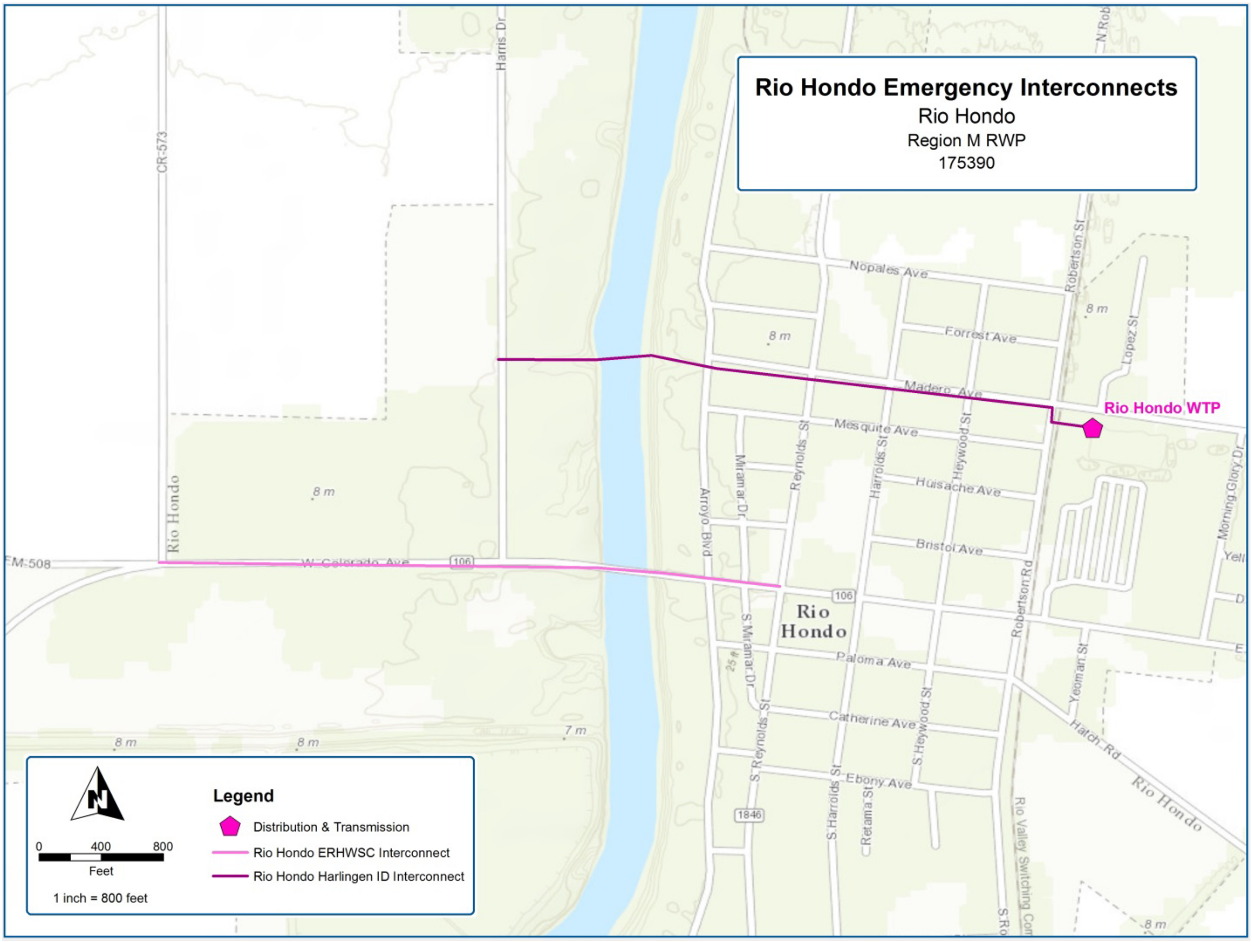

Figure 5-8 Rio Hondo Emergency Interconnects

Available Supply

The emergency interconnect would have the capacity to provide 1 MGD of treated water from East Rio Hondo WSC, and 1 MGD of raw water from Harlingen ID. However, Rio Hondo is only expected to use the emergency interconnect for a portion of each drought year and so supplies are based on 30 days of raw water and 30 days of treated water per year.

Engineering and Costing

Costs for this strategy from the UCM include a pump station, pipeline, land acquisition, and pipeline right-of-way. It is assumed that the construction period for this strategy is one year.

Table 5-79 outlines the estimated project requirements and costs.

Table 5-79 Rio Hondo Emergency Interconnects Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *City of Rio Hondo - Emergency Interconnects*	
Item	***Estimated Costs for Facilities***
Transmission Pipeline (16 in dia., 1.1 miles and 18 in dia., 1.4 miles)	$881,000
Transmission Pump Station(s) & Storage Tank(s)	$765,000
TOTAL COST OF FACILITIES	**$1,646,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$532,000
Environmental & Archaeology Studies and Mitigation	$108,000
Land Acquisition and Surveying (30 acres)	$100,000
Interest During Construction (4% for 1 years with a 1% ROI)	$84,000
TOTAL COST OF PROJECT	**$2,470,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$207,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$14,000
Pumping Energy Costs (44773 kW-hr @ 0.09 $/kW-hr)	$667
TOTAL ANNUAL COST	**$221,667**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	70
Annual Cost of Water ($ per acft)	$3,167
Annual Cost of Water ($ per 1,000 gallons)	$9.72

Implementation Issues

Impacts typical of distribution and transmission projects are discussed in Section 5.2.

SAN BENITO

Table 5-80 San Benito Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			3,607	4,053	4,529	5,088	5,705	6,346
Total Supply			4,782	4,782	4,782	4,782	4,782	4,782
Projected Supply Surplus/Deficit			**1,175**	**729**	**253**	**-306**	**-923**	**-1,564**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: CCID No. 2		$668	730	894	1057	1220	1384	1547
Advanced Municipal Conservation		$652	0	0	0	146	420	750
Need after Conservation			**1,905**	**1,623**	**1,310**	**1,060**	**881**	**733**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Groundwater Supply	$2,033,000	$181	1,120	1,120	1,120	1,120	1,120	1,120
Surplus/Deficit after WMS			**3,025**	**2,743**	**2,430**	**2,180**	**2,001**	**1,853**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Potable Reuse (Phase I)	$11,303,000	$1,349	1,120	1,120	1,120	1,120	1,120	0

Year			2020	2030	2040	2050	2060	2070
Potable Reuse (Phase II)	$18,148,000	$732	0	0	0	0	0	3,360
Non-Potable Reuse	$1,921,000	$192	1,120	1,120	1,120	1,120	1,120	1,120
RGRWA Regional Facility Project		$3,237	0	0	0	0	600	1,250

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. San Benito's 2011 GPCD was estimated at 123, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use.

Groundwater Supply

Project Source

This strategy was submitted by the City of San Benito to the RWPG.

Description

This strategy is for the construction of two groundwater wells and raw water collection lines to supplement the City's water supply. The groundwater, expected to be brackish, will be mixed with the current surface water source at 10% to 15% the average daily demand. The City plans to construct the wells in phases, with the first well installed within five years at the WTP No. 2 site. It is anticipated that a pilot well and water quality study will be needed to implement this strategy.

Available Supply

Each groundwater well will supply about 500 GPM, a total of 1 MGD for both wells.

Engineering and Costing

Costs for this strategy from the UCM include groundwater wells, well field piping, land acquisition, and pipeline right-of-way. Land acquisition was only included for one groundwater well, as the first well will be located on the City's WTP No. 2 site. It is assumed that the construction period for this strategy is one year.

Table 5-81 outlines the project requirements and cost estimate developed in UCM.

Table 5-81 San Benito Groundwater Supply Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
City of San Benito – Groundwater Supply

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$1,449,000
TOTAL COST OF FACILITIES	**$1,449,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$507,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000

Cost Estimate Summary ***Water Supply Project Option*** ***City of San Benito – Groundwater Supply***	
Item	***Estimated Costs for Facilities***
Interest During Construction (4% for 1 years with a 1% ROI)	$69,000
TOTAL COST OF PROJECT	**$2,033,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$170,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$14,000
Pumping Energy Costs (216504 kW-hr @ 0.09 $/kW-hr)	$19,000
TOTAL ANNUAL COST	**$203,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$181
Annual Cost of Water ($ per 1,000 gallons)	$0.56

Implementation Issues

Impacts typical of distribution and transmission projects are discussed in Section 5.2.

SANTA ROSA

Table 5-82 Santa Rosa Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			295	325	358	400	448	498
Total Supply			238	238	238	238	238	238
Projected Supply Surplus/Deficit			**-57**	**-87**	**-120**	**-162**	**-210**	**-260**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: La Feria, CCID No. 3		$460	72	73	74	75	76	77
Advanced Municipal Conservation		$652	0	0	0	0	1	24
Need after Conservation			**15**	**-14**	**-46**	**-87**	**-133**	**-159**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization	$42,500	$143	0	25	50	100	150	175
Surplus/Deficit after WMS			**15**	**11**	**4**	**13**	**17**	**16**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brackish Desalination Plant	$8,272,000	$2,559	0	560	560	560	560	560

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Santa Rosa's 2011 GPCD was estimated at 88, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use.

SOUTH PADRE ISLAND

Table 5-83 South Padre Island Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			3,228	3,755	4,292	4,875	5,478	6,098
Total Supply			1,762	1,762	1,762	1,762	1,762	1,762
Projected Supply Surplus/Deficit			**-1,466**	**-1,993**	**-2,530**	**-3,113**	**-3,716**	**-4,336**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Bayview via LMWD		$380	437	481	527	574	624	675
ID Conservation: CCID No. 6 via LMWD		$386	371	447	523	598	674	750
Advanced Municipal Conservation		$652	248	606	1,028	1,518	2,065	2,662
Need after Conservation			**-410**	**-459**	**-453**	**-422**	**-353**	**-250**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Brackish Desalination Plant		$1,773	1,034	1,034	1,034	1,034	1,034	1,034
LMWD Potable Reuse		$2,865	379	379	379	379	379	379
Surplus/Deficit after WMS			**1,003**	**954**	**960**	**991**	**1,060**	**1,163**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
LMWD Non-potable Reuse Project		$1,929	162	162	162	162	162	162
LMWD Seawater Desalination Plant		$7,175	517	517	517	517	517	517
RGRWA Regional Facility Project		$3,237	1,100	1,650	2,200	2,750	3,350	4,000

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. South Padre Island's 2011 GPCD was estimated at 877, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

VALLEY MUNICIPAL UTILITY DISTRICT NO. 2

Table 5-84 Valley MUD No. 2 Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supply**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rancho Viejo	Yes		835	965	1,099	1,246	1,399	1,557
Brownsville			150	150	150	150	150	150
Olmito WSC			14	14	14	14	14	14
County-Other, Cameron			47	47	47	47	47	47

Irrigation, Cameron			1,935	1,928	1,921	1,914	1,907	1,901
Total Demands			**2,981**	**3,104**	**3,231**	**3,371**	**3,517**	**3,669**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rancho Viejo			1,295	1,295	1,295	1,295	1,295	1,295
Brownsville			150	150	150	150	150	150
Olmito WSC			14	14	14	14	14	14
County-Other, Cameron			47	47	47	47	47	47
Irrigation, Cameron			1,374	1,369	1,364	1,359	1,354	1,349
Total			**2,880**	**2,875**	**2,870**	**2,865**	**2,860**	**2,855**
WWP Needs (Surplus +/ Need -)			**-101**	**-229**	**-361**	**-506**	**-657**	**-814**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rancho Viejo Advanced Municipal Conservation*		$652	50	135	239	361	500	652
Need after Conservation			**-51**	**-93**	**-121**	**-144**	**-157**	**-162**
Recommended Strategy			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Surplus/Deficit after WMS			**-51**	**-93**	**-121**	**-144**	**-157**	**-162**
Total Supplies with WMS			**2,930**	**3,010**	**3,109**	**3,226**	**3,360**	**3,507**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rancho Viejo			1,345	1,430	1,534	1,656	1,795	1,947
Brownsville			150	150	150	150	150	150
Olmito WSC			14	14	14	14	14	14
County-Other, Cameron			47	47	47	47	47	47
Irrigation, Cameron			1,374	1,369	1,364	1,359	1,354	1,349
Total WWP Surplus/Deficit			**-51**	**-93**	**-121**	**-144**	**-157**	**-162**
Total WWP Municipal Surplus/Deficit			**510**	**466**	**436**	**411**	**396**	**390**
Total WWP Irrigation Surplus/Deficit			**-561**	**-559**	**-557**	**-555**	**-553**	**-552**
Alternate Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Valley MUD #2 New BGD Plant	$3,760,000	$6,430	0	0	0	0	100	100

* Full WMS supply to Rancho Viejo

COUNTY-OTHER

Table 5-85 Cameron County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			7,749	8,100	8,494	8,992	9,569	10,176
Total Supply			2,632	2,585	2,585	2,585	2,585	2,585
Projected Supply Surplus/Deficit			**-5,117**	**-5,515**	**-5,909**	**-6,407**	**-6,984**	**-7,591**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Brownsville ID		$442	47	52	57	63	68	73
ID Conservation: CCID6 via Bayview ID		$386	20	24	28	32	36	40

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Cameron Co. ID No. 2		$668	222	271	321	371	420	470
ID Conservation: Harlingen ID		$213	16	57	97	137	178	218
ID Conservation: Harlingen ID via Harlingen		$213	4	14	24	34	45	55
ID Conservation: Hidalgo & Cameron Co. ID No. 9		$1,069	11	18	24	31	38	45
ID Conservation: La Feria ID		$460	185	188	190	193	195	198
Advanced Municipal Conservation		$652	230	506	776	1,143	1,607	2,118
Need after Conservation			**-4,359**	**-4,358**	**-4,363**	**-4,371**	**-4,364**	**-4,337**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen WWTP 2 Potable Reuse		$1,957	0	0	18	18	18	18
MHWSC Expand Existing Groundwater Wells (Cameron Co.)		$1,254	3	3	3	3	3	3
Acquisition of Water Rights through Urbanization Bayview ID	$12,500	$211	5	5	5	5	5	5
Acquisition of Water Rights through Urbanization CCID2	$135,000	$211	54	1,772	278	278	278	278
Expand Existing Groundwater Supply	$5,880,000	$188	4,500	4,500	4,500	4,500	4,500	4,500
Surplus/Deficit after WMS			**0**	**1,763**	**280**	**269**	**274**	**298**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Harlingen New BGD Plant		$2,180	0	0	10	10	10	10
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase I)		$316	1	1	1	0	0	0
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase II)		$195	0	0	0	3	3	3
Valley MUD #2 New BGD Plant		$6,430	0	0	0	0	3	3

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. The 2011 GPCD for Cameron County-Other was estimated at 155, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Groundwater Supply Expansion

Project Source

This strategy was identified by the Regional Water Planning Group.

Description

This strategy is to provide additional supply to Cameron County-Other with the installation of fresh groundwater wells.

Available Yield

The available supply is 4,500 acre-ft./year beginning in 2020, based on the needs estimate for Cameron County.

Engineering and Costing

The UCM was utilized to develop estimated costs for this strategy based on assumptions about the individual wells. The wells were costed with a capacity of 50 gpm. Well piping and land acquisition were also included in the cost estimate.

The estimated costs and project requirements for this strategy are presented in Table 5-86.

Table 5-86 Cameron County-Other Groundwater Supply Cost and Yield Projections

Cost Estimate Summary Water Supply Project Option Cameron - Groundwater Supply Expansion	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$7,995,000
TOTAL COST OF FACILITIES	**$7,995,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,798,000
Environmental & Archaeology Studies and Mitigation	$47,000
Interest During Construction (4% for 1 years with a 1% ROI)	$380,000
TOTAL COST OF PROJECT	**$11,220,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$939,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$80,000
Pumping Energy Costs (488047 kW-hr @ 0.09 $/kW-hr)	$44,000
TOTAL ANNUAL COST	**$1,063,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	4,500
Annual Cost of Water ($ per acft)	$236
Annual Cost of Water ($ per 1,000 gallons)	$0.72

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

IRRIGATION

Table 5-87 Cameron Irrigation, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			334,604	319,102	303,265	287,191	271,285	271,285
Total Supply			146,629	146,354	146,343	145,804	145,530	145,255
Projected Supply Surplus/ Deficit			**-187,975**	**-172,748**	**-156,922**	**-141,387**	**-125,755**	**-126,030**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Adams Garden ID		$41	431	678	921	1163	1402	1642
ID Conservation: Bayview ID		$380	995	1094	1194	1296	1402	1513
ID Conservation: Brownsville		$442	2078	2313	2542	2766	2988	3216
ID Conservation: CCID10		$394	430	468	507	545	586	629
ID Conservation: CCID16		$395	255	274	291	309	327	345
ID Conservation: CCID2		$668	6407	7830	9229	10614	11980	13366
ID Conservation: CCID6		$386	2364	2843	3314	3779	4238	4705
ID Conservation: CCID6 via Bayview ID		$386	845	1016	1184	1351	1514	1682
ID Conservation: CCID6 via CCID10		$386	351	422	492	561	629	698
ID Conservation: Delta Lake ID via Valley Acres ID		$671	47	92	136	180	224	268
ID Conservation: Harlingen ID		$213	651	2264	3862	5448	7018	8593
ID Conservation: Harlingen ID via La Feria ID		$213	2	7	12	17	22	26
ID Conservation: HCCID9		$1,069	241	394	546	697	845	995
ID Conservation: La Feria ID		$460	7200	7293	7368	7439	7506	7589
ID Conservation: Valley Acres ID		$366	63	78	96	114	134	156
On-Farm Conservation		$1,392	40,989	40,989	40,989	40,989	40,989	40,989
Need after Conservation			**-124,626**	**-104,693**	**-84,239**	**-64,119**	**-43,951**	**-39,618**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	1,022	1,125	1,230	1,340	1,453	1,560
Conversion of WRs to DMI			-4,561	-11,875	-19,880	-28,133	-36,431	-36,432
Surplus/Deficit after WMS			**-128,165**	**-115,443**	**-102,889**	**-90,912**	**-78,928**	**-74,489**

Table 5-88 Cameron Irrigation, Rio Grande Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			21,358	20,368	19,357	19,331	17,316	17,316
Total Supply			9,650	9,632	9,613	9,597	9,579	9,561
Projected Supply Surplus/Deficit			**-11,708**	**-10,736**	**-9,744**	**-9,734**	**-7,737**	**-7,755**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Adams Garden ID		$41	28	43	59	74	89	105
ID Conservation: Bayview ID		$380	63	70	76	83	89	97
ID Conservation: Brownsville		$442	133	148	162	177	191	205
ID Conservation: CCID10		$394	27	30	32	35	37	40
ID Conservation: CCID16		$395	16	17	19	20	21	22
ID Conservation: CCID2		$668	409	500	589	677	765	853
ID Conservation: CCID6		$386	151	181	211	241	271	300
ID Conservation: CCID6 via Bayview ID		$386	54	65	76	86	97	107
ID Conservation: CCID6 via CCID10		$386	22	27	31	36	40	45
ID Conservation: Delta Lake ID via Valley Acres ID		$671	3	6	9	12	14	17
ID Conservation: Harlingen ID		$213	42	147	247	348	448	549
ID Conservation: Harlingen ID via La Feria ID		$213	0	0	0	0	0	1
ID Conservation: HCCID9		$1,069	15	25	35	44	54	64
ID Conservation: La Feria ID		$460	460	465	470	475	479	484
ID Conservation: Valley Acres ID		$366	4	5	6	7	9	10
On-Farm Conservation		$1,392	2,616	2,616	2,616	2,616	2,616	2,616
Need after Conservation			**-7,665**	**-6,391**	**-5,106**	**-4,803**	**-2,517**	**-2,240**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	65	72	79	86	93	100
Conversion of WRs to DMI			-291	-758	-1,269	-1,796	-2,325	-2,325
Surplus/Deficit after WMS			**-7,891**	**-7,077**	**-6,296**	**-6,513**	**-4,750**	**-4,466**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. The Irrigation needs in Cameron County are partially met by Irrigation District Conservation strategies and decrease over the planning period. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Cameron County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-89 Cameron Livestock, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			315	315	315	315	315	315
Total Supply			742	742	742	742	742	742
Projected Supply Surplus/Deficit			**427**	**427**	**427**	**427**	**427**	**427**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Bayview ID		$380	18	19	21	23	25	27
ID Conservation: Cameron Co. ID No. 2		$668	40	48	57	65	75	83
ID Conservation: CCID6 via Bayview ID		$386	15	18	21	24	27	30
ID Conservation: Hidalgo & Cameron Co. ID No. 9		$1,069	4	6	8	9	12	14
ID Conservation: La Feria ID		$460	65	66	67	68	69	69
Need after Conservation			**569**	**584**	**601**	**616**	**635**	**650**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**569**	**584**	**601**	**616**	**635**	**650**

Table 5-90 Cameron Livestock, Rio Grande Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			19	19	19	19	19	19
Total Supply			44	44	44	44	44	44
Projected Supply Surplus/Deficit			**25**	**25**	**25**	**25**	**25**	**25**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Bayview ID		$380	1	1	1	1	2	2
ID Conservation: Cameron Co. ID No. 2		$668	2	3	3	4	4	5
ID Conservation: CCID6 via Bayview ID		$386	1	1	1	1	2	2
ID Conservation: Hidalgo & Cameron Co. ID No. 9		$1,069	0	0	0	1	1	1
ID Conservation: La Feria ID		$460	4	4	4	4	4	4
Need after Conservation			**34**	**34**	**34**	**36**	**38**	**39**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**34**	**34**	**34**	**36**	**38**	**39**

There are no projected needs for Livestock in Cameron County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MANUFACTURING

Table 5-91 Cameron Manufacturing, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			4,708	5,111	5,510	5,856	6,324	6,829
Total Supply			4,575	4,575	4,575	4,575	4,575	4,575
Projected Supply Surplus/Deficit			**-133**	**-536**	**-935**	**-1,281**	**-1,749**	**-2,254**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Bayview ID		$380	4	4	5	5	5	6
ID Conservation: CCID6 via Bayview ID		$386	3	4	5	5	6	7
ID Conservation: Harlingen ID via Harlingen		$213	4	14	24	34	45	55
Implementation of Best Management Practices		$2,500	471	511	551	586	632	683
Need after Conservation			**349**	**-3**	**-350**	**-651**	**-1,061**	**-1,504**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville Resaca Restoration		$1,182	1	1	1	1	1	1
Brownsville Banco Morales Reservoir		$168	77	78	78	78	78	79
Brownsville Southside WWTP Potable Reuse -Phase I		$1,647	0	23	23	23	0	0
Brownsville Southside WWTP Potable Reuse -Phase II		$1,170	0	0	0	0	29	29
Brownsville Seawater Desalination Demonstration (Phase I)		$5,560	56	56	56	56	0	0
Brownsville Seawater Desalination Demonstration (Phase II)		$3,708	0	0	0	0	565	565
Harlingen WWTP 2 Potable Reuse		$1,957	0	0	22	22	22	22
LMWD Brackish Desalination Plant		$1,773	1	1	1	1	1	1
Acquisition of Water Rights through Urbanization for Cameron Irrigation	$425,000	$211	0	0	170	470	365	808
Surplus/Deficit after WMS			**483**	**155**	**0**	**0**	**0**	**0**
Alternative Strategies	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville/Matamoros Weir and Reservoir		$77	387	388	389	391	392	394
Harlingen New BGD Plant		$2,180	0	0	12	12	12	12

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 BMP for Industrial Users.

MINING

Table 5-92 Cameron Mining, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			264	277	191	126	61	28
Total Supply			492	491	490	490	489	488
Projected Supply Surplus/Deficit			**228**	**214**	**299**	**364**	**428**	**460**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	26	28	19	13	6	3
Need after Conservation			**254**	**242**	**318**	**377**	**434**	**463**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**254**	**242**	**318**	**377**	**434**	**463**

Implementation of Best Management Practices

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 BMP for Industrial Users.

STEAM-ELECTRIC

Table 5-93 Cameron Steam-Electric, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			1,523	1,780	2,094	2,477	2,944	3,428
Total Supply			823	823	823	823	823	823
Projected Supply Surplus/Deficit			**-700**	**-957**	**-1,271**	**-1,654**	**-2,121**	**-2,605**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID via Valley Acres ID		$671	40	77	115	153	190	228
ID Conservation: Valley Acres ID		$366	47	62	77	94	113	133
Implementation of Best Management Practices		$2,500	152	178	209	248	294	343
Need after Conservation			**-461**	**-640**	**-870**	**-1,159**	**-1,524**	**-1,901**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville Non-Potable Water Reuse Pipeline		$168	6,721	6,721	6,721	6,721	6,721	6,721
Brownsville Resaca Restoration		$1,182	1	1	1	1	1	1
Brownsville Banco Morales Reservoir		$688	46	46	46	46	46	46
Brownsville Seawater Desalination Demonstration (Phase I)		$1,647	33	33	33	33	0	0

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville Seawater Desalination Demonstration (Phase II)		$1,170	0	0	0	0	332	332
Brownsville Southside WWTP Potable Reuse -Phase I		$5,560	0	48	48	48	0	0
Brownsville Southside WWTP Potable Reuse -Phase II		$3,708	0	0	0	0	60	60
Surplus/Deficit after WMS			**6,340**	**6,209**	**5,979**	**5,690**	**5,636**	**5,259**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Brownsville/Matamoros Weir and Reservoir		$77	228	228	229	230	231	232

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 BMP for Industrial Users.

5.3.2 Hidalgo County

Irrigation Districts/WWP

Irrigation District Conservation Water Management Strategies are recommended for all of the Irrigation Districts in Hidalgo County. Figure 5-9 shows a map of the Hidalgo County IDs. Additionally, this section includes Hidalgo County Drainage District No. 1, which intends to implement the Delta Watershed Project.

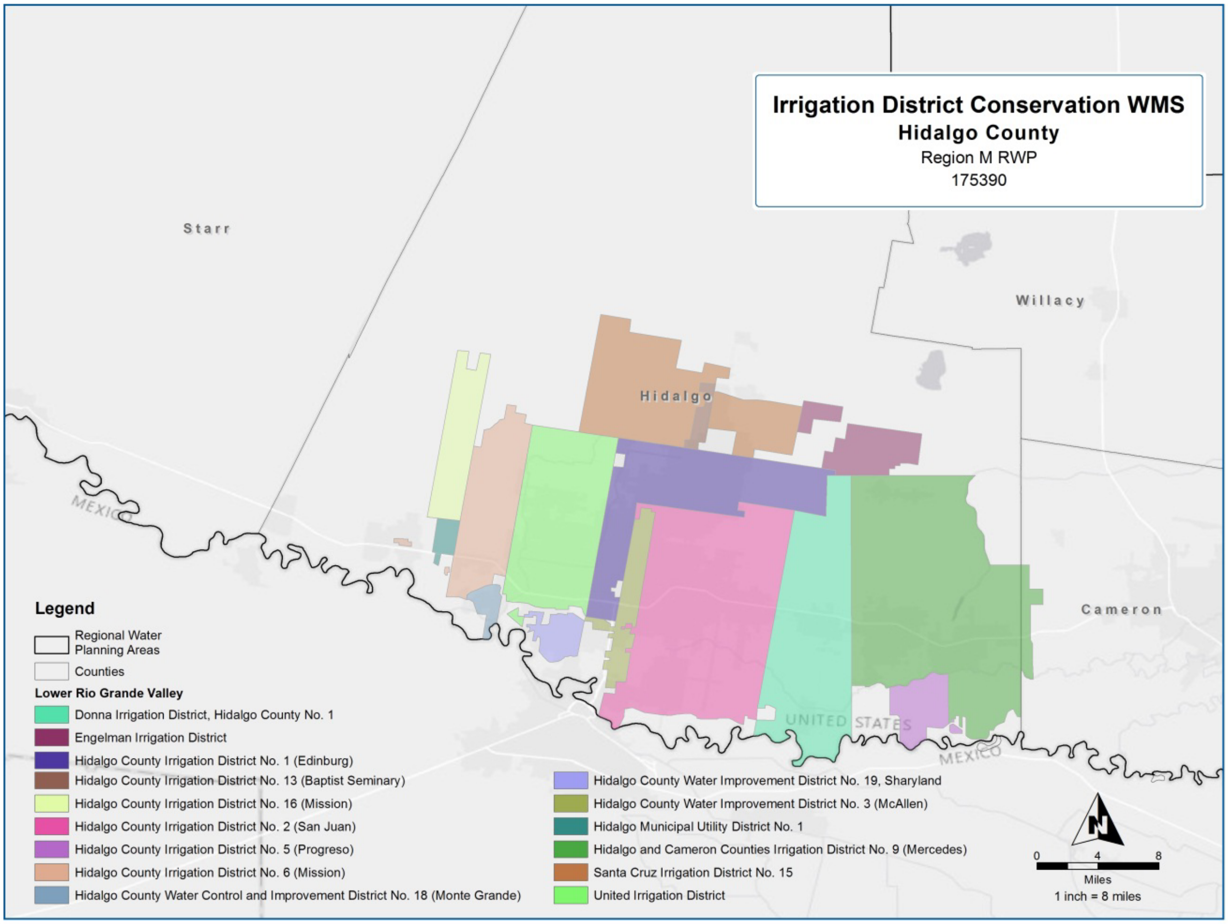

Figure 5-9 Hidalgo County Irrigation District Conservation WMS

DONNA IRRIGATION DISTRICT, HIDALGO COUNTY NO. 1

Donna ID serves irrigators in Hidalgo County, the City of Donna, and North Alamo WSC. This system is predominantly open canals. The strategy below was submitted by Donna ID Hidalgo County No. 1 to the RWPG.

Table 5-94 Donna ID Conservation WMS Cost Projections

Cost Estimate Summary ***Donna Irrigation District*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Pipe, Gate (Vent) Wells, gates, connecting structures	$5,406,000
TOTAL COST OF FACILITIES	**$5,406,000**
Engineering and Permitting	$973,000
TOTAL COST OF PROJECT	**$6,379,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$505,963
O&M Cost (based on reduced pumping and canal rider costs)	-$43,210
TOTAL ANNUAL COST	**$462,752**
Available Project Yield (acft/yr)	989
Annual Cost of Water ($ per acft)	$468
Annual Cost of Water ($ per 1,000 gallons)	$1.44

ENGLEMAN IRRIGATION DISTRICT

Engleman ID's conveyance system is predominantly open canals, serving irrigators in Hidalgo County. Engleman ID supplies water to irrigators in to Hidalgo County. The strategies below were submitted by Engleman ID to the RWPG.

Table 5-95 Engleman ID Conservation WMS Cost Projections

Cost Estimate Summary ***Engleman Irrigation District*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Pipeline Replacement	$750,000
Canal Lining, Leak Prevention, Improvement of Connectivity	$3,750,000
TOTAL COST OF PROJECT	**$4,500,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$356,926
O&M Cost (based on reduced pumping and canal rider costs)	-$1,991
TOTAL ANNUAL COST	**$354,935**
Available Project Yield (acft/yr)	831
Annual Cost of Water ($ per acft)	$427
Annual Cost of Water ($ per 1,000 gallons)	$1.31

HIDALGO AND CAMERON COUNTIES IRRIGATION DISTRICT NO. 9 (MERCEDES)

HCCID No. 9 serves irrigators in Cameron and Hidalgo Counties, with 96% of the acreage in Hidalgo and only 4% in Cameron. In addition to irrigation water, this district supplies raw water to the cities of La Villa, Mercedes, Elsa, Weslaco, Edcouch, and North Alamo WSC. The conveyance system consists of canals that are both lined and unlined and a large amount of pipelines. The following strategies were submitted by Hidalgo and Cameron Counties ID No. 9 to the RWPG.

Table 5-96 Hidalgo and Cameron Counties ID No. 9 Conservation WMS Cost Projections

Cost Estimate Summary Hidalgo & Cameron County Irrigation District 9 Irrigation District Conservation	
Item	***Estimated Costs for Facilities***
Lining of the Mercedes Main Canal	$52,000,000
River Lift Pump Modernization	$2,000,000
TOTAL COST OF PROJECT	**$54,000,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,283,113
O&M Cost (based on reduced pumping and canal rider costs)	-$8,192
TOTAL ANNUAL COST	**$4,274,921**
Available Project Yield (acft/yr)	4000
Annual Cost of Water ($ per acft)	$1,069
Annual Cost of Water ($ per 1,000 gallons)	$3.28

HIDALGO COUNTY DRAINAGE DISTRICT NO. 1

Delta Watershed Project

Hidalgo County Drainage District manages the drainage canals serving parts of Hidalgo County, and does not currently divert water from the Rio Grande. However, the District intends to develop two storage reservoirs to capture irrigation tailwaters and precipitation run-off for beneficial use which would otherwise flow to the Laguna Madre. Strategies submitted by Hidalgo County Drainage District No. 1 to the RWPG.

Description

This strategy is to reclaim storm water and irrigation runoff into the Hidalgo County Drainage District (HCDD) No. 1 master drainage system and retain this water in two reservoirs adjacent to the main floodwater channel in Northeast Hidalgo County. The reclaimed water will be sold to municipalities and water supply corporations for potable water treatment, and to irrigation districts for agricultural uses. The reservoirs can provide storm water control and management by reducing water volume during major rainfall events for detention reasons. This strategy will also provide education to the general public under the MS4 program.

A map of the Delta Watershed Project Reservoirs is shown in Figure 5-10.

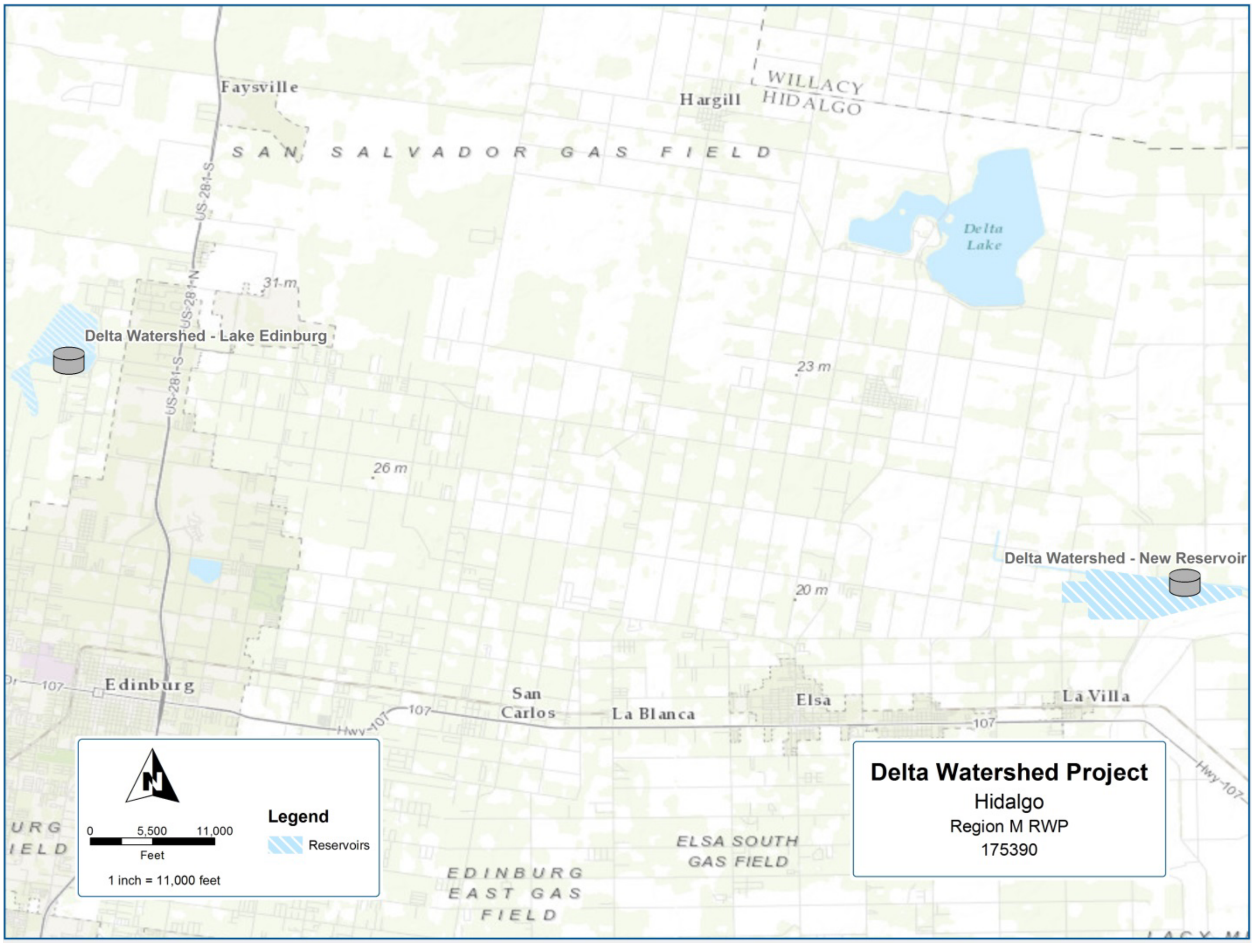

Figure 5-10 Delta Watershed Project Reservoir Locations

Available Supply

The Hidalgo County Drainage District 1 worked with the TCEQ on an approved Hydrologic Variance to the Nueces Rio Grande WAM which establishes the firm yield of the Delta Watershed.[18] The resulting Firm Yield is 7,522 acre-feet/year. Because this water will be treated to reduce TDS prior to distribution to any end users, an estimated 80% membrane recovery rate was applied for a total supply of 6017 acre-ft./year.

The WMS seeks to provide 3739 acre-ft./year (2000 acre-ft./year to NAWSC, and 1739 acre-ft./year to Hidalgo County Irrigators in the Nueces Rio Grande basin) from the Edinburg Reservoir, and 2278 acre-ft./year (400 acre-ft./year to La Villa, and 1878 to Hidalgo County Irrigators in the Nueces Rio Grande basin) from the proposed new reservoir. The 2011 Regional Water Supply Facilities Plan indicated that about 15 MGD could be developed for beneficial use, which may be available in years with regular precipitation.

[18] *Rio Grande Regional Water Planning Group (Region M) Hydrologic Variance Request #2,* Jeff Walker, TWDB, March 10, 2015.

Environmental Issues

An anticipated benefit to sea grass growth and species composition is expected by reducing fresh water flows into the Lower Laguna Madre. Reservoirs constructed entirely on dry land require no federal 404 permit. Typical environmental issues include impacts that may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities.

Engineering and Costing

Two feasibility studies have been conducted for this strategy. In 2006, a study titled *Hidalgo County Water Development Project* investigated water availability within the Hidalgo County Master Drainage Systems. Background water quality conditions were also studied by collecting fifteen water samples across the study area. The study concluded that water could be developed for beneficial use. In 2011, the *Regional Water Supply Facilities Plan* studied the feasibility of the proposed strategy. Potential project sites were evaluated with consideration of the availability of water floodplain and environmental concerns. Alternative water treatment processes were also evaluated with consideration of the water quality conditions with the drainage system.

Costs for this strategy from the UCM include a pump station, pipeline, pipeline right-of-way, water treatment, reservoir, and land acquisition. It is assumed that the construction period for this strategy is one year.

Table 5-97 outlines project requirements and cost estimates for the Edinburg Reservoir. Table 5-98 shows the project requirements and costs for the proposed new reservoir.

Table 5-97 Delta Watershed Project, Lake Edinburg Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Hidalgo County Drainage District #1 - Delta Watershed Project, Lake Edinburg***	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool 4250 acft, 425 acres)	$4,552,000
Water Treatment Plant (5 MGD)	$13,444,000
TOTAL COST OF FACILITIES	**$17,996,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,299,000
Environmental & Archaeology Studies and Mitigation	$945,000
Land Acquisition and Surveying (428 acres)	$1,301,000
Interest During Construction (4% for 1 years with a 1% ROI)	$930,000
TOTAL COST OF PROJECT	**$27,471,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,573,000
Reservoir Debt Service (5.5 percent, 40 years)	$540,000
Operation and Maintenance	
Dam and Reservoir (1.5% of Cost of Facilities)	$68,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,570,000
TOTAL ANNUAL COST	**$4,751,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	3,739
Annual Cost of Water ($ per acft)	$1,271
Annual Cost of Water ($ per 1,000 gallons)	$3.90

Table 5-98 Delta Watershed Project, New Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Hidalgo County Drainage District #1 - Delta Watershed Project, New Reservoir*	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Off-Channel Storage/Ring Dike (Conservation Pool 2800 acft, 350 acres)	$10,274,000
Intake Pump Stations (2.7 MGD)	$850,000
Transmission Pipeline (16 in dia., 3 miles)	$756,000
Water Treatment Plant (3 MGD)	$8,630,000
TOTAL COST OF FACILITIES	**$20,510,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$7,141,000
Environmental & Archaeology Studies and Mitigation	$854,000
Land Acquisition and Surveying (387 acres)	$1,183,000
Interest During Construction (4% for 1 years with a 1% ROI)	$1,040,000
TOTAL COST OF PROJECT	**$30,728,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,211,000
Reservoir Debt Service (5.5 percent, 40 years)	$1,013,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$29,000
Dam and Reservoir (1.5% of Cost of Facilities)	$154,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,656,000
Pumping Energy Costs (153544 kW-hr @ 0.09 $/kW-hr)	$14,000
TOTAL ANNUAL COST	**$4,077,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,278
Annual Cost of Water ($ per acft)	$1,790
Annual Cost of Water ($ per 1,000 gallons)	$5.49

Implementation Issues

Permits and other considerations:

- U.S. Army Corps of Engineers Section 404 permit
- TCEQ Section 401 Certification
- TCEQ Section 401 TPDES permit
- U.S. Fish and Wildlife Service Incidental Take Permit through Section 7 Consultation
- Section 106 approval from Texas Historical Commission
- Antiquities Permit for archeological investigations
- TCEQ water permitting
- TCEQ requires a water right
- Although there are no dry year environmental flow requirements in this watershed, the impact of the reservoirs on habitat and wildlife downstream should be monitored.
- Salinity of captured water may fluctuate and pose difficulties for treatment.
- Distribution to end users via the Irrigation District canals requires water quality at or beyond that of raw water from the diversion point at the Rio Grande.

HIDALGO COUNTY IRRIGATION DISTRICT NO. 1 (EDINBURG)

HCID No. 1 has a conveyance system of mostly open canals, serving irrigators in Hidalgo County and the cities of Mission, McAllen and Sharyland WSC. Additionally, HCID No. 1 passes water through their system to Hidalgo MUD No. 1, HCID No. 13, and Santa Cruz ID. The strategies below were submitted by Hidalgo County ID No. 1 to the RWPG.

Table 5-99 Hidalgo County ID No. 1 Conservation WMS Cost Projections

Cost Estimate Summary Hidalgo County Irrigation District No. 1 Irrigation District Conservation	
Item	***Estimated Costs for Facilities***
Interconnect 29st canal-Freddy Gonzales Phase	$3,553,400
Interconnection 29th street Canal-Phase II	$2,992,110
Interconnection - Donna Interconnect - Phase III	$2,384,280
Interconnection-Donna Interconnect Phase IV	$403,485
Main Canal Improvements - Phase I	$20,200,000
Main Canal Improvements - Phase II	$5,800,000
West Main Canal Improvements - Phase I	$9,800,000
West Main Canal Improvements - Phase II	$9,800,000
TOTAL COST OF PROJECT	**$54,933,275**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,357,137
O&M Cost (based on reduced pumping and canal rider costs)	-$26,853
TOTAL ANNUAL COST	**$4,330,284**
Available Project Yield (acft/yr)	13112
Annual Cost of Water ($ per acft)	$330
Annual Cost of Water ($ per 1,000 gallons)	$1.01

HIDALGO COUNTY IRRIGATION DISTRICT NO. 2 (SAN JUAN)

HCID No. 2 delivers water to irrigators in Hidalgo County, North Alamo WSC, the cities of Alamo, McAllen, Pharr, San Juan, Edinburg, Rio Grande City, and Falcon Rural WSC. The district's conveyance network consists of approximately 225 miles of pipeline, 21 miles of lined canals, and 46 miles of unlined canals. There is one 1,800 acre-ft. storage reservoir and two pump stations. Strategies submitted by Hidalgo County ID No. 2 to the RWPG.

Table 5-100 Hidalgo County ID No. 2 Conservation WMS Cost Projections

Cost Estimate Summary Hidalgo County Irrigation District No. 2 Irrigation District Conservation	
Item	***Estimated Costs for Facilities***
General System Improvements and Leak Prevention	$7,285,560
Pipeline Improvement Project I-22 and I-7A	$3,681,723
Rehabilitation of Alamo Main Canal - Re-lining	$3,077,466
Rehabilitation of Alamo Main Canal - Automate Controls and Replace leaking gates	$644,121
TOTAL COST OF PROJECT	**$14,688,870**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,165,076
O&M Cost (based on reduced pumping and canal rider costs)	$10,026
TOTAL ANNUAL COST	**$1,175,102**

Cost Estimate Summary *Hidalgo County Irrigation District No. 2* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Available Project Yield (acft/yr)	4077
Annual Cost of Water ($ per acft)	$288
Annual Cost of Water ($ per 1,000 gallons)	$0.88

HIDALGO COUNTY IRRIGATION DISTRICT NO. 5 (PROGRESO)

Progresso's conveyance system is predominantly pipelines, with some canals. There are three pump stations and three reservoirs, with a combined storage capacity of 200 acre-ft. Progresso ID only serves irrigation users in Hidalgo County. Strategies submitted by Hidalgo County ID No. 5 to the RWPG are shown below.

Table 5-101 Hidalgo County ID No. 5 Conservation WMS Cost Projections

Cost Estimate Summary *Hidalgo County Irrigation District No. 5* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
General System Improvements and Leak Prevention	$4,800,000
Replacement of Wooden Control Gate Main Reservoir, construction of Gate-well at Trunk Main Pipeline split at Santiago Galvan RD	$410,000
TOTAL COST OF PROJECT	**$5,210,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$413,241
O&M Cost (based on reduced pumping and canal rider costs)	-$5,736
TOTAL ANNUAL COST	**$407,505**
Available Project Yield (acft/yr)	1215
Annual Cost of Water ($ per acft)	$335
Annual Cost of Water ($ per 1,000 gallons)	$1.03

HIDALGO COUNTY IRRIGATION DISTRICT NO. 6 (MISSION)

Mission No. 6 delivers to irrigators and Agua SUD. The conveyance system has approximately 76 miles of pipelines, 43 miles of lined canals, and some unlined canals. The District has four pumps stations and reservoir storage capacity of 1,050 acre-ft. The following district conservation WMS was developed based on the characteristics of the Mission No. 6 system.

Table 5-102 Hidalgo County ID No. 6 Conservation WMS Cost Projections

Cost Estimate Summary *Hidalgo County Irrigation District No. 6 / Mission 6* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$8,100,599
Installation of Pipeline	$4,469,573
General Repairs and Improvements	$1,249,466
TOTAL COST OF PROJECT	**$13,819,638**

Cost Estimate Summary *Hidalgo County Irrigation District No. 6 / Mission 6* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,096,131
O&M Cost (based on reduced pumping and canal rider costs)	-$33,843
TOTAL ANNUAL COST	**$1,062,287**
Available Project Yield (acft/yr)	2787
Annual Cost of Water ($ per acft)	$381
Annual Cost of Water ($ per 1,000 gallons)	$1.17

HIDALGO COUNTY IRRIGATION DISTRICT NO. 13 (BAPTIST SEMINARY)

HCID No. 13 serves only irrigators in Hidalgo County through a conveyance system of primarily pipeline. The following Irrigation District Improvements WMS was developed for HCID No. 13 based on the system's components and layout.

Table 5-103 Hidalgo County ID No. 13 Conservation WMS Cost Projections

Cost Estimate Summary *Hidalgo County Irrigation District No. 13* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
General Repairs and Improvements	$660,339
TOTAL COST OF PROJECT	**$660,339**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$52,376
O&M Cost (based on reduced pumping and canal rider costs)	-$532
TOTAL ANNUAL COST	**$51,844**
Available Project Yield (acft/yr)	102
Annual Cost of Water ($ per acft)	$508
Annual Cost of Water ($ per 1,000 gallons)	$1.56

HIDALGO COUNTY IRRIGATION DISTRICT NO. 16 (MISSION)

Mission No. 16 serves irrigation users, Agua SUD, and the city of La Joya. This conveyance system is predominantly lined and open canals, with some pipelines totally approximately 60 miles in length. Strategies submitted by Hidalgo County ID No. 16 to the RWPG are shown below.

Table 5-104 Hidalgo County ID No. 16 Conservation WMS Cost Projections

Cost Estimate Summary *Hidalgo County Irrigation District No. 16* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
General Improvements and Water Loss Prevention	$1,680,000
Canal Re-Lining, Elevated Main Canal	$1,853,600
TOTAL COST OF PROJECT	**$3,533,600**
ANNUAL COST	

Cost Estimate Summary *Hidalgo County Irrigation District No. 16* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Debt Service (5.5 percent, 20 years)	$280,274
O&M Cost (based on reduced pumping and canal rider costs)	-$64,248
TOTAL ANNUAL COST	**$216,026**
Available Project Yield (acft/yr)	1455
Annual Cost of Water ($ per acft)	$148
Annual Cost of Water ($ per 1,000 gallons)	$0.46

HIDALGO COUNTY WATER CONTROL AND IMPROVEMENT DISTRICT NO. 18 (MONTE GRANDE)

HCWCID No. 18 delivers irrigation and mining water within Hidalgo County. The following Irrigation District Conservation WMS was developed based on characteristics of this system.

Table 5-105 Hidalgo County WCID No. 18 Conservation WMS Cost Projections

Cost Estimate Summary *Hidalgo County Water Control and Improvement District No. 18* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$350,928
Installation of Pipeline	$218,118
TOTAL COST OF PROJECT	**$569,047**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$45,135
O&M Cost (based on reduced pumping and canal rider costs)	-$1,548
TOTAL ANNUAL COST	**$43,587**
Available Project Yield (acft/yr)	119
Annual Cost of Water ($ per acft)	$366
Annual Cost of Water ($ per 1,000 gallons)	$1.12

HIDALGO COUNTY WATER IMPROVEMENT DISTRICT NO. 3 (MCALLEN)

HCWID No. 3 is predominantly open canals, which serve irrigation, mining, and industrial water users in Hidalgo County as well as the City of McAllen. The District maintains a 189 acre-ft. of storage off-channel reservoir and approximately 30 miles of canals and pipelines. Strategies submitted by Hidalgo County WID No. 3 to the RWPG.

Table 5-106 Hidalgo County WID No. 3 Conservation WMS Cost Projections

Cost Estimate Summary *Hidalgo County Water Irrigation District No. 3* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$8,000,000
Customer Water Use Management Tools	$450,000
Renewal of Lawn Irrigation Systems	$600,000
TOTAL COST OF PROJECT	**$9,050,000**

Cost Estimate Summary ***Hidalgo County Water Irrigation District No. 3*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$717,818
O&M Cost (based on reduced pumping and canal rider costs)	-$1,430
TOTAL ANNUAL COST	**$716,388**
Available Project Yield (acft/yr)	2291
Annual Cost of Water ($ per acft)	$313
Annual Cost of Water ($ per 1,000 gallons)	$0.96

Renewal of Lawn Irrigation Systems

Description

This strategy is to rehabilitate the District's irrigation lines to urbanized open spaces for customers to easily irrigate lawns and landscaping which are currently irrigated with treated water from the City of McAllen. The strategy would be implemented in residential, commercial, and park areas within the District. The City of McAllen will benefit from this strategy by reducing the demand need for irrigation from their potable water system.

Available Supply

The District's goal is to rehabilitate system lines to access 250 customers that average one acre in size. This would save approximately 300 acre-ft. of treated water per year.

HIDALGO MUNICIPAL UTILITY DISTRICT NO. 1

Hidalgo MUD serves irrigators in their district and also treats surface water for municipal use in the utility district. The Irrigation District WMS below was developed for this system.

Table 5-107 Hidalgo MUD No. 1 Conservation WMS Cost Projections

Cost Estimate Summary ***Hidalgo M.U.D. No. 1*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Canal Lining	$526,393
Installation of Pipeline	$332,723
TOTAL COST OF PROJECT	**$859,115**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$68,142
O&M Cost (based on reduced pumping and canal rider costs)	-$2,350
TOTAL ANNUAL COST	**$65,792**
Available Project Yield (acft/yr)	180
Annual Cost of Water ($ per acft)	$366
Annual Cost of Water ($ per 1,000 gallons)	$1.12

SANTA CRUZ IRRIGATION DISTRICT NO. 15

Santa Cruz ID receives water that passes through Hidalgo County Irrigation District No. 1 and delivers that water to irrigators, Sharyland WSC, North Alamo WSC, and some individual domestic users who purchase raw water for lawn watering. The District's conveyance systems consists of predominately pipelines and unlined canals. Strategies submitted by Santa Cruz ID No. 15 to the RWPG.

Table 5-108 Santa Cruz ID Conservation WMS Cost Projections

Cost Estimate Summary Santa Cruz Irrigation District 15 Irrigation District Conservation	
Item	***Estimated Costs for Facilities***
Canal Re-Lining	$1,248,499
Santa Cruz Irrigation District 15 Water Conservation Program: Pipe Replacement Project	$1,570,810
General Improvements and Loss Prevention	$780,000
Replace Unlined Canal with Pipeline	$981,400
TOTAL COST OF PROJECT	**$4,580,709**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$363,328
O&M Cost (based on reduced pumping and canal rider costs)	-$42,357
TOTAL ANNUAL COST	**$320,971**
Available Project Yield (acft/yr)	3599
Annual Cost of Water ($ per acft)	$89
Annual Cost of Water ($ per 1,000 gallons)	$0.27

HIDALGO COUNTY WATER IMPROVEMENT DISTRICT NO. 19, SHARYLAND PLANTATION ID

Sharyland ID delivers only irrigation water for use in Hidalgo County through a conveyance system of primarily open canals. The Irrigation District Conservation WMS developed below is based on information about the current conveyance system.

Table 5-109 Sharyland ID Conservation WMS Cost Projections

Cost Estimate Summary Sharyland, Hidalgo County Improvement District No. 19 Irrigation District Conservation	
Item	***Estimated Costs for Facilities***
Canal Lining	$1,620,120
Installation of Pipeline	$1,024,046
TOTAL COST OF PROJECT	**$2,644,166**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$209,727
O&M Cost (based on reduced pumping and canal rider costs)	-$7,233
TOTAL ANNUAL COST	**$202,494**
Available Project Yield (acft/yr)	554
Annual Cost of Water ($ per acft)	$366
Annual Cost of Water ($ per 1,000 gallons)	$1.12

UNITED IRRIGATION DISTRICT

Irrigation District Conservation

United ID has a conveyance system of approximately 150 miles of primarily open canals, and minimal storage. This district delivers to irrigation water users, Sharyland WSC and the cities of Mission and McAllen.

Table 5-110 United ID Conservation WMS Cost Projections

Cost Estimate Summary *United Irrigation District* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining Main Canal	$12,000,000
TOTAL COST OF PROJECT	**$12,000,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$951,803
O&M Cost (based on reduced pumping and canal rider costs)	-$4,486
TOTAL ANNUAL COST	**$947,317**
Available Project Yield (acft/yr)	7093
Annual Cost of Water ($ per acft)	$134
Annual Cost of Water ($ per 1,000 gallons)	$0.41

Off-Channel Reservoir

Project Source

This strategy was submitted by United Irrigation District to the RWPG.

Description

This strategy is for an off-channel storage reservoir between the diversion point from the Rio Grande and the first pumping station in the United Irrigation District system.There is a delay between the time that the users in the district request water and the time when the Irrigation Districts can divert that water from the river because of the distance that the water must travel. Water is ordered 2-8 days in advance based on forecasted needs. In the time (generally 2-3 days) between when water is released and when it is diverted, rainfall in the district can fill the available storage space in the main canals and reduce demands. When this happens, the District has nowhere to store the water they have requested but their water right holder account is charged with 90% of the volume that was released for them. United ID has quantified these losses annually from 2008 to 2012, estimating an average of 3.7% of their annual diversions is lost as a result of insufficient storage.

A storage reservoir is proposed between the pump station at the Rio Grande and the first pump station within the ID canal network which would have a 640 AF storage capacity, as opposed to the estimated 80 AF capacity of their main canal. This would allow for general operational improvements within the district, but will also yield an estimated additional 2,000 AF of supply in a drought of record scenario without any additional water rights.

United ID also manages Hidalgo County Irrigation District No. 16, which is upriver from United. With the approval of the Watermaster, United would be able to pump and store any water that HCID No. 16 is unable to divert as a result of their limited storage and periodic equipment failures. HCID No. 16 is estimated to lose 5% of their annual diversions.

A map with the location of the United ID Reservoir is shown in Figure 5-11.

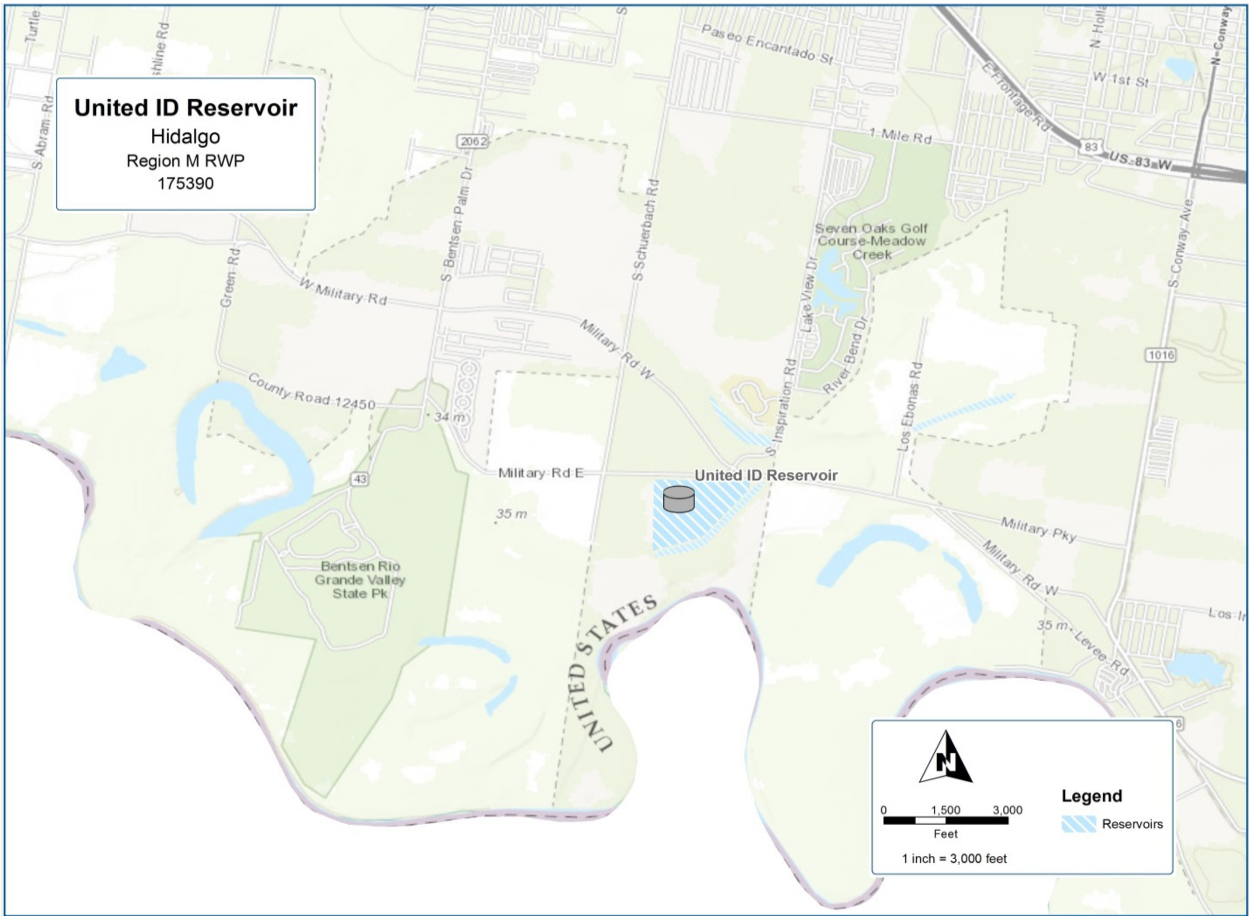

Figure 5-11 United ID Off-Channel Reservoir

Available Supply

In order to estimate the supplies available with this strategy, the loss estimates from inability to divert were applied to the diversion projections for drought of record conditions. Over the planning horizon, the United ID losses are estimated at 2,000 AF and the HCID No. 16 losses were estimated at 900. Taking into consideration that these losses may not be 100% eliminated, and for a conservative estimate, 1,500 AF and 500 AF were estimated for United and HCID 16, respectively for a total increase in supplies of 2,000 AF.

Environmental Issues

Construction of this reservoir would require inundation of 45 acres of land, currently used as farmland. Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution which are typical of any construction project. There would be a reduction in water left in the channel of the Rio Grande equivalent to the firm yield of the project, estimated at 2,000 acre-ft./year. There are no dry-year environmental subsistence flow requirements for the portion of the Rio Grande downstream of United ID's diversion point. Reservoirs constructed entirely on dry land require no federal 404 permit. Other typical environmental issues include impacts that may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities.

Engineering and Costing

The Unified Cost Model was used to estimate the costs of construction and maintenance for the reservoir (Table 5-111). Because a site has been identified, costs were included directly.

Table 5-111 United ID Off-Channel Reservoir Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
United Irrigation District - Off-Channel Reservoir

Item	***Estimated Costs for Facilities***
Off-Channel Storage/Ring Dike (Conservation Pool 620 acft, 45 acres)	$4,372,000
TOTAL COST OF FACILITIES	**$4,372,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,530,000
Environmental & Archaeology Studies and Mitigation	$953,000
Land Acquisition and Surveying (50 acres)	$1,271,000
Interest During Construction (4% for 1 years with a 1% ROI)	$286,000
TOTAL COST OF PROJECT	**$8,412,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,000
Reservoir Debt Service (5.5 percent, 40 years)	$522,000
Operation and Maintenance	
Dam and Reservoir (1.5% of Cost of Facilities)	$66,000
Pumping Energy Costs (47137 kW-hr @ 0.09 $/kW-hr)	$4,000
TOTAL ANNUAL COST	**$595,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,000
Annual Cost of Water ($ per acft)	$298
Annual Cost of Water ($ per 1,000 gallons)	$0.91

Implementation Issues

No additional water rights are required. The District will divert water under its existing rights; Certificate of Adjudication No. A847-001. However, pumping water rights owned by HCID No. 16 will require approval by the watermaster. Construction permitting will be required.

WUG and WUG/WWP

Hidalgo County WUG and WUG/WWP that have recommended strategies with associated capital costs and locations which do not have individual maps associated with them are represented in Figure 5-12. A list of these WMS and their map numbers is given in Table 5-112.

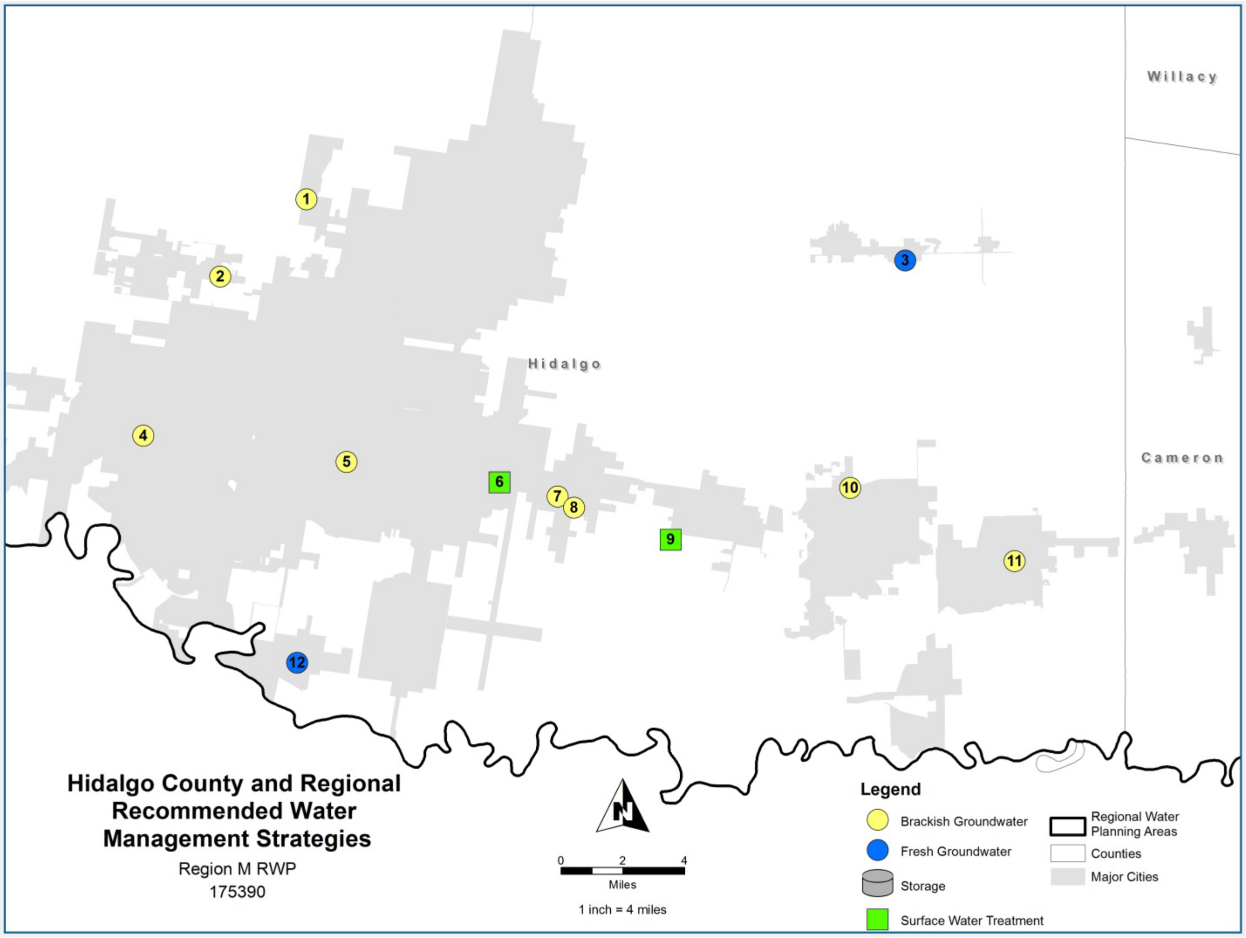

Figure 5-12 Hidalgo County and Regional Recommended WMS

Table 5-112 Map Legend: Hidalgo County and Regional Recommended Water Management Strategies

Map Number	Entity	Water Management Strategy Name	Water Management Strategy Category
1	Sharyland WSC	Water Treatment Plant No. 3 Brackish Groundwater Desalination	Brackish Groundwater
2	Sharyland WSC	Water Treatment Plant No. 2 Brackish Groundwater Desalination	Brackish Groundwater
3	Edcouch	Groundwater Supply	Fresh Groundwater
4	Mission	New Brackish Groundwater Treatment Plant	Brackish Groundwater
5	McAllen	New Brackish Groundwater Treatment Plant	Brackish Groundwater
6	San Juan	Water Treatment Plant No. 1 Upgrade and Expansion	Surface Water Treatment
7	Alamo	New Brackish Groundwater Treatment Plant	Brackish Groundwater
8	Alamo	Groundwater Well	Brackish Groundwater

Map Number	Entity	Water Management Strategy Name	Water Management Strategy Category
9	Donna	Water Treatment Plant Expansion	Surface Water Treatment
10	Weslaco	Groundwater Development and Blending	Brackish Groundwater
11	Mercedes	New Brackish Groundwater Desalination Plant	Brackish Groundwater
12	Hidalgo	Expand Existing Groundwater Wells	Fresh Groundwater

AGUA SPECIAL UTILITY DISTRICT

Table 5-113 Agua SUD Water Supply and Demand Analysis (Acre-feet/year)

Demands	Sole Supplier		2020	2030	2040	2050	2060	2070
WUG Water Demand	Yes		5,622	6,771	7,963	9,194	10,459	11,700
County-Other			64	64	64	64	64	64
Mission***			33	33	33	33	33	33
Penitas**	Yes		603	732	865	1,001	1,139	1,275
Palmview**	Yes		743	897	1,056	1,220	1,388	1,554
La Joya***			184	184	184	184	184	184
Mining			12	12	12	12	12	12
Sullivan City**	Yes		544	647	755	869	989	1,107
Total Demands			**7,805**	**9,340**	**10,932**	**12,577**	**14,268**	**15,929**
Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			4,844	4,844	4,844	4,844	4,844	4,844
County-Other			55	55	55	55	55	55
Mission***			28	28	28	28	28	28
Penitas**			520	520	520	520	520	520
Palmview**			640	640	640	640	640	640
La Joya***			159	159	159	159	159	159
Mining			10	10	10	10	10	10
Sullivan City**			469	469	469	469	469	469
Total			**6,725**	**6,725**	**6,725**	**6,725**	**6,725**	**6,725**
WWP Needs (Surplus +/ Need -)			**-1,080**	**-2,615**	**-4,207**	**-5,852**	**-7,543**	**-9,204**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID #16		$148	284	366	449	532	615	697
ID Conservation: HCID #6		$381	722	798	875	952	1,028	1,105
WUG Advanced Municipal Conservation		$652	0	0	131	527	1,058	1,688
Penitas Advanced Municipal Conservation		$652	0	5	39	86	147	218
Palmview Advanced Municipal Conservation		$652	0	0	21	75	145	230
Sullivan City Advanced Municipal Conservation		$652	0	0	0	13	61	118
Need after Conservation			**-75**	**-1,445**	**-2,692**	**-3,667**	**-4,490**	**-5,148**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

West Agua SUD Potable Reuse Phase I	$14,455,000	$2,974	784	784	784	784	784	784
West Agua SUD Potable Reuse Phase II	$8,796,000	$2,145	0	0	896	896	896	896
East Agua SUD Potable Reuse Phase I	$13,019,000	$2,358	1,050	1,050	1,050	1,050	1,050	1,050
East Agua SUD Potable Reuse Phase II	$3,561,000	$3,881	0	0	0	210	210	210
Agua SUD Acquisition of Water Rights through Urbanization	$340,000	$143	200	400	1,000	1,800	2,600	2,600
Surplus/Deficit after WMS			**1,959**	**789**	**1,038**	**1,073**	**1,050**	**392**
Total Supplies with WMS			**9,764**	**10,129**	**11,970**	**13,650**	**15,318**	**16,321**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			7,013	7,308	8,309	9,625	10,990	11,735
County-Other			134	136	146	153	155	156
Mission***			40	41	50	57	58	59
Penitas**			743	765	1,002	1,120	1,208	1,292
Palmview**			918	941	1,226	1,373	1,490	1,590
La Joya***			226	230	260	272	276	280
Mining			14	15	24	26	26	27
Sullivan City**			675	694	953	1,024	1,115	1,183
Total Surplus/Deficit			9,764	10,129	11,970	13,651	15,319	16,322
Needs After WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			1,391	537	346	431	531	35
County-Other			70	72	82	89	91	92
Mission***			7	8	17	24	25	26
Penitas**			140	33	137	119	69	17
Palmview**			175	44	170	153	102	36
La Joya***			42	46	76	88	92	96
Mining			2	3	12	14	14	15
Sullivan City**			131	47	198	155	126	76
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant	$18,136,000	$2,616	0	0	0	1,212	1,212	1,212
Agua SUD Non-Potable Reuse	$4,026,000	$2,946	280	280	280	280	280	280
RGRWA Regional Facility Project		$3,237	0	700	700	2,900	4,600	6,350

*Only partially in Agua SUD CCN, demands show estimated portion in CCN

**Since Agua SUD is the only source for these entities/parts of entities, assume shortages are shared evenly

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Agua SUD' 2011 GPCD was estimated at 104, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use.

West WWTP Direct Potable Reuse

Project Source

This strategy was submitted by Agua Special Utility District to the RWPG.

Description

The Agua Special Utility District (SUD) owns the West Agua WWTP, located in Sullivan City, Texas. Currently there is no reuse water supplied from the existing wastewater treatment plant. This direct potable reuse strategy involves reuse water being pumped from the wastewater treatment plant to the water supply reservoirs located at Agua SUD's Abram's WTP in order to supplement raw water from the Rio Grande. Tertiary treatment would be required at the wastewater treatment plant prior to pumping the treated effluent to the water supply reservoir.

A map of the approximate locations of the Agua SUD reuse lines is shown in Figure 5-13.

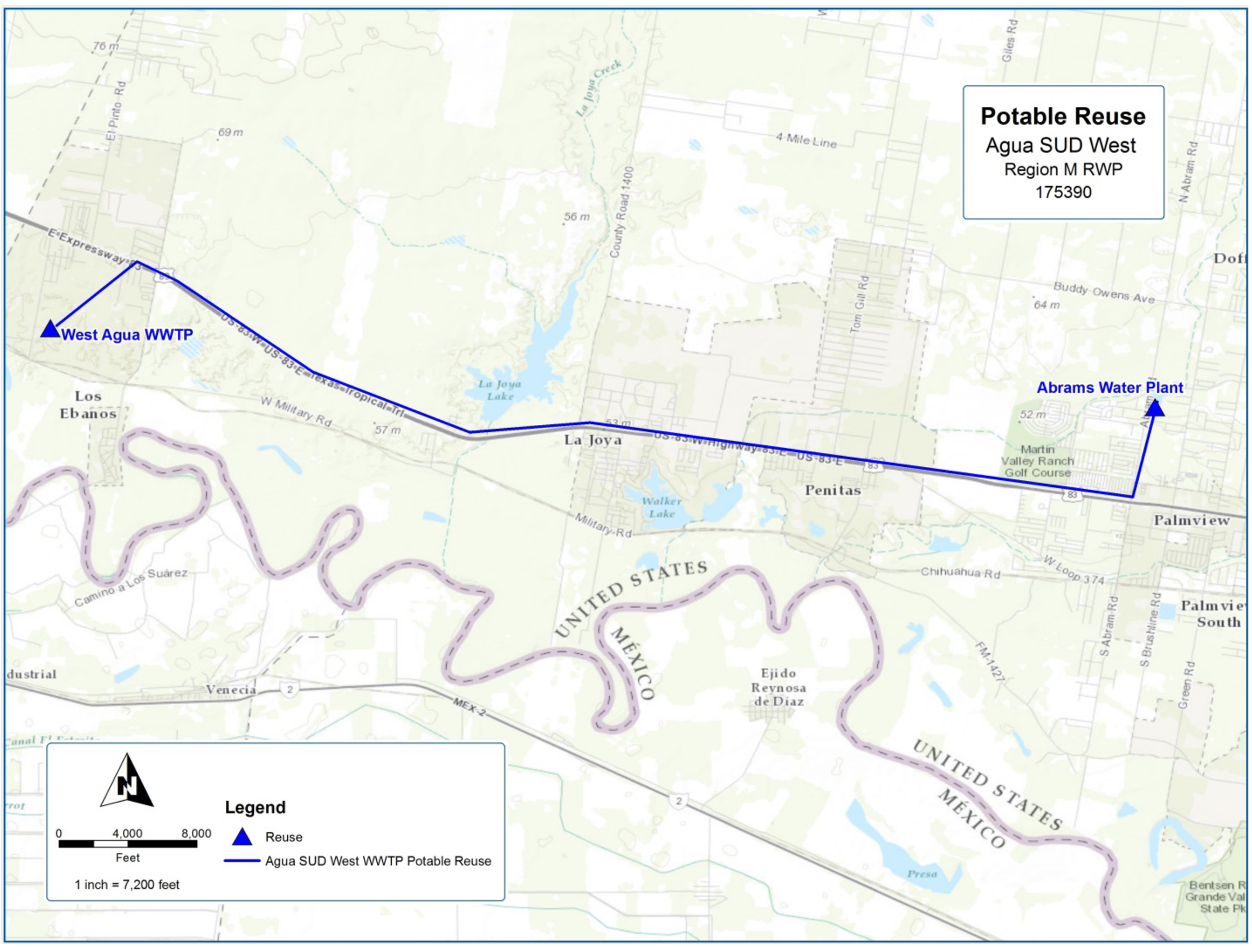

Figure 5-13 Agua SUD West WWTP Potable Reuse

Available Supply

The West Agua WWTP produces 1.4 MGD of reclaimed water. Based on demand projections for Agua SUD, it is anticipated that the effluent flow will increase to 3 MGD by 2040. Project calculations assume 60% of the effluent stream will be treated and that the maximum produced water volume is 50% of the effluent stream, taking into account membrane recovery rates. The resulting supply is 784 acre-ft./year in Phase I (2020-2030) and 1,680 acre-ft./year in Phase II (2040 – 2070). 80,000 ft. of pipeline

Engineering and Costing

The Agua SUD Potable Reuse option would include two new pump stations and pipelines to transfer the treated effluent from both wastewater treatment plants to the water supply reservoirs. Additional treatment would be needed at each wastewater treatment plant. Because the pipelines would transfer the reuse water into existing reservoirs, no additional storage would be required. It is assumed that the construction period would be 2 years.

Table 5-114, and Table 5-115 outline the estimated project requirements and costs for Phase I and II of the project. It was assumed that filtration at the wastewater treatment plants will be needed in addition to membrane treatment; therefore Treatment Level 2 – Simple Filtration was used in the UCM. The existing plant footprints were assumed to have adequate space for the additional treatment and pump stations, so land acquisition is not required at the WWTP.

The pipeline and pump station to transfer the treated effluent to the water supply reservoirs was sized for build-out capacities and included in the 2020 phase. The treatment plant costs and O&M in Phase II are limited to the additional capacity.

Table 5-114 Agua SUD West WWTP Potable Reuse Project Requirements and Costs- Phase I

Cost Estimate Summary
Water Supply Project Option
Agua Special Utility District - West WWTP Potable Reuse - Phase I

Item	***Estimated Costs for Facilities***
Intake Pump Stations (0.7 MGD)	$924,000
Transmission Pipeline (10 in dia., 11 miles)	$3,162,000
Two Water Treatment Plants (0.7 MGD and 0.7 MGD)	$5,497,000
TOTAL COST OF FACILITIES	**$9,583,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,196,000
Environmental & Archaeology Studies and Mitigation	$284,000
Land Acquisition and Surveying (143 acres)	$446,000
Interest During Construction (4% for 2 years with a 1% ROI)	$946,000
TOTAL COST OF PROJECT	**$14,455,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,210,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$55,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,049,000
Pumping Energy Costs (204115 kW-hr @ 0.09 $/kW-hr)	$18,000
TOTAL ANNUAL COST	**$2,332,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	784
Annual Cost of Water ($ per acft)	$2,974
Annual Cost of Water ($ per 1,000 gallons)	$9.13

Table 5-115 Agua SUD West WWTP Potable Reuse Project Requirements and Costs – Phase II

Cost Estimate Summary *Water Supply Project Option* *Agua Special Utility District - West Potable Reuse -Phase II*	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (0.8 MGD and 0.8 MGD)	$6,089,000
TOTAL COST OF FACILITIES	**$6,089,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,131,000
Interest During Construction (4% for 2 years with a 1% ROI)	$576,000
TOTAL COST OF PROJECT	**$8,796,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$736,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$1,162,000
Pumping Energy Costs (267557 kW-hr @ 0.09 $/kW-hr)	$24,000
TOTAL ANNUAL COST	**$1,922,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	896
Annual Cost of Water ($ per acft)	$2,145
Annual Cost of Water ($ per 1,000 gallons)	$6.58
Two Water Treatment Plants (0.8 MGD and 0.8 MGD)	$6,089,000

Implementation Issues

Implementation of an indirect potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Construction of the new pipelines may also include any of the following permits: U.S. Army Corps of Engineers Section 404 permit, TPWD Sand, Shell, Gravel and Marl permit, TPDES Storm Water Pollution Prevention Plan, TXDOT right-of-way permit. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

East WWTP Potable Reuse

Project Source

This strategy was submitted by Agua Special Utility District to the RWPG.

Description

The Agua Special Utility District (SUD) is building a second plant, East Agua WWTP, located near Palmview, Texas. This direct potable reuse strategy involves reuse water being pumped from the wastewater treatment plant to the water supply reservoirs located at Agua SUD 429 WTP in order to supplement raw water from the Rio Grande. Tertiary treatment would be required at the wastewater treatment plant prior to pumping the treated effluent to the WTP storage reservoir.

A map of the approximate locations of the Agua SUD reuse lines is shown in Figure 5-14.

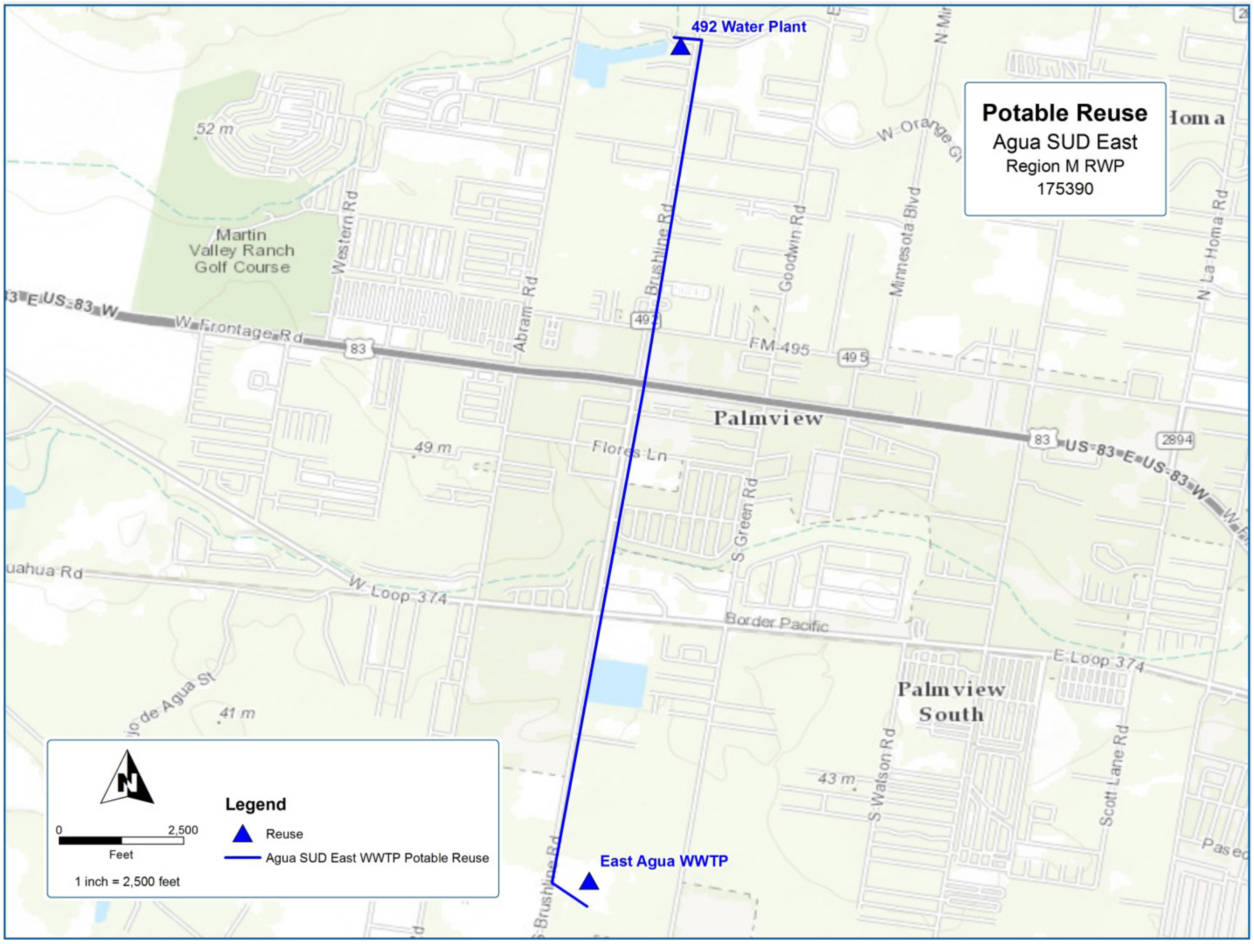

Figure 5-14 Agua SUD East WWTP Potable Reuse

Available Supply

Agua SUD projects that Phase 1 of the East Agua WWTP will be constructed and in operation by March 2016. Phase 1 of this WWTP will be capable of producing 2.5 MGD of reclaimed water, with 75% of capacity produced by 2021 and 90% of capacity produced by 2025. Project calculations assume 60% of the effluent stream will be treated and that the maximum produced water volume is 50% of the effluent stream, taking into account membrane recovery rates. Based on demands and availability, Phase I (2020 – 2040) supplies equal 1,050 acre-ft./year and Phase II (2050 – 2070) supplies equal 1,260 acre-ft./year.

Engineering and Costing

Table 5-116, and Table 5-117 outline the estimated project requirements and costs for Phase I and II of the project. It was assumed that filtration at the wastewater treatment plants will be needed in addition to membrane treatment; therefore Treatment Level 2 – Simple Filtration was used on the UCM spreadsheet. The existing plant footprints were assumed to have adequate space for the additional treatment and pump stations, so land acquisition is not required at the WWTP.

The pipeline and pump station to transfer the treated effluent to the water supply reservoirs was sized for build-out capacities and included in the 2020 phase. The treatment plant costs and O&M in Phase II are limited to the additional capacity.

Table 5-116 Agua SUD East WWTP Potable Reuse Project Requirements and Costs – Phase I

Cost Estimate Summary *Water Supply Project Option* *Agua Special Utility District - East WWTP Potable Reuse - Phase I*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (1 MGD)	$1,173,000
Transmission Pipeline (8 in dia., 3 miles)	$820,000
Two Water Treatment Plants (0.9 MGD and 0.9 MGD)	$6,902,000
TOTAL COST OF FACILITIES	**$8,895,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,072,000
Environmental & Archaeology Studies and Mitigation	$78,000
Land Acquisition and Surveying (44 acres)	$122,000
Interest During Construction (4% for 2 years with a 1% ROI)	$852,000
TOTAL COST OF PROJECT	**$13,019,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,089,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$38,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,317,000
Pumping Energy Costs (351277 kW-hr @ 0.09 $/kW-hr)	$32,000
TOTAL ANNUAL COST	**$2,476,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,050
Annual Cost of Water ($ per acft)	$2,358
Annual Cost of Water ($ per 1,000 gallons)	$7.24

Table 5-117 Agua SUD East WWTP Potable Reuse Project Requirements Phase II

Cost Estimate Summary *Water Supply Project Option* *Agua Special Utility District - East Potable Reuse -Phase II*	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (0.2 MGD and 0.2 MGD)	$2,465,000
TOTAL COST OF FACILITIES	**$2,465,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$863,000
Interest During Construction (4% for 2 years with a 1% ROI)	$233,000
TOTAL COST OF PROJECT	**$3,561,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$298,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$471,000
Pumping Energy Costs (509363 kW-hr @ 0.09 $/kW-hr)	$46,000
TOTAL ANNUAL COST	**$815,000**

Cost Estimate Summary ***Water Supply Project Option*** ***Agua Special Utility District - East Potable Reuse -Phase II***	
Item	***Estimated Costs for Facilities***
Available Project Yield (acft/yr), based on a Peaking Factor of 1	210
Annual Cost of Water ($ per acft)	$3,881
Annual Cost of Water ($ per 1,000 gallons)	$11.91

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Construction of the new pipelines may also include any of the following permits: U.S. Army Corps of Engineers Section 404 permit, TPWD Sand, Shell, Gravel and Marl permit, TPDES Storm Water Pollution Prevention Plan, TXDOT right-of-way permit. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

ALAMO

Table 5-118 Alamo Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			3231	3909	4607	5326	6064	6787
Current Water Supply/Supplier	**Type**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total Supply			2,227	2,227	2,227	2,227	2,227	2,227
Projected Supply Surplus/Deficit			**-1,004**	**-1,682**	**-2,380**	**-3,099**	**-3,837**	**-4,560**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID #2		$288	100	166	232	297	363	429
Advanced Municipal Conservation		$652	0	0	159	403	722	1,097
Need after Conservation			**-904**	**-1,516**	**-1,989**	**-2,399**	**-2,752**	**-3,034**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization	$1,700,000	$143	0	0	0	1,000	1,000	1,000
Alamo Groundwater Well		$113	1,100	1,100	1,100	1,100	1,100	1,100
Alamo BGD Plant		$2,655	896	896	896	896	896	896
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	50	50	50	50	50	50
Net Supply Surplus/Deficit			**1,162**	**550**	**77**	**667**	**314**	**32**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RGRWA Regional Facility Project		$3,237	850	1,500	2,200	2,950	3,650	4,400

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5Advanced Municipal Water Conservation. Alamo's 2011 GPCD was estimated at 133, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Groundwater Well

Project Source

This strategy was submitted by the City of Alamo to the RWPG.

Description

This strategy is to provide additional groundwater to the City of Alamo with the installation of a groundwater well. The City operates a 5 MGD conventional water treatment plant supplied by an existing well. The new well will be located approximately 1,000 feet from the existing well. It is assumed that the salinity of the new well will be similar to the existing well, so it is assumed primary desalination treatment will not be needed.

Available Supply

It is estimated that the new groundwater well could provide an additional 1,100 acre-ft./year to the City's water treatment plant.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and operations and maintenance. It is assumed that the construction period for this strategy is one year.

Table 5-119 outlines project elements and estimated costs.

Table 5-119 Alamo Groundwater Well Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option City of Alamo - Groundwater Well	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$811,000
TOTAL COST OF FACILITIES	**$811,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$284,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 2 years with a 1% ROI)	$78,000
TOTAL COST OF PROJECT	**$1,181,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$99,000
Operation and Maintenance	

Cost Estimate Summary ***Water Supply Project Option*** ***City of Alamo - Groundwater Well***	
Item	***Estimated Costs for Facilities***
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$8,000
Pumping Energy Costs (223701 kW-hr @ 0.09 $/kW-hr)	$20,000
TOTAL ANNUAL COST	**$127,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,100
Annual Cost of Water ($ per acft)	$115
Annual Cost of Water ($ per 1,000 gallons)	$0.35

Implementation Issues

No implementation issues have been identified.

Alamo Brackish Groundwater Desalination Plant

Project Source

This strategy was recommended in the 2011 Regional Water Plan and updated by the RWPG.

Description

This strategy is to drill a new brackish groundwater well and constructing a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates for Alamo, the new brackish groundwater plant is sized to pump 1,120 acre-ft./year, and supply 896 acre-ft./year starting and 2020.

Environmental Issues

The primary environmental issue associated with brackish groundwater supply is the disposal of concentrate. It is assumed that the concentrate will be disposed of via surface water discharge, however a specific location and TDS limits will need to be determined during preliminary design.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. It is assumed that the construction period for this strategy is one and a half years.

Table 5-120 outlines the project requirements and cost estimate developed in UCM.

Table 5-120 Alamo BGD Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of Alamo - Brackish Groundwater Desalination***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$697,000
Two Water Treatment Plants (1 MGD and 1 MGD)	$8,664,000
TOTAL COST OF FACILITIES	**$9,361,000**

Cost Estimate Summary
Water Supply Project Option
City of Alamo - Brackish Groundwater Desalination

Item	*Estimated Costs for Facilities*
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,277,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (4% for 2 years with a 1% ROI)	$886,000
TOTAL COST OF PROJECT	**$13,532,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,132,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,228,000
Pumping Energy Costs (128519 kW-hr @ 0.09 $/kW-hr)	$12,000
TOTAL ANNUAL COST	**$2,379,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	896
Annual Cost of Water ($ per acft)	$2,655
Annual Cost of Water ($ per 1,000 gallons)	$8.15

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

ALTON

Table 5-121 Alton Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			2,071	2,524	2,990	3,464	3,943	4,413
Total Supply			1,286	1,286	1,286	1,286	1,286	1,286
Projected Supply Surplus/Deficit			**-785**	**-1,238**	**-1,704**	**-2,178**	**-2,657**	**-3,127**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: United ID via Sharyland WSC		$134	115	129	143	157	171	184
ID Conservation: Santa Cruz ID via Sharyland WSC		$89	232	253	275	297	319	342
ID Conservation: HCID1 via Sharyland WSC		$330	50	125	300	300	300	300
Advanced Municipal Conservation		$652	0	70	200	376	592	844
Need after Conservation			**-388**	**-661**	**-786**	**-1,049**	**-1,275**	**-1,457**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sharyland WSC Water Treatment Plant No. 2 Brackish Groundwater Desalination		$2,630	189	189	189	189	189	189

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sharyland WSC Water Treatment Plant No. 3 Brackish Groundwater Desalination		$2,630	171	171	171	171	171	171
Sharyland Water Rights through Urbanization		$143	180	552	930	1,365	1,972	1,992
Surplus/Deficit after WMS			**152**	**251**	**504**	**676**	**1,057**	**895**

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Alton's 2011 GPCD was estimated at 125, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

DONNA

Table 5-122 Donna Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			2,610	3,126	3,660	4,219	4,802	5,375
Total Supply			2,975	2,975	2,975	2,975	2,975	2,975
Projected Supply Surplus/Deficit			**365**	**-151**	**-685**	**-1,244**	**-1,827**	**-2,400**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Donna ID		$468	85	336	587	839	1,090	1,341
Advanced Municipal Conservation		$652	0	0	4	172	411	698
Need after Conservation			**450**	**185**	**-93**	**-233**	**-326**	**-361**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Donna WTP Expansion	$23,545,000	$2,512	950	950	2,240	2,240	2,240	2,240
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	0	50	50	50	50	50
Net Supply Surplus/Deficit			**1,400**	**1,185**	**2,197**	**2,057**	**1,964**	**1,929**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Donna BGD Plant with Wells (phase I)	$9,440,000	$2,349	700	700	700	0	0	0
Donna BGD Plant with Wells (phase II)	$5,849,000	$3,357	0	0	0	1,000	1,000	1,000

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Donna's 2011 GPCD was estimated at127 and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Water Treatment Plant Expansion</u>

Project Source

This strategy was submitted by the City of Donna to the RWPG.

Description

This strategy is for the expansion of the City of Donna's Water Treatment Plant. The treatment plant is currently under violation for capacity with TCEQ and needs to be expanded. The WMS includes increased water treatment plant capacity, acquisition of water rights, new storage reservoir, and new raw water pump station.

The existing WTP currently relies on an existing irrigation canal for raw water, but the canal is unreliable and the plant has seen recent raw water shortages. Constructing a raw water reservoir at the plant and a raw water pump station for conveyance to the proposed reservoir will supply the City with a reliable raw water source.

Available Supply

This strategy would expand the water treatment plant from 4 MGD to 6 MGD, supplying an additional 2,240 acre-ft./year of drinking water.

Engineering and Costing

Costs for this strategy from the UCM include water treatment plant expansion, storage, and pump station. The plant has sufficient land area for expansion, so land acquisition for the water treatment plant was not included in the costing model. It is assumed that the construction period for this strategy is two year.

Costs include the purchase of water rights available through voluntary conversion of irrigation rights, which are limited to 995 acre-ft. in the first year of implementation and the remaining water rights as they become available through voluntary conversion from Irrigation to DMI. A unit capital cost of $2,500 per acre-ft. has been estimated as the market value for water rights, which applies to 468 acre-feet purchased outside the Donna ID. Under Subchapter O of Chapter 49 Texas Water Code, a municipal supplier can buy water rights to the net irrigable acres in a subdivision at 68% of the market value. It is assumed that a portion of the urbanized land is within Donna's jurisdiction and this reduced rate would apply to 527 acre-ft., purchased at a unit capital cost of $1,700 per acre-ft.

Table 5-123 outlines the project requirements and cost estimate developed in UCM.

Table 5-123 Water Treatment Plant Expansion Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *City of Donna - Water Treatment Plant Expansion*	
Item	***Estimated Costs for Facilities***
Terminal Storage (Conservation Pool 258 acft, 25 acres)	$6,741,000
Intake Pump Stations (2.1 MGD)	$1,076,000
Water Treatment Plant (2 MGD)	$6,367,000
Purchase of Water Rights	$1,975,000
TOTAL COST OF FACILITIES	**$16,159,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond	$5,656,000

Cost Estimate Summary Water Supply Project Option City of Donna - Water Treatment Plant Expansion	
Item	***Estimated Costs for Facilities***
Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	
Environmental & Archaeology Studies and Mitigation	$93,000
Land Acquisition and Surveying (25 acres)	$96,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,541,000
TOTAL COST OF PROJECT	**$23,545,000**
ANNUAL COST (2020-2030)	
Debt Service (5.5 percent, 20 years)	$1,142,000
Reservoir Debt Service (5.5 percent, 40 years)	$617,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$31,000
Dam and Reservoir (1.5% of Cost of Facilities)	$101,000
Water Treatment Plant (2.5% of Cost of Facilities)	$484,000
Pumping Energy Costs (311895 kW-hr @ 0.09 $/kW-hr)	$11,000
TOTAL ANNUAL COST	**$2,386,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	950
Annual Cost of Water ($ per acft)	$2,512
Annual Cost of Water ($ per 1,000 gallons)	$7.71
Purchase of Additional Water Rights (acft/yr @ $/acft)	$2,193,000
ANNUAL COST (2040-2050)	
Debt Service	$173,942
Reservoir Debt Service (5.5 percent, 40 years)	$617,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$38,000
Dam and Reservoir (1.5% of Cost of Facilities)	$101,000
Water Treatment Plant (2.5% of Cost of Facilities)	$637,000
Pumping Energy Costs (274098 kW-hr @ 0.09 $/kW-hr)	$28,000
TOTAL ANNUAL COST	**$1,594,942**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,240
Annual Cost of Water ($ per acft)	$712
Annual Cost of Water ($ per 1,000 gallons)	$2.18
ANNUAL COST (2060-2070)	
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$38,000
Dam and Reservoir (1.5% of Cost of Facilities)	$101,000
Water Treatment Plant (2.5% of Cost of Facilities)	$637,000
Pumping Energy Costs (274098 kW-hr @ 0.09 $/kW-hr)	$28,000
TOTAL ANNUAL COST	**$804,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,240
Annual Cost of Water ($ per acft)	$359
Annual Cost of Water ($ per 1,000 gallons)	$1.10

Implementation Issues

No major implementation issues are expected for this strategy. As with any project, necessary state and federal permits must be obtained before construction can begin.

EDCOUCH

Table 5-124 Edcouch Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			358	419	484	554	630	705
Total Supply			330	330	330	330	330	330
Projected Supply Surplus/Deficit			**-28**	**-89**	**-154**	**-224**	**-300**	**-375**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: H&CC ID #9		$1,069	25	41	57	73	89	105
Advanced Municipal Conservation		$652	0	0	0	0	1	35
Need after Conservation			**-3**	**-48**	**-97**	**-151**	**-210**	**-235**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights - HCCID9	$68,000	$143	40	40	40	100	100	100
Groundwater Supply	$1,106,000	$218	500	500	500	500	500	500
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	50	50	50	50
Net Supply Surplus/Deficit			**722**	**677**	**678**	**624**	**565**	**540**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Edcouch's 2011 GPCD was estimated at 91, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Edcouch Groundwater Supply

Project Source

This strategy was submitted by the City of Edcouch to the RWPG.

Description

This strategy is for the construction of a groundwater well and raw water transmission line to deliver water to the existing 1.5 MGD Water Treatment Plant. The City of Edcouch currently receives raw water from the Rio Grande through the canal system operated by Hidalgo County Irrigation District No. 9. This strategy would ensure a reliable secondary source of raw water for the City of Edcouch in case of limited supplies through the irrigation district.

This City anticipates drilling a pilot well and conducting a water quality study to ensure the present water treatment processes at the existing WTP can treat the new water supply. After testing, the City will identify if additional treatment would be needed at the WTP.

Available Supply

The project a submitted included a 600 GPM well, which is assumed to operate 50% of the time. This well would supply 500 acre-ft. of groundwater per year to supplement the existing raw surface water supply.

Engineering and Costing

Costs for this strategy from the UCM include a well pump, well field piping, and land acquisition. It is assumed that the construction period for this strategy is two years.

Table 5-125 outlines the estimated project requirements and costs.

Table 5-125 Edcouch Groundwater Supply Project requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of Edcouch – New Groundwater Supply***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$759,000
TOTAL COST OF FACILITIES	**$759,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$266,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 2 years with a 1% ROI)	$73,000
TOTAL COST OF PROJECT	**$1,106,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$92,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$8,000
Pumping Energy Costs (99753 kW-hr @ 0.09 $/kW-hr)	$9,000
TOTAL ANNUAL COST	**$109,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	500
Annual Cost of Water ($ per acft)	$218
Annual Cost of Water ($ per 1,000 gallons)	$0.67

Implementation Issues

No major implementation issues are associated with this strategy. The City of Edcouch would need to receive permits from the TCEQ.

EDINBURG

Table 5-126 Edinburg Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			13,113	15,899	18,772	21,714	24,721	27,667
Total Supply			8,903	8,903	8,903	8,903	8,903	8,903
Projected Supply Surplus/Deficit			**-4,210**	**-6,996**	**-9,869**	**-12,811**	**-15,818**	**-18,764**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			2020	2030	2040	2050	2060	2070
ID Conservation: Delta Lake ID Via NAWSC		$671	1	2	2	3	4	4
ID Conservation: Donna ID Via NAWSC		$468	0	0	1	1	1	2
ID Conservation: HCCID9 via NAWSC		$1,069	0	1	1	1	2	2
ID Conservation: HCID #1		$330	1,292	1,396	1,499	1,603	1,707	1,811
ID Conservation: HCID #1 via NAWSC		$330	0	0	1	1	1	1
ID Conservation: HCID #2		$288	140	233	325	417	510	602
ID Conservation: HCID #2 via NAWSC		$288	0	1	1	1	1	1
ID Conservation: Santa Cruz ID via NAWSC		$89	1	1	1	1	1	1
Advanced Municipal Conservation		$652	0	83	790	1,809	3,125	4,662
Need after Conservation			**-2,776**	**-5,279**	**-7,248**	**-8,974**	**-10,466**	**-11,678**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Reuse Water for Cooling Tower and Landscaping	$9,971,000	$400	2,622	3,180	3,754	3,920	3,920	3,920
NAWSC Delta Area Brackish Groundwater Desalination Plant		$1,781	0	0	0	0	4	4
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	2
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	205	205	205	205	205	205
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	12	20	20	20
North Cameron Regional WTP Wellfield Expansion		$843	0	0	0	0	0	0
Acquisition of Water Rights through Urbanization - HCID#1	170,000	$143	100	1,000	1,500	2,500	4,000	4,000
Acquisition of Water Rights through Urbanization - HCID#2	170,000	$143	100	1,100	2,000	3,000	4,000	4,000
Net Supply Surplus/Deficit			**251**	**206**	**223**	**671**	**1,683**	**473**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RGRWA Regional Facility Project		$3,237	3,550	6,350	9,200	12,150	15,150	18,100

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Edinburg's 2011 GPCD was estimated at 128, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Direct Non-Potable Reuse</u>

Project Source

This strategy was submitted by the City of Edinburg to the RWPG.

Description

For this direct non-potable reuse strategy, the City of Edinburg would provide the University of Texas Pan America (UTPA) with reuse water from their wastewater treatment plant. UTPA would use the reclaimed water for non-potable needs such as cooling water makeup and landscape irrigation.

A map of the approximate alignment for the Edinburg WWTP Non-Potable Reuse line is shown in Figure 5-15.

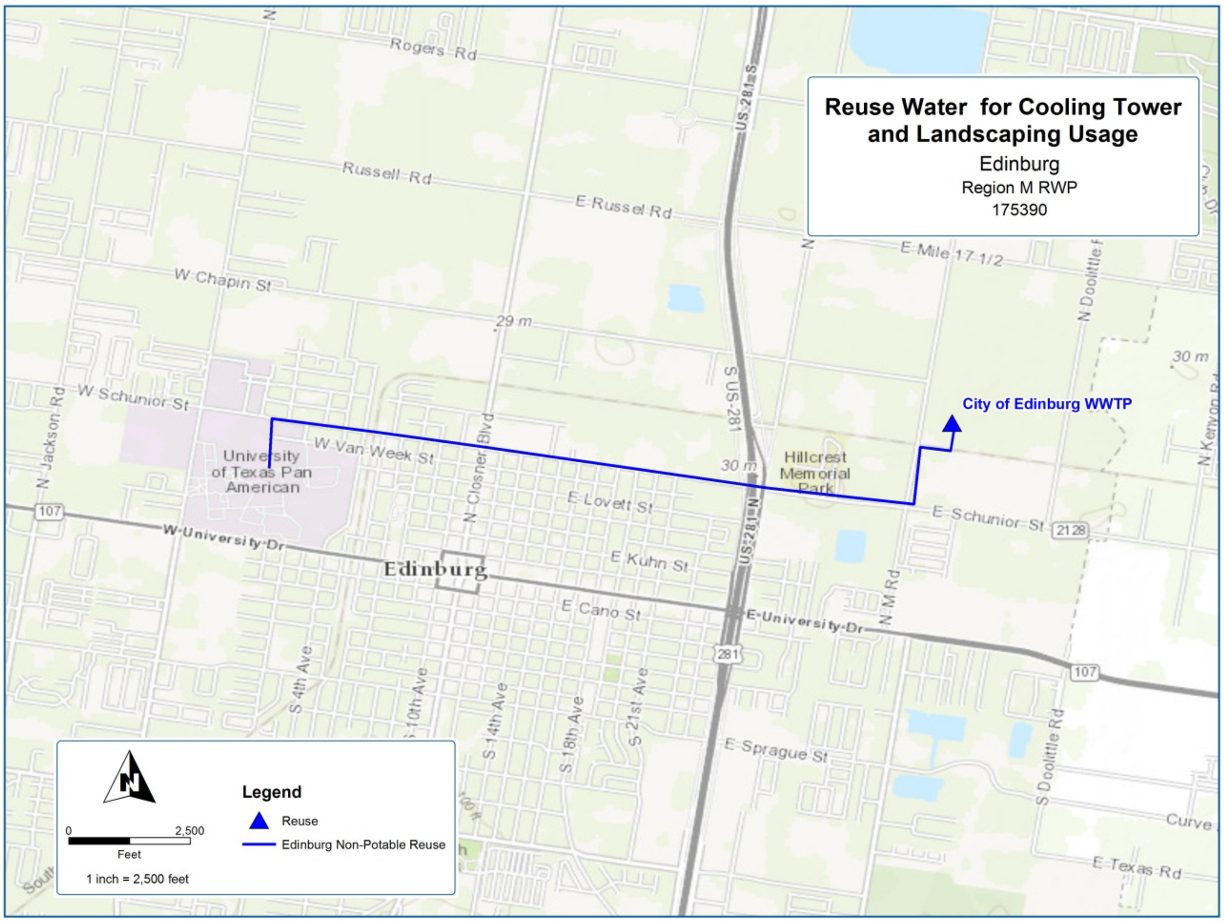

Figure 5-15 Edinburg WWTP Non-Potable Reuse Map

Available Supply

The City of Edinburg wastewater treatment plant currently supplies approximately 3.5 MGD of reuse water. It has the capacity to provide an additional 3.5 MGD, or 3,920 acre-ft./year, of reclaimed water to be used by UTPA. It is likely that additional reuse water would be available in future years, however that is outside of the scope of this specific strategy. Non-potable water in this RWP is accounted for as addressing a maximum of 20% of the City's demands, or 2,662 acre-ft. in 2020, and the remainder is sold to manufacturing.

Engineering and Costing

This strategy involves construction of a pump station and pipeline to convey the reclaimed water from the wastewater treatment plant to the UTPA campus. It was assumed that some additional tertiary treatment at the plant would also be installed. It is assumed that the construction period would be 1.5 years.

Table 5-127 outlines the project requirements and cost estimates developed in UCM. Treatment Level 1 was used in UCM to provide a cost estimate for the small amount of additional treatment that may be required.

Table 5-127 Edinburg Non-Potable Reuse WMS, Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of Edinburg - Reuse Water for Cooling Tower and Landscaping Usage***	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (3.7 MGD)	$2,014,000
Transmission Pipeline (14 in dia., 3 miles)	$3,291,000
Water Treatment Plant (3.5 MGD)	$1,691,000
TOTAL COST OF FACILITIES	**$6,996,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,284,000
Environmental & Archaeology Studies and Mitigation	$75,000
Land Acquisition and Surveying (43 acres)	$118,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$498,000
TOTAL COST OF PROJECT	**$9,971,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$834,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$83,000
Water Treatment Plant (2.5% of Cost of Facilities)	$558,000
Pumping Energy Costs (1040655 kW-hr @ 0.09 $/kW-hr)	$94,000
TOTAL ANNUAL COST	**$1,569,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	3,920
Annual Cost of Water ($ per acft)	$400
Annual Cost of Water ($ per 1,000 gallons)	$1.23

Implementation Issues

Approval for a reclaimed water system is needed from TCEQ. Construction of the new pipeline may also include any of the following permits: U.S. Army Corps of Engineers Section 404 permit, TPWD Sand, Shell, Gravel and Marl permit, TPDES Storm Water Pollution Prevention Plan, TXDOT right-of-way permit.

ELSA

Table 5-128 Elsa Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			811	963	1,121	1,289	1,466	1,641
Total Supply			910	909	909	909	908	908
Projected Supply Surplus/Deficit			**99**	**-54**	**-212**	**-380**	**-558**	**-733**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: H&CC ID #9		$1,069	64	105	146	187	228	269
Advanced Municipal Conservation		$652	0	0	0	11	79	163
Need after Conservation			**163**	**52**	**-66**	**-183**	**-251**	**-301**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization	$170,000	$143	0	0	0	0	100	150
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	200	200	200	200
Net Supply Surplus/Deficit			**163**	**52**	**134**	**17**	**49**	**49**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
New Brackish Water Treatment Plant	$8,400,000	$2,593	560	560	560	560	560	560
WTP Expansion and Interconnect to Engleman ID	$9,836,000	$671	2,240	2,240	2,240	2,240	2,240	2,240

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Elsa's 2011 GPCD was estimated at 112, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

HIDALGO

Table 5-129 Hidalgo Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			1,859	2,254	2,662	3,079	3,505	3,923
Total Supply			1,499	1,499	1,499	1,499	1,499	1,499
Projected Supply Surplus/Deficit			**-360**	**-755**	**-1,163**	**-1,580**	**-2,006**	**-2,424**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	11	112	256	442	660
Need after Conservation			**-360**	**-744**	**-1,051**	**-1,324**	**-1,564**	**-1,764**

Recommended Strategies	Capital Cost ($)	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
Expand Existing Groundwater Wells	$656,000	$260	300	300	300	300	300	300
Acquisition of Water Rights through Urbanization	$1,000,000	$211	400	500	1,050	1,050	1,500	1,500
Surplus/Deficit after WMS			**340**	**56**	**299**	**26**	**236**	**36**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RGRWA Regional Facility Project		$3,237	400	800	1,200	1,600	2,050	2,450

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5Advanced Municipal Water Conservation. Hidalgo's 2011 GPCD was estimated at 125, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Groundwater Supply Expansion

Project Source

This strategy was recommended in the 2011 Regional Water Plan and updated by the RWPG.

Description

This strategy is to provide additional supply to Hidalgo with the installation of additional fresh groundwater wells.

Available Supply

The proposed groundwater wells would provide 300 acre-ft./year in 2020.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water disinfection. It is assumed that the construction period for this strategy is one year.

Table 5-130 outlines the project requirements and cost estimate developed in UCM.

Table 5-130 Hidalgo Groundwater Supply Expansion Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
Hidalgo - Groundwater Supply Expansion

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$436,000
Water Treatment Plant (0.3 MGD)	$27,000
TOTAL COST OF FACILITIES	**$463,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$162,000
Environmental & Archaeology Studies and Mitigation	$6,000

Cost Estimate Summary
Water Supply Project Option
Hidalgo - Groundwater Supply Expansion

Item	***Estimated Costs for Facilities***
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$23,000
TOTAL COST OF PROJECT	**$656,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$55,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$4,000
Water Treatment Plant (2.5% of Cost of Facilities)	$16,000
Pumping Energy Costs (32536 kW-hr @ 0.09 $/kW-hr)	$3,000
TOTAL ANNUAL COST	**$78,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	300
Annual Cost of Water ($ per acft)	$260
Annual Cost of Water ($ per 1,000 gallons)	$0.80

Implementation Issues

No major implementation issues are expected for this strategy. Varying groundwater quality in the Gulf Coast Aquifer is a concern, but freshwater wells are productive in the area near Hidalgo. All recommended groundwater pumping is guided by the MAG values. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

HIDALGO COUNTY MUNICIPAL UTILITY DISTRICT NO. 1

Table 5-131 Hidalgo County MUD No. 1 Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			570	682	801	923	1,049	1,174
Total Supply			273	273	273	273	273	273
Projected Supply Surplus/Deficit			**-297**	**-409**	**-528**	**-650**	**-776**	**-901**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID#1		$468	52	56	60	65	69	73
ID Conservation: HC MUD #1		$366	44	48	52	57	61	66
Advanced Municipal Conservation		$652	0	0	0	0	0	56
Need after Conservation			**-201**	**-305**	**-415**	**-529**	**-646**	**-706**
Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization from HCID1	$484,500	$143	285	285	285	785	785	785
Acquisition of Water Rights through Urbanization from HCID6	$537,500	$211	215	215	215	715	715	715
Surplus/Deficit after WMS			**299**	**195**	**85**	**971**	**854**	**794**

Alternative Strategy	Capital Cost ($)	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
RGRWA Regional Facility Project		$3,237	300	450	550	650	800	950

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Hidalgo County MUD No. 1's 2011 GPCD was estimated at 82, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use.

LA JOYA

Table 5-132 La Joya Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			652	783	919	1060	1207	1351
Total Supply			1,142	1,142	1,142	1,142	1,142	1,142
Projected Supply Surplus/Deficit			**490**	**359**	**223**	**82**	**-65**	**-209**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID No. 16		$148	42	55	67	79	91	104
ID Conservation: HCID No. 16 via Agua SUD		$148	7	9	11	13	14	16
ID Conservation: HCID No. 6 via Agua SUD		$381	17	19	21	22	24	26
Advanced Municipal Conservation		$652	0	0	0	0	56	125
Need after Conservation			**556**	**441**	**321**	**196**	**121**	**62**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
West WWTP Potable Reuse - Phase I		$2,974	18	18	18	18	18	18
West WWTP Potable Reuse - Phase II		$2,145	0	0	27	27	27	27
East WWTP Potable Reuse - Phase I		$2,358	25	25	25	25	25	25
East WWTP Potable Reuse - Phase II		$3,881	0	0	0	8	8	8
Surplus/Deficit after WMS			**599**	**484**	**391**	**275**	**200**	**141**
Alternate Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant		$2,649	0	0	0	40	40	40
Agua SUD Non-Potable Reuse		$2,946	37	37	51	51	51	51

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. La Joya's 2011 GPCD was estimated at 125, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

LA VILLA

Table 5-133 La Villa Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			275	328	385	443	504	564
Total Supply			246	246	246	246	246	246
Projected Supply Surplus/Deficit			**-29**	**-82**	**-139**	**-197**	**-258**	**-318**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: H&CC ID #9		$1,069	17	27	38	49	60	70
Advanced Municipal Conservation		$652	0	0	0	17	42	71
Need after Conservation			**-12**	**-55**	**-101**	**-131**	**-157**	**-176**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization	$85,000	$143	50	55	50	50	100	100
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	100	100	100	100
Net Supply Surplus/Deficit			**38**	**0**	**49**	**19**	**43**	**24**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
New Brackish Water Treatment Plant	$8,276,000	$2,559	560	560	560	560	560	560
HCDD Delta Watershed Project		$1,790	400	400	400	400	400	400

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. La Villa's 2011 GPCD was estimated at 108, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

MCALLEN

Table 5-134 McAllen Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			38,728	47,219	55,875	64,722	73,748	82,563
Total Supply			30,753	30,753	30,753	30,753	30,753	30,753
Projected Supply Surplus/Deficit			**-7,975**	**-16,466**	**-25,122**	**-33,969**	**-42,995**	**-51,810**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID #1		$330	542	586	629	673	716	760
ID Conservation: HCID #2		$288	359	595	832	1,068	1,305	1,541
ID Conservation: HC WID #3		$313	1,802	2,063	2,324	2,585	2,846	3,107
ID Conservation: United ID		$134	2,052	2,298	2,544	2,791	3,037	3,283
Advanced Municipal Conservation		$652	1,674	5,608	10,888	17,372	23,904	29,468
Need after Conservation			**-1,546**	**-5,316**	**-7,905**	**-9,480**	**-11,187**	**-13,651**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Raw Water Line Project	$1,662,000	$225	800	800	800	800	800	800
BGD Plant	$21,946,000	$2,034	2,688	2,688	2,688	2,688	2,688	2,688
South WWTP Potable Reuse - Phase I	$20,143,000	$1,958	0	2,000	0	0	0	0
South WWTP Potable Reuse - Phase II	$6,232,000	$2,702	0	0	2,500	0	0	0
South WWTP Potable Reuse - Phase III	$9,732,000	$2,101	0	0	0	3,500	3,500	3,500
North WWTP Potable Reuse - Phase I	$14,145,000	$2,353	0	0	1,120	0	0	0
North WWTP Potable Reuse - Phase II	$8,888,000	$989	0	0	0	2,000	2,000	2,000
Acquisition of Water Rights through Urbanization	$1,360,000	$143	0	0	800	800	2,200	4,700
Net Supply Surplus/Deficit			**1,942**	**172**	**3**	**308**	**1**	**37**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Expand Existing Groundwater Wells -Phase I	$940,000	$234	0	500	500	500	0	0
Expand Existing Groundwater Wells -Phase II	$1,004,000	$146	0	0	0	0	1,500	1,500
McAllen Non-Potable Reuse	$12,123,000	$1,064	1,950	1,950	1,950	1,950	1,950	1,950
RGRWA Regional Facility Project		$3,237	4,350	12,800	21,500	30,350	39,350	48,150

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. McAllen's 2011 GPCD was estimated at 220, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

HCID No. 1 Raw Water Line Project

Project Source

This strategy was submitted by the City of McAllen to the RWPG.

Description

This strategy is for the construction of a raw water line from Hidalgo County Irrigation District No. 1 to the City's North Water Treatment Plant. The raw water line would provide the WTP with a second source of raw water from the irrigation canal, an important redundancy that does not currently exist.

A map of the proposed pipeline alignment is shown in Figure 5-16.

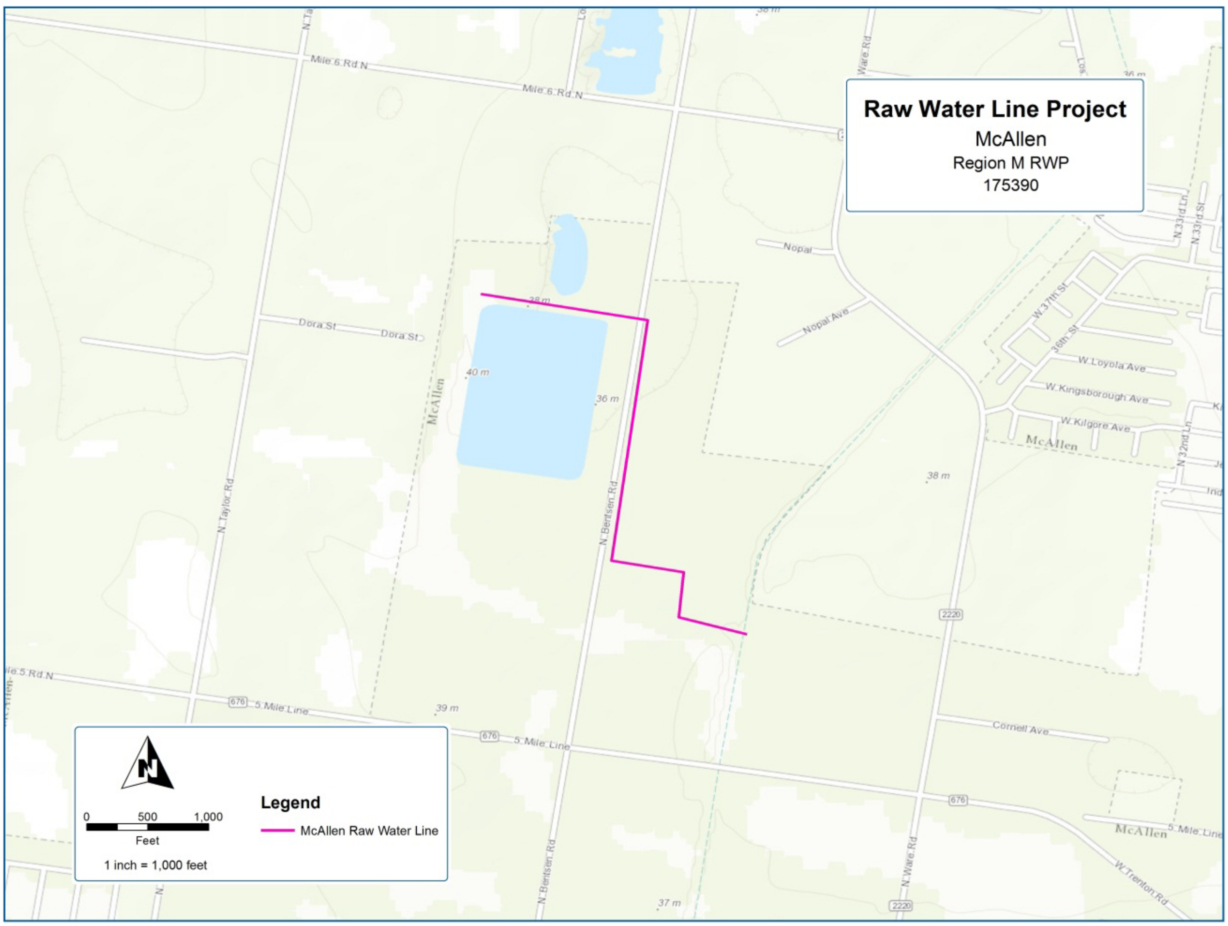

Figure 5-16 McAllen HCID No. 1 Raw Water Pipeline Map

Available Supply

Executed water rights and the raw waterline will provide the City of McAllen 800 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include a pump station, pipeline, land acquisition, and pipeline right-of-way.

Table 5-135 outlines the project requirements and cost estimate developed in UCM.

Table 5-135 HCID No. 1 Raw Water Line Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *McAllen Public Utility - HCID No. 1 Raw Water Line Project*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (0.8 MGD)	$880,000
Transmission Pipeline (6 in dia., 1 miles)	$217,000
TOTAL COST OF FACILITIES	**$1,097,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$373,000
Environmental & Archaeology Studies and Mitigation	$35,000
Land Acquisition and Surveying (15 acres)	$48,000
Interest During Construction (4% for 2 years with a 1% ROI)	$109,000
TOTAL COST OF PROJECT	**$1,662,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$139,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$24,000
Pumping Energy Costs (185192 kW-hr @ 0.09 $/kW-hr)	$17,000
TOTAL ANNUAL COST	**$180,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	800
Annual Cost of Water ($ per acft)	$225
Annual Cost of Water ($ per 1,000 gallons)	$0.69

Implementation Issues

The project is completely within the City of McAllen's city limits and no major issues are known at this time. Construction of the new pipeline may include any of the following permits: U.S. Army Corps of Engineers Section 404 permit, TPWD Sand, Shell, Gravel and Marl permit, TPDES Storm Water Pollution Prevention Plan, TXDOT right-of-way permit. Additionally, easement acquisition may be required for the pipeline route.

McAllen South Wastewater Treatment Plant Potable Reuse

Project Source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the McAllen South Wastewater Treatment Plant to the McAllen South Water Treatment Plant.

The estimate route for the South WWTP Potable Reuse Pipeline is shown in Figure 5-17.

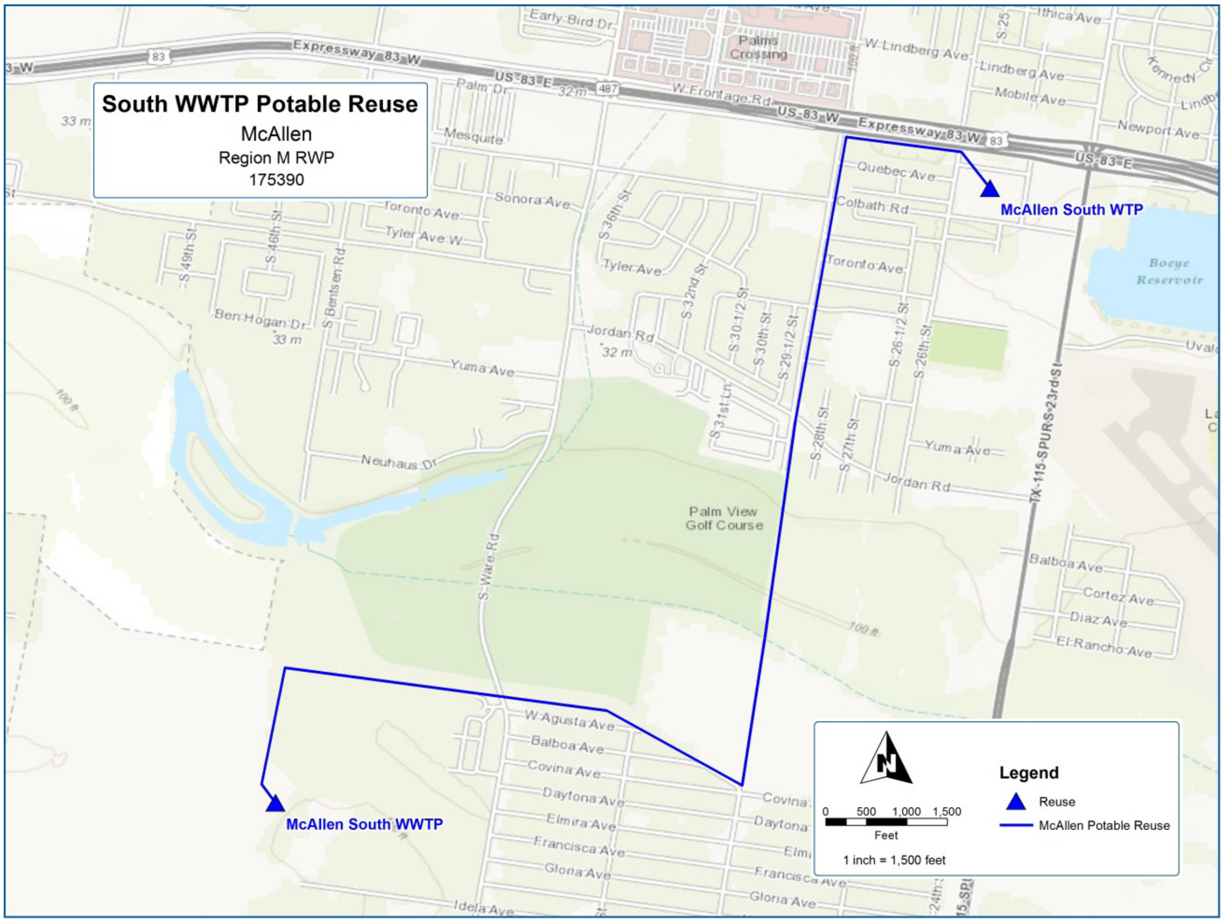

Figure 5-17 McAllen South WWTP Potable Reuse Pipeline Location

Available Supply

Based on recorded wastewater treatment plant flows, the current annual average flow for McAllen South WWTP is 6.23 MGD. Based on projected population growth in McAllen, it is anticipated that the annual average flow for the WWTP will increase to 7.7 MGD in 2030, 9.2 MGD in 2040, and 10.71 MGD in 2050. It is assumed that half of the effluent flow, minus 2.0 MGD already provided for non-potable reuse from the plant, will be produced for potable reuse. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 2,000 to 4,200 acre-ft./year of wastewater effluent would be used.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to McAllen South WTP would be constructed. It is assumed that the construction period would be 2 years for each phase.

Table 5-136, Table 5-137 and Table 5-138 outline the estimated project requirements and costs. Treatment Levels 2 and 4 were used on the UCM spreadsheet to estimate the costs for addition of the advanced treatment facilities.

Table 5-136 McAllen South WWTP Potable Reuse Phase I Project Requirements

Cost Estimate Summary *Water Supply Project Option* *McAllen - McAllen South WWTP Potable Reuse - Phase I*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.9 MGD)	$1,112,000
Transmission Pipeline (14 in dia., 3 miles)	$697,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,492,000
Two Water Treatment Plants (1.8 MGD and 1.8 MGD)	$10,523,000
TOTAL COST OF FACILITIES	**$13,824,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,804,000
Environmental & Archaeology Studies and Mitigation	$77,000
Land Acquisition and Surveying (46 acres)	$120,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,318,000
TOTAL COST OF PROJECT	**$20,143,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,686,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$50,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,004,000
Pumping Energy Costs (328602 kW-hr @ 0.09 $/kW-hr)	$30,000
TOTAL ANNUAL COST	**$3,770,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,000
Annual Cost of Water ($ per acft)	$1,885
Annual Cost of Water ($ per 1,000 gallons)	$5.78

Table 5-137 McAllen South WWTP Potable Reuse Phase II Project Requirements

Cost Estimate Summary *Water Supply Project Option* *McAllen - McAllen South WWTP Potable Reuse -Phase II*	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (0.5 MGD and 0.5 MGD)	$4,314,000
TOTAL COST OF FACILITIES	**$4,314,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,510,000
Interest During Construction (4% for 2 years with a 1% ROI)	$408,000
TOTAL COST OF PROJECT	**$6,232,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$521,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$824,000
Pumping Energy Costs (63460 kW-hr @ 0.09 $/kW-hr)	$6,000
TOTAL ANNUAL COST	**$1,351,000**

Cost Estimate Summary *Water Supply Project Option* *McAllen - McAllen South WWTP Potable Reuse -Phase II*	
Item	***Estimated Costs for Facilities***
Available Project Yield (acft/yr), based on a Peaking Factor of 1	500
Annual Cost of Water ($ per acft)	$2,702
Annual Cost of Water ($ per 1,000 gallons)	$8.29

Table 5-138 McAllen South WWTP Potable Reuse Phase III Project Requirements

Cost Estimate Summary *Water Supply Project Option* *McAllen - McAllen South WWTP Potable Reuse -Phase III*	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (0.9 MGD and 0.9 MGD)	$6,680,000
TOTAL COST OF FACILITIES	**$6,680,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,338,000
Environmental & Archaeology Studies and Mitigation	$77,000
Interest During Construction (4% for 2 years with a 1% ROI)	$637,000
TOTAL COST OF PROJECT	**$9,732,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$814,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$1,275,000
Pumping Energy Costs (135038 kW-hr @ 0.09 $/kW-hr)	$12,000
TOTAL ANNUAL COST	**$2,101,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,000
Annual Cost of Water ($ per acft)	$2,101
Annual Cost of Water ($ per 1,000 gallons)	$6.45

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

McAllen North Wastewater Treatment Plant Potable Reuse

Project Source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the McAllen North Wastewater Treatment Plant to the McAllen North Water Treatment Plant.

The estimate route for the North WWTP Potable Reuse Pipeline is shown in Figure 5-18.

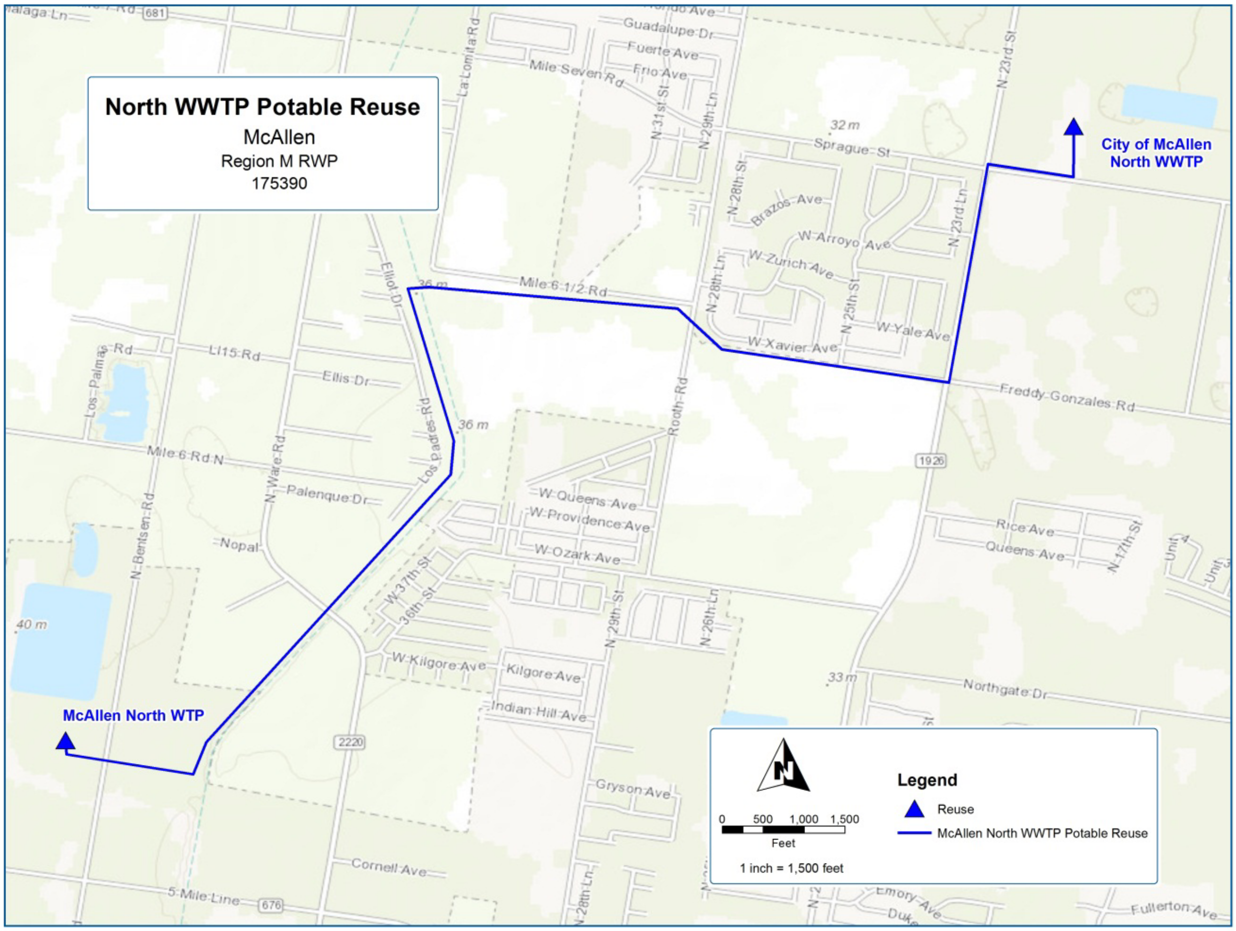

Figure 5-18 **McAllen South WWTP Potable Reuse Pipeline Location**

Available Supply

Based on recorded wastewater treatment plant flows, the current annual average flow for McAllen North WWTP is 5.7 MGD. Based on projected population growth in McAllen, it is anticipated that the annual average flow for the WWTP will increase to 8.46 MGD in 2040 and 9.85 MGD in 2050. It is assumed that half of the effluent flow, minus 3.0 MGD already provided for non-potable reuse from the plant, will be produced for potable reuse. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 1,344 to 2,400 acre-ft./year of wastewater effluent would be used.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to

McAllen North WTP would be constructed. It is assumed that the construction period would be 2 years.

Table 5-139 and Table 5-140 outline the estimated project requirements and costs for Phases I and II. Treatment Levels 2 and 4 were used on the UCM spreadsheet to estimate the costs for addition of the advanced treatment facilities.

Table 5-139 McAllen North WWTP Potable Reuse Phase I Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option McAllen - McAllen North WWTP Potable Reuse -Phase I	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.1 MGD)	$1,012,000
Transmission Pipeline (10 in dia., 3 miles)	$223,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,129,000
Two Water Treatment Plants (1 MGD and 1 MGD)	$7,272,000
TOTAL COST OF FACILITIES	**$9,636,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,361,000
Environmental & Archaeology Studies and Mitigation	$86,000
Land Acquisition and Surveying (50 acres)	$136,000
Interest During Construction (4% for 2 years with a 1% ROI)	$926,000
TOTAL COST OF PROJECT	**$14,145,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,184,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$39,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,388,000
Pumping Energy Costs (267516 kW-hr @ 0.09 $/kW-hr)	$24,000
TOTAL ANNUAL COST	**$2,635,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$2,353
Annual Cost of Water ($ per 1,000 gallons)	$7.22

Table 5-140 McAllen North WWTP Potable Reuse Phase II Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option McAllen - McAllen South WWTP Potable Reuse -Phase II	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (0.8 MGD and 0.8 MGD)	$6,089,000
TOTAL COST OF FACILITIES	**$6,089,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,131,000
Environmental & Archaeology Studies and Mitigation	$86,000
Interest During Construction (4% for 2 years with a 1% ROI)	$582,000
TOTAL COST OF PROJECT	**$8,888,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$744,000
Operation and Maintenance	

Cost Estimate Summary ***Water Supply Project Option*** ***McAllen - McAllen South WWTP Potable Reuse -Phase II***	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (2.5% of Cost of Facilities)	$1,162,000
Pumping Energy Costs (786907 kW-hr @ 0.09 $/kW-hr)	$71,000
TOTAL ANNUAL COST	**$1,977,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,000
Annual Cost of Water ($ per acft)	$989
Annual Cost of Water ($ per 1,000 gallons)	$3.03

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

Brackish Groundwater Water Treatment Plant

Project Source

This strategy was recommended in the 2011 Regional Water Plan and updated by the Regional Water Planning Group.

Description

This strategy is for drilling four new groundwater wells and constructing a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates for McAllen, the new brackish groundwater plant is sized for 3 MGD of treatment, which will yield 2,688 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. It is assumed that the construction period for this strategy is one and a half years.

Table 5-141 outlines the project requirements and cost estimate developed in UCM.

Table 5-141 New Brackish Groundwater Treatment Plant Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of McAllen - Brackish Water Desalination***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,138,000
Two Water Treatment Plants (3 MGD R.O. and 3 MGD Conventional)	$19,808,000
TOTAL COST OF FACILITIES	**$21,946,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$7,681,000

Cost Estimate Summary ***Water Supply Project Option*** ***City of McAllen - Brackish Water Desalination***	
Item	***Estimated Costs for Facilities***
Environmental & Archaeology Studies and Mitigation	$23,000
Land Acquisition and Surveying (5 acres)	$10,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$1,558,000
TOTAL COST OF PROJECT	**$31,218,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,612,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$21,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,806,000
Pumping Energy Costs (313087 kW-hr @ 0.09 $/kW-hr)	$28,000
TOTAL ANNUAL COST	**$5,467,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,688
Annual Cost of Water ($ per acft)	$2,034
Annual Cost of Water ($ per 1,000 gallons)	$6.24

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

MERCEDES

Table 5-142 Mercedes Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			2223	2648	3091	3558	4049	4531
Total Supply			1,943	1,943	1,943	1,943	1,943	1,943
Projected Supply Surplus/Deficit			**-280**	**-705**	**-1,148**	**-1,615**	**-2,106**	**-2,588**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: H&CC ID No. 9		$1,069	88	144	200	256	312	368
Advanced Municipal Conservation		$652	0	0	80	225	433	679
Need after Conservation			**-192**	**-561**	**-868**	**-1,134**	**-1,361**	**-1,541**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Potable Reuse	$17,051,000	$1,958	1,670	1,670	1,670	1,670	1,670	1,670
Surplus/Deficit after WMS			**1,478**	**1,109**	**802**	**536**	**309**	**129**
Alternate Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Expand Existing Groundwater Wells	$1,001,000	$223	560	560	560	560	560	560
BGD Plant	$12,062,000	$4,926	0	0	435	435	435	435
RGRWA Regional Facility Project		$3,237	250	700	1,150	1,600	2,100	2,550

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Mercedes' 2011 GPCD was estimated at 111, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Mercedes Wastewater Treatment Plant Potable Reuse</u>

Project Source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the Mercedes Wastewater Treatment Plant to the Mercedes Water Treatment Plant for potable reuse.

The estimate route of the Mercedes WWTP Potable Reuse Pipeline is shown in Figure 5-19.

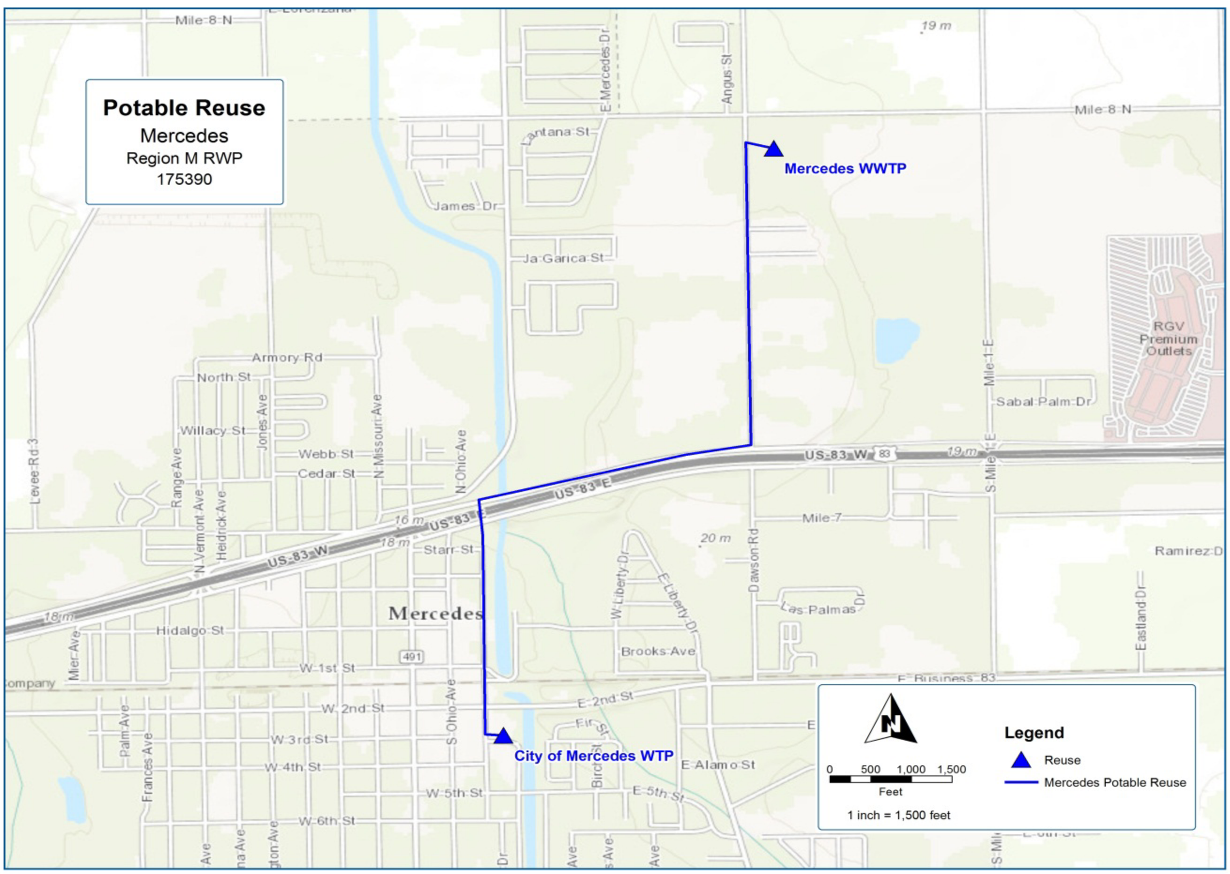

Figure 5-19 Mercedes WWTP Potable Reuse Pipeline Location

Available Supply

Based on recorded wastewater treatment plant flows, the annual average flow for Mercedes WWTP is 2.97 MGD. Approximately half of that flow is assumed to be available on a consistent basis therefore 1.49 MGD, or 1,670 acre-ft./year, would be produced for potable reuse. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 2,000 acre-ft./year of wastewater effluent would be used.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to the Mercedes WTP would be constructed. It is assumed that the construction period would be 2 years.

Table 5-143 outlines the estimated project requirements and cost estimate. Treatment Levels 2 and 4 were used on the UCM spreadsheet to estimate the costs for addition of the advanced treatment facilities.

Table 5-143 Mercedes WWTP Potable Reuse Project Requirements

Cost Estimate Summary Water Supply Project Option Mercedes - Mercedes WWTP Potable Reuse	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (1.6 MGD)	$1,230,000
Transmission Pipeline (10 in dia., 2 miles)	$267,000
Storage Tanks (Other Than at Booster Pump Stations)	$962,000
Two Water Treatment Plants (1.5 MGD and 1.5 MGD)	$9,263,000
TOTAL COST OF FACILITIES	**$11,722,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,090,000
Environmental & Archaeology Studies and Mitigation	$48,000
Land Acquisition and Surveying (32 acres)	$75,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,116,000
TOTAL COST OF PROJECT	**$17,051,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,427,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$43,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,765,000
Pumping Energy Costs (387712 kW-hr @ 0.09 $/kW-hr)	$35,000
TOTAL ANNUAL COST	**$3,270,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,670
Annual Cost of Water ($ per acft)	$1,958
Annual Cost of Water ($ per 1,000 gallons)	$6.01

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

MILITARY HIGHWAY WATER SUPPLY CORPORATION

See Section 5.3.1 Cameron County.

MISSION

Table 5-144 Mission Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			20,212	24,704	29,290	33,954	38,684	43,305
Total Supply			12,190	12,190	12,190	12,190	12,190	12,190
Projected Supply Surplus/Deficit			**-8,022**	**-12,514**	**-17,100**	**-21,764**	**-26,494**	**-31,115**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: United ID		$134	2,052	2,298	2,544	2,791	3,037	3,283
ID Conservation: HCID16 via Agua SUD		$148	1	2	2	2	3	3
ID Conservation: HCID6 via Agua SUD		$381	3	3	4	4	4	5
Advanced Municipal Conservation		$652	925	3,046	5,874	8,424	10,984	13,799
Need after Conservation			**-5,041**	**-7,165**	**-8,676**	**-10,543**	**-12,466**	**-14,025**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BGD Plant	$31,914,000	$2,070	2,688	2,688	2,688	2,688	2,688	2,688
Potable Reuse -Phase I	$32,565,000	$1,572	3,920	3,920	3,920	0	0	0
Potable Reuse -Phase II	$27,630,000	$734	0	0	0	7,840	7,840	7,840
West Agua SUD Potable Reuse Phase I		$2,974	3	3	3	3	3	3
West Agua SUD Potable Reuse Phase II		$2,145	0	0	9	9	9	9
East Agua SUD Potable Reuse Phase I		$2,358	4	4	4	4	4	4
East Agua SUD Potable Reuse Phase II		$3,881	0	0	0	6	6	6
Acquisition of Water Rights through Urbanization	$1,020,000	$143	0	600	2,100	3,500	3,500	3,500
Net Supply Surplus/Deficit			**1,575**	**51**	**49**	**3,508**	**1,585**	**26**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant		$2,649	0	0	0	7	7	7
Agua SUD Non-Potable Reuse		$2,946	7	7	9	9	9	9
RGRWA Regional Facility Project		$3,237	6,650	11,150	15,700	20,350	25,100	29,700

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Mission's 2011 GPCD was estimated at 193, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

Mission Brackish Groundwater Desalination Plant

Project Source

This strategy was recommended in the 2011 Regional Water Plan.

Description

This strategy is for drilling three new brackish groundwater wells and constructing a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates for Mission, the new brackish groundwater plant would treat 3 MGD (3360 acre-ft./year) and produce 2,688 acre-ft. per year, assuming 80% R.O. efficiency.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. It is assumed that the construction period for this strategy is one and a half years.

Table 5-145 outlines the project requirements and cost estimate developed in UCM.

Table 5-145 Mission BGD Plant Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of Mission - Brackish Water Desalination***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$2,628,000
Two Water Treatment Plants (3 MGD and 3 MGD)	$19,808,000
TOTAL COST OF FACILITIES	**$22,436,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$7,853,000
Environmental & Archaeology Studies and Mitigation	$23,000
Land Acquisition and Surveying (5 acres)	$10,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$1,592,000
TOTAL COST OF PROJECT	**$31,914,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,670,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$26,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,806,000
Pumping Energy Costs (697947 kW-hr @ 0.09 $/kW-hr)	$63,000
TOTAL ANNUAL COST	**$5,565,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,688
Annual Cost of Water ($ per acft)	$2,070
Annual Cost of Water ($ per 1,000 gallons)	$6.35

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

<u>Mission Direct Potable Reuse</u>

Project Source

This strategy was identified by the RWPG.

Description

This strategy is for the City of Mission to use wastewater effluent for direct potable reuse. Effluent from the Mission Wastewater Treatment plant will be pumped to the South Water Treatment Plant for conventional treatment after it has gone through advanced treatment.

The estimate route of the Mission WWTP Potable Reuse Pipeline is shown in Figure 5-20.

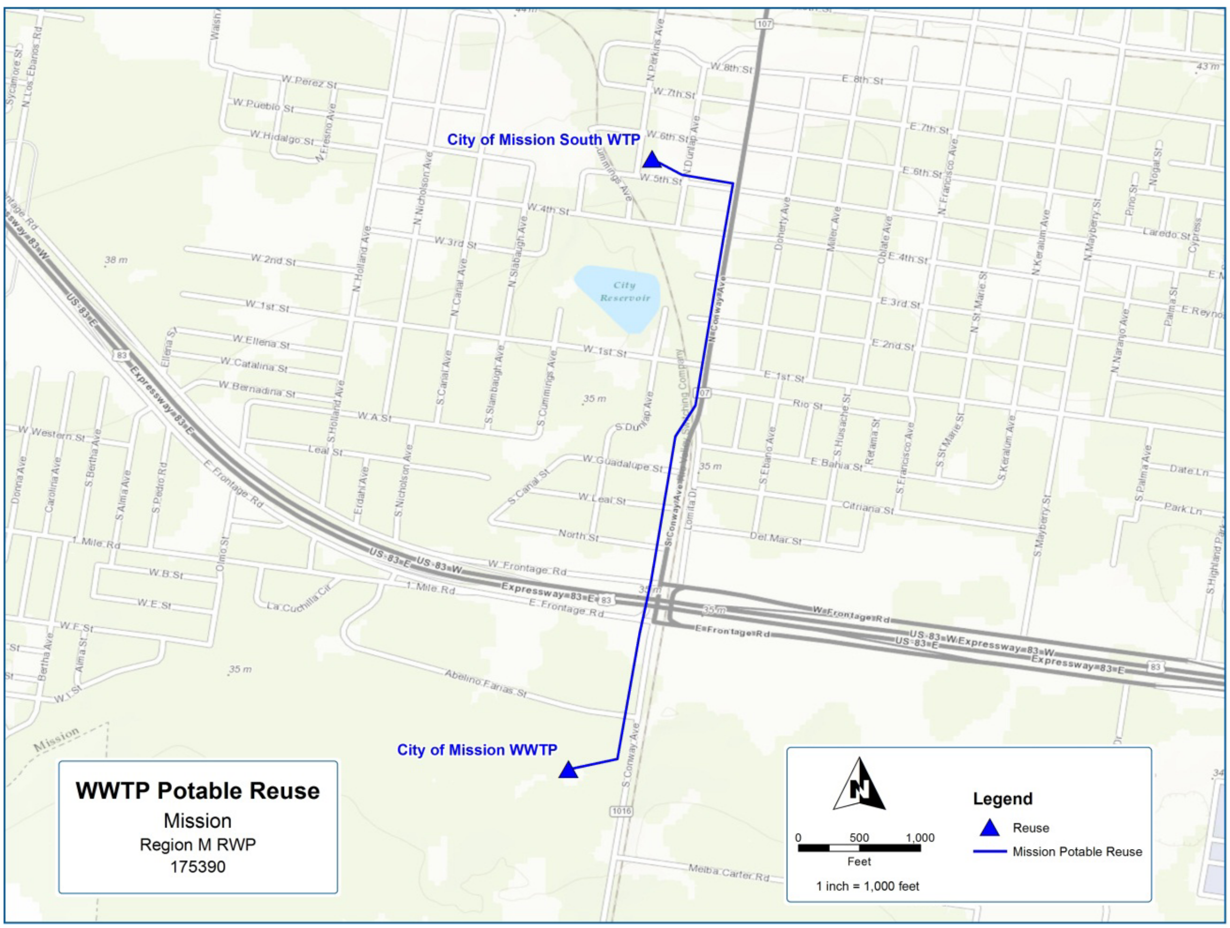

Figure 5-20 Mission WWTP Potable Reuse

Available Supply

The Mission Wastewater Treatment Plant has the capacity currently treats 7 MGD on average. It is assumed approximately half of the effluent flow can be produced for potable reuse, supplying the City with an additional 3.5 MGD, or 3,920 acre-ft./year, of water starting in 2020. Mission's population is projected to nearly double by the year 2050, allowing for more potable reuse in the future. Phase II supplies the City will be supplied with approximately 7 MGD, or 7,840 acre-ft./year, of potable reuse water in later decades. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 4,700 to 9,400 acre-ft./year of wastewater effluent would be used.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to the WTP would be constructed. The pipeline was sized for ultimate build-out during phase I of the project. It is assumed that the construction period for each phase would be 2 years.

Table 5-146 and Table 5-147 outline the estimated project requirements used to develop the cost estimates for Phase I and Phase II. Treatment Levels 2 and 4 were used on the UCM spreadsheet to estimate the costs for addition of the advanced treatment facilities.

Table 5-146 Mission WWTP Potable Reuse Phase I Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
Mercedes - Mercedes WWTP Potable Reuse - Phase I

Item	***Estimated Costs for Facilities***
Intake Pump Stations (3.7 MGD)	$1,484,000
Transmission Pipeline (20 in dia., 1 miles)	$2,007,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,649,000
Two Water Treatment Plants (3.5 MGD and 3.5 MGD)	$17,431,000
TOTAL COST OF FACILITIES	**$22,571,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$7,799,000
Environmental & Archaeology Studies and Mitigation	$25,000
Land Acquisition and Surveying (22 acres)	$39,000
Interest During Construction (4% for 2 years with a 1% ROI)	$2,131,000
TOTAL COST OF PROJECT	**$32,565,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,725,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$74,000
Water Treatment Plant (2.5% of Cost of Facilities)	$3,313,000
Pumping Energy Costs (543556 kW-hr @ 0.09 $/kW-hr)	$49,000
TOTAL ANNUAL COST	**$6,161,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	3,920
Annual Cost of Water ($ per acft)	$1,572
Annual Cost of Water ($ per 1,000 gallons)	$4.82

Table 5-147 Mission WWTP Potable Reuse Phase II Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Mercedes - Mercedes WWTP Potable Reuse -Phase II*	
Item	***Estimated Costs for Facilities***
Storage Tanks (Other Than at Booster Pump Stations)	$1,649,000
Two Water Treatment Plants (3.5 MGD and 3.5 MGD)	$17,431,000
TOTAL COST OF FACILITIES	**$19,080,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,678,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,808,000
TOTAL COST OF PROJECT	**$27,630,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,312,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$16,000
Water Treatment Plant (2.5% of Cost of Facilities)	$3,313,000
Pumping Energy Costs (1248980 kW-hr @ 0.09 $/kW-hr)	$112,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$5,753,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	7,840
Annual Cost of Water ($ per acft)	$734
Annual Cost of Water ($ per 1,000 gallons)	$2.25

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

NORTH ALAMO WATER SUPPLY CORPORATION

See Section 5.3.1 Cameron County.

PALMHURST

Table 5-148 Palmhurst Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			932	1,149	1,369	1,591	1,813	2,030
Total Supply			579	579	579	579	579	579
Projected Supply Surplus/Deficit			**-353**	**-570**	**-790**	**-1,012**	**-1,234**	**-1,451**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: United ID via Sharyland WSC		$134	53	59	66	72	78	85
ID Conservation: Santa Cruz ID via Sharyland WSC		$89	20	22	24	25	27	29

ID Conservation: HCID1 via Sharyland WSC		$330	40	44	47	50	53	57
Advanced Municipal Conservation		$652	57	166	306	472	659	861
Need after Conservation			**-183**	**-280**	**-348**	**-392**	**-416**	**-420**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sharyland WSC Water Treatment Plant No. 2 Brackish Groundwater Desalination		$2,630	90	90	90	90	90	90
Sharyland WSC Water Treatment Plant No. 3 Brackish Groundwater Desalination		$2,630	72	72	72	72	72	72
Sharyland WSC Acquisition of Water Rights through Urbanization - United ID		$143	8	15	15	15	84	90
Sharyland WSC Acquisition of Water Rights through Urbanization - HCID #1		$143	10	25	60	60	60	60
Sharyland WSC Acquisition of Water Rights through Urbanization - Santa Cruz ID		$143	21	78	120	210	288	288
Surplus/Deficit after WMS			**18**	**0**	**9**	**55**	**178**	**180**

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Palmhurst's 2011 GPCD was estimated at 259, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

PALMVIEW

Table 5-149 Palmview Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			743	897	1,056	1,220	1,388	1,554
Total Supply			640	640	640	640	640	640
Projected Supply Surplus/Deficit			**-103**	**-257**	**-416**	**-580**	**-748**	**-914**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID16 via Agua SUD		$148	27	35	43	51	59	66
ID Conservation: HCID6 via Agua SUD		$381	69	76	83	91	98	105
Advanced Municipal Conservation		$652	0	0	21	75	145	230
Need after Conservation			**-7**	**-146**	**-269**	**-364**	**-447**	**-512**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD West WWTP Potable Reuse - Phase I		$2,974	75	75	75	75	75	75
Agua SUD West WWTP Potable Reuse - Phase II		$2,145	0	0	224	224	224	224

Year			2020	2030	2040	2050	2060	2070
Agua SUD East WWTP Potable Reuse - Phase I		$2,358	100	100	100	100	100	100
Agua SUD East WWTP Potable Reuse - Phase II		$3,881	0	0	0	46	46	46
Agua SUD Acquisition of Water Rights through Urbanization		$143	8	16	40	72	104	104
Net Supply Surplus/Deficit			**175**	**44**	**170**	**153**	**102**	**36**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant		$2,649	0	0	0	160	160	160
Agua SUD Non-Potable Reuse		$2,946	149	149	208	208	208	208

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Palmview's 2011 GPCD was estimated at 104, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

PENITAS

Table 5-150 Penitas Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			603	732	865	1,001	1,139	1,275
Total Supply			520	520	520	520	520	520
Projected Supply Surplus/Deficit			**-83**	**-212**	**-345**	**-481**	**-619**	**-755**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID6 via Agua SUD		$381	56	62	68	74	79	85
ID Conservation: HCID16 via Agua SUD		$148	22	28	35	41	47	54
Advanced Municipal Conservation		$652	0	5	39	86	147	218
Need after Conservation			**-5**	**-117**	**-204**	**-280**	**-345**	**-398**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD West WWTP Potable Reuse - Phase I		$2,974	61	61	61	61	61	61
Agua SUD West WWTP Potable Reuse - Phase II		$2,145	0	0	179	179	179	179
Agua SUD East WWTP Potable Reuse - Phase I		$2,358	81	81	81	81	81	81
Agua SUD East WWTP Potable Reuse - Phase II		$3,881	0	0	0	42	42	42
Agua SUD Acquisition of Water Rights through Urbanization		$143	4	8	20	36	52	52
Net Supply Surplus/Deficit			**140**	**33**	**137**	**119**	**69**	**17**

Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant		$2,649	0	0	0	130	130	130
Agua SUD Non-Potable Reuse		$2,946	121	121	169	169	169	169

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Penitas' 2011 GPCD was estimated at 103, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

PHARR

Table 5-151 Pharr Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			9,923	11,933	14,021	16,183	18,415	20,607
Total Supply			9,817	9,817	9,817	9,817	9,817	9,817
Projected Supply Surplus/Deficit			**-106**	**-2,116**	**-4,204**	**-6,366**	**-8,598**	**-10,790**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID #2		$288	420	697	974	1,250	1,527	1,804
Advanced Municipal Conservation		$652	0	0	167	848	1,777	2,884
Need after Conservation			**314**	**-1,419**	**-3,063**	**-4,268**	**-5,294**	**-6,102**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Potable Reuse	$38,422,000	$807	6,721	6,721	6,721	6,721	6,721	6,721
Net Supply Surplus/Deficit			**7,035**	**5,302**	**3,658**	**2,453**	**1,427**	**619**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Non-Potable Reuse	$5,118,000	$1,696	500	500	500	500	500	500
RGRWA Regional Facility Project		$3,237	20	2,050	4,150	6,300	8,600	10,750

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Pharr's 2011 GPCD was estimated at 108, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Pharr Direct Potable Reuse

Project Source

This strategy was submitted by the City of Pharr to the RWPG.

Description

This direct potable reuse strategy is to augment the City of Pharr's raw water supply with reuse water. A portion of the wastewater treatment plant effluent would be treated to near drinking water standards, stored in a buffering pond, and then pumped to a raw water storage pond where it would mix with raw Rio Grande water supplied by Hidalgo County Irrigation District No. 2.

This strategy was presented to and approved by TWDB in a Water Reuse Priority and Implementation Plan Report, prepared in September 2011.

The approximate alignment of the Pharr WWTP potable reuse pipeline for the Raw Water Reservoir Augmentation WMS is shown in Figure 5-21.

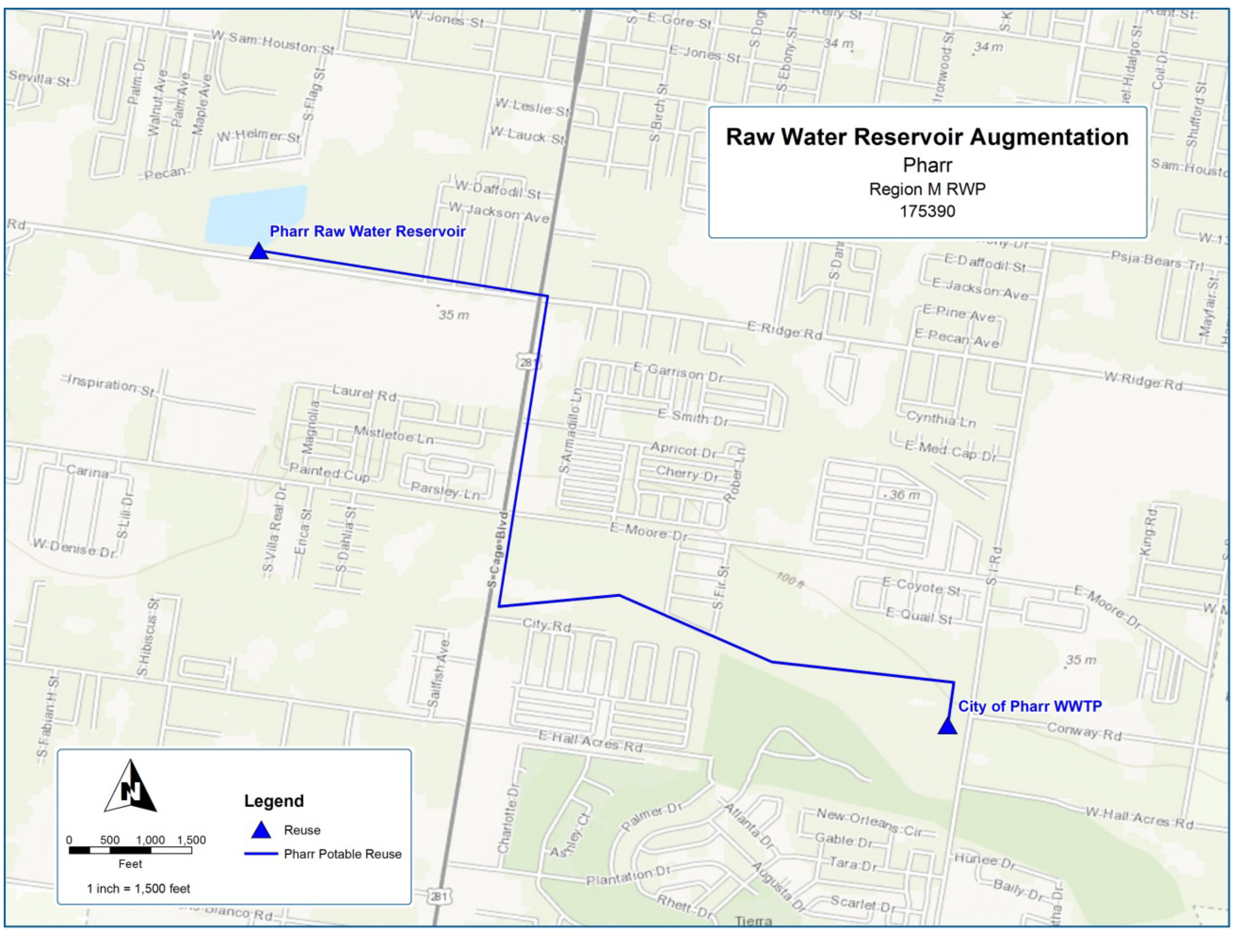

Figure 5-21 Pharr WWTP Potable Reuse Map

BLACK & VEATCH
Building a world of difference.

Available Supply

The current plant flow of the City of Pharr wastewater treatment plant is 6 MGD. This project would produce 4 MGD of that flow initially and an additional 2 MGD is anticipated to be available in the near future. The total available supply for this strategy is 6 MGD, or 6,721 acre-ft./year. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 5,376 to 8,065 acre-ft./year of wastewater effluent would be used.

Engineering and Costing

The components of this project include an advanced reclaimed water treatment plant, storage pond, and pump station to be construction next to the existing wastewater treatment plant on City owned land. A pipeline is also required to convey the reclaimed water to the raw water storage pond near the water treatment plant. The advanced treatment plant will consist of membrane filtration, reverse osmosis, and UV disinfection. Concentrate disposal from the treatment processes would be discharged to the Arroyo Colorado with the traditional WWTP discharge. It is assumed that the construction period would be 1.5 years.

Table 5-152 outlines the estimated project requirements and the cost estimate. Treatment Level 3 (new) was used on the UCM spreadsheet to estimate the costs for addition of the advanced treatment facilities.

Table 5-152 Pharr Potable Reuse Project Requirements

Cost Estimate Summary Water Supply Project Option City of Pharr - Potable Reuse	
Item	***Estimated Costs for Facilities***
Off-Channel Storage/Ring Dike (Conservation Pool 43 acft, acres)	$2,531,000
Intake Pump Stations (6.3 MGD)	$2,326,000
Transmission Pipeline (20 in dia., 3 miles)	$1,650,000
Water Treatment Plant (6 MGD)	$20,475,000
TOTAL COST OF FACILITIES	**$26,982,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$9,361,000
Environmental & Archaeology Studies and Mitigation	$63,000
Land Acquisition and Surveying (38 acres)	$98,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$1,918,000
TOTAL COST OF PROJECT	**$38,422,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$2,914,000
Reservoir Debt Service (5.5 percent, 40 years)	$224,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$75,000
Dam and Reservoir (1.5% of Cost of Facilities)	$38,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,048,000
Pumping Energy Costs (1404694 kW-hr @ 0.09 $/kW-hr)	$126,000
TOTAL ANNUAL COST	**$5,425,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	6,721
Annual Cost of Water ($ per acft)	$807
Annual Cost of Water ($ per 1,000 gallons)	$2.48

Implementation Issues

Final design of the direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Construction of the new pipeline may also include any of the following permits: U.S. Army Corps of Engineers Section 404 permit, TPWD Sand, Shell, Gravel and Marl permit, TPDES Storm Water Pollution Prevention Plan, TXDOT right-of-way permit. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

PROGRESO

Table 5-153 Progresso Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			722	868	1,020	1,177	1,339	1,498
Total Supply			696	696	696	696	696	696
Projected Supply Surplus/Deficit			**-26**	**-172**	**-324**	**-481**	**-643**	**-802**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	7	55	122	202
Need after Conservation			**-26**	**-172**	**-317**	**-426**	**-521**	**-600**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Cameron Co.)		$1,254	150	150	150	150	150	150
MHWSC Acquisition of Water Rights through Urbanization		$143	34	139	227	321	460	573
ERHWSC New Surface WTP via MHWSC		$736	100	100	100	100	100	100
Net Supply Surplus/Deficit			**258**	**217**	**159**	**145**	**189**	**223**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase I)		$316	31	31	31	0	0	0
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase II)		$195	0	0	0	79	79	79

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Progreso's 2011 GPCD was estimated at 101, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

SAN JUAN

Table 5-154 San Juan Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			6,152	7,448	8,782	10,154	11,561	12,940
Total Supply			4,275	4,275	4,275	4,275	4,275	4,275
Projected Supply Surplus/Deficit			**-1,877**	**-3,173**	**-4,507**	**-5,879**	**-7,286**	**-8,665**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID #2		$288	133	221	309	397	485	573
ID Conservation: HCID #2 via NAWSC		$288	11	19	26	34	41	49
ID Conservation: Delta Lake ID via NAWSC		$671	28	54	80	106	132	158
ID Conservation: Donna ID via NAWSC		$468	4	14	24	35	45	56
ID Conservation: HCCID9 via NAWSC		$1,069	17	28	39	50	61	72
ID Conservation: HCID1 via NAWSC		$330	15	16	18	19	20	21
ID Conservation: Santa Cruz ID via NAWSC		$89	19	20	22	24	26	28
Advanced Municipal Conservation		$652	0	15	330	799	1,411	2,128
Need after Conservation			**-1,650**	**-2,786**	**-3,659**	**-4,415**	**-5,065**	**-5,580**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WTP No. 1 Upgrade and Expansion	$9,561,000	$1,058	1,792	1,792	1,792	1,792	1,792	1,792
Acquisition of Water Rights through Urbanization - HCID #2	$340,000	$143	200	800	1,600	1,600	1,600	1,600
MHWSC Expand Existing Groundwater Wells (Cameron Co.)		$1,254	5	5	5	5	5	5
MHWSC Acquisition of Water Rights through Urbanization		$143	2	9	14	20	350	350
ERHWSC New Surface WTP via MHWSC		$736	5	5	5	5	5	5
NAWSC Delta Area Brackish Groundwater Desalination Plant		$1,781	0	0	0	0	800	800
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	70
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	12	230	230	230	230	230
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	227	735	735	735
North Cameron Regional WTP Wellfield Expansion		$843	52	52	52	52	52	52
Net Supply Surplus/Deficit			**418**	**106**	**267**	**24**	**504**	**59**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase I)		$316	2	2	2	0	0	0

Year			2020	2030	2040	2050	2060	2070
MHWSC Expand Existing Groundwater Wells (Hidalgo Co. Phase II)		$195	0	0	0	5	5	5
RGRWA Regional Facility Project		$3,237	1,750	2,850	3,900	5,250	6,550	7,850

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. San Juan's 2011 GPCD was estimated at 137, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Water Treatment Plant No. 1 Upgrade and Expansion to Include BGD</u>

Project Source

This strategy was submitted by San Juan to the RWPG.

Description

This strategy consists of expanding and upgrading Water Treatment Plant No. 1 including facilities to manufacture liquid chlorine due to a neighborhood hazard, and installing ground water wells with membrane treatment.

Available Supply

The project as submitted included 3 MGD of brackish groundwater treatment capacity, but because of MAG limitations on the Gulf Coast Aquifer in Hidalgo County this strategy was scaled down to 1.5 MGD, or 1,680 acre-ft./year.

Engineering and Costing

The components of this project include three new groundwater wells, well field piping, and membrane filters. The advanced treatment plant will consist of membrane filtration. It is assumed that concentrate disposal from the treatment processes would be discharged to surface water. It is assumed that the construction period would be 1.5 years.

Table 5-155 outlines the estimated project requirements used to develop the cost estimate. Treatment Level 4 was used on the UCM spreadsheet to estimate the costs for addition of the new membrane filters. The total costs for this option are presented in

Table 5-155 City of San Juan - WTP No. 1 Upgrade and Expansion to Include BGD Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of San Juan - WTP No. 1 Upgrade and Expansion to Include BGD***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,574,000
Two Water Treatment Plants (1.5 MGD and 1.5 MGD)	$5,133,000
TOTAL COST OF FACILITIES	**$6,707,000**

Cost Estimate Summary ***Water Supply Project Option*** ***City of San Juan - WTP No. 1 Upgrade and Expansion to Include BGD***	
Item	***Estimated Costs for Facilities***
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,347,000
Environmental & Archaeology Studies and Mitigation	$22,000
Land Acquisition and Surveying (3 acres)	$8,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$477,000
TOTAL COST OF PROJECT	**$9,561,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$800,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$16,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,036,000
Pumping Energy Costs (488091 kW-hr @ 0.09 $/kW-hr)	$44,000
TOTAL ANNUAL COST	**$1,896,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,792
Annual Cost of Water ($ per acft)	$1,058
Annual Cost of Water ($ per 1,000 gallons)	$3.25

Implementation Issues

Approval for concentrate disposal will be needed from TCEQ. Construction of the groundwater well may also include purchase of land and a TXDOT right-of-way permit. As with any project, necessary state and federal permits must be obtained before construction can begin.

SHARYLAND WATER SUPPLY CORPORATION

Table 5-156 Sharyland WSC Water Supply and Demand Analysis (Acre-feet/year)

Demands Supplies	Sole Supplier		2020	2030	2040	2050	2060	2070
WUG Water Demand	Yes		8,026	9,722	11,460	13,252	15,094	16,896
Alton	Yes		2,071	2,524	2,990	3,464	3,943	4,413
Palmhurst	Yes		932	1,149	1,369	1,591	1,813	2,030
Hidalgo Co-Other			311	311	311	311	311	311
Total Demands			**11,340**	**13,706**	**16,130**	**18,618**	**21,161**	**23,650**
Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supply			4,985	4,985	4,985	4,985	4,985	4,985
Alton			1,286	1,286	1,286	1,286	1,286	1,286
Palmhurst			579	579	579	579	579	579
Hidalgo Co-Other			311	311	311	311	311	311
Total Supplies			**7,160**	**7,160**	**7,160**	**7,160**	**7,160**	**7,160**
Projected Supply Surplus/Deficit			**-4,180**	**-6,546**	**-8,970**	**-11,458**	**-14,001**	**-16,490**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID1		$330	470	507	545	583	621	658
ID Conservation: United ID		$134	617	692	766	840	914	988

ID Conservation: Santa Cruz ID No. 15		$89	232	253	275	297	319	342
WUG Advanced Municipal Conservation		$652	231	968	1,507	2,235	3,141	4,164
Alton Advanced Municipal Conservation		$652	0	70	200	376	592	844
Palmhurst Advanced Municipal Conservation		$652	57	166	306	472	659	861
Need after Conservation			**-2,329**	**-3,626**	**-5,088**	**-6,352**	**-7,433**	**-8,291**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Sharyland WSC Water Treatment Plant No. 2 Brackish Groundwater Desalination	$13,253,000	$2,630	900	900	900	900	900	900
Sharyland WSC Water Treatment Plant No. 3 Brackish Groundwater Desalination	$13,253,000	$2,630	900	900	900	900	900	900
Sharyland WSC Acquisition of Water Rights through Urbanization - HCID #1	$340,000	$143	200	500	1,200	1,200	1,200	1,200
Sharyland WSC Acquisition of Water Rights through Urbanization - Santa Cruz ID	$595,000	$143	350	1,300	2,000	3,500	4,800	4,800
Sharyland WSC Acquisition of Water Rights through Urbanization - United ID	$238,000	$143	140	250	250	250	1,400	1,500
Total Supplies			**11,501**	**13,930**	**16,292**	**19,016**	**22,928**	**24,659**
Surplus/Deficit after WMS			**161**	**224**	**162**	**398**	**1,767**	**1,009**
Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supply			8,150	9,909	11,508	13,326	16,032	17,244
Alton			2,072	2,539	3,072	3,708	4,556	4,853
Palmhurst			950	1,149	1,378	1,646	1,991	2,210
Hidalgo Co-Other			329	332	334	336	349	352
Total Supplies			**11,501**	**13,930**	**16,292**	**19,016**	**22,928**	**24,659**
Projected Supply Surplus/Deficit			**161**	**224**	**162**	**398**	**1,767**	**1,009**
Needs After WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supply			124	187	48	74	938	348
Alton			1	15	82	244	613	440
Palmhurst			18	0	9	55	178	180
Hidalgo Co-Other			18	21	23	25	38	41
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RGRWA Regional Facility Project		$3,237	1,050	4,300	7,700	11,200	15,700	17,850

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide

discussed in section 5.2.5 Advanced Municipal Water Conservation. Sharyland WSC's 2011 GPCD was estimated at 169, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Water Treatment Plant No. 2 Brackish Groundwater Desalination

Project Source

This strategy was submitted by Sharyland WSC to the RWPG.

Description

This strategy is to provide additional supply to Sharyland WSC Water Treatment Plant No. 2 with the installation of a groundwater well and high pressure reverse osmosis system.

Available Supply

The proposed groundwater well is sized to pump 1,125 acre-ft./year and reverse osmosis system would provide the WTP No. 2 with 900 acre-ft./year of supply. This assumes an 80% membrane recovery rate.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, water treatment, and land acquisition. It is assumed that the construction period would be one year. Table 5-157 outlines the project requirements and cost estimate developed in UCM.

Table 5-157 Sharyland WTP No. 2 BGD Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option Sharyland WSC - Water Well and RO Unit at WTP #2	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$814,000
Two Water Treatment Plants (1 MGD and 1 MGD)	$8,664,000
TOTAL COST OF FACILITIES	**$9,478,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,318,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$449,000
TOTAL COST OF PROJECT	**$13,253,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,109,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$8,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,228,000
Pumping Energy Costs (246581 kW-hr @ 0.09 $/kW-hr)	$22,000
TOTAL ANNUAL COST	**$2,367,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	900
Annual Cost of Water ($ per acft)	$2,630
Annual Cost of Water ($ per 1,000 gallons)	$8.07

Implementation Issues

No major implementation issues are expected for this strategy. Approval for concentrate disposal will be needed from TCEQ. Construction of a groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

Water Treatment Plant No. 3 Brackish Groundwater Desalination

Project Source

This strategy was submitted by Sharyland WSC to the RWPG.

Description

This strategy is to provide additional supply to Sharyland WSC Water Treatment Plant No. 3 with the installation of a groundwater well and high pressure reverse osmosis system. Water Treatment Plant No. 3 has been recently completed.

Available Supply

The proposed groundwater well is sized to pump 1,125 acre-ft./year and reverse osmosis system would provide the WTP No. 2 with 900 acre-ft./year of supply. This assumes an 80% membrane recovery rate.

Engineering and Costing

Costs for this strategy from the UCM include well field pumping, well field piping, and water treatment, and land acquisition. Slightly too moderately saline groundwater was assumed to be available at approximately 800 ft. below ground surface for cost estimation purposes. It is assumed that the construction period would be one year.

Table 5-158 outlines the project requirements and cost estimate developed in UCM.

Table 5-158 WTP No. 3 BGD Project Requirements

Cost Estimate Summary Water Supply Project Option Sharyland WSC - Water Well and RO Unit at WTP #3	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$814,000
Two Water Treatment Plants (1 MGD and 1 MGD)	$8,664,000
TOTAL COST OF FACILITIES	**$9,478,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,318,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$449,000
TOTAL COST OF PROJECT	**$13,253,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,109,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$8,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,228,000
Pumping Energy Costs (246581 kW-hr @ 0.09 $/kW-hr)	$22,000

Cost Estimate Summary ***Water Supply Project Option*** ***Sharyland WSC - Water Well and RO Unit at WTP #3***	
Item	***Estimated Costs for Facilities***
TOTAL ANNUAL COST	**$2,367,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	900
Annual Cost of Water ($ per acft)	$2,630
Annual Cost of Water ($ per 1,000 gallons)	$8.07

Implementation Issues

No major implementation issues are expected for this strategy. Approval for concentrate disposal will be needed from TCEQ. Construction of a groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

SULLIVAN CITY

Table 5-159 Sullivan City Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			544	647	755	869	989	1,107
Total Supply			469	469	469	469	469	469
Projected Supply Surplus/Deficit			**-75**	**-178**	**-286**	**-400**	**-520**	**-638**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID16 via Agua SUD		$148	20	26	31	37	43	49
ID Conservation: HCID6 via Agua SUD		$381	50	56	61	66	72	77
Advanced Municipal Conservation		$652	0	0	0	13	61	118
Need after Conservation			**-5**	**-97**	**-194**	**-283**	**-345**	**-394**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD West WWTP Potable Reuse - Phase I		$2,974	55	55	55	55	55	55
Agua SUD West WWTP Potable Reuse - Phase II		$2,145	0	0	224	224	224	224
Agua SUD East WWTP Potable Reuse - Phase I		$2,358	73	73	73	73	73	73
Agua SUD East WWTP Potable Reuse - Phase II		$3,881	0	0	0	15	15	15
Agua SUD Acquisition of Water Rights through Urbanization		$143	8	16	40	72	104	104
Net Supply Surplus/Deficit			**131**	**47**	**198**	**155**	**126**	**76**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant		$2,649	0	0	0	117	117	117
Agua SUD Non-Potable Reuse		$2,946	109	109	152	152	152	152

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Sullivan City's 2011 GPCD was estimated at 106, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

WESLACO

Table 5-160 Weslaco Water Supply and Demand Analysis (Acre-feet/year)

Demands			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Demand			7,873	9,551	11,271	13,040	14,852	16,625
Military Highway WSC			175	175	175	175	175	175
Total			**8,048**	**9,726**	**11,446**	**13,215**	**15,027**	**16,800**
Total Supply			**4,972**	**4,972**	**4,972**	**4,972**	**4,972**	**4,972**
Projected Supply Surplus/Deficit			**-3,076**	**-4,754**	**-6,474**	**-8,243**	**-10,055**	**-11,828**
Current Water Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			4,797	4,797	4,797	4,797	4,797	4,797
Military Highway WSC			175	175	175	175	175	175
Total			**4,972**	**4,972**	**4,972**	**4,972**	**4,972**	**4,972**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: H&CC ID No. 9		$1,069	267	438	609	780	951	1,122
WUG Advanced Municipal Conservation		$652	241	893	1,427	2,144	3,030	4,032
Need after Conservation			**-2,568**	**-3,423**	**-4,438**	**-5,319**	**-6,074**	**-6,674**
Recommended Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
North WWTP Potable Reuse -Phase I	$14,444,000	$2,378	1,120	1,120	1,120	1,120	0	0
North WWTP Potable Reuse -Phase II	$19,548,000	$1,738	0	0	0	0	3,360	3,360
Acquisition of Water Rights through Urbanization	$1,154,300	$143	679	1,375	3,000	3,500	3,500	3,500
Brackish Groundwater Mixing	$980,000	$159	560	560	560	560	560	560
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	370	370	370	370	370	370
Surplus/Deficit after WMS			**161**	**2**	**612**	**231**	**1,716**	**1,116**
Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supplies			8,034	9,553	11,883	13,271	16,568	17,741
Military Highway WSC			175	175	175	175	175	175
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Weslaco			161	2	612	231	1,716	1,116
Military Highway WSC			0	0	0	0	0	0

Alternative Strategies	Capital Cost ($)	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
Scalping Plants	$1,346,000	$1,455,000	1	1	1	1	1	1
BGD Plant	$17,694,000	$1,900	c	1,630	1,630	1,630	1,630	1,630
RGRWA Regional Facility Project		$3,237	2,800	4,500	6,200	7,950	9,800	11,550

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Weslaco's 2011 GPCD was estimated at 165, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Weslaco North Wastewater Treatment Plant Potable Reuse

Project Source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the Weslaco North Wastewater Treatment Plant to the Weslaco Water Treatment Plant.

The approximate alignment of the North WWTP Potable Reuse pipeline is shown in Figure 5-22.

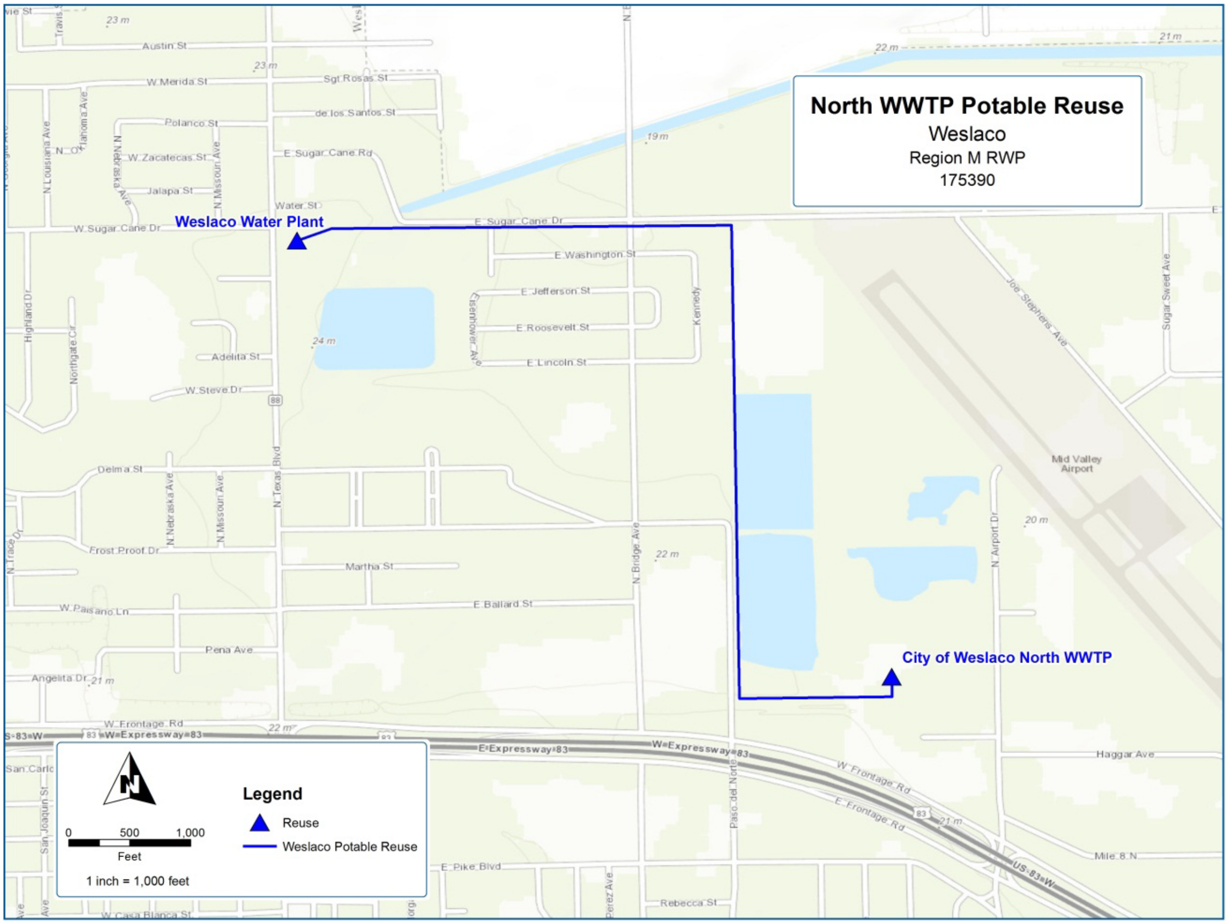

Figure 5-22 Weslaco North WWTP Potable Reuse Pipeline Location

Available Supply

The annual average flow for Weslaco North WWTP is 3.14 MGD. The annual average flow for the WWTP is anticipated to increase to 6.0 MGD in 2060 based on projected population growth in Weslaco. It is assumed that 60% of the effluent flow will be available to treat for potable reuse and produced water supplies could be up to 50% of total effluent flows. Phase I would supply 1,120 acre-ft./year in 2020 and Phase II would supply a total of 3,360 acre-ft./year beginning in 2060.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to the Weslaco WTP would be constructed and twinned in Phase II in the same right of way. It is assumed that the construction period for each phase would be 2 years.

Table 5-161 and Table 5-162 outline the project requirements and cost estimate developed in UCM. Treatment Levels 2 and 4 were used to estimate the costs for addition of the advanced treatment facilities.

Table 5-161 Weslaco North WWTP Potable Reuse Phase I Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Weslaco - Weslaco North WWTP Potable Reuse -Phase I*	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Intake Pump Stations (1.1 MGD)	$1,014,000
Transmission Pipeline (8 in dia., 2 miles)	$206,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,443,000
Two Water Treatment Plants (1 MGD and 1 MGD)	$7,272,000
TOTAL COST OF FACILITIES	**$9,935,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$3,467,000
Environmental & Archaeology Studies and Mitigation	$38,000
Land Acquisition and Surveying (26 acres)	$59,000
Interest During Construction (4% for 2 years with a 1% ROI)	$945,000
TOTAL COST OF PROJECT	**$14,444,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$1,209,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$42,000
Water Treatment Plant (2.5% of Cost of Facilities)	$1,388,000
Pumping Energy Costs (266468 kW-hr @ 0.09 $/kW-hr)	$24,000
TOTAL ANNUAL COST	**$2,663,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$2,378
Annual Cost of Water ($ per 1,000 gallons)	$7.30

Table 5-162 Weslaco North WWTP Potable Reuse Phase II Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Weslaco - Weslaco North WWTP Potable Reuse -Phase II*	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Intake Pump Stations (2.1 MGD)	$1,580,000
Transmission Pipeline (10 in dia., 2 miles)	$611,000
Two Water Treatment Plants (2 MGD and 2 MGD)	$11,336,000
TOTAL COST OF FACILITIES	**$13,527,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,704,000
Environmental & Archaeology Studies and Mitigation	$38,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,279,000
TOTAL COST OF PROJECT	**$19,548,000**
ANNUAL COST	

Cost Estimate Summary ***Water Supply Project Option*** ***Weslaco - Weslaco North WWTP Potable Reuse -Phase II***	
Item	***Estimated Costs for Facilities***
Debt Service (5.5 percent, 20 years)	$1,636,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$46,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,158,000
Pumping Energy Costs (583467 kW-hr @ 0.09 $/kW-hr)	$53,000
TOTAL ANNUAL COST	**$3,893,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,240
Annual Cost of Water ($ per acft)	$1,738
Annual Cost of Water ($ per 1,000 gallons)	$5.33

Implementation Issues

Implementation of a potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

<u>Groundwater Development and Blending</u>

Project Source

This strategy was submitted by the City of Weslaco to the RWPG.

Description

This strategy is for the construction of a groundwater well to supplement the City's drinking water supply. The City plans to blend the brackish groundwater with treated drinking water. The City is currently supplied with raw water from Hidalgo and Cameron Counties Irrigation District No. 9. This strategy would provide the City with an alternate source of water especially during times of drought.

Possible well site locations still need to be evaluated and it is anticipated that a pilot well and water quality study will be required.

Available Supply

It is anticipated that 0.5 MGD would be produced from the well.

Engineering and Costing

Costs for this strategy from the UCM include a well pump, well field piping, and land acquisition. It is assumed that the construction period for this strategy is one year.

The project requirements and costs for this option are presented in Table 5-163.

Table 5-163 Weslaco Groundwater Development and Blending Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *City of Weslaco - Groundwater Supply - Wells*	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$695,000
TOTAL COST OF FACILITIES	**$695,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$243,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$34,000
TOTAL COST OF PROJECT	**$980,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$82,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
TOTAL ANNUAL COST	**$89,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	560
Annual Cost of Water ($ per acft)	$159
Annual Cost of Water ($ per 1,000 gallons)	$0.49

Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin.

COUNTY-OTHER

Table 5-164 Hidalgo County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			4,952	6,075	7,232	8,393	9,553	10,691
Total Supply			3,587	3,587	3,587	3,587	3,587	3,587
Projected Supply Surplus/Deficit			**-1,365**	**-2,488**	**-3,645**	**-4,806**	**-5,966**	**-7,104**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	31	61	91	120	150	180
ID Conservation: Delta Lake ID via NAWSC		$671	0	1	1	2	2	3
ID Conservation: Donna ID		$468	0	1	2	3	3	4
ID Conservation: Donna ID via NAWSC		$468	0	0	0	1	1	1
ID Conservation: Donna ID via MHWSC		$468	0	0	0	0	0	0
ID Conservation: Hidalgo Co. ID No. 6		$381	46	51	55	60	65	70
ID Conservation: Hidalgo Co. ID No. 6 via Agua SUD		$381	6	7	7	8	8	9

Year			2020	2030	2040	2050	2060	2070
ID Conservation: Hidalgo Co. ID No. 16		$148	8	10	12	14	17	19
ID Conservation: Hidalgo Co. ID No. 16 via Agua SUD		$148	2	3	4	4	5	6
ID Conservation: Hidalgo & Cameron Co. ID No. 9		$1,069	147	242	336	431	525	619
ID Conservation: HCID2		$288	3	4	6	8	10	11
ID Conservation: HCID2 via NAWSC		$288	0	0	0	1	1	1
ID Conservation: Santa Cruz ID No. 15		$89	3	3	4	4	4	4
ID Conservation: Santa Cruz ID No. 15 via Sharyland		$89	3	3	4	4	4	4
ID Conservation: HCID1 via Santa Cruz ID		$330	3	3	4	4	4	4
ID Conservation: United ID via Sharyland WSC		$134	8	9	10	11	12	13
ID Conservation: HCID1 via Sharyland WSC		$330	6	7	7	8	8	9
Advanced Municipal Conservation		$652	0	52	179	353	567	817
Need after Conservation			**-1,098**	**-2,031**	**-2,924**	**-3,770**	**-4,579**	**-5,330**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
West Agua SUD Potable Reuse Phase I		$2,974	6	6	6	6	6	6
West Agua SUD Potable Reuse Phase II		$2,145	0	0	9	9	9	9
East Agua SUD Potable Reuse Phase I		$2,358	65	65	65	65	65	65
East Agua SUD Potable Reuse Phase II		$3,881	0	0	0	6	6	6
NAWSC Delta Area Brackish Groundwater Desalination Plant		$1,781	0	0	0	0	2	2
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	37
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	0	4	4	4	4	4
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	104	105	105	105
North Cameron Regional WTP Wellfield Expansion		$843	1	1	1	1	1	1
ERHWSC Surface WTP		$5,963	5	5	5	5	5	5
MHWSC Expand Existing GW Supply (Cameron County)		$1,254	3	3	3	3	3	3
Acquisition of Water Rights through Urbanization Santa Cruz ID	$85,000	$211	34	198	385	349	637	712
Acquisition of Water Rights through Urbanization Sharyland ID	$175,000	$211	70	202	350	523	710	717

Year			2020	2030	2040	2050	2060	2070
Acquisition of Water Rights through Urbanization HCID #6	$200,000	$211	80	541	1,166	1,399	2,191	2,223
Acquisition of Water Rights through Urbanization HCID #16	$102,500	$211	41	312	252	102	22	89
Acquisition of Water Rights through Urbanization Engleman ID	$715,000	$211	0	286	148	765	383	913
Acquisition of Water Rights through Urbanization Hidalgo Irrigation	$675,604	$211	270	776	1,328	1,963	2,637	2,637
Acquisition of Water Rights through Urbanization Cameron Irrigation	$1,087,500	$211	435	435	435	435	435	435
Acquisition of Water Rights through Urbanization HCID13	$80,000	$211	32	32	32	32	32	32
Acquisition of Water Rights through Urbanization HWID 3	$162,500	$211	65	0	0	0	0	0
Acquisition of Water Rights through Urbanization HCID1	$72,500	$211	29	0	0	0	0	0
Acquisition of Water Rights through Urbanization via MHWSC		$143	2	6	9	13	19	24
Acquisition of Water Rights through Urbanization via MHWSC		$143	1	3	3	3	14	15
Surplus/Deficit after WMS			**41**	**843**	**1,381**	**2,018**	**2,707**	**2,710**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD New BGD Plant		$2,649	0	0	0	14	14	14
Agua SUD Non-Potable Reuse		$2,946	13	13	18	18	18	18

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. The 2011 GPCD for Hidalgo County-Other was estimated at 121, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

IRRIGATION

Table 5-165 Hidalgo Irrigation, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			614,089	585,364	554,359	519,165	482,460	482,460
Total Supply			241,824	240,807	240,331	239,852	239,371	238,894
Projected Supply Surplus/Deficit			**-372,265**	**-344,557**	**-314,028**	**-279,313**	**-243,089**	**-243,566**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			2020	2030	2040	2050	2060	2070
ID Conservation: Donna ID		$468	812	3201	5570	7920	10246	12580
ID Conservation: Delta Lake ID		$671	2390	4649	6887	9105	11300	13505
ID Conservation: Delta Lake ID via Engleman ID		$671	403	784	1162	1535	1906	2278
ID Conservation: Delta Lake ID via Valley Acres ID		$671	310	603	893	1180	1465	1750
ID Conservation: Engleman ID		$427	865	949	1033	1118	1206	1298
ID Conservation: HCID1		$330	4401	4749	5084	5415	5741	6076
ID Conservation: HCID1 via HCID13		$330	243	262	281	300	318	336
ID Conservation: HCID1 via HCMUD1		$330	54	59	62	66	70	75
ID Conservation: HCID1 via Santa Cruz ID		$330	4192	4524	4843	5158	5468	5789
ID Conservation: HCID13		$508	116	153	189	226	264	302
ID Conservation: HCID16		$148	1057	1364	1666	1965	2261	2559
ID Conservation: HCID19		$366	531	563	593	623	653	684
ID Conservation: HCID2		$288	2605	4319	6013	7693	9355	11028
ID Conservation: HCID5		$335	1164	1163	1159	1155	1150	1148
ID Conservation: HCID6		$381	1919	2121	2316	2509	2700	2894
ID Conservation: HCMUD1		$366	41	45	49	53	57	60
ID Conservation: HC WCID18		$366	29	33	36	40	44	49
ID Conservation: HC WID3		$313	395	451	506	561	614	669
ID Conservation: HCCID9		$1,069	2473	4053	5616	7165	8699	10241
ID Conservation: Santa Cruz ID		$89	3590	3912	4229	4549	4871	5210
ID Conservation: United ID		$134	2586	2893	3192	3488	3779	4076
ID Conservation: Valley Acres ID		$366	410	514	626	747	877	1019
On-Farm Conservation		$1392	75,226	75,226	75,226	75,226	75,226	75,226
Need after Conservation			**-267,266**	**-231,168**	**-192,367**	**-149,436**	**-105,065**	**-97,294**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	1,875	2,065	2,249	2,423	2,585	2,775
Conversion of WRs to DMI			-6,734	-17,549	-30,021	-44,337	-59,489	-59,477
Surplus/Deficit after WMS			**-272,125**	**-246,652**	**-220,139**	**-191,350**	**-161,969**	**-153,996**
Alternative Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Delta Watershed Project - Edinburg Lake		$1,271	1,739	1,739	1,739	1,739	1,739	1,739
Delta Watershed Project - New Reservoir		$1,790	1,878	1,878	1,878	1,878	1,878	1,878

Table 5-166 Hidalgo Irrigation, RG Basin Water Supply and Demand Analysis

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand (AF/yr)			25,587	24,390	23,098	21,632	20,103	20,103
Total Supply (AF/yr)			10,055	10,035	10,013	9,994	9,976	9,955
Projected Supply Surplus/Deficit			**-15,532**	**-14,355**	**-13,085**	**-11,638**	**-10,127**	**-10,148**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Donna ID		$468	34	133	232	330	427	524
ID Conservation: Delta Lake ID		$671	100	194	287	379	471	563
ID Conservation: Delta Lake ID via Engleman ID		$671	17	33	48	64	79	95
ID Conservation: Delta Lake ID via Valley Acres ID		$671	13	25	37	49	61	73
ID Conservation: Engleman ID		$427	36	40	43	47	50	54
ID Conservation: HCID1		$330	183	198	212	226	239	253
ID Conservation: HCID1 via HCID13		$330	10	11	12	12	13	14
ID Conservation: HCID1 via HCMUD1		$330	2	2	3	3	3	3
ID Conservation: HCID1 via Santa Cruz ID		$330	175	188	202	215	228	241
ID Conservation: HCID13		$508	5	6	8	9	11	13
ID Conservation: HCID16		$148	44	57	69	82	94	107
ID Conservation: HCID19		$366	22	23	25	26	27	28
ID Conservation: HCID2		$288	109	180	251	321	390	459
ID Conservation: HCID5		$335	48	48	48	48	48	48
ID Conservation: HCID6		$381	80	88	97	105	112	121
ID Conservation: HCMUD1		$366	2	2	2	2	2	3
ID Conservation: HC WCID18		$366	1	1	2	2	2	2
ID Conservation: HC WID3		$313	16	19	21	23	26	28
ID Conservation: HCCID9		$1,069	103	169	234	299	362	427
ID Conservation: Santa Cruz ID		$89	150	163	176	190	203	217
ID Conservation: United ID		$134	108	121	133	145	157	170
ID Conservation: Valley Acres ID		$366	17	21	26	31	37	42
On-Farm Conservation		$1392	3,134	3,134	3,134	3,134	3,134	3,134
Need after Conservation			**-11,122**	**-9,498**	**-7,783**	**-5,895**	**-3,951**	**-3,529**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	78	86	94	101	108	116
Conversion of WRs to DMI			-281	-731	-1,251	-1,847	-2,479	-2,478
Surplus/Deficit after WMS			**-11,324**	**-10,144**	**-8,940**	**-7,641**	**-6,322**	**-5,892**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. The Irrigation needs in Hidalgo County are partially met by Irrigation District Conservation strategies and decrease over the planning period. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Hidalgo County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-167 Hidalgo Livestock, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			754	754	754	754	754	754
Total Supply			1,648	1,648	1,648	1,648	1,648	1,648
Projected Supply Surplus/Deficit			**894**	**894**	**894**	**894**	**894**	**894**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	35	69	103	136	170	204
ID Conservation: Hidalgo & Cameron Co. ID No. 9		$1,069	42	68	95	122	149	175
Need after Conservation			**971**	**1,031**	**1,092**	**1,152**	**1,213**	**1,273**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Surplus/Deficit after WMS			**971**	**1,031**	**1,092**	**1,152**	**1,213**	**1,273**

Table 5-168 Hidalgo Livestock, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			76	76	76	76	76	76
Total Supply			106	106	106	106	106	106
Projected Supply Surplus/Deficit			**30**	**30**	**30**	**30**	**30**	**30**
Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**			
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	4	7	10	14	17	21
ID Conservation: Hidalgo & Cameron Co. ID No. 9		$1,069	4	7	10	12	15	18
Need after Conservation			**38**	**44**	**50**	**56**	**62**	**69**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
-			-	-	-	-	-	-
Surplus/Deficit after WMS			**38**	**44**	**50**	**56**	**62**	**69**

There are no projected needs for Livestock in Hidalgo County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MANUFACTURING

Table 5-169 Hidalgo Manufacturing, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			5,461	5,909	6,357	6,756	7,276	7,836
Total Supply			4,433	4,433	4,433	4,433	4,433	4,433
Projected Supply Surplus/Deficit			**-1,028**	**-1,476**	**-1,924**	**-2,323**	**-2,843**	**-3,403**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID Via NAWSC		$671	18	35	52	69	86	103
ID Conservation: Delta Lake ID Via Valley Acres		$671	10	20	30	40	50	60
ID Conservation: Hidalgo County WID No. 3		$313	66	76	85	95	104	114
ID Conservation: Valley Acres ID		$366	14	17	21	25	30	35
ID Conservation: HCID1 via Edinburg		$330	4	5	5	5	6	6
ID Conservation: HCID1 via NAWSC		$330	11	12	13	14	15	16
ID Conservation: HCID2 via NAWSC		$288	6	9	13	17	20	24
Implementation of Best Management Practices		$2,500	546	591	636	676	728	784
Need after Conservation			**-353**	**-711**	**-1,069**	**-1,382**	**-1,805**	**-2,261**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	1
North Cameron Regional WTP Wellfield Expansion		$843	160	160	160	160	160	160
Acquisition of Water Rights through Urbanization - Brownsville ID	$210,000	$211	84	300	400	600	800	1,100
Acquisition of Water Rights through Urbanization - Adams Garden ID	$65,000	$211	26	51	130	160	210	250
Acquisition of Water Rights through Urbanization - CCWID10	$155,000	$211	62	150	250	300	425	500
Acquisition of Water Rights through Urbanization - CCID16	$75,000	$211	30	50	129	162	210	250
Surplus/Deficit after WMS			**9**	**0**	**0**	**0**	**0**	**0**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 BMP for Industrial Users.

MINING

Table 5-170 Hidalgo Mining, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			2,636	3,356	3,892	4,467	5,128	5,964
Total Supply			1,399	1,398	1,395	1,393	1,390	1,387
Projected Supply Surplus/Deficit			**-1,237**	**-1,958**	**-2,497**	**-3,074**	**-3,738**	**-4,577**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID16		$148	10	13	17	19	22	25
ID Conservation: HCID16 via Agua SUD		$148	0	1	1	1	1	1
ID Conservation: HCID6 via Agua SUD		$381	1	1	1	1	2	2
ID Conservation: HC WCID18		$366	82	95	107	118	129	141
ID Conservation: HC WID3		$313	10	12	13	15	16	18
Implementation of Best Management Practices		$2,500	264	336	389	447	513	596
Need after Conservation			**-871**	**-1,500**	**-1,969**	**-2,474**	**-3,055**	**-3,794**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD West WWTP Potable Reuse - Phase I		$2,974	1	1	1	1	1	1
Agua SUD West WWTP Potable Reuse - Phase II		$2,145	0	0	9	9	9	9
Agua SUD East WWTP Potable Reuse - Phase I		$2,358	2	2	2	2	2	2
Agua SUD East WWTP Potable Reuse - Phase II		$3,881	0	0	0	2	2	2
Agua SUD Acquisition of Water Rights through Urbanization		$143	0	0	0	0	0	0
Surplus/Deficit after WMS			**-868**	**-1,498**	**-1,957**	**-2,460**	**-3,041**	**-3,780**
Alternative Strategies	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agua SUD Non-Potable Reuse		$2,946	2	2	3	3	3	3

Table 5-171 Hidalgo Mining, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			208	264	306	352	404	470
Total Supply			63	62	62	62	62	62
Projected Supply Surplus/Deficit			**-145**	**-202**	**-244**	**-290**	**-342**	**-408**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID16		$148	1	1	1	2	2	2
ID Conservation: HC WCID18		$366	7	7	8	9	10	11
ID Conservation: HC WID3		$313	1	1	1	1	1	1
Implementation of Best Management Practices		$2,500	21	26	31	35	40	47

Year			2020	2030	2040	2050	2060	2070
Need after Conservation			**-116**	**-167**	**-203**	**-243**	**-288**	**-347**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Surplus/Deficit after WMS			**-116**	**-167**	**-203**	**-243**	**-288**	**-347**

The Mining needs are partially met by the Implementation of Best Management Practices, however due to the decreased reliability of Mining water rights in a drought year, Hidalgo County Mining is left with shortages in years of limited supply. Additionally, there may be further groundwater supplies for Mining that exceed the MAG values for the Gulf Coast Aquifer. Due to limited reporting requirements and no active Groundwater Conservation District, it is not certain that these water sources are currently being used in excess of the MAG.

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 BMP for Industrial Users.

STEAM-ELECTRIC

Table 5-172 Hidalgo Steam-Electric, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			14,151	16,545	19,462	23,018	27,354	32,507
Total Supply			12,203	12,203	12,203	12,203	12,203	12,203
Projected Supply Surplus/Deficit			**-1,948**	**-4,342**	**-7,259**	**-10,815**	**-15,151**	**-20,304**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID1		$330	34	37	39	42	45	48
ID Conservation: HCID6		$381	16	17	19	20	22	24
ID Conservation: Valley Acres ID		$366	67	83	102	121	143	166
Implementation of Best Management Practices		$2,500	1,415	1,655	1,946	2,302	2,735	3,251
Need after Conservation			**-416**	**-2,551**	**-5,153**	**-8,330**	**-12,206**	**-16,816**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Additional Groundwater Supply	$538,000	$500	100	100	100	100	100	100
Acquisition of Water Rights through Urbanization Cameron County Irrigation	$2,032,500	$211	0	813	1,484	2,048	3,021	2,578
Acquisition of Water Rights through Urbanization Valley Acres ID	$322,500	$211	129	375	634	907	1,186	1,199
Acquisition of Water Rights through Urbanization - Bayview ID	$360,000	$211	144	427	728	1,044	1,369	1,386

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization - Donna ID	$67,500	$211	27	22	643	2,543	4,810	5,348
Acquisition of Water Rights through Urbanization - Maverick County ID	$45,000	$211	18	919	1,748	2,493	3,273	3,316
Acquisition of Water Rights through Urbanization - HCCID9	$7,500,000	$211	0	0	0	0	0	3,000
Surplus/Deficit after WMS			**2**	**106**	**184**	**805**	**1,553**	**111**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 BMP for Industrial Users.

<u>Groundwater Supply Expansion</u>

Project Source

This strategy was identified by the Regional Water Planning Group.

Description

This strategy is to provide additional supply to Hidalgo County Steam-Electric with the installation of fresh groundwater wells.

Available Yield

The available supply is 100 acre-ft./year beginning in 2020, based on the needs estimate for Hidalgo Steam Electric.

Engineering and Costing

The UCM was utilized to develop estimated costs for this strategy based on assumptions about the individual wells. The wells were costed with a capacity of 25 gpm. Well piping and land acquisition were also included in the cost estimate.

The estimated costs and project requirements for this strategy are presented in Table 5-173.

Table 5-173 Hidalgo Steam-Electric Groundwater Supply Expansion

Cost Estimate Summary
Water Supply Project Option
Steam Electric, Hidalgo – Additional Groundwater Supply

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$361,000
TOTAL COST OF FACILITIES	**$361,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$126,000
Environmental & Archaeology Studies and Mitigation	$25,000
Land Acquisition and Surveying (2 acres)	$7,000
Interest During Construction (4% for 1 years with a 1% ROI)	<u>$19,000</u>

Cost Estimate Summary ***Water Supply Project Option*** ***Steam Electric, Hidalgo – Additional Groundwater Supply***	
Item	***Estimated Costs for Facilities***
TOTAL COST OF PROJECT	**$538,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$45,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$4,000
Pumping Energy Costs (10845 kW-hr @ 0.09 $/kW-hr)	$1,000
TOTAL ANNUAL COST	**$50,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	100
Annual Cost of Water ($ per acft)	$500
Annual Cost of Water ($ per 1,000 gallons)	$1.53

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

5.3.3 Jim Hogg County

WUG and WUG/WWP

Jim Hogg County WUG and WUG/WWP that have recommended strategies with associated capital costs and locations which do not have individual maps associated with them are represented in Figure 5-23.

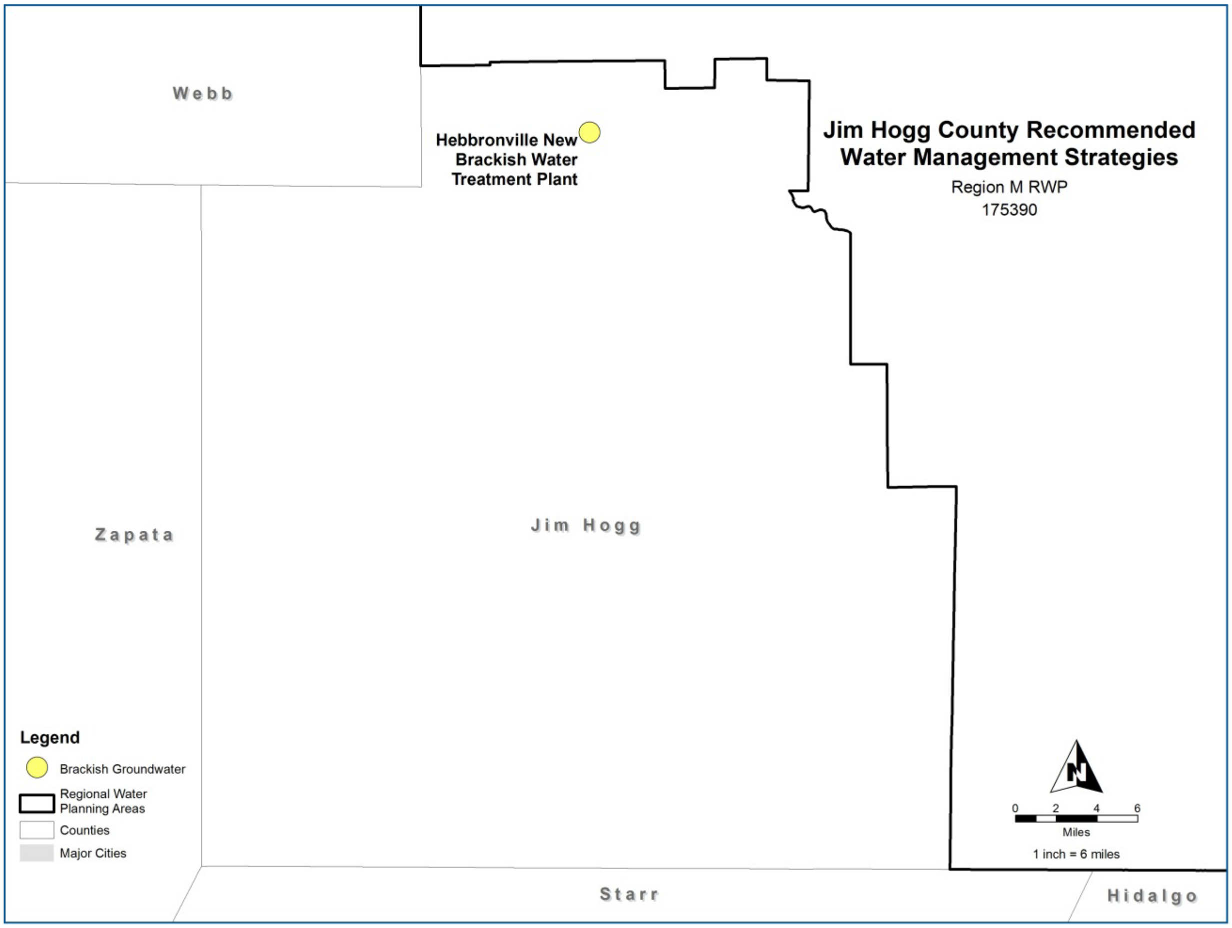

Figure 5-23 Jim Hogg County Recommended Water Management Strategies

HEBBRONVILLE

Table 5-174 Hebbronville Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			592	616	638	673	709	745
Total Supply			592	592	592	592	592	592
Projected Supply Surplus/Deficit			**0**	**-24**	**-46**	**-81**	**-117**	**-153**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	1	14	37	69	105
Need after Conservation			0	-23	-32	-44	-48	-48

Recommended Strategy	Capital Costs ($)	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
New Brackish Water Treatment Plant	$8,275,000	$2,557	560	560	560	560	560	560
Surplus/Deficit after WMS			**560**	**537**	**528**	**516**	**512**	**512**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Hebbronville's 2011 GPCD was estimated at 115, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

New Brackish Groundwater Treatment Plant

Project Source

This strategy was identified by the RWPG.

Description

This strategy is to drill a new brackish groundwater well and construct a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates for Hebbronville, the new brackish groundwater plant is sized for 560 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. Membrane treatment efficiency is assumed to be 80%, so the wells and wellfield piping are designed to 700 acre-ft./year. It is assumed that the construction period for this strategy is one and a half years and would begin in 2020.

Table 5-175 outlines the project requirements and cost estimate developed in UCM.

Table 5-175 Hebbronville Brackish Groundwater Treatment Plant Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
Hebbronville - Brackish Groundwater Desalination

Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$673,000
Water Treatment Plant (0.5 MGD)	$5,145,000
TOTAL COST OF FACILITIES	**$5,818,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,036,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$413,000
TOTAL COST OF PROJECT	**$8,275,000**

Cost Estimate Summary ***Water Supply Project Option*** ***Hebbronville - Brackish Groundwater Desalination***	
Item	***Estimated Costs for Facilities***
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$692,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$726,000
Pumping Energy Costs (77418 kW-hr @ 0.09 $/kW-hr)	$7,000
TOTAL ANNUAL COST	**$1,432,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	560
Annual Cost of Water ($ per acft)	$2,557
Annual Cost of Water ($ per 1,000 gallons)	$7.85

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

COUNTY-OTHER

Table 5-176 Jim Hogg County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			100	104	108	114	120	126
Total Supply			286	286	286	286	286	286
Projected Supply Surplus/Deficit			**186**	**182**	**178**	**172**	**166**	**160**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**186**	**182**	**178**	**172**	**166**	**160**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**186**	**182**	**178**	**172**	**166**	**160**

IRRIGATION

Table 5-177 Jim Hogg Irrigation, Nueces-Rio Grande Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			351	330	318	331	361	361
Total Supply			140	140	140	140	140	140
Projected Supply Surplus/Deficit			**-211**	**-190**	**-178**	**-191**	**-221**	**-221**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			2020	2030	2040	2050	2060	2070
On-Farm Conservation		$1,392	43	43	43	43	43	43
Need after Conservation			**-168**	**-147**	**-135**	**-148**	**-178**	**-178**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Additional Groundwater Wells	$2,117,000	$657	250	250	250	250	250	250
Surplus/Deficit after WMS			**82**	**103**	**115**	**102**	**72**	**72**

Table 5-178 Jim Hogg Irrigation, Rio Grande Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			88	83	80	83	90	90
Total Supply			60	60	60	60	60	60
Projected Supply Surplus/Deficit			**-28**	**-23**	**-20**	**-23**	**-30**	**-30**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
On-Farm Conservation		$1,392	11	11	11	11	11	11
Need after Conservation			**-17**	**-12**	**-9**	**-12**	**-19**	**-19**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Additional Groundwater Wells	$2,117,000	$657	50	50	50	50	50	50
Surplus/Deficit after WMS			**33**	**38**	**41**	**38**	**31**	**31**

Groundwater Supply Expansion

Project Source

This strategy was identified by the Regional Water Planning Group.

Description

This strategy is to provide additional supply to Jim Hogg Irrigation with the installation of fresh groundwater wells.

Available Yield

The available supply is 300 acre-ft./year beginning in 2020, based on the needs estimate for Jim Hogg County.

Engineering and Costing

The UCM was utilized to develop estimated costs for this strategy based on assumptions about the individual wells. The wells were costed with a capacity of 50 gpm. Well piping and land acquisition were also included in the cost estimate.

The estimated costs and project requirements for this strategy are presented in Table 5-179.

Table 5-179 Jim Hogg Irrigation Groundwater Wells Cost and Yield Projections

Cost Estimate Summary *Water Supply Project Option* *Jim Hogg Irrigation Groundwater Wells*	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,464,000
TOTAL COST OF FACILITIES	**$1,464,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$512,000
Environmental & Archaeology Studies and Mitigation	$29,000
Land Acquisition and Surveying (3 acres)	$6,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$106,000
TOTAL COST OF PROJECT	**$2,117,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$177,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$15,000
Pumping Energy Costs (60311 kW-hr @ 0.09 $/kW-hr)	$5,000
TOTAL ANNUAL COST	**$197,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	300
Annual Cost of Water ($ per acft)	$657
Annual Cost of Water ($ per 1,000 gallons)	$2.01

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

LIVESTOCK

Table 5-180 Jim Hogg Livestock, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			327	327	327	327	327	327
Total Supply			327	327	327	327	327	327
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

Table 5-181 Jim Hogg Livestock, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			109	109	109	109	109	109
Total Supply			109	109	109	109	109	109

Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

There are no projected needs for Livestock in Jim Hogg County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MINING

Table 5-182 Jim Hogg Mining, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			84	87	65	48	31	20
Total Supply			84	87	65	48	31	20
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	8	9	7	5	3	2
Need after Conservation			**8**	**9**	**7**	**5**	**3**	**2**
Recommended Strategy	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**8**	**9**	**7**	**5**	**3**	**2**

Table 5-183 Jim Hogg Mining, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			9	10	7	5	3	2
Total Supply			9	10	7	5	3	2
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	1	1	1	1	0	0
Need after Conservation			**1**	**1**	**1**	**1**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**1**	**1**	**1**	**1**	**0**	**0**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include those described in Section 5.2.6 Best Management Practices for Industrial Users.

5.3.4 Maverick County

Irrigation Districts/WWP

Irrigation District Conservation is recommended for the ID located in Maverick County. Figure 5-24 shows a map of the Maverick County WCID.

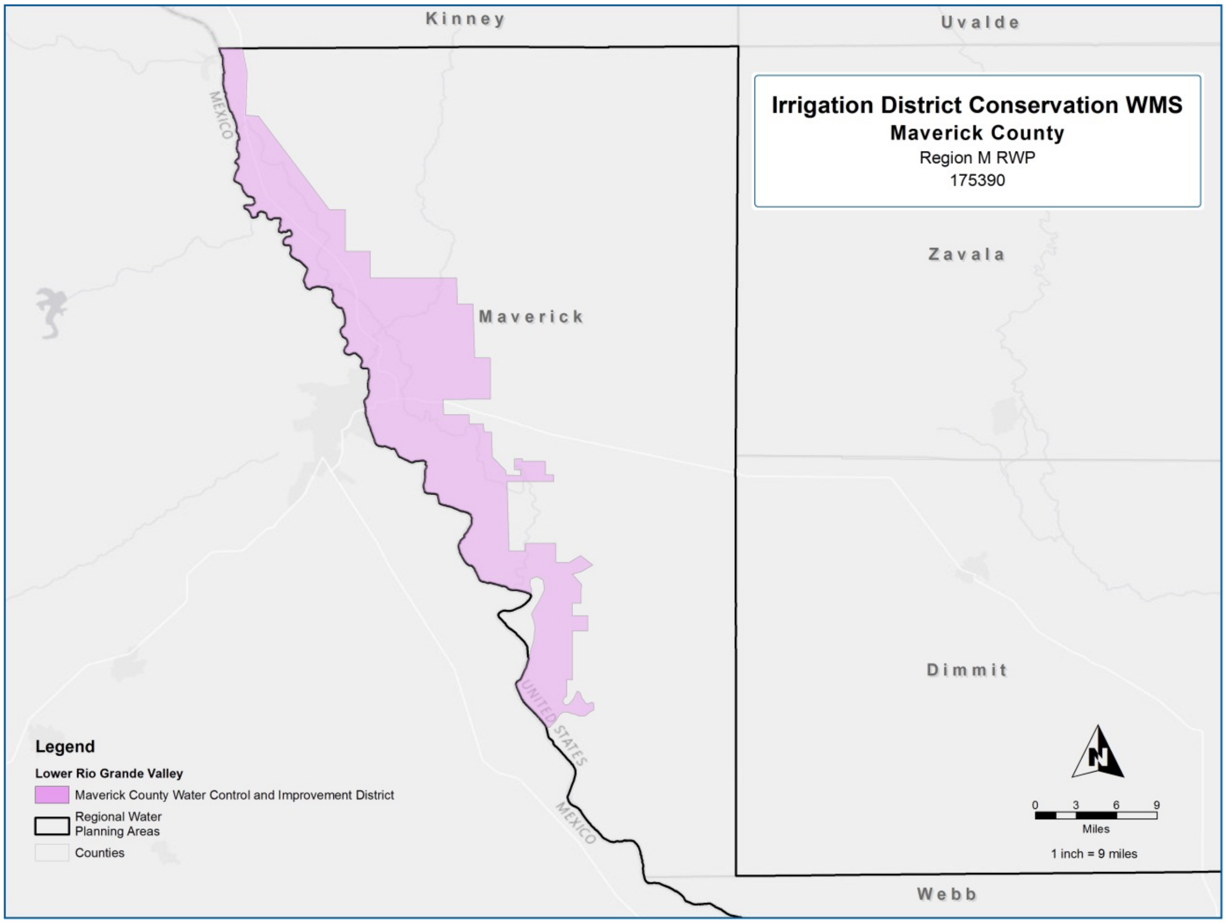

Figure 5-24 Maverick County Irrigation District Conservation

MAVERICK COUNTY WATER CONTROL AND IMPROVEMENT DISTRICT

Maverick County WCID delivers water to irrigators, mining users, and other municipal users within Maverick County. The District has two reservoirs with a combined storage capacity of 260 acre-ft. and approximately 300 miles of lined and unlined canals.

Table 5-184 Maverick County WCID Conservation Cost Projections

Cost Estimate Summary *Maverick County WCID* *Irrigation District Conservation*	
Item	***Estimated Costs for Facilities***
Canal Lining	$22,664,130
Installation of Pipeline	$14,325,556
General Repairs and Improvements	$5,884,789
TOTAL COST OF PROJECT	**$42,874,475**

Cost Estimate Summary
Maverick County WCID
Irrigation District Conservation

Item	***Estimated Costs for Facilities***
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,400,670
O&M Cost (based on reduced pumping and canal rider costs)	-$105,922
TOTAL ANNUAL COST	**$3,294,748**
Available Project Yield (acft/yr)	8659
Annual Cost of Water ($ per acft)	$380
Annual Cost of Water ($ per 1,000 gallons)	$1.17

WUG and WUG/WWP

Maverick County WUG and WUG/WWP that have recommended strategies with associated capital costs and locations which do not have individual maps associated with them are represented in Figure 5-25.

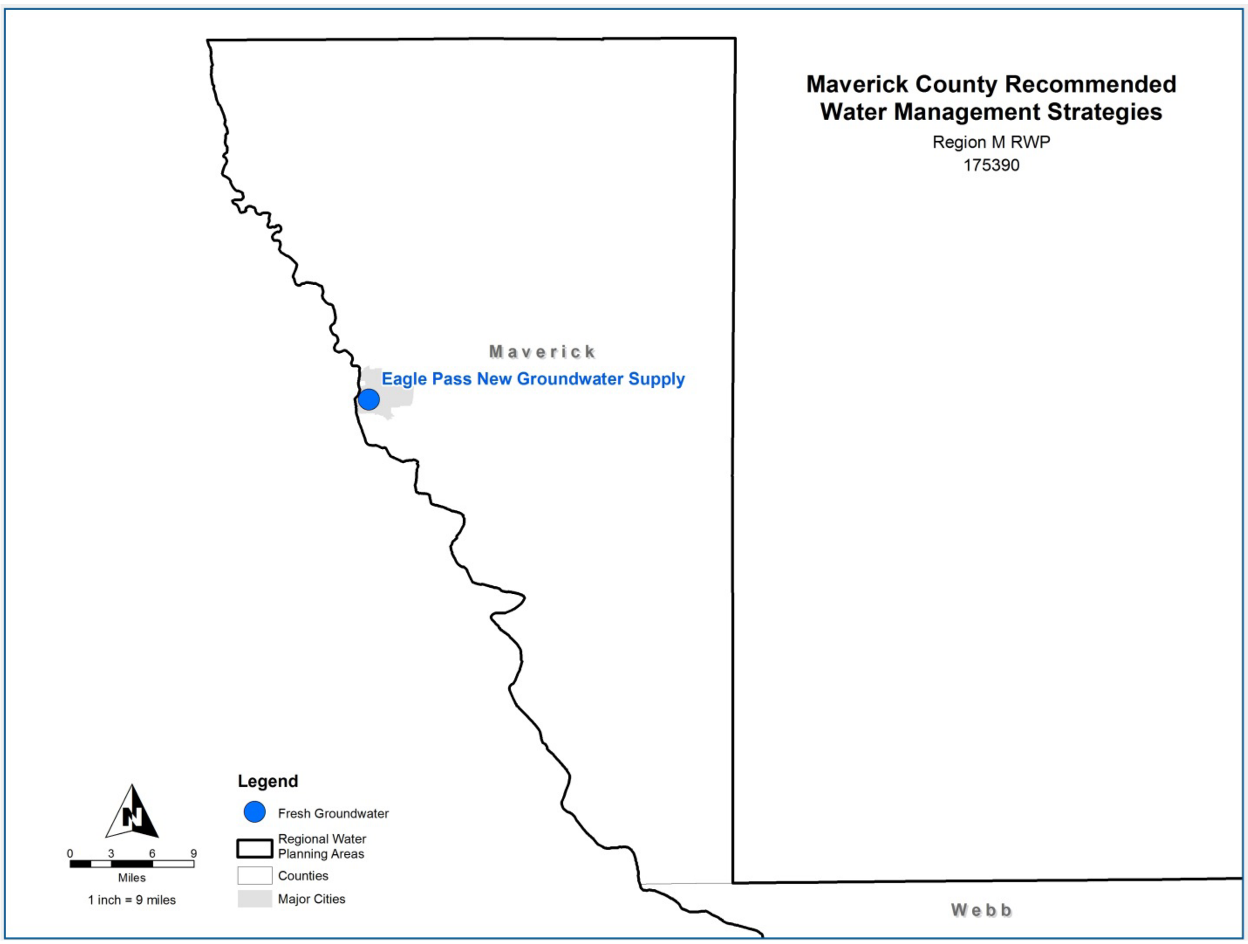

Figure 5-25 Maverick County Recommended Water Management Strategies

EAGLE PASS

Table 5-185 Eagle Pass Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			6,004	6,841	7,639	8,506	9,374	10,215
Total Supply			7,947	7,947	7,947	7,947	7,947	7,947
Projected Supply Surplus/Deficit			**1,943**	**1,106**	**308**	**-559**	**-1,427**	**-2,268**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	208	728	1,313	1,758	2,290	2,869
Need after Conservation			**2,151**	**1,834**	**1,621**	**1,199**	**863**	**601**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
New Groundwater Supply	$1,072,000	$199	0	0	0	700	700	700
Surplus/Deficit after WMS			**2,151**	**1,834**	**1,621**	**1,899**	**1,563**	**1,301**
Alternative Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BGD Plant	$8,272,000	$2,568	0	0	0	560	560	560

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Eagle Pass' 2011 GPCD was estimated at 182, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

New Groundwater Supply

Project Source

This strategy was identified by the RWPG.

Description

This strategy is to drill a new fresh groundwater well and provide disinfection treatment for the groundwater.

Available Supply

Based on preliminary needs estimates for Eagle Pass, the new fresh groundwater well is sized for 700 acre-ft./year and would be constructed in 2050.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and disinfection treatment. It is assumed that the construction period for this strategy is one year.

Table 5-186 outlines the project requirements and cost estimate developed in UCM.

Table 5-186 Eagle Pass New Groundwater Supply Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Eagle Pass - New Groundwater Plant*	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$715,000
Water Treatment Plant (0.6 MGD)	$46,000
TOTAL COST OF FACILITIES	**$761,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$266,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$37,000
TOTAL COST OF PROJECT	**$1,072,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$90,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$28,000
Pumping Energy Costs (150983 kW-hr @ 0.09 $/kW-hr)	$14,000
TOTAL ANNUAL COST	**$139,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	700
Annual Cost of Water ($ per acft)	$199
Annual Cost of Water ($ per 1,000 gallons)	$0.61

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TXDOT right-of-way permit.

COUNTY-OTHER

Table 5-187 Maverick County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			4,269	4,697	5,113	5,579	6,056	6,523
Total Supply			6,520	6,520	6,520	6,520	6,520	6,520
Projected Supply Surplus/Deficit			**2,251**	**1,823**	**1,407**	**941**	**464**	**-3**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Maverick Co. WCID No. 1		$380	381	428	476	524	571	619
Advanced Municipal Conservation		$652	0	0	0	0	0	306
Need after Conservation			**2,632**	**2,251**	**1,883**	**1,465**	**1,035**	**922**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**2,632**	**2,251**	**1,883**	**1,465**	**1,035**	**922**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. The 2011 GPCD for Maverick County-Other was estimated at 128, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

IRRIGATION

Table 5-188 Maverick Irrigation, Nueces Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			61	59	58	57	56	56
Total Supply			465	464	464	464	464	464
Projected Supply Surplus/Deficit			**404**	**405**	**406**	**407**	**408**	**408**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Maverick County WCID1		$380	9	10	12	13	14	15
On-Farm Conservation		$1,392	5	5	5	5	5	5
Need after Conservation			**418**	**420**	**423**	**425**	**427**	**428**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	2	2	2	2	3	3
Conversion of WRs to DMI			-6	-15	-24	-33	-41	-41
Surplus/Deficit after WMS			**413**	**407**	**401**	**395**	**388**	**390**

Table 5-189 Maverick Irrigation, Rio Grande Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			52,932	51,827	50,845	49,894	49,020	49,020
Total Supply			38,820	38,757	38,694	38,631	38,568	38,504
Projected Supply Surplus/Deficit			**-13,280**	**-13,280**	**-13,280**	**-13,280**	**-13,280**	**-13,280**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Maverick County WCID1		$380	8,185	9,197	10,183	11,157	12,118	13,099
On-Farm Conservation		$1,392	4,499	4,499	4,499	4,499	4,499	4,499
Need after Conservation			**-596**	**416**	**1,402**	**2,376**	**3,337**	**4,318**
Recommended Strategy	**Capital Cost ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	160	181	205	231	260	279
Conversion of WRs to DMI			-621	-1,475	-2,357	-3,237	-4,076	-4,088
Surplus/Deficit after WMS			**-1,056**	**-878**	**-750**	**-631**	**-478**	**509**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. The Irrigation needs in Maverick County are partially met by Irrigation District Conservation strategies and decrease over the planning period. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Maverick County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-190 Maverick Livestock, Nueces Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			125	125	125	125	125	125
Total Supply			125	125	125	125	125	125
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

Table 5-191 Maverick Livestock, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			374	374	374	374	374	374
Total Supply			374	374	374	374	374	374
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--			-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

There are no projected needs for Livestock in Maverick County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MANUFACTURING

Table 5-192 Maverick Manufacturing, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			93	98	103	107	114	121
Total Supply			14	14	14	14	14	14
Projected Supply Surplus/Deficit			**-79**	**-84**	**-89**	**-93**	**-100**	**-107**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	9	10	10	11	11	12
Need after Conservation			**-70**	**-74**	**-79**	**-82**	**-89**	**-95**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
New Groundwater Supply	$538,000	$500	100	100	100	100	100	100
Surplus/Deficit after WMS			**30**	**26**	**21**	**18**	**11**	**5**

Implementation of Best Management Practices

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

New Groundwater Supply

Project Source

This strategy was identified by the Regional Water Planning Group.

Description

This strategy is to provide additional supply to Maverick County Manufacturing with the installation of fresh groundwater wells.

Available Yield

The available supply is 100 acre-ft./year beginning in 2020, based on the needs estimate for Hidalgo Steam Electric.

Engineering and Costing

The UCM was utilized to develop estimated costs for this strategy based on assumptions about the individual wells. The wells were costed with a capacity of 25 gpm. Well piping and land acquisition were also included in the cost estimate.

The estimated costs and project requirements for this strategy are presented in Table 5-193.

Table 5-193 Maverick County Manufacturing New Groundwater Supply Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
Manufacturing, Maverick - New Groundwater Supply

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$361,000
TOTAL COST OF FACILITIES	**$361,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$126,000
Environmental & Archaeology Studies and Mitigation	$25,000
Land Acquisition and Surveying (2 acres)	$7,000
Interest During Construction (4% for 1 years with a 1% ROI)	$19,000
TOTAL COST OF PROJECT	**$538,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$45,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$4,000
Pumping Energy Costs (10845 kW-hr @ 0.09 $/kW-hr)	$1,000
TOTAL ANNUAL COST	**$50,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	100
Annual Cost of Water ($ per acft)	$500
Annual Cost of Water ($ per 1,000 gallons)	$1.53

MINING

Table 5-194 Maverick Mining, Nueces Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			398	547	587	460	335	243
Total Supply			77	77	77	77	76	76
Projected Supply Surplus/Deficit			**-321**	**-470**	**-510**	**-383**	**-259**	**-167**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Maverick County WCID#1		$380	13	14	16	17	19	20
Implementation of Best Management Practices		$2,500	40	55	59	46	34	24
Need after Conservation			**-268**	**-401**	**-435**	**-320**	**-207**	**-123**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**-268**	**-401**	**-435**	**-320**	**-207**	**-123**

Table 5-195 Maverick Mining, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Water Demand			1,590	2,190	2,346	1,842	1,339	974
Total Supply			607	605	603	603	602	601
Projected Supply Surplus/Deficit			**-983**	**-1,585**	**-1,743**	**-1,239**	**-737**	**-373**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Maverick County WCID#1		$380	50	56	62	68	74	80
Implementation of Best Management Practices		$2,500	159	219	235	184	134	97
Need after Conservation			**-933**	**-1,529**	**-1,681**	**-1,171**	**-663**	**-293**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
-	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**-933**	**-1,529**	**-1,681**	**-1,171**	**-663**	**-293**

The Mining needs are partially met by the Implementation of Best Management Practices, however due to the decreased reliability of Mining water rights in a drought year, Maverick County Mining is left with shortages in years of limited supply. Additionally, there may be further groundwater supplies for Mining that exceed the MAG values for the Gulf Coast Aquifer. Due to limited reporting requirements and no active Groundwater Conservation District, it is not certain that these water sources are currently being used in excess of the MAG.

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

5.3.5 Starr County

WUG and WUG/WWP

Starr County WUG and WUG/WWP that have recommended strategies with associated capital costs and locations which do not have individual maps associated with them are represented in Figure 5-26.

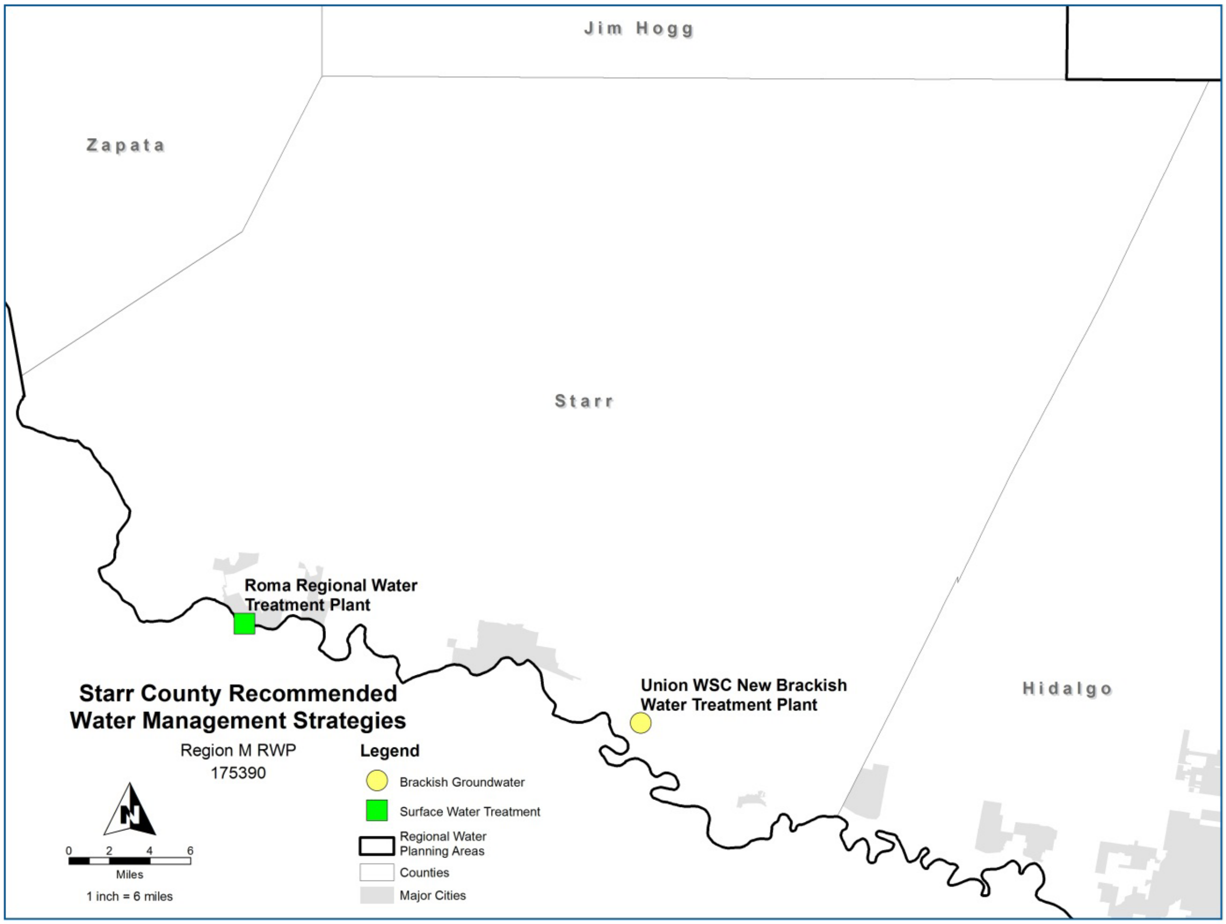

Figure 5-26 Starr County Recommended Water Management Strategies

AGUA SPECIAL UTILITY DISTRICT

See Section 5.3.2 Hidalgo County.

ESCOBARES

Table 5-196 Escobares Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			169	184	203	221	238	253
Total Supply			169	184	203	221	238	253
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					

Conservation	Capital Costs ($)	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

LA GRULLA

Table 5-197 La Grulla Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			337	373	406	441	475	506
Total Supply			552	552	552	552	552	552
Projected Supply Surplus/Deficit			**215**	**179**	**146**	**111**	**77**	**46**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	11	40	40	40	40	40
Need after Conservation			**226**	**219**	**186**	**151**	**117**	**86**
Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**226**	**219**	**186**	**151**	**117**	**86**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. La Grulla's 2011 GPCD was estimated at 169, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

RIO GRANDE CITY

Table 5-198 Rio Grande City Water Supply and Demand Analysis (Acre-feet/year)

Demands	Sole Supplier		2020	2030	2040	2050	2060	2070
WUG Water Demand	Yes		3,839	4,262	4,660	5,075	5,464	5,820
Rio WSC	Yes		432	471	509	549	587	623
County-Other, Starr			355	355	355	355	355	355
Total Demands			**4,626**	**5,088**	**5,524**	**5,979**	**6,406**	**6,798**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			3,703	3,703	3,703	3,703	3,703	3,703
Rio WSC			366	366	366	366	366	366
County-Other, Starr			305	305	305	305	305	305
Total			**4,374**	**4,374**	**4,374**	**4,374**	**4,374**	**4,374**
WWP Needs (Surplus +/ Need -)			**535**	**112**	**-286**	**-701**	**-1,090**	**-1,446**

Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: HCID #2		$330	27	44	62	79	97	114
Rio Grande City Advanced Municipal Conservation*		$652	173	512	906	1,356	1,801	2,108
Rio WSC Advanced Municipal Conservation**		$652	0	0	9	29	55	84
Need after Conservation			**735**	**668**	**691**	**763**	**863**	**860**
Recommended Strategies	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio Grande City Water Meter Replacement	$5,059,000	$1,143	370	370	370	370	370	370
Surplus/Deficit after WMS			**1,105**	**1,038**	**1,061**	**1,133**	**1,233**	**1,230**
Total Supplies with WMS			**4,944**	**5,300**	**5,721**	**6,208**	**6,697**	**7,050**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			4,058	4,412	4,820	5,285	5,744	6,066
Rio WSC			531	532	542	564	592	623
County-Other, Starr			355	356	358	359	360	362
Total WWP Surplus/Deficit			**318**	**212**	**197**	**229**	**291**	**252**
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total WUG Surplus/Deficit			219	150	160	210	280	246
Rio WSC			99	61	33	15	5	0
County-Other, Starr			0	1	3	4	5	7
Alternate Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio Grande City BGD Plant	$8,282,000	$2,570	0	469	469	469	469	469
Rio Grande City Acquisition of Water Rights through Urbanization	$476,000	$143	280	280	280	560	560	560

* Full WMS supply to Rio Grande City

** Full WMS supply to Rio WSC

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Rio Grande City's 2011 GPCD was estimated at 223, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

Water Meter Replacement

Project Source

This strategy was submitted by Rio Grande City of the RWPG.

Description

This strategy is to replace existing broken and malfunctioning water meters with 100% lead-free meters equipped with automated meter reading equipment within the City's distribution system.

The current water meters are not 100% lead-free and are experiencing significant water loss as evidenced by meter and billing records.

Available Supply

The City estimates 10% to 15% of their current water losses can be conserved. Therefore, 10% of the current WUG supply, or 370 acre-ft./year, was used as the WMS yield.

Engineering and Costing

Rio Grande City estimates the capital cost for this strategy at approximately $3,560,000. Table 5-199 outlines the project requirements and other cost metrics developed in UCM.

Table 5-199 Rio Grande City Water Meter Replacement Costs

Cost Estimate Summary Water Supply Project Option Rio Grande City – Water Meter Replacement	
Item	***Estimated Costs for Facilities***
Water Meter Replacement	$3,560,000
TOTAL COST OF FACILITIES	**$3,560,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,246,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$253,000
TOTAL COST OF PROJECT	**$5,059,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$423,000
Operation and Maintenance	
TOTAL ANNUAL COST	**$423,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	370
Annual Cost of Water ($ per acft)	$1,143
Annual Cost of Water ($ per 1,000 gallons)	$3.51

Implementation Issues

No implementation issues have been identified.

RIO WATER SUPPLY CORPORATION

Table 5-200 Rio WSC Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			396	435	473	513	551	587
Total Supply			330	330	330	330	330	330
Projected Supply Surplus/Deficit			**-66**	**-105**	**-143**	**-183**	**-221**	**-257**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio WSC Advanced Municipal Conservation		$652	0	0	9	29	55	84
ID Conservation: HCID #2 via Rio Grande City		$288	3	4	6	7	9	11
Need after Conservation			**-63**	**-101**	**-129**	**-147**	**-157**	**-162**

Recommended Strategy	Capital Costs ($)	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
Rio Grande City Water Meter Replacement		$1,143	162	162	162	162	162	162
Surplus/Deficit after WMS			**99**	**61**	**33**	**15**	**5**	**0**
Alternate Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio Grande City BGD Plant		$2,570	0	48	48	48	48	48

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Rio WSC's 2011 GPCD was estimated at 100, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

ROMA

Table 5-201 Roma Water Supply and Demand Analysis (Acre-feet/year)

Demands	Sole Supplier		2020	2030	2040	2050	2060	2070
WUG Water Demand	Yes		1,357	1,476	1,590	1,719	1,849	1,968
Escobares	Yes		169	184	203	221	238	253
County-Other, Starr			250	250	250	250	250	250
Total Demand			1,776	1,910	2,043	2,190	2,337	2,471
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			1,989	1,974	1,955	1,937	1,920	1,905
Escobares			169	184	203	221	238	253
County-Other, Starr			250	250	250	250	250	250
Total			**2,408**	**2,408**	**2,408**	**2,408**	**2,408**	**2,408**
WWP Needs (Surplus +/ Need -)			**632**	**498**	**365**	**218**	**71**	**-63**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Roma Advanced Municipal Conservation*		$652	0	0	0	0	0	93
Need after Conservation			**632**	**498**	**365**	**218**	**71**	**30**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Roma Water Right Purchase and Regional WTP	$45,625,000	$1,366	1,500	1,500	1,500	1,500	1,500	1,500
Total Supply with WMS			**3,908**	**3,474**	**3,455**	**3,437**	**3,420**	**3,498**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			2,089	2,074	2,055	2,037	2,020	2,098
Escobares			169	184	203	221	238	253
County-Other, Starr			1,650	1,650	1,650	1,650	1,650	1,650
Total WWP Surplus/Deficit			**2,132**	**1,998**	**1,865**	**1,718**	**1,571**	**1,530**
Needs after WMS	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Total WUG Surplus/Deficit			732	598	465	318	171	130
Escobares			0	0	0	0	0	0
County-Other, Starr			1,400	1,400	1,400	1,400	1,400	1,400

* Full WMS supply to Roma

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Roma's 2011 GPCD was estimated at 117, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Regional Water Treatment Plant

Project Source

This strategy was submitted by the City of Roma to the RWPG.

Description

This strategy is to construct a Regional Water Treatment Plant to serve the City of Roma, Falcon Rural WSC, El Sauz WSC, El Tanque WSC, and Rio WSC. The consolidation of treatment facilities for this strategy may provide significant cost savings when compared to each entity operating independently.

Available Supply

This strategy, as submitted, would provide an initial drinking water supply of 10 MGD in 2015 and expand to 16.7 MGD in 2040, with a build-out capacity of 22.7 MGD in 2060. However, the regional water demands are significantly less than the proposed supplies, and the strategy has been modified to show a 5 MGD treatment plant built in 2020, which treats the City of Roma's existing water rights (1,989 AF in 2020). Purchase of 1,500 surface water rights in 2020 and another 500 AF in 2040 is included as a component of the WMS, and allows for the system to meet regional demands.

Engineering and Costing

This strategy consists of a conventional water treatment plant, utilizing microfiltration instead of dual media filters due to increased salinity of surface water. The costs for this strategy were estimated in the UCM and consisted of a conventional WTP and a filtration process. It is assumed that the construction period for this strategy is two years.

Table 5-202 outlines the project requirements and cost estimate developed in UCM.

Table 5-202 Roma Regional Water Treatment Plant Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***City of Roma - Regional Water Treatment Plant***	
Item	***Estimated Costs for Facilities***
Two Water Treatment Plants (5 MGD and 5 MGD)	$27,827,000
TOTAL COST OF FACILITIES	**$31,577,000**

Cost Estimate Summary
Water Supply Project Option
City of Roma - Regional Water Treatment Plant

Item	*Estimated Costs for Facilities*
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$11,052,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (5 acres)	$6,000
Interest During Construction (4% for 2 years with a 1% ROI)	$2,985,000
TOTAL COST OF PROJECT	**$45,625,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,818,000
Operation and Maintenance	
Water Treatment Plant (2.5% of Cost of Facilities)	$3,831,000
TOTAL ANNUAL COST	**$7,649,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	5,600
Annual Cost of Water ($ per acft)	$1,366
Annual Cost of Water ($ per 1,000 gallons)	$4.19

Implementation Issues

There are two major implementation issues associated with this strategy: the risk of one or more of the five entities not agreeing to join the regional approach and not being able to secure the necessary water rights for each phase.

UNION WATER SUPPLY CORPORATION

Table 5-203 Union WSC Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			827	910	991	1,076	1,156	1,231
Total Supply			446	446	446	446	446	446
Projected Supply Surplus/Deficit			**-381**	**-464**	**-545**	**-630**	**-710**	**-785**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	25	70	124	185
Need after Conservation			**-381**	**-464**	**-520**	**-560**	**-586**	**-600**
Recommended Strategies	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BGD Plant	$8,282,000	$2,570	560	560	560	560	560	560
Water Line Replacement and Automatic Meter Reading System	$4,258,000	$4,045	88	88	88	88	88	88
Surplus/Deficit after WMS			**267**	**184**	**128**	**88**	**62**	**48**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Union WSC's 2011 GPCD was estimated at 108, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Union WSC Brackish Groundwater Desalination Plant

Project Source

This strategy was identified by the RWPG.

Description

This strategy is for drilling a new brackish groundwater well and constructing a new reverse osmosis water treatment plant to treat the brackish water to potable drinking water standards.

Available Supply

Based on preliminary needs estimates Union WSC, the new brackish groundwater plant is sized for 560 acre-ft./year and would be implemented in 2020.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. It is assumed that the construction period for this strategy is one and a half years.

Table 5-204 outlines the project requirements and cost estimate developed in UCM.

Table 5-204 Union WSC BGD Plant Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option Union WSC Brackish Groundwater Desalination	
Item	*Estimated Costs for Facilities*
Well Fields (Wells, Pumps, and Piping)	$677,000
Two Water Treatment Plants (0.5 MGD)	$5,145,000
TOTAL COST OF FACILITIES	**$5,822,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,038,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$414,000
TOTAL COST OF PROJECT	**$8,282,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$693,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$7,000
Water Treatment Plant (2.5% of Cost of Facilities)	$726,000
Pumping Energy Costs (142130 kW-hr @ 0.09 $/kW-hr)	$13,000
TOTAL ANNUAL COST	**$1,439,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	560
Annual Cost of Water ($ per acft)	$2,570
Annual Cost of Water ($ per 1,000 gallons)	$7.88

Implementation Issues

No major implementation issues are expected for this strategy. Approval for additional concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land and a TXDOT right-of-way permit.

Water Meter Replacement

Project Source

This strategy was submitted by Union WSC to the RWPG.

Description

This strategy is to replace all existing meters with 100% lead-free smart meters with built in leak detection and install an automatic meter reading system. This will eliminate significant water losses, increase the system's efficiency, and ensure compliance with anticipated future regulations.

Available Supply

Union WSC estimates that replacing the outdated meters and deteriorated pipes will save the Corporation approximately 88 acre-ft./year.

Engineering and Costing

Union WSC submitted this project for consideration to the 2012 and 2013 Drinking Water State Revolving Fund Intended Use Plans administered by the TWDB. In December 2012, the TWDB approved the Corporation's financial assistance request of $2,995,875 for design and construction. This project is currently being implemented and is in Design Phase. Table 5-205 outlines the estimates costs using the UCM.

Table 5-205 Union WSC Water Meter Replacement Project Costs

Cost Estimate Summary Water Supply Project Option Rio Grande City - Union WSC Water Meter Replacement	
Item	***Estimated Costs for Facilities***
Water Meter Replacement	$2,996,000
TOTAL COST OF FACILITIES	**$2,996,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,049,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$213,000
TOTAL COST OF PROJECT	**$4,258,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$356,000
Operation and Maintenance	
TOTAL ANNUAL COST	**$356,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	88
Annual Cost of Water ($ per acft)	$4,045
Annual Cost of Water ($ per 1,000 gallons)	$12.41

Implementation Issues

No implementation issues are anticipated for this strategy.

COUNTY-OTHER

Table 5-206 Starr County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			3,640	3,956	4,259	4,607	4,954	5,276
Total Supply			928	928	928	928	928	928
Projected Supply Surplus/Deficit			**-2,712**	**-3,028**	**-3,331**	**-3,679**	**-4,026**	**-4,348**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	0	121	354	614
ID Conservation: HCID #2 via Rio Grande City		$288	2	3	5	6	7	9
Need after Conservation			**-2,710**	**-3,025**	**-3,326**	**-3,552**	**-3,664**	**-3,725**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio Grande City Water Meter Replacement		$1,143	48	48	48	48	48	48
Roma Water Right Purchase and Regional WTP		$1,336	1400	1400	1400	1400	1400	1400
Additional Groundwater Wells	$2,541,000	$595	400	400	400	400	400	400
Acquisition of Water Rights through Urbanization Starr Irrigation	$2,157,165	$211	863	2,391	4,030	5,794	7,752	7,751
Surplus/Deficit after WMS			**1**	**1,215**	**2,552**	**4,090**	**5,936**	**5,874**
Alternate Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Rio Grande City BGD Plant		$2,570	0	43	43	43	43	43

<u>Advanced Water Conservation</u>

Methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. The 2011 GPCD for Starr County-Other was estimated at 124, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>Additional Groundwater Wells</u>

Project Source

This strategy was identified by the Regional Water Planning Group.

Description

This strategy is to provide additional supply to Starr County-Other with the installation of fresh groundwater wells.

Available Yield

The available supply is 400 acre-ft./year beginning in 2020.

Engineering and Costing

The UCM was utilized to develop estimated costs for this strategy based on assumptions about the individual wells. The wells were costed with a capacity of 50 gpm. Well piping and land acquisition were also included in the cost estimate.

The estimated costs and project requirements for this strategy are presented in Table 5-207.

Table 5-207 Starr County-Other Additional Groundwater Wells

Cost Estimate Summary Water Supply Project Option Starr County-Other Additional Groundwater Wells	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,757,000
TOTAL COST OF FACILITIES	**$1,757,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$615,000
Environmental & Archaeology Studies and Mitigation	$35,000
Land Acquisition and Surveying (3 acres)	$7,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$127,000
TOTAL COST OF PROJECT	**$2,541,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$213,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$18,000
Pumping Energy Costs (80415 kW-hr @ 0.09 $/kW-hr)	$7,000
TOTAL ANNUAL COST	**$238,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	400
Annual Cost of Water ($ per acft)	$595
Annual Cost of Water ($ per 1,000 gallons)	$1.83

IRRIGATION

Table 5-208 Starr Irrigation, Rio Grande Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			13,483	11,085	8,646	6,192	3,714	3,714
Total Supply			8,829	8,801	8,773	8,745	8,717	8,689
Projected Supply Surplus/Deficit			**-4,654**	**-2,284**	**127**	**2,553**	**5,003**	**4,975**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
On-Farm Conservation		$1392	1,652	1,652	1,652	1,652	1,652	1,652
Need after Conservation			**-3,002**	**-632**	**1,779**	**4,205**	**6,655**	**6,627**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			2020	2030	2040	2050	2060	2070
Biological Control of A. Donax	$172,000	$49	41	39	35	29	20	21
Conversion of WRs to DMI			-753	-2,031	-3,415	-4,896	-6,529	-6,519
Surplus/Deficit after WMS			**-3,714**	**-2,624**	**-1,601**	**-662**	**146**	**129**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. The Irrigation needs in Starr County decrease over the planning period. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Starr County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-209 Starr Livestock, N-RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			153	153	153	153	153	153
Total Supply			240	240	240	240	240	240
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

Table 5-210 Starr Livestock, Rio Grande Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			865	865	865	865	865	865
Total Supply			865	865	865	865	865	865
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

There are no projected needs for Livestock in Starr County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MANUFACTURING

Table 5-211 Starr Manufacturing, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			14	15	16	17	18	19
Total Supply			14	14	14	14	14	14
Projected Supply Surplus/Deficit			**0**	**-1**	**-2**	**-3**	**-4**	**-5**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	1	2	2	2	2	2
Need after Conservation			**1**	**1**	**0**	**-1**	**-2**	**-3**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Acquisition of Water Rights through Urbanization Starr Irrigation	$2,500	$211	0	0	0	1	2	3
Surplus/Deficit after WMS			**1**	**1**	**0**	**0**	**0**	**0**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

MINING

Table 5-212 Starr Mining, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			131	160	178	197	221	251
Total Supply			81	81	81	81	81	81
Projected Supply Surplus/Deficit			**-49**	**-78**	**-96**	**-115**	**-139**	**-169**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	13	16	18	20	22	25
Need after Conservation			**-36**	**-62**	**-78**	**-95**	**-117**	**-144**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**-36**	**-62**	**-78**	**-95**	**-117**	**-144**

Table 5-213 Starr Mining, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			440	537	597	661	740	840
Total Supply			478	477	477	476	475	475
Projected Supply Surplus/Deficit			**0**	**-60**	**-120**	**-185**	**-265**	**-365**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					

Conservation	Capital Cost	Unit Cost ($/AFY)	2020	2030	2040	2050	2060	2070
Implementation of Best Management Practices		$2,500	44	54	60	66	74	84
Need after Conservation			**44**	**-6**	**-60**	**-119**	**-191**	**-281**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**44**	**-6**	**-60**	**-119**	**-191**	**-281**

The Mining needs are partially met by the Implementation of Best Management Practices, however due to the decreased reliability of Mining water rights in a drought year, Starr County Mining is left with shortages in years of limited supply. Additionally, there may be further groundwater supplies for Mining that exceed the MAG values for the Gulf Coast Aquifer. Due to limited reporting requirements and no active Groundwater Conservation District, it is not certain that these water sources are currently being used in excess of the MAG.

Implementation of Best Management Practices

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

5.3.6 Webb County

WUG and WUG/WWP

Webb County WUG and WUG/WWP that have recommended strategies with associated capital costs and locations which do not have individual maps associated with them are represented in Figure 5-27.

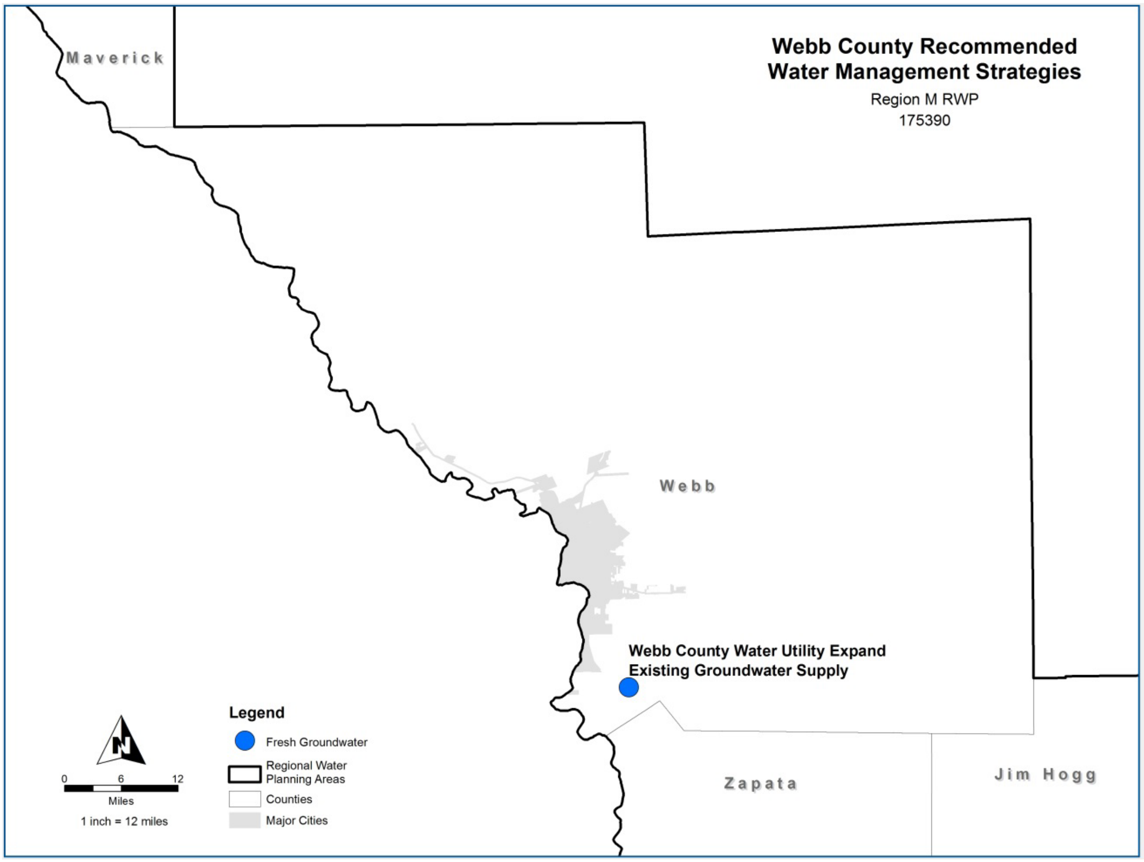

Figure 5-27 Webb County Recommended Water Management Strategies

EL CENIZO

Table 5-214 El Cenizo Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			390	464	537	606	675	737
Total Supply			390	464	537	606	639	639
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**-36**	**-98**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	0	0	29	65
Need after Conservation			**0**	**0**	**0**	**0**	**-7**	**-33**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Webb County Water Utility Expand Existing Groundwater Supply		$570	0	0	0	0	150	150
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**143**	**117**

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. El Cenizo's 2011 GPCD was estimated at 93, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

LAREDO

Table 5-215 Laredo Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supplier**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Demand			41,867	50,337	58,587	66,336	73,905	80,785
Manufacturing - Nueces	Yes		18	20	22	23	25	26
Manufacturing - Rio Grande	Yes		3	3	3	3	3	4
Total Demands			**41,888**	**50,360**	**58,612**	**66,362**	**73,933**	**80,815**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supply			58,726	58,726	58,726	58,726	58,726	58,726
Manufacturing - Nueces			18	18	18	19	19	18
Manufacturing - Rio Grande			3	3	3	2	2	3
Total Supplies			**58,747**	**58,747**	**58,747**	**58,747**	**58,747**	**58,747**
Projected Supply Surplus/Deficit			**16,859**	**8,387**	**135**	**-7,615**	**-15,186**	**-22,068**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	0	2,600	6,242	10,397
Manufacturing - Nueces Implementation of BMP		$2,500	2	2	2	2	3	3
Need after Conservation			**16,861**	**8,389**	**137**	**-5,013**	**-8,942**	**-11,668**
Recommended Strategies	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
South Laredo WWTP Potable Reuse -Phase I	$43,467,000	$1,476	0	5,725	5,725	5,725	0	0
South Laredo WWTP Potable Reuse -Phase II	$36,408,000	$1,219	0	0	0	0	8,960	0
South Laredo WWTP Potable Reuse -Phase II	$19,857,000	$1,298	0	0	0	0	0	11,760
Surplus/Deficit after WMS			**16,861**	**14,114**	**5,862**	**712**	**19**	**92**

Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supply			58,726	64,451	64,449	67,048	73,923	80,877
Manufacturing - Nueces			20	20	22	23	26	26
Manufacturing - Rio Grande			3	3	3	3	3	4
Total Supplies			**58,749**	**64,474**	**64,474**	**67,074**	**73,952**	**80,907**
Projected Supply Surplus/Deficit			**16,861**	**14,114**	**5,862**	**712**	**19**	**92**
Needs After WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Supply			16,859	14,114	5,862	712	18	92
Manufacturing - Nueces			2	0	0	0	1	0
Manufacturing - Rio Grande			0	0	0	0	0	0
Alternative Strategies	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
1st Expansion of El Pico WTP	$34,963,000	$321	16,800	16,800	16,800	16,800	16,800	16,800
2nd Expansion of El Pico WTP	$34,963,000	$321	0	16,800	16,800	16,800	16,800	16,800
3rd Expansion of El Pico WTP	$40,126,000	$261	0	0	20,160	20,160	20,160	20,160
4th Expansion of El Pico WTP	$75,571,000	$235	0	0	0	43,200	43,200	43,200
BGD Plant	$44,574,000	$1,567	0	0	0	5000	5000	5000
Non-Potable Reuse	$11,878,000	$1,005	2,100	2,100	2,100	2,100	2,100	2,100

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Laredo's 2011 GPCD was estimated at 134, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

<u>South Laredo Wastewater Treatment Plant Potable Reuse</u>

Project source

This strategy was identified by the RWPG.

Description

This direct potable reuse strategy is to pump treated effluent from the South Laredo Wastewater Treatment Plant to the Laredo Jefferson Water Treatment Plant.

The approximate alignment of the South Laredo WWTP Potable Reuse Pipeline is shown in Figure 5-28.

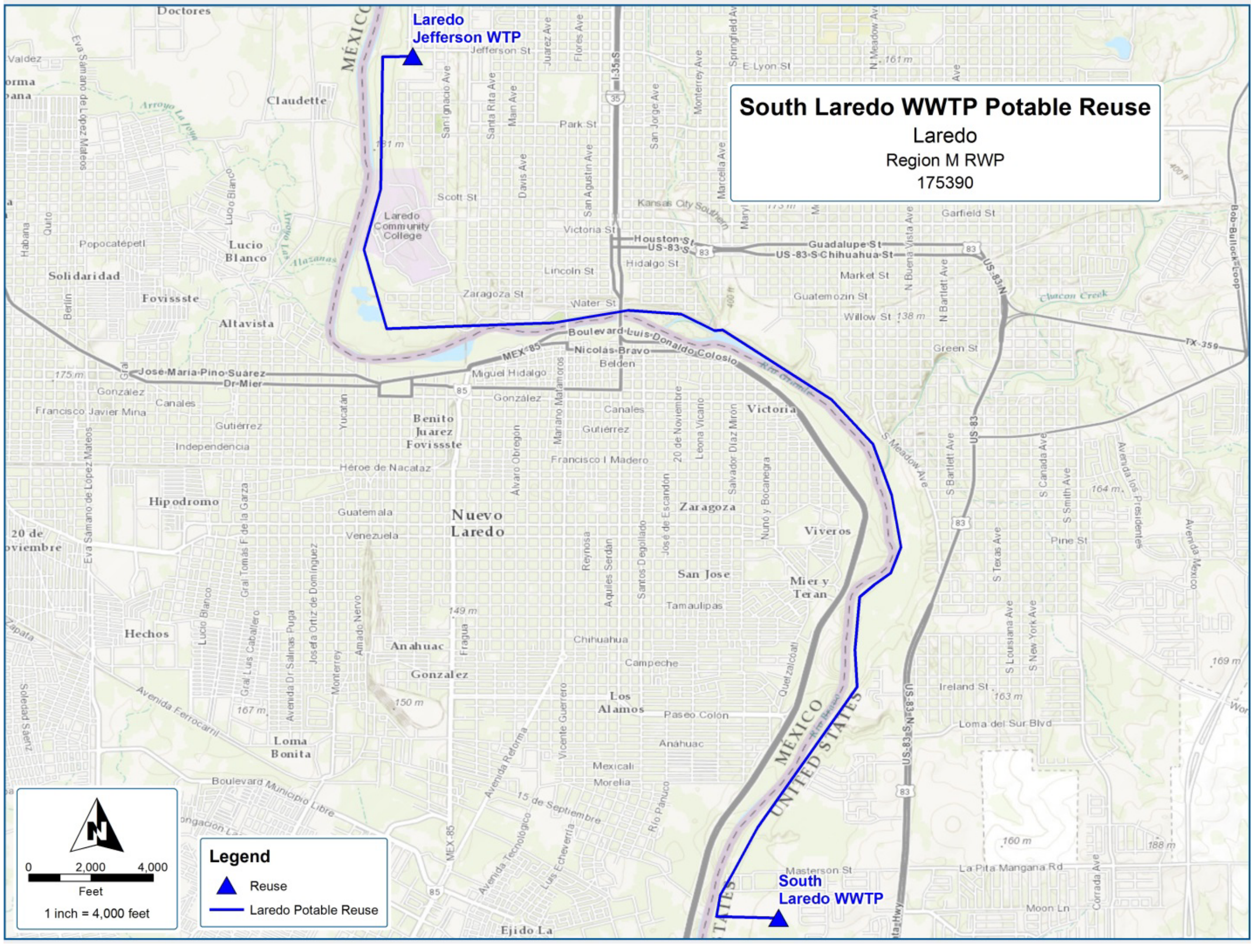

Figure 5-28 South Laredo WWTP Potable Reuse Pipeline Location

Available Supply

In Phase I, 5.11 MGD, or 5,725 acre-ft./year, would be produced for potable reuse. Phase II of this strategy will produce 8 MGD, or 8,960 acre-ft./year of reuse water to meet Laredo's future needs. It is assumed that 20% of the influent water would be lost through the treatment process, therefore 6,870 to 10,750 acre-ft./year of wastewater effluent would be used. As the population continues to increase, a third phase would come online in 2070 and would produce 10.5 MGD, or 11,160 acre-ft./year, of potable reuse from 17,640 acre-ft./year of WWTP effluent.

Engineering and Costing

Additional treatment for the wastewater treatment plant effluent would include microfiltration, reverse osmosis, and advanced oxidation. The concentrate waste would be disposed with the remainder of the effluent that is discharged from the plant. A new pump station and ground storage tank at the wastewater treatment plant site and a pipeline to convey the reuse water to Jefferson WTP would be constructed. During Phase II construction, the pump station would be expanded to ultimate build out capacity and the original pipeline would be twinned with a second pipeline to convey the additional water. It is assumed that the construction period for each phase would be two years. Phase I would begin in 2030, Phase II in 2060, and Phase III in 2070.

Table 5-216 through Table 5-218 outline the estimated costs and project requirements used to develop the cost estimate. Treatment Levels 2 and 4 were used on the UCM spreadsheet to estimate the costs for addition of the advanced treatment facilities.

Table 5-216 South Laredo WWTP Potable Reuse Phase I Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Laredo - South Laredo WWTP Potable Reuse - Phase I*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (5.4 MGD)	$2,890,000
Transmission Pipeline (18 in dia., 3 miles)	$783,000
Storage Tanks (Other Than at Booster Pump Stations)	$2,095,000
Water Treatment Plant (5.1 MGD)	$23,974,000
TOTAL COST OF FACILITIES	**$29,742,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$10,370,000
Environmental & Archaeology Studies and Mitigation	$199,000
Land Acquisition and Surveying (109 acres)	$312,000
Interest During Construction (4% for 2 years with a 1% ROI)	$2,844,000
TOTAL COST OF PROJECT	**$43,467,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,637,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$101,000
Water Treatment Plant (2.5% of Cost of Facilities)	$4,553,000
Pumping Energy Costs (1945793 kW-hr @ 0.09 $/kW-hr)	$175,000
TOTAL ANNUAL COST	**$8,466,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	5,725
Annual Cost of Water ($ per acft)	$1,479
Annual Cost of Water ($ per 1,000 gallons)	$4.54

Table 5-217 South Laredo WWTP Potable Reuse Phase II Project Requirements and Costs

Cost Estimate Summary *Water Supply Project Option* *Laredo - South Laredo WWTP Potable Reuse - Phase II*	
Item	***Estimated Costs for Facilities***
Intake Pump Stations (3 MGD)	$3,122,000
Transmission Pipeline (18 in dia., 3 miles)	$4,784,000
Storage Tanks (Other Than at Booster Pump Stations)	$2,185,000
Water Treatment Plant Expansion (2.9 MGD)	$14,912,000
TOTAL COST OF FACILITIES	**$25,003,000**
	x
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$8,512,000
Environmental & Archaeology Studies and Mitigation	$199,000
Land Acquisition and Surveying (106 acres)	$312,000

Cost Estimate Summary	
Water Supply Project Option	
Laredo - South Laredo WWTP Potable Reuse - Phase II	
Item	***Estimated Costs for Facilities***
Interest During Construction (4% for 2 years with a 1% ROI)	$2,382,000
TOTAL COST OF PROJECT	**$36,408,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,047,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	$4,802,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,836,000
Pumping Energy Costs (643647 kW-hr @ 0.09 $/kW-hr)	$233,000
TOTAL ANNUAL COST	$10,918,000
Available Project Yield (acft/yr), based on a Peaking Factor of 1	8,960
Annual Cost of Water ($ per acft)	$1,219
Annual Cost of Water ($ per 1,000 gallons)	$3.74

Table 5-218 South Laredo WWTP Potable Reuse Phase III Project Requirements and Costs

Cost Estimate Summary	
Water Supply Project Option	
Laredo - South Laredo WWTP Potable Reuse - Phase III	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (2.5 MGD)	$13,368,000
TOTAL COST OF FACILITIES	**$13,368,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,679,000
Environmental & Archaeology Studies and Mitigation	$199,000
Land Acquisition and Surveying (106 acres)	$312,000
Interest During Construction (4% for 2 years with a 1% ROI)	$1,299,000
TOTAL COST OF PROJECT	**$19,857,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,709,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	$7,638,000
Water Treatment Plant (2.5% of Cost of Facilities)	$2,543,000
Pumping Energy Costs (2184780 kW-hr @ 0.09 $/kW-hr)	$372,000
TOTAL ANNUAL COST	**$15,262,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	11,760
Annual Cost of Water ($ per acft)	$1,298
Annual Cost of Water ($ per 1,000 gallons)	$3.98

Implementation Issues

Implementation of a direct potable reuse project would require approval by TCEQ. Any requirements developed by TCEQ for potable reuse by the time this project is constructed would need to be met. Additionally, local public opinion of potable reuse would have to be taken into account and a public relations campaign may be required.

RIO BRAVO

Table 5-219 Rio Bravo Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			585	690	795	895	996	1,089
Total Supply			959	959	959	959	959	959
Projected Supply Surplus/Deficit			**374**	**269**	**164**	**64**	**-37**	**-130**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	0	0	41	96
Need after Conservation			**374**	**269**	**164**	**64**	**4**	**-34**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Webb County Water Utility Expand Existing Groundwater Supply		$570	0	0	0	0	150	150
Surplus/Deficit after WMS			**374**	**269**	**164**	**64**	**154**	**116**

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Rio Bravo's 2011 GPCD was estimated at 96, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

WEBB COUNTY WATER UTILITY

Table 5-220 Webb County Water Utility Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supplier**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Cenizo	Yes		390	464	537	606	675	737
Rio Bravo	Yes		585	690	795	895	996	1,089
Laredo			182	182	182	182	182	182
County Other			12	12	12	12	12	12
Total Demands			**1,169**	**1,348**	**1,526**	**1,695**	**1,865**	**2,020**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Cenizo			639	639	639	639	639	639
Rio Bravo			959	959	959	959	959	959
Laredo			182	182	182	182	182	182
County Other			12	12	12	12	12	12
Total			**1,792**	**1,792**	**1,792**	**1,792**	**1,792**	**1,792**
WWP Needs (Surplus +/ Need -)			**623**	**444**	**266**	**97**	**-73**	**-228**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Cenizo Advanced Municipal Conservation*		$652	0	0	0	0	29	65

Rio Bravo Advanced Municipal Conservation**		$652	0	0	0	0	41	96
Need after Conservation			**623**	**444**	**266**	**97**	**-3**	**-67**
Recommended Strategies	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Expand Existing Groundwater Supply	$504,000	$570	0	0	0	0	100	100
Surplus/Deficit after WMS			623	444	266	97	97	33
Total Supplies with WMS			1,792	1,792	1,792	1,792	1,862	1,953
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Cenizo			639	639	639	639	718	754
Rio Bravo			959	959	959	959	1,050	1,105
Laredo			182	182	182	182	182	182
County Other			12	12	12	12	12	12
Total WWP Surplus/Deficit			**623**	**444**	**266**	**97**	**97**	**33**
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
El Cenizo			249	175	102	33	43	17
Rio Bravo			374	269	164	64	54	16
Laredo			0	0	0	0	0	0
County Other			0	0	0	0	0	0

* Full WMS supply to El Cenizo
** Full WMS supply to Rio Bravo

<u>Groundwater Supply Expansion</u>

Project Source

This strategy was identified by the RWPG.

Description

This strategy is to provide additional supply to Webb County Water Utility with the installation of additional fresh groundwater wells.

Available Supply

The proposed groundwater wells would provide 100 acre-ft./year in 2060.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water disinfection. It is assumed that the construction period for this strategy is one year. Table 5-221 outlines the project requirements and cost estimate developed in UCM.

Table 5-221 Webb County Water Utility Groundwater Expansion Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Webb County Water Utility - Groundwater Supply Expansion***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$337,000
Water Treatment Plant (0.1 MGD)	$18,000
TOTAL COST OF FACILITIES	**$355,000**

Cost Estimate Summary
Water Supply Project Option
Webb County Water Utility - Groundwater Supply Expansion

Item	*Estimated Costs for Facilities*
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$124,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (4% for 1 years with a 1% ROI)	$18,000
TOTAL COST OF PROJECT	**$504,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$42,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$3,000
Water Treatment Plant (2.5% of Cost of Facilities)	$11,000
Pumping Energy Costs (10845 kW-hr @ 0.09 $/kW-hr)	$1,000
TOTAL ANNUAL COST	**$57,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	100
Annual Cost of Water ($ per acft)	$570
Annual Cost of Water ($ per 1,000 gallons)	$1.75

Implementation Issues

No major implementation issues are expected for this strategy. All recommended groundwater pumping is guided by the MAG values. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

COUNTY-OTHER

Table 5-222 Webb County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			912	1,076	1,252	1,423	1,585	1,732
Total Supply			191	191	191	191	191	191
Projected Supply Surplus/Deficit			**-721**	**-885**	**-1,061**	**-1,232**	**-1,394**	**-1,541**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	0	31	108	195
Need after Conservation			**-721**	**-885**	**-1,061**	**-1,201**	**-1,286**	**-1,346**
Recommended Strategies	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Additional Ground Water Wells	$8,891,000	$593	1,400	1,400	1,400	1,400	1,400	1,400
Surplus/Deficit after WMS			**679**	**515**	**339**	**199**	**114**	**54**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide

discussed in section 5.2.5 Advanced Municipal Water Conservation. The 2011 GPCD for Webb County-Other was estimated at 116, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

Additional Groundwater Wells

Project Source

This strategy was identified by the RWPG.

Description

This strategy is to provide additional supply to Webb County-Other with the installation of fresh groundwater wells.

Available Yield

Based on preliminary needs estimates for Webb County-Other, the proposed groundwater wells would provide 1,400 acre-ft./year beginning in 2020.

Engineering and Costing

UCM was used to estimate costs based on the project requirements shown below. The wells were costed with a capacity of 50 gpm.

The total estimated costs and project requirements for this strategy are presented in Table 5-223.

Table 5-223 Webb County-Other Additional Groundwater Wells Project Requirements and Costs

Cost Estimate Summary ***Water Supply Project Option*** ***Webb County-Additional Groundwater Wells***	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$6,148,000
TOTAL COST OF FACILITIES	**$6,148,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,152,000
Environmental & Archaeology Studies and Mitigation	$122,000
Land Acquisition and Surveying (11 acres)	$25,000
Interest During Construction (4% for 1.5 years with a 1% ROI)	$444,000
TOTAL COST OF PROJECT	**$8,891,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$744,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$61,000
Pumping Energy Costs (281453 kW-hr @ 0.09 $/kW-hr)	$25,000
TOTAL ANNUAL COST	**$830,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,400
Annual Cost of Water ($ per acft)	$593
Annual Cost of Water ($ per 1,000 gallons)	$1.82

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TCEQ well drilling permit, purchase of land and a TXDOT right-of-way permit.

IRRIGATION

Table 5-224 Webb Irrigation, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			7,612	7,612	7,612	7,612	7,612	7,612
Total Supply			6,314	6,302	6,290	6,278	6,267	6,255
Projected Supply Surplus/Deficit			**-1,298**	**-1,310**	**-1,322**	**-1,334**	**-1,345**	**-1,357**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
On-Farm Conservation		$1392	932	932	932	932	932	932
Need after Conservation			**-366**	**-378**	**-390**	**-402**	**-413**	**-425**
Recommended Strategy	**Capital Cost**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	23	27	31	36	41	44
Surplus/Deficit after WMS			**-343**	**-351**	**-359**	**-366**	**-372**	**-381**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Maverick County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-225 Webb Livestock, Nueces Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			507	507	507	507	507	507
Total Supply			507	507	507	507	507	507
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

Table 5-226 Webb Livestock, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			69	69	69	69	69	69
Total Supply			69	69	69	69	69	69
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

Table 5-227 Webb Livestock, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			553	553	553	553	553	553
Total Supply			553	553	553	553	553	553
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

There are no projected needs for Livestock in Webb County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MANUFACTURING

Table 5-228 Webb Manufacturing, Nueces Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			18	20	22	23	25	26
Total Supply			18	18	18	19	19	18
Projected Supply Surplus/Deficit			**0**	**-2**	**-4**	**-4**	**-6**	**-8**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	2	2	2	2	3	3
Need after Conservation			**2**	**0**	**-2**	**-2**	**-4**	**-5**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
South Laredo WWTP Potable Reuse -Phase I		$1,479	0	0	2	2	0	0

Year			2020	2030	2040	2050	2060	2070
South Laredo WWTP Potable Reuse -Phase II		$1,219	0	0	0	0	4	0
South Laredo WWTP Potable Reuse -Phase III		$1,298	0	0	0	0	0	5
Surplus/Deficit after WMS			**2**	**0**	**0**	**0**	**1**	**0**

Table 5-229 Webb Manufacturing, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			3	3	3	3	3	4
Total Supply			3	3	3	2	2	3
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**-1**	**-1**	**-1**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**-1**	**-1**	**-1**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
South Laredo WWTP Potable Reuse -Phase I		$1,479	0	0	0	1	0	0
South Laredo WWTP Potable Reuse -Phase II		$1,219	0	0	0	0	1	0
South Laredo WWTP Potable Reuse -Phase III		$1,298	0	0	0	0	0	1
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

Implementation of Best Management Practices

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

MINING

Table 5-230 Webb Mining, Nueces Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			3,099	2,414	1,811	1,234	554	403
Total Supply			2,411	2,412	2,411	2,412	2,412	2,412
Projected Supply Surplus/Deficit			**-688**	**-2**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	310	241	181	123	55	40
Need after Conservation			**-378**	**239**	**181**	**123**	**55**	**40**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**-378**	**239**	**181**	**123**	**55**	**40**

Table 5-231 Webb Mining, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			517	402	302	205	92	67
Total Supply			397	397	397	396	396	396
Projected Supply Surplus/Deficit			**-120**	**-5**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	52	40	30	21	9	7
Need after Conservation			**-68**	**35**	**30**	**21**	**9**	**7**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**-68**	**35**	**30**	**21**	**9**	**7**

Table 5-232 Webb Mining, RG Basin Water Supply and Demand Analysis(Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			6,715	5,231	3,925	2,673	1,200	873
Total Supply			5,248	5,247	5,248	5,248	5,248	5,248
Projected Supply Surplus/Deficit			**-1,467**	**-1,467**	**-1,467**	**-1,467**	**-1,467**	**-1,467**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	672	523	393	267	120	87
Need after Conservation			**-796**	**-944**	**-1,075**	**-1,200**	**-1,347**	**-1,380**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**-796**	**-944**	**-1,075**	**-1,200**	**-1,347**	**-1,380**

The Mining needs are partially met by the Implementation of Best Management Practices, however due to the decreased reliability of Mining water rights in a drought year, Webb County Mining is left with shortages in years of limited supply. Additionally, there may be further groundwater supplies for Mining that exceed the MAG values for the Gulf Coast Aquifer. Due to limited reporting requirements and no active Groundwater Conservation District, it is not certain that these water sources are currently being used in excess of the MAG.

Implementation of Best Management Practices

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

STEAM-ELECTRIC

Table 5-233 Webb Steam-Electric, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			1,298	1,517	1,784	2,110	2,508	2,981
Total Supply			2,725	2,725	2,725	2,725	2,725	2,725
Projected Supply Surplus/Deficit			**1,427**	**1,208**	**941**	**615**	**217**	**-256**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	130	152	178	211	251	298
Need after Conservation			**1,557**	**1,360**	**1,119**	**826**	**468**	**42**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**1,557**	**1,360**	**1,119**	**826**	**468**	**42**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

5.3.7 Willacy County

Irrigation Districts/WWP

Irrigation District Conservation is recommended for the ID located in Willacy County. Figure 5-29 shows a map of the Willacy County ID.

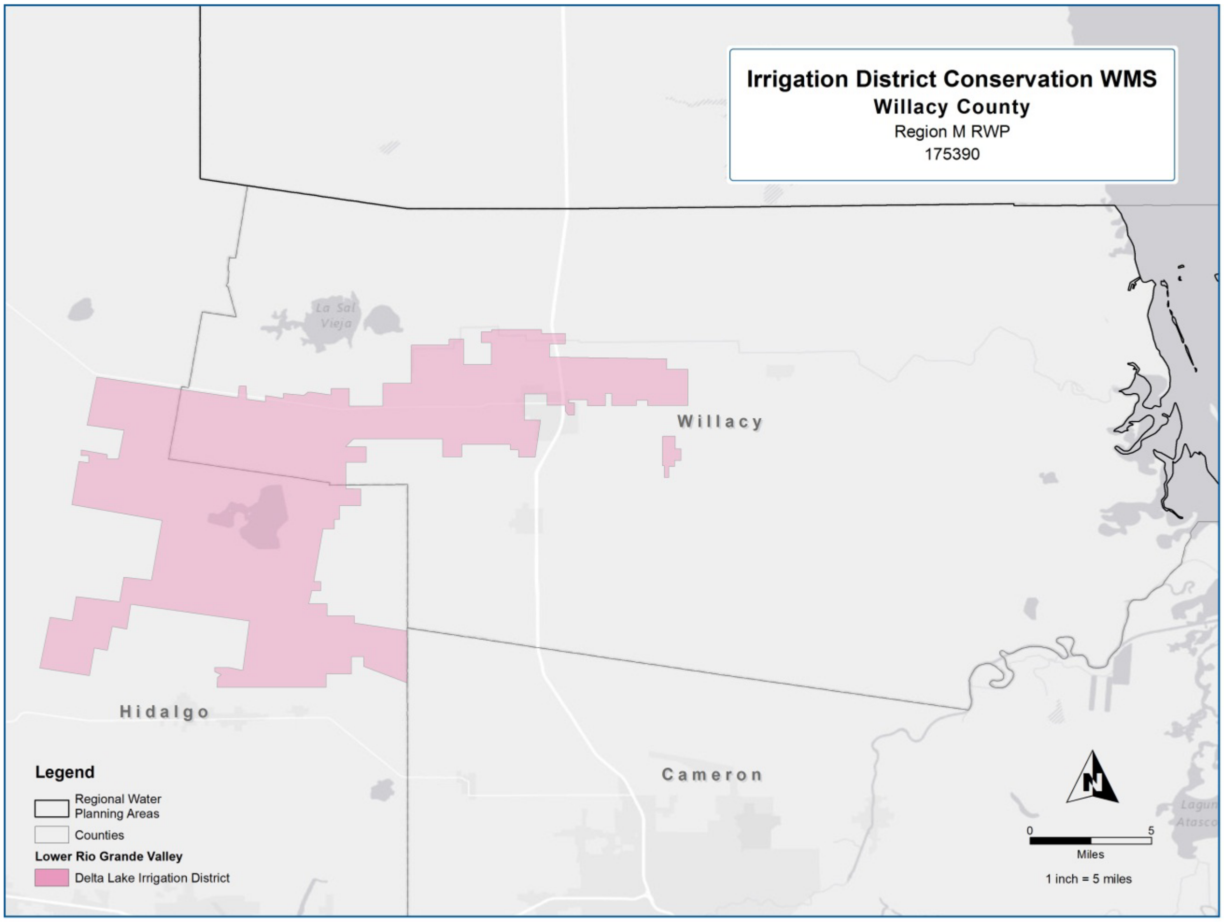

Figure 5-29 Willacy County Irrigation District WMS

DELTA LAKE IRRIGATION DISTRICT

Delta Lake Irrigation District serves irrigators in Hidalgo and Willacy Counties, and delivers raw water to Raymondville, Lyford, La Sara, Monte Alto, Hargill, and North Alamo WSC. Engleman ID and Valley Acres ID both pass water through Delta Lake's system. The Delta Lake conveyance network has almost 70 miles of open canals, comprising about 90% of the District's conveyance network. Strategies submitted by Delta Lake ID to the RWPG.

Table 5-234 Delta Lake Irrigation District Conservation WMS Cost Projections

Cost Estimate Summary Delta Lake Irrigation District Irrigation District Conservation	
Item	***Estimated Costs for Facilities***
Bypass Canal Lining Project	$2,411,280
J Canal improvement and repairs	$2,241,600

Cost Estimate Summary ***Delta Lake Irrigation District*** ***Irrigation District Conservation***	
Item	***Estimated Costs for Facilities***
Main Canal lining project	$38,718,620
Main J Canal Lining Project	$6,480,000
Canal A, Canal H&I and Canal J. Replacement	$2,526,300
TOTAL COST OF PROJECT	**$52,377,800**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$4,154,445
O&M Cost (based on reduced pumping and canal rider costs)	-$14,554
TOTAL ANNUAL COST	**$4,139,891**
Available Project Yield (acft/yr)	6166
Annual Cost of Water ($ per acft)	$671
Annual Cost of Water ($ per 1,000 gallons)	$2.06

WUG and WUG/WWP

Willacy County WUG and WUG/WWP with recommended strategies with associated capital costs and locations without individual maps associated with them are shown in Figure 5-30.

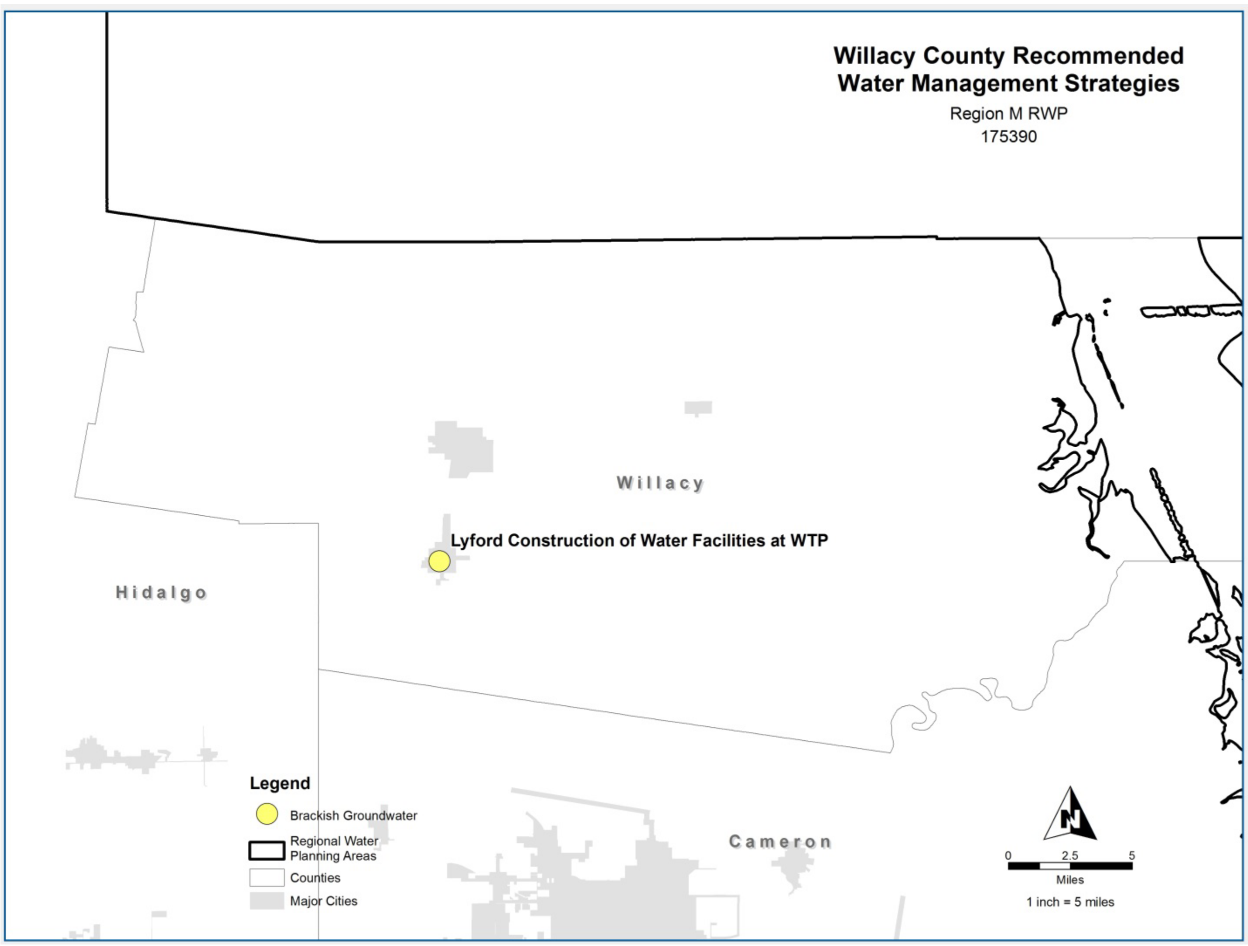

Figure 5-30 Willacy County Recommended Water Management Strategies

EAST RIO HONDO WATER SUPPLY CORPORATION

See Section 5.3.1 Cameron County.

LYFORD

Table 5-235 Lyford Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			291	314	338	368	400	432
Total Supply			588	588	588	588	588	588
Projected Supply Surplus/Deficit			**297**	**274**	**250**	**220**	**188**	**156**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	51	100	148	197	245	294
Need after Conservation			**348**	**374**	**398**	**417**	**433**	**450**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Lyford Brackish Groundwater Desalination	$6,950,000	$1,217	1,120	1120	1120	1120	1120	1120
Surplus/Deficit after WMS			**1,468**	**1,494**	**1,518**	**1,537**	**1,553**	**1,570**

Lyford Brackish Groundwater Desalination

Project Source

This strategy was submitted the City of Lyford to the RWPG.

Description

This strategy is to install a ground water well and reverse osmosis membrane water treatment facility to provide an alternate source of water for the City of Lyford. The proposed location would be adjacent to the City's water treatment plant where the water would receive conventional treatment after the reverse osmosis process.

Available Supply

This strategy would provide an additional 1 MGD of drinking water supply to the City in 2020.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and water treatment. Based on the BRACS study, well depth is estimated at 1,000 ft. below ground surface. The well is sized to pump 125% of the produced water supply to account for treatment efficiency. It is assumed that the construction period for this strategy is one year. Table 5-236 outlines the project requirements and cost estimate developed in UCM.

Table 5-236 Lyford Water BGD Project Requirements and Costs

Cost Estimate Summary Water Supply Project Option City of Lyford - Brackish Groundwater Well and Desalination	
Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$985,000

Cost Estimate Summary ***Water Supply Project Option*** ***City of Lyford - Brackish Groundwater Well and Desalination***	
Item	***Estimated Costs for Facilities***
Water Treatment Plant (1 MGD)	$3,820,000
TOTAL COST OF FACILITIES	**$4,805,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,682,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (4% for 2 years with a 1% ROI)	$455,000
TOTAL COST OF PROJECT	**$6,950,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$582,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$10,000
Water Treatment Plant (2.5% of Cost of Facilities)	$744,000
Pumping Energy Costs (305057 kW-hr @ 0.09 $/kW-hr)	$27,000
TOTAL ANNUAL COST	**$1,363,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$1,217
Annual Cost of Water ($ per 1,000 gallons)	$3.73

Implementation Issues

No major implementation issues are expected for this strategy. Approval for concentrate disposal will be needed from TCEQ. Construction of the new groundwater well and piping may also include purchase of land if there is not adequate room at the water treatment plant site.

NORTH ALAMO WATER SUPPLY CORPORATION

See Section 5.3.1 Cameron County.

RAYMONDVILLE

Table 5-237 Raymondville Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			1,522	1,652	1,784	1,944	2,115	2,286
Total Supply			5,642	5,642	5,642	5,642	5,642	5,642
Projected Supply Surplus/Deficit			**4,120**	**3,990**	**3,858**	**3,698**	**3,527**	**3,356**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	297	577	858	1139	1420	1701
Advanced Municipal Conservation		$652	0	0	34	107	208	324
Need after Conservation			**4,417**	**4,567**	**4,750**	**4,944**	**5,155**	**5,381**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**4,417**	**4,567**	**4,750**	**4,944**	**5,155**	**5,381**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Raymondville's 2011 GPCD was estimated at 115, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

SAN PERLITA

Table 5-238 San Perlita Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			235	260	286	315	344	371
Total Supply			225	225	225	225	225	225
Projected Supply Surplus/Deficit			**-10**	**-35**	**-61**	**-90**	**-119**	**-146**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID via NAWSC		$671	4	7	11	14	18	21
ID Conservation: Donna ID via NAWSC		$468	0	2	3	5	6	7
ID Conservation: HCCID9 via NAWSC		$1,069	2	4	5	7	8	10
ID Conservation: HCID1 via NAWSC		$330	2	2	2	3	3	3
ID Conservation: HCID2 via NAWSC		$288	1	2	3	4	5	6
ID Conservation: Santa Cruz ID via NAWSC		$89	2	2	3	3	3	4
Advanced Municipal Conservation		$652	14	38	63	93	121	153
Need after Conservation			**15**	**22**	**29**	**39**	**45**	**58**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NAWSC Delta Area Brackish Groundwater Desalination Plant		$1,781	0	0	0	0	19	19
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	9
NAWSC Converted WR and Water Treatment Plant No. 5 Expansion		$654	2	30	30	30	30	30
NAWSC Converted WR and Delta WTP Expansion		$748	0	0	30	44	44	44
North Cameron Regional WTP Wellfield Expansion		$843	7	7	7	7	7	7
Surplus/Deficit after WMS			**24**	**59**	**96**	**120**	**145**	**167**

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in discussed in section 5.2.5 Advanced Municipal Water Conservation. San Perlita's 2011 GPCD was estimated at 330, and therefore the conservation WMS includes a 1% annual reduction in municipal use.

SEBASTIAN MUNICIPAL UTILITY DISTRICT

Table 5-239 Sebastian MUD Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			149	159	176	195	212	230
Total Supply			204	204	204	204	204	204
Projected Supply Surplus/Deficit			**55**	**45**	**28**	**9**	**-8**	**-26**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: CCID No. 3, La Feria		$460	62	63	63	64	65	66
Need after Conservation			**117**	**108**	**91**	**73**	**57**	**40**
Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**117**	**108**	**91**	**73**	**57**	**40**

COUNTY-OTHER

Table 5-240 Willacy County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			67	75	83	91	99	107
Total Supply			168	168	168	168	168	168
Projected Supply Surplus/Deficit			**101**	**93**	**85**	**77**	**69**	**61**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	13	25	38	50	63	75
Need after Conservation			**114**	**118**	**123**	**127**	**132**	**136**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**114**	**118**	**123**	**127**	**132**	**136**

IRRIGATION

Table 5-241 Willacy Irrigation, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			69,253	69,074	68,936	68,814	68,741	68,741
Total Supply			22,039	22,003	21,967	21,931	21,894	21,858
Projected Supply Surplus/Deficit			**-47,214**	**-47,071**	**-46,969**	**-46,883**	**-46,847**	**-46,883**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	1,902	3,699	5,479	7,243	8,989	10,743

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
On-Farm Conservation		$1392	8,483	8,483	8,483	8,483	8,483	8,483
Need after Conservation			**-36,829**	**-34,889**	**-33,007**	**-31,157**	**-29,375**	**-27,657**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	211	244	280	321	368	395
Conversion of WRs to DMI			-309	-422	-690	-980	-1,262	-1,290
Surplus/Deficit after WMS			**-36,927**	**-35,067**	**-33,417**	**-31,816**	**-30,269**	**-28,552**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. The Irrigation needs in Willacy County are partially met by Irrigation District Conservation strategies and decrease over the planning period. Although increased on-farm conservation efforts are recommended, it is not likely that those strategies will reduce the demand for Irrigation water. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Willacy County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-242 Willacy Livestock, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			261	261	261	261	261	261
Total Supply			588	588	588	588	588	588
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ID Conservation: Delta Lake ID		$671	30	58	87	115	143	171
Need after Conservation			**30**	**58**	**87**	**115**	**143**	**171**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**30**	**58**	**87**	**115**	**143**	**171**

There are no projected needs for Livestock in Willacy County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MANUFACTURING

Table 5-243 Willacy Manufacturing, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			136	136	136	136	136	136
Total Supply			129	129	129	129	129	129
Projected Supply Surplus/Deficit			**-7**	**-7**	**-7**	**-7**	**-7**	**-7**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**

Year			2020	2030	2040	2050	2060	2070
ID Conservation: Delta Lake via NAWSC		$671	4	9	13	17	21	25
ID Conservation: HCID1 via NAWSC		$330	3	3	3	3	4	4
ID Conservation: HCID2 via NAWSC		$288	1	2	3	4	5	6
Implementation of Best Management Practices		$2,500	14	14	14	14	14	14
Need after Conservation			**15**	**21**	**26**	**31**	**37**	**42**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
NAWSC La Sara Desalination Plant Expansion		$2,104	0	0	0	0	0	1
North Cameron Regional WTP Wellfield Expansion		$843	85	85	85	85	85	85
Acquisition of WR through Urbanization	$5,000	$211	2	4	7	9	10	10
Surplus/Deficit after WMS			**102**	**110**	**118**	**125**	**132**	**138**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

MINING

Table 5-244 Willacy Mining, NRG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			2020	2030	2040	2050	2060	2070
Water Demand			49	51	38	28	18	12
Total Supply			49	49	49	49	49	49
Projected Supply Surplus/Deficit			**0**	**-2**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	5	5	4	3	2	1
Need after Conservation			**5**	**3**	**4**	**3**	**2**	**1**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**5**	**3**	**4**	**3**	**2**	**1**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

5.3.8 Zapata County

WUG and WUG/WWP

Zapata County WUG and WUG/WWP that have recommended strategies with associated capital costs and locations which do not have individual maps associated with them are represented in Figure 5-31.

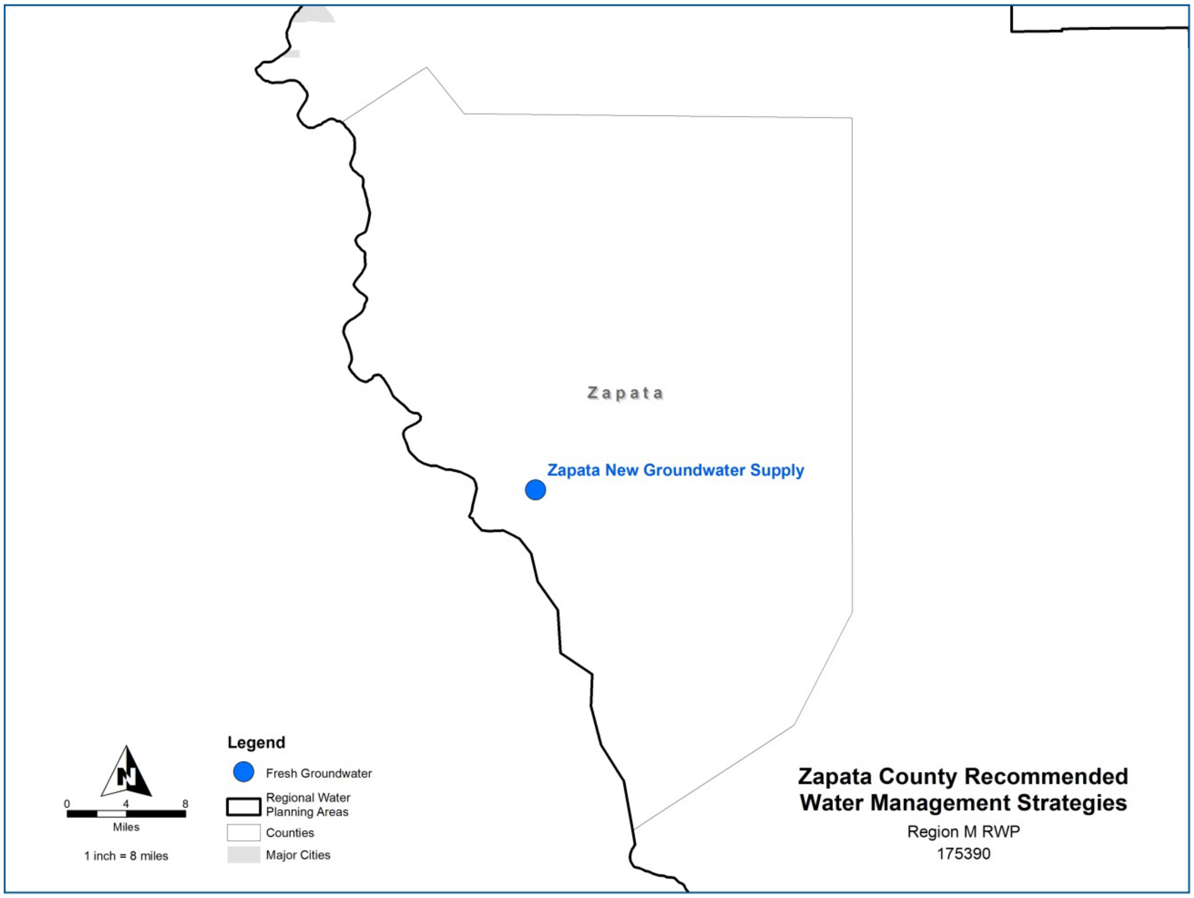

Figure 5-31 Zapata County Recommended Water Management Strategies

SAN YGNACIO MUNICIPAL UTILITY DISTRICT

Table 5-245 San Ygnacio MUD Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			190	217	248	283	321	361
Total Supply			284	284	284	284	284	284
Projected Supply Surplus/Deficit			**94**	**67**	**36**	**1**	**-37**	**-77**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	6	23	40	55	74	97

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Need after Conservation			**100**	**90**	**76**	**56**	**37**	**20**
Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**100**	**90**	**76**	**56**	**37**	**20**

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. San Ygnacio MUD's 2011 GPCD was estimated at 179, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

ZAPATA COUNTY WATERWORKS

Table 5-246 Zapata County Waterworks Water Supply and Demand Analysis (Acre-feet/year)

Demands	**Sole Supplier**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Demand	Yes		2,415	2,767	3,167	3,625	4,114	4,628
County-Other, Zapata			184	184	184	184	184	184
Total Demands			**2,599**	**2,951**	**3,351**	**3,809**	**4,298**	**4,812**
WUG Supplies			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			2,118	2,118	2,118	2,118	2,118	2,118
County-Other, Zapata			184	184	184	184	184	184
Total			**2,302**	**2,302**	**2,302**	**2,302**	**2,302**	**2,302**
WWP Needs (Surplus +/ Need -)			**-297**	**-649**	**-1,049**	**-1,507**	**-1,996**	**-2,510**
Evaluation of Selected Water Management Strategies				**Additional Supply by Decade**				
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Zapata Advanced Municipal Conservation*		$652	81	294	491	692	942	1,232
Need after Conservation			**-216**	**-355**	**-558**	**-815**	**-1,054**	**-1,278**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Zapata County Waterworks New Groundwater Supply	$2,323,000	$175	1,680	1,680	1,680	1,680	1,680	1,680
Surplus/Deficit after WMS			1,464	1,325	1,122	865	626	402
Total Supplies with WMS			**4,063**	**4,276**	**4,473**	**4,674**	**4,924**	**5,214**
Water Supplies with WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WUG Water Supply			3,499	3,712	3,909	4,110	4,360	4,650
County-Other, Zapata			564	564	564	564	564	564
Total WWP Surplus/Deficit			**1,464**	**1,325**	**1,122**	**865**	**626**	**402**
Needs after WMS			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Total WUG Surplus/Deficit			1,084	945	742	485	246	22
County-Other, Zapata			380	380	380	380	380	380

* Full WMS supply to Zapata Waterworks

Advanced Water Conservation

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. Zapata County Waterworks' 2011 GPCD was estimated at 175, and therefore the conservation WMS includes a 1% annual reduction in municipal use until the GPCD reached 140.

ZAPATA COUNTY WW GROUNDWATER SUPPLY

Project Source

This strategy was identified by the RWPG.

Description

This strategy is to drill a new fresh groundwater well and provide disinfection treatment for the groundwater.

Available Supply

Based on preliminary needs estimates for Zapata County Waterworks, the new fresh groundwater well is sized for 1,680 acre-ft./year.

Engineering and Costing

Costs for this strategy from the UCM include groundwater well pumping, well field piping, land acquisition, and disinfection treatment. It is assumed that the construction period for this strategy is one year. Table 5-247 outlines the project requirements and cost estimate developed in UCM.

Table 5-247 Zapata County WW Groundwater Supply Project Requirements and Costs

Cost Estimate Summary
Water Supply Project Option
Zapata County Waterworks - New Groundwater Supply

Item	***Estimated Costs for Facilities***
Well Fields (Wells, Pumps, and Piping)	$1,562,000
Water Treatment Plant (1.5 MGD)	$90,000
TOTAL COST OF FACILITIES	**$1,652,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$578,000
Environmental & Archaeology Studies and Mitigation	$12,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (4% for 1 years with a 1% ROI)	$79,000
TOTAL COST OF PROJECT	**$2,323,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$194,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$16,000
Water Treatment Plant (2.5% of Cost of Facilities)	$54,000
Pumping Energy Costs (337744 kW-hr @ 0.09 $/kW-hr)	$30,000
TOTAL ANNUAL COST	**$294,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,680

Cost Estimate Summary ***Water Supply Project Option*** ***Zapata County Waterworks - New Groundwater Supply***	
Item	***Estimated Costs for Facilities***
Annual Cost of Water ($ per acft)	$175
Annual Cost of Water ($ per 1,000 gallons)	$0.54

Implementation Issues

No major implementation issues are expected for this strategy. Construction of the new groundwater well and piping may also include a TXDOT right-of-way permit.

COUNTY-OTHER

Table 5-248 Zapata County-Other Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			391	452	523	601	682	767
Total Supply			187	187	187	187	187	187
Projected Supply Surplus/Deficit			**-204**	**-265**	**-336**	**-414**	**-495**	**-580**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Advanced Municipal Conservation		$652	0	0	17	46	82	124
Need after Conservation			**-204**	**-265**	**-319**	**-368**	**-413**	**-456**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Zapata County Waterworks New Groundwater Supply		$175	380	380	380	380	380	380
Acquisition of Water Rights through Urbanization	$215,000	$211	86	247	397	545	661	661
Surplus/Deficit after WMS			**262**	**362**	**458**	**557**	**628**	**585**

<u>Advanced Water Conservation</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP identified in the BMP Guide discussed in section 5.2.5 Advanced Municipal Water Conservation. The 2011 GPCD for Zapata County-Other was estimated at 138, and therefore the conservation WMS includes a 0.5% annual reduction in municipal use through the planning horizon.

IRRIGATION

Table 5-249 Zapata Irrigation, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			4,717	4,455	4,215	3,981	3,800	3,800
Total Supply			3,432	3,421	3,411	3,400	3,389	3,378
Projected Supply Surplus/Deficit			**-1,285**	**-1,034**	**-804**	**-581**	**-411**	**-422**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
On-Farm Conservation		$1392	578	578	578	578	578	578
Need after Conservation			**-707**	**-456**	**-226**	**-3**	**167**	**156**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Biological Control of A. Donax	$172,000	$49	14	16	17	19	20	22
Conversion of WRs to DMI			-81	-215	-345	-474	-577	-577
Surplus/Deficit after WMS			**-774**	**-655**	**-554**	**-458**	**-390**	**-399**

Irrigation needs reflect the shortages on the highest demand year and the lowest supply year, with the understanding that these needs will not be met entirely in this scenario. The Irrigation needs in Zapata County decrease over the planning period. In a drought year Irrigation surface water rights are only allocated after Domestic, Municipal, and Industrial water rights have been filled, therefore Zapata County Irrigation is left with shortages in years of limited supply.

LIVESTOCK

Table 5-250 Zapata Livestock, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			479	479	479	479	479	479
Total Supply			479	479	479	479	479	479
Projected Supply Surplus/Deficit			**0**	**0**	**0**	**0**	**0**	**0**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Need after Conservation			**0**	**0**	**0**	**0**	**0**	**0**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**0**	**0**	**0**	**0**	**0**	**0**

There are no projected needs for Livestock in Zapata County over the planning period; therefore no Water Management Strategies were identified for this WUG.

MINING

Table 5-251 Zapata Mining, RG Basin Water Supply and Demand Analysis (Acre-feet/year)

Year			**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Water Demand			911	954	707	525	332	214
Total Supply			983	983	983	982	982	982
Projected Supply Surplus/Deficit			**72**	**29**	**276**	**457**	**650**	**768**
Evaluation of Selected Water Management Strategies			**Additional Supply by Decade**					
Conservation	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Implementation of Best Management Practices		$2,500	91	95	71	53	33	21
Need after Conservation			**163**	**124**	**347**	**510**	**683**	**789**
Recommended Strategy	**Capital Costs ($)**	**Unit Cost ($/AFY)**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
--	-	-	-	-	-	-	-	-
Surplus/Deficit after WMS			**163**	**124**	**347**	**510**	**683**	**789**

<u>Implementation of Best Management Practices</u>

This strategy includes methods and practices that either reduce demand for water supply or increase the efficiency of supply. These strategies include the BMP in section 5.2.6 Best Management Practices for Industrial Users.

Texas Water Development Board

RIO GRANDE
REGIONAL WATER PLANNING GROUP

2016 Region M Water Plan

Chapter 6: Impacts of Plan and Protection of Resources

BLACK & VEATCH
Building a world of difference.

Table of Contents

Table of Tables

List of Abbreviations

Acre-ft.	acre-feet
ID	Irrigation District
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TWDB	Texas Water Development Board
WUG	Water User Group

Chapter 6. Impacts of Plan and Protection of Resources

The 2016 Rio Grande Regional Water Plan (Region M Plan) is consistent with long-term protection of the states water resources, agricultural resources, and natural resources and is based on principles outlined in the Texas Administrative Code Chapter 357. The Region M Plan was developed with an understanding of the importance of coordinated development, management, and conservation of water resources to meet Region M's short and long term water needs. This plan recognizes and respects all laws and existing permits applicable to water use for the state and regional water planning areas. Recommendations regarding the development of groundwater have taken into account the rules and goals of groundwater conservation districts and the conservation goals established through the TWDB.

The Region M Plan identifies strategies recommended to meet the region's projected municipal and livestock needs, and a portion of the irrigation, steam electric power generation, and manufacturing needs at reasonable costs. The non-municipal needs that were not met within the representative drought year model are discussed in the socio-economic impacts analysis, which is included at the end of this chapter. The impacts of voluntary conversion of water rights from irrigation to municipal designation are discussed in more detail in section 6.1.6.

Environmental impacts of each type of water management strategy are discussed here and in Section 5.2.

6.1 Impacts of Water Management Strategies

Impacts of the five major Water Management Strategies recommended in the Regional Water Plan are discussed below.

6.1.1 Reuse

Direct potable and non-potable reuse projects are considered for Region M.

Potable

These strategies result in lower wastewater effluent flows which cause a reduction in organic levels in the receiving streams. However, there is also less water discharged to the local watershed which can reduce the quantity of water available for other users and environmental flows and can reduce assimilative capacity used by downstream wastewater treatment plant dischargers.

Many of the locations where potable reuse was recommended are in the Nueces-Rio Grande Basin, but the source waters are predominantly from the Rio Grande. Impacts of wastewater reuse projects will primarily impact the flows into the drainage network, including the Arroyo Colorado. There are water rights holders along the Arroyo Colorado and other drainage canals in the Nueces Rio-Grande basin that could potentially be impacted, including irrigators, some shrimp farming and other aquaculture.

If potable reuse projects involve the effluent being stored in a raw water reservoir prior to treatment, water quality of the reservoir may be impacted. If membrane treatment, like reverse osmosis, is used as a part of the advanced treatment process to meet potable water quality requirements, options for discharge of the waste stream will need to consider minimizing impacts to the receiving environment.

Non-Potable

Non-potable reuse may have the same impacts of reduced wastewater treatment plant effluent flows as potable reuse. For non-potable reuse used for irrigation, there is a potential to accumulate byproducts, such as salts and other minerals, in the soil which may be present in run-off water.

Environmental Impacts

Potential environment impacts for recommended and alternative reuse strategies have been identified and categorized as described below.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect and wetland.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted. Therefore it was assumed that the permanent acreage impacted for a WMS is what would impact habitats.

E. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy. The number of threatened and endangered species came from the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

F. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

G. Reduction in WWTP Effluent (Acre-Ft./Year)

Environmental impacts may be seen due to lower WWTP effluent flows to the discharge streams for wastewater effluent reuse strategies. These impacts could include:

- Decreases to the stream flow/level
- Change in the water quality by reducing the organic levels
- Effects to fish and wildlife that inhabit the streams

A summary of the identified and quantified environmental impacts for reuse projects is presented in Table 6-1.

Table 6-1 Environmental Impacts of Reuse Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Brownsville	Non-Potable Water Reuse Pipeline	6,721	116	128	0	116	17	0	6,721
Brownsville	Brownsville Southside WWTP Potable Reuse	4,000	41	45	0	41	17	0	4,000
Harlingen	Harlingen Wastewater Treatment Plant 2 Potable Reuse	1,825	57	63	0	57	17	0	1,825
Harlingen	Non-potable Reuse Project	677	42	46	0	42	17	0	677
La Feria	Non-Potable Wastewater Reuse	174	13	14	0	13	17	0	174
Laguna Madre	Port Isabel Water Reclamation Facility Potable Reuse	820	87	96	1	87	17	0	820
Laguna Madre	Non-potable Reuse	350	14	15	0	14	17	0	350
San Benito	Potable Reuse	1,120	44	48	0	44	17	0	1,120
San Benito	Non-Potable Reuse	1,120	32	35	0	32	17	0	1,120
Agua SUD	East WWTP Direct Potable Reuse - Phase 1	1,050	44	48	0	44	9	0	1,050
Agua SUD	West WWTP Direct Potable Reuse - Phase 1	784	143	157	0	143	9	0	784
Agua SUD	East WWTP Direct Potable Reuse - Phase 2	1,260	0	5	0	0	9	0	1,260
Agua SUD	West WWTP Direct Potable Reuse - Phase 2	1,680	0	15	0	0	9	0	1,680
Agua SUD	Non-Potable Reuse	280	0	2	0	0	9	0	280

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Edinburg	Reuse Water for Cooling Tower and Landscaping Usage	3,920	43	47	0	43	9	0	3,920
McAllen	South WWTP Potable Reuse	2,000	46	51	0	46	9	0	2,000
McAllen	North WWTP Potable Reuse	1,120	50	55	0	50	9	0	1,120
McAllen	Non-potable Reuse Project	1,950	49	54	0	49	9	0	1,950
Mercedes	Potable Reuse	1,670	32	35	0	32	9	0	1,670
Mission	WWTP Potable Reuse Phase 1	3,920	22	24	0	22	9	0	3,920
Mission	WWTP Potable Reuse Phase 2	7,840	0	2	0	0	9	0	7,840
Pharr	Potable Reuse	6,721	38	42	0	38	9	0	6,721
Pharr	Non-potable Reuse Project	500	34	37	0	34	9	0	500
Weslaco	North WWTP Potable Reuse	1,120	26	29	0	26	9	0	1,120
Weslaco	Scalping Plants	0	1	1	0	1	9	0	0
Laredo	Zacate Creek WWTP Potable Reuse	5,725	54	59	1	54	5	0	5,725
Laredo	Non-potable Reuse Project	2,100	21	23	1	21	5	0	2,100

*First decade of implementation yield (acre-ft./year)

6.1.2 Desalination

The disposal of concentrate from brackish desalination facilities will increase levels of Total Dissolved Solids (TDS) in the receiving streams. Many of the facilities that are currently treating brackish groundwater dispose of concentrate in the drainage canal network in the Nueces-Rio Grande Basin. This network of canals is usually brackish, and discharges into the Laguna Madre, parts of which are naturally hyper-saline. The greatest recent threat to wildlife in the Lower Laguna Madre has been increased inflows of low-salinity water.

As with any groundwater development project, there is potential to affect the quality of the aquifer as more water is drawn from it. Land subsidence may be a by-product of increased groundwater pumping. All groundwater development strategies for both fresh and brackish wells were scaled to fit within the conservation goals for each region of the targeted aquifer.

Seawater desalination facilities would dispose of brine concentrate back into the Gulf of Mexico. Although the waste stream would be highly concentrated with TDS, it would have minimal effects of the Gulf once it was dispersed. Intake and discharge facilities would have to be careful engineered to cause the least disturbance to the natural habitat of species in that location.

Environmental Impacts

Potential environment impacts for recommended and alternative brackish groundwater and seawater desalination strategies have been identified and categorized as described below.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity
- The impact of wells and wellfields are given by the UCM, which includes 0.5 acres per well

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect and wetland.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted. Therefore it was assumed that the permanent acreage impacted for a WMS is what would impact habitats.

E. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy. The number of threatened and endangered species came from the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

F. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural

resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

G. Volume of Brine (Acre-ft.)

The Volume of Brine quantifies the amount of brine concentrate from the desalination process that is released as surface water discharge. It is assumed that brackish groundwater desalination plants are 80% efficient, so 20% of the amount of water pumped from the aquifer is discharged as brine concentrate. An efficiency of 50% was assumed for seawater desalination.

H. TDS of Brine (mg/L)

The Total Dissolved Solids (TDS) of Brine provides the concentrate of the brine discharge. This number was calculated by assuming that the raw brackish groundwater has a TDS of 3,500 mg/L and the TDS of the seawater is 35,000 mg/L. A TDS of 500 mg/L was used for the finished water for both types of desalination.

A summary of the identified and quantified environmental impacts for desalination projects is presented in Table 6-2.

Table 6-2 Environmental Impacts of Desalination Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G	H
Agua SUD	New Brackish Water Treatment Plant	1,344	3	4	0	3	9	0	269	19,375
Alamo	Brackish Groundwater Desalination Plant	896	2	3	0	2	9	0	179	19,375
Brownsville	Seawater Desalination Demonstration - Pilot	2,800	8	9	1	8	17	0	1,400	86,500
Brownsville	Seawater Desalination Demonstration - Build-Out	28,000	31	34	1	31	17	0	14,000	86,500
Combes	Brackish Groundwater Desalination Plant	125	1	2	0	1	17	0	25	19,375
Donna	Brackish Groundwater Desalination Plant	700	1	2	0	1	9	0	140	19,375
Eagle Pass	Brackish Groundwater Desalination Plant	560	1	2	0	1	5	0	112	19,375
East Rio Hondo WSC	North Cameron Regional WTP Wellfield Expansion	400	1	2	0	1	17	0	80	19,375
El Jardin WSC	Brackish Desalination Plant	560	1	2	0	1	17	0	112	19,375
Elsa	New Brackish Water Treatment Plant	560	1	2	0	1	9	0	112	19,375
Harlingen	Brackish Groundwater Desalination Plant	1,000	1	2	0	1	17	0	200	19,375
Hebbronville	New Brackish Water Treatment Plant	560	1	2	0	1	2	0	112	19,375
La Feria	Water Well with R.O. Unit	1,120	1	2	0	1	17	0	224	19,375
La Villa	New Brackish Water Treatment Plant	560	1	2	0	1	9	0	112	19,375
Laguna Madre	Brackish Groundwater Desalination Plant	2,240	3	4	0	3	17	0	448	19,375
Laguna Madre	Seawater Desalination Plant	1,120	8	9	0	8	17	0	560	86,500

Entity	WMS Name	Yield*	A	B	C	D	E	F	G	H
Laredo	Brackish Groundwater Desalination Plant	5,000	6	7	0	6	5	0	1,000	19,375
Lyford	Brackish Groundwater Well and Desalination	1,120	1	2	0	1	14	0	224	19,375
McAllen	Brackish Groundwater Desalination Treatment	2,688	5	6	0	5	9	0	538	19,375
Mercedes	Brackish Groundwater Desalination Plant	435	1	2	0	1	9	0	87	19,375
Mission	Brackish Groundwater Desalination Plant	2,688	5	6	0	5	9	0	538	19,375
North Alamo WSC	North Cameron Regional WTP Wellfield Expansion	800	1	2	0	1	17	0	160	19,375
North Alamo WSC	Delta Area RO Plant 2 MGD	2,250	3	4	0	3	14	0	450	19,375
North Alamo WSC	La Sara RO Plant, expand well field	1,120	2	3	0	2	14	0	224	19,375
Olmito WSC	Brackish Desalination Plant	560	1	2	0	1	17	0	112	19,375
Primera	RO WTP with Groundwater Well	1,120	4	5	0	4	17	0	224	19,375
RGRWA	Regional Facility Project - Seawater Desal	5,470	41	45	0	41	17	0	2,735	86,500
Rio Grande City	Brackish Groundwater Desalination Plant	560	1	2	0	1	8	0	112	19,375
San Juan	WTP No. 1 Upgrade and Expansion to include BGD	1,792	3	4	0	3	9	0	358	19,375
Santa Rosa	Brackish Desalination Plant	560	1	2	0	1	17	0	112	19,375
Sharyland WSC	Water Well and R.O. Unit at WTP #2	900	2	3	0	2	9	0	180	19,375
Sharyland WSC	Water Well and R.O. Unit at WTP #3	900	2	3	0	2	9	0	180	19,375
Union WSC	Brackish Groundwater Desalination Plant	560	1	2	0	1	8	0	112	19,375
Valley MUD #2	Brackish Groundwater Desalination Plant	100	1	2	0	1	17	0	20	19,375
Weslaco	Brackish Groundwater Desalination Plant	1,630	2	3	0	2	9	0	326	19,375

*First decade of implementation yield (acre-ft./year)

6.1.3 Fresh Groundwater Development

Water quality concerns from fresh groundwater projects are minimal, however as with any groundwater development project, there is potential to affect the quality of the aquifer as more water is drawn from it. As with brackish groundwater development, land subsidence may be a by-product of fresh groundwater pumping. All groundwater development strategies for both fresh and brackish wells were scaled to fit within the conservation goals for each region of the targeted aquifer.

Environmental Impacts

Potential environment impacts for fresh groundwater strategies have been identified and categorized as described below.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity
- The impact of wells and wellfields are given by the UCM, which includes 0.5 acres per well

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect and wetland.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted. Therefore it was assumed that the permanent acreage impacted for a WMS is what would impact habitats.

E. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy. The number of threatened and endangered species came from the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

F. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural

resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative fresh groundwater projects is presented in Table 6-3.

Table 6-3 Environmental Impacts of Fresh Groundwater Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F
Alamo	Groundwater Well	1,100	1	1	0	1	9	0
County-Other	Expand Groundwater Supply	3,000	0	10	0	0	17	0
County-Other	Additional Groundwater Wells	400	3	6	0	3	8	0
County-Other	Additional Groundwater Wells	1,400	11	22	0	11	5	0
Eagle Pass	New Groundwater Supply	700	1	1	0	1	5	0
Edcouch	New Groundwater Supply	500	1	1	0	1	9	0
Hidalgo	Expand Existing Groundwater Wells	300	1	1	0	1	9	0
Irrigation	Additional Groundwater Wells	300	3	6	0	3	2	0
McAllen	Expand Existing Groundwater Wells	500	1	1	0	1	9	0
Mercedes	Expand Existing Groundwater Wells	560	1	1	0	1	9	0
Military Highway WSC	Expand Existing Groundwater Wells (Cameron County)	625	1	1	0	1	17	0
Military Highway WSC	Expand Existing Groundwater Wells (Hidalgo County)	250	1	1	0	1	9	0
San Benito	Groundwater Supply	1,120	1	1	0	1	17	0
Steam Elec - Nueces-Rio Grande	Additional Groundwater Wells	100	2	4	0	2	9	0
Webb County Water Utility	Expand Existing Groundwater Supply	100	1	1	0	1	5	0
Weslaco	Groundwater Blending	560	1	1	0	1	9	0
Zapata County Waterworks	New Groundwater Supply	1,680	2	2	0	2	7	0

*First decade of implementation yield (acre-ft./year)

6.1.4 Water Infrastructure and Distribution Systems

Water infrastructure and distribution system strategies include recommended improvements to Irrigation District and municipal distribution and transmission systems, new storage reservoirs, and new and upgraded surface water treatment plants. The main impacts from these types of strategies are temporary as they are only seen during construction. Improvements to Irrigation District distribution Systems reduce water loss, which allows for great flows in irrigation canals and can positively impact species that inhabit them.

Environmental Impacts

Potential environment impacts for water infrastructure and distribution systems strategies have been identified and categorized as described below.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Inundation Acreage

The Inundation Acreage applies to reservoirs only and it equal to the amount of land that will be inundated by the construction of the reservoir.

D. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a '1' if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect and wetland.

E. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted. Therefore it was assumed that the permanent acreage impacted for a WMS is what would impact habitats.

F. Threatened and Endangered Species Count

Threatened and Endangered Species Count refers to how the strategy will impact those species in the area once implemented. This impact was quantified based on the number of federally listed threatened and endangered species located within the county of the strategy. The number of threatened and endangered species came from the Texas Parks and Wildlife Department Rare, Threatened and Endangered Species of Texas database (http://tpwd.texas.gov/gis/rtest/).

G. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural

resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative irrigation district improvements projects is presented in Table 6-4.

Table 6-4 Environmental Impacts of Irrigation District Improvements Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Adam Gardens Irrigation District	Irrigation District Conservation	500	0	4	0	1	0	17	0
Bayview Irrigation District No. 11	Irrigation District Conservation	1,810	0	105	0	1	0	17	0
Brownsville Irrigation District	Irrigation District Conservation	2,616	0	156	0	1	0	17	0
Cameron County Irrigation District No. 16	Irrigation District Conservation	270	0	17	0	1	0	17	0
Cameron County Irrigation District No. 2	Irrigation District Conservation	4,754	0	765	0	1	0	17	0
Cameron County Irrigation District No. 6	Irrigation District Conservation	7,402	0	298	0	1	0	17	0
Cameron County Water Improvement District No. 10	Irrigation District Conservation	395	0	24	0	1	0	17	0
Delta Lake Irrigation District	Irrigation District Conservation	6,166	0	635	0	1	0	14	0
Donna Irrigation District	Irrigation District Conservation	532	0	77	0	1	0	9	0
Engleman Irrigation District	Irrigation District Conservation	831	0	55	0	1	0	9	0
Harlingen Irrigation District	Irrigation District Conservation	1,137	0	40	0	1	0	17	0
Hidalgo County Drainage District 1	Delta Watershed Project - Edinburg Lake	3,739	428	535	428	1	428	9	0
Hidalgo County Drainage District 1	Delta Watershed Project - New Reservoir	2,278	387	484	387	0	387	9	0
Hidalgo and Cameron Counties Irrigation District No. 9	Irrigation District Conservation	2,948	0	655	0	1	0	17	0
Hidalgo County Irrigation District No. 1	Irrigation District Conservation	13,111	0	666	0	1	0	9	0
Hidalgo County Irrigation District No. 13	Irrigation District Conservation	194	0	8	0	1	0	9	0
Hidalgo County Irrigation District No. 16	Irrigation District Conservation	485	0	43	0	1	0	9	0
Hidalgo County Irrigation District No. 2	Irrigation District Conservation	4,077	0	178	0	1	0	9	0
Hidalgo County Irrigation District No. 5	Irrigation District Conservation	1,215	0	63	0	1	0	9	0
Hidalgo County Irrigation District No. 6	Irrigation District Conservation	3,237	0	168	0	1	0	9	0
Hidalgo County Water Control and Improvement District No. 18	Irrigation District Conservation	119	0	7	0	1	0	9	0

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
Hidalgo County Water Improvement District No. 3	Irrigation District Conservation	2,284	0	110	0	1	0	9	0
Hidalgo Municipal Utility District No. 1	Irrigation District Conservation	180	0	10	0	1	0	9	0
La Feria La Feria Irrigation District No. 3	Irrigation District Conservation	2,064	0	622	0	1	0	17	0
Maverick County Water Control and Improvements District	Irrigation District Conservation	10,780	0	520	0	1	0	5	0
Santa Cruz Irrigation District No. 15	Irrigation District Conservation	2,899	0	56	0	1	0	9	0
Sharyland/ Hidalgo County Improvement District No. 19	Irrigation District Conservation	554	0	32	0	1	0	9	0
United Irrigation District	Irrigation District Conservation	7,093	0	145	0	1	0	9	0
United Irrigation District	Off-Channel Reservoir	2,000	50	100	45	1	50	9	0
Valley Acres Irrigation District	Irrigation District Conservation	510	0	30	0	1	0	17	0

*First decade of implementation yield (acre-ft./year)

A summary of the identified and quantified environmental impacts for recommended and alternative municipal infrastructure is presented in Table 6-5.

Table 6-5 Environmental Impacts of Municipal Infrastructure Strategies

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
East Rio Hondo WSC	Harlingen WW Interconnect	112	56	62	0	0	56	17	0
McAllen	Raw Water Line Project	800	15	17	0	0	15	9	0
Rio Hondo	Emergency Interconnects	70	30	33	0	0	30	17	0
Brownsville Public Utilities Board	Banco Morales Reservoir	3,835	60	75	60	0	60	17	0
Brownsville Public Utilities Board	Resaca Restoration	877	40	50	40	0	40	17	0
Brownsville Public Utilities Board	Brownsville/Matamoros Weir and Reservoir	19,176	300	375	300	0	300	17	0
Manufacturing - Rio Grande	Transfer of Surplus from Eagle Pass	70	0	0	0	0	0	5	0
RGRWA	Regional Facility Project - Groundwater, Surface Water, and Reuse	20,000	216	324	216	0	216	17	0
Donna	WTP Expansion & Urbanized Water Rights	950	25	28	0	0	25	9	0
East Rio Hondo WSC	Surface Water Treatment Plant (Phase I)	11,200	67	74	0	0	67	17	0
Elsa	WTP Expansion and Interconnect to Engleman ID	2,240	35	39	0	0	35	9	0
Laredo	Expansion of El Pico WTP (Phases 1-4)	28,000	13	14	0	0	13	5	0

Entity	WMS Name	Yield*	A	B	C	D	E	F	G
North Alamo WSC	NAWSC Converted WR and Water Treatment Plant No. 5 Expansion	1,120	5	6	0	0	5	9	0
North Alamo WSC	NAWSC Converted WR and Delta WTP Expansion	4,480	5	6	0	0	5	9	0
Roma	Water Right Purchase and Regional Water Treatment Plant	1,500	5	6	0	1	5	8	0

*First decade of implementation yield (acre-ft./year)

6.1.5 Conservation

Conservation strategies, including Advanced Municipal Conservation, Implementation of Best Management Practices for Industrial users, and Irrigation Conservation, focus on decreasing water usage, which results in lowered flow to wastewater treatment plants. However, wastewater influent flow typically has the same amount of organic waste, which can require wastewater treatment plant upgrades to maintain target organic levels in the receiving stream.

Environmental Impacts

Potential environment impacts for conservation strategies have been identified and categorized as described below.

A. Acres Impacted Permanently

Acres Impacted Permanently refers to the total amount of area that will be permanently impacted due to the implementation of a strategy. The following conservative assumptions were made (unless more detailed information for a specific was available):

- The acres impacted for pipelines is equivalent to the right of way easements required, it is assumed 100 ft. for ROW unless otherwise known
- Water treatment plant impacts are estimated using UCM, which is based on the plant capacity

B. Construction Impacted Acreage

Temporary environmental impacts may be seen during construction activities, such as increased air and noise pollution, and land disturbance activities. However, these effects are typical of any construction project. The Construction Impacted Acreage was estimated as 110% (rounded up to a whole number) of the permanently impacted acreage.

C. Wetland Impact

The Wetland Impact refers to the probability that implementation of a water management strategy will affect a wetland. The location of wetlands in the Region was determined using the National Wetlands Inventory located at http://www.fws.gov/wetlands/Data/Mapper.html.

A strategy received a one if all or part of the strategy is located in a wetland or if it is close enough to where construction activities are likely to impact the wetland. All other strategies received zeros. If the exact location of project is unknown it was given a zero because it was assumed that it would be located on a site that would not affect and wetland.

D. Habitat Impacted Acreage

Habitat Impacted Acreage refers to how the strategy will impact the habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted. Therefore it was assumed that the permanent acreage impacted for a WMS is what would impact habitats.

E. Cultural Resources Impact

Cultural Resources Impact refers to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people, including locations, buildings and features with scientific, cultural or historic value. It is assumed that no water management strategies negatively affect cultural resources. Mitigation costs are included for strategies that require infrastructure so it is assumed that none would be built in a location or way that disrupts culturally sensitive locations.

A summary of the identified and quantified environmental impacts for recommended and alternative advanced municipal conservation projects is presented in Table 6-6. Additionally, it should be noted that because conservation reduces demand, this type of strategy decreases the amount of water that is discharged from a WWTP.

Table 6-6 Environmental Impacts for Advanced Municipal Conservation Strategies

Entity	WMS Name	Yield*	A	B	C	D	E
Agua SUD	Advanced Municipal Water Conservation	131	0	0	0	0	0
Alamo	Advanced Municipal Water Conservation	159	0	0	0	0	0
Alton	Advanced Municipal Water Conservation	70	0	0	0	0	0
Brownsville	Advanced Municipal Water Conservation	1,081	0	0	0	0	0
Combes	Advanced Municipal Water Conservation	5	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	230	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	52	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	309	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	121	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	31	0	0	0	0	0
County-Other	Advanced Municipal Water Conservation	17	0	0	0	0	0
Donna	Advanced Municipal Water Conservation	4	0	0	0	0	0
Eagle Pass	Advanced Municipal Water Conservation	208	0	0	0	0	0
East Rio Hondo WSC	FM 2925 Water Transmission Line	30	142	178	0	142	0

Entity	WMS Name	Yield*	A	B	C	D	E
East Rio Hondo WSC	Municipal (UV Disinfection FM 510 WTP)	11	0	0	0	0	0
East Rio Hondo WSC	Advanced Municipal Water Conservation	1	0	0	0	0	0
Edcouch	Advanced Municipal Water Conservation	1	0	0	0	0	0
Edinburg	Advanced Municipal Water Conservation	8	0	0	0	0	0
El Cenizo	Advanced Municipal Water Conservation	29	0	0	0	0	0
El Jardin WSC	Distribution Pipeline Replacement	11	0	394	0	0	0
El Jardin WSC	Advanced Municipal Water Conservation	37	0	0	0	0	0
Elsa	Advanced Municipal Water Conservation	11	0	0	0	0	0
Harlingen	Advanced Municipal Water Conservation	401	0	0	0	0	0
Hebbronville	Advanced Municipal Water Conservation	1	0	0	0	0	0
Hidalgo	Advanced Municipal Water Conservation	11	0	0	0	0	0
Hidalgo MUD No. 1	Advanced Municipal Water Conservation	56	0	0	0	0	0
La Feria	Rainwater Harvesting	24	0	0	0	0	0
La Feria	Advanced Municipal Water Conservation	25	0	0	0	0	0
La Grulla	Advanced Municipal Water Conservation	11	0	0	0	0	0
La Joya	Advanced Municipal Water Conservation	56	0	0	0	0	0
La Villa	Advanced Municipal Water Conservation	17	0	0	0	0	0
Laguna Vista	Advanced Municipal Water Conservation	182	0	0	0	0	0
Laredo	Advanced Municipal Water Conservation	2,600	0	0	0	0	0
Los Indios	Advanced Municipal Water Conservation	2	0	0	0	0	0
McAllen	Advanced Municipal Water Conservation	1,674	0	0	0	0	0
Mercedes	Advanced Municipal Water Conservation	80	0	0	0	0	0
Military Highway WSC	Advanced Municipal Water Conservation	133	0	0	0	0	0
Mission	Advanced Municipal Water Conservation	925	0	0	0	0	0
North Alamo WSC	Advanced Municipal Water Conservation	860	0	0	0	0	0
Olmito WSC	Advanced Municipal Water Conservation	22	0	0	0	0	0
Palm Valley	Advanced Municipal Water Conservation	8	0	0	0	0	0

Entity	WMS Name	Yield*	A	B	C	D	E
Palmhurst	Advanced Municipal Water Conservation	57	0	0	0	0	0
Palmview	Advanced Municipal Water Conservation	21	0	0	0	0	0
Penitas	Advanced Municipal Water Conservation	5	0	0	0	0	0
Pharr	Advanced Municipal Water Conservation	167	0	0	0	0	0
Port Isabel	Advanced Municipal Water Conservation	52	0	0	0	0	0
Primera	Advanced Municipal Water Conservation	9	0	0	0	0	0
Progreso	Advanced Municipal Water Conservation	7	0	0	0	0	0
Rancho Viejo	Advanced Municipal Water Conservation	50	0	0	0	0	0
Raymondville	Advanced Municipal Water Conservation	34	0	0	0	0	0
Rio Bravo	Advanced Municipal Water Conservation	41	0	0	0	0	0
Rio Grande City	Advanced Municipal Water Conservation	173	0	0	0	0	0
Rio Grande City	Rio Grande City Water Meter Replacement	370	0	1	0	0	0
Rio WSC	Advanced Municipal Water Conservation	29	0	0	0	0	0
Roma	Advanced Municipal Water Conservation	93	0	0	0	0	0
San Benito	Advanced Municipal Water Conservation	146	0	0	0	0	0
San Juan	Advanced Municipal Water Conservation	15	0	0	0	0	0
San Perlita	Advanced Municipal Water Conservation	14	0	0	0	0	0
San Ygnacio MUD	Advanced Municipal Water Conservation	6	0	0	0	0	0
Santa Rosa	Advanced Municipal Water Conservation	1	0	0	0	0	0
Sharyland WSC	Advanced Municipal Water Conservation	231	0	0	0	0	0
South Padre Island	Advanced Municipal Water Conservation	248	0	0	0	0	0
Sullivan City	Advanced Municipal Water Conservation	13	0	0	0	0	0
Union WSC	Automatic Meter Reading System	88	0	1	0	0	0
Union WSC	Advanced Municipal Water Conservation	25	0	0	0	0	0
Weslaco	Advanced Municipal Water Conservation	241	0	0	0	0	0
Zapata County Waterworks	Advanced Municipal Water Conservation	81	0	0	0	0	0

*First decade of implementation yield (acre-ft./year)

Table 6-7 Environmental Impacts for Implementation of BMP Strategies

Entity	WMS Name	Yield*	A	B	C	D	E
Manufacturing - Nueces-Rio Grande	Implementation of BMP	471	0	1	0	0	0
Steam Elec - Nueces-Rio Grande	Implementation of BMP	152	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	26	0	1	0	0	0
Steam Elec - Nueces-Rio Grande	Implementation of BMP	1,415	0	1	0	0	0
Manufacturing - Nueces-Rio Grande	Implementation of BMP	546	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	264	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	21	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	8	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	1	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	159	0	1	0	0	0
Mining - Nueces	Implementation of BMP	40	0	1	0	0	0
Manufacturing - Rio Grande	Implementation of BMP	9	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	44	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	13	0	1	0	0	0
Manufacturing - Rio Grande	Implementation of BMP	1	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	672	0	1	0	0	0
Mining - Nueces	Implementation of BMP	310	0	1	0	0	0
Steam Elec - Rio Grande	Implementation of BMP	130	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	52	0	1	0	0	0
Manufacturing - Nueces	Implementation of BMP	2	0	1	0	0	0
Manufacturing - Nueces-Rio Grande	Implementation of BMP	14	0	1	0	0	0
Mining - Nueces-Rio Grande	Implementation of BMP	5	0	1	0	0	0
Mining - Rio Grande	Implementation of BMP	91	0	1	0	0	0

*First decade of implementation yield (acre-ft./year)

6.1.6 Conversion of Surface Water Rights through Urbanization

This strategy is for voluntary conversion of Irrigation Water Rights to Municipal Water Rights as land is converted from agricultural and rural uses to urban uses. The intent of this strategy is to provide additional Municipal and Industrial water from the areas that are already being urbanized, and not to take any additional Irrigation Water Rights from land that would still require them.

For the purpose of this plan, it was assumed that the increase in Municipal Water Demand is proportional to the decrease in Irrigation Demand. The urbanization rate was calculated for each county based on the rate at which Irrigation Demand decreases. The reduction in agricultural supplies, called ‘exclusion,’ and the increase in DMI supplies were estimated using a conservative estimate of the rate of conversion of water rights or exclusion, 75% of the projected urbanization rate.

The 2020 urbanization rate is 0.7 times the 2030 rate to account for the seven years between when the numbers were projected (in 2013) and 2020. Table 6-8 shows the projected agricultural demands, the rate at which water rights are converted in each county, the reduction in irrigation supplies, and the reduction in irrigated acreage, assuming that each acre of land that is irrigated has an associated 2.5 acre-feet of water rights. Although there is measured historical urbanization for Jim Hogg and Webb Counties, these measurements were not considered statistically reliable based on the amount of total urbanization water rights. No urbanization was projected for Webb County.

Table 6-8 Urbanization Rates and Available Converted Water Rights per County (Acre-feet/year)

	2020	2030	2040	2050	2060	2070
Cameron County						
Agricultural Demands	355,962	339,470	322,622	305,522	288,601	288,601
Exclusion Rate	1.82%	3.47%	3.72%	3.98%	4.15%	0.00%
Reduction in Agricultural Supplies (Cumulative)	4,852	12,633	21,149	29,929	38,756	38,757
Reduction in Irrigated Acreage (Cumulative)	4,039	11,593	19,403	27,434	35,492	35,492
Hidalgo County						
Agricultural Demands	639,676	609,754	577,457	540,797	502,563	502,563
Exclusion Rate	1.84%	3.51%	3.97%	4.76%	5.30%	0.00%
Reduction in Agricultural Supplies (Cumulative)	7,015	18,280	31,272	46,184	61,968	61,955
Reduction in Irrigated Acreage (Cumulative)	5,815	16,687	28,566	42,238	56,739	56,739
Jim Hogg County						
Agricultural Demands	439	413	398	414	451	451
Exclusion Rate	2.33%	4.44%	2.72%	-3.02%	-6.70%	0.00%
Reduction in Agricultural Supplies (Cumulative)	0	0	0	0	0	0
Reduction in Irrigated Acreage (Cumulative)	0	0	0	0	0	0
Maverick County						
Agricultural Demands	52,993	51,886	50,903	49,951	49,076	49,076
Exclusion Rate	0.82%	1.57%	1.42%	1.40%	1.31%	0.00%
Reduction in Agricultural Supplies (Cumulative)	627	1,490	2,381	3,270	4,117	4,129
Reduction in Irrigated Acreage (Cumulative)	444	1,282	2,031	2,759	3,432	3,432
Starr County						
Agricultural Demands	13,483	11,085	8,646	6,192	3,714	3,714
Exclusion Rate	7.00%	13.34%	16.50%	21.29%	30.01%	0.00%
Reduction in Agricultural Supplies (Cumulative)	753	2,031	3,415	4,896	6,529	6,519
Reduction in Irrigated Acreage (Cumulative)	291	806	1,358	1,950	2,607	2,607
Webb County						
Agricultural Demands	7,612	7,612	7,612	7,612	7,612	7,612
Exclusion Rate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Reduction in Agricultural Supplies (Cumulative)	0	0	0	0	0	0
Reduction in Irrigated Acreage (Cumulative)	0	0	0	0	0	0
Willacy County						
Agricultural Demands	69,253	69,074	68,936	68,814	68,741	68,741

	2020	2030	2040	2050	2060	2070
Exclusion Rate	0.10%	0.19%	0.15%	0.13%	0.08%	0.00%
Reduction in Agricultural Supplies (Cumulative)	309	422	690	980	1,262	1,290
Reduction in Irrigated Acreage (Cumulative)	81	236	356	461	524	524
Zapata County						
Agricultural Demands	4,717	4,455	4,215	3,981	3,800	3,800
Exclusion Rate	2.19%	4.17%	4.04%	4.16%	3.41%	0.00%
Reduction in Agricultural Supplies (Cumulative)	81	215	345	474	577	577
Reduction in Irrigated Acreage (Cumulative)	83	238	383	525	637	637
Total Reduction in Agricultural Supplies (Cumulative)	**13,638**	**35,071**	**59,252**	**85,734**	**113,210**	**113,227**
Total Reduction in Irrigated Acreage (Cumulative)	**10,754**	**30,843**	**52,096**	**75,368**	**99,431**	**99,431**

The TCEQ rules establish conversion ratios of 2 acre-ft. of Class A Irrigation Water Rights and 2.5 Class B Water Rights to 1 acre-ft. of Municipal Water Rights. Therefore, if the infrastructure that was previously used to convey an amount of water associated with Irrigation Water Rights is later used to convey water for the converted Municipal Water Rights, a lesser amount of water would be seen. This would result in less available push water. Due to the efficiencies associated with the current condition of Irrigation District (ID) conveyance systems, more water would need to be diverted in order to convey the appropriate amount to the end user. However, if the recommended improvements to ID conveyance systems are implemented, this effect would be minimized.

Environmental Impacts

Potential environment impacts for conversion and purchase of surface water rights strategies have been identified. The largest impact from urbanization of irrigation water rights is the land that is no longer irrigated. Table 6-8 quantifies the amount of acreage per county. The reduction of irrigated acreage was estimated as the amount of urbanized water rights divided by 2.5, based on the standard authorization per acre. It was assumed that the permanent acreage impacted is the same as would impact habitats in the local area.

6.1.7 Biological Control of Arundo Donax

The strategy for biological control of Arundo Donax will have positive impacts to the Rio Grande because it is aimed to reduce an invasive species and make more water available for the river.

6.2 Protection of Resources

All of the recommendations in the Regional Water Plan are consistent with the laws and requirements that protect the water within the Region. The amount of water used for recommended strategies are within the limitations of the Water Availability Model for surface water and the Groundwater Availability Model.

6.2.1 Surface Water Resources

The Rio Grande River Valley supports a wide variety of natural resources. Although there are no required minimum environmental flows for the river, it is important to refrain from negatively impacting the Rio Grande and harming the native wildlife. Based on the cursory evaluations performed to date, the recommended strategies would not significantly alter the water quality of the river system. The net amount of water diverted from the Rio Grande will not be increased by the implementation of the recommended strategies. It is not anticipated that any recommendations would result in major threats to agriculture, natural resources, or navigation. Some strategies, like biological control of Arundo Donax, may allow for native species to be reestablished along waterways that had been overtaken by this invasive species.

The RWPG considered the Texas Clean Rivers Program and the Federal Clean Water Act, which aim to protect the water quality of surface water sources. All of the recommended and alternative WMS are consistent with their goals.

In 1991, the Texas Legislature created the Texas Clean Rivers Program (CRP) in order to address water quality concerns in a coordinated manner.[1] CRP conducts water quality monitoring, assessment, and public outreach across the state through partnerships between TCEQ and local agencies. The International Boundary and Water Commission (USIBWC) administers the CRP in the Rio Grande Basin, and the Nueces River Authority administers both the Nueces and Nueces-Rio Grande Basins. The programs include regular water sampling, and coordination with other agencies and residents to identify and evaluate water quality issues. The Region M Planning Group has considered the issues identified through the Texas CRP and Clean Water Act, which are discussed below.

The 1972 Federal Water Pollution Control Act, now called the Clean Water Act, is the federal law that establishes the framework for monitoring and control of point-source discharges through National Pollutant Discharge Elimination System (NPDES), requires cities to obtain permits for stormwater or non-point-source discharges, and authorizes federal assistance for public owned treatment works.[2] The Clean Water Act has a national goal of “fishable, swimmable” water bodies, and states are required to identify any waters that do not meet this goal and develop total maximum daily loads (TMDLs) for them. TMDLs are intended to guide watershed management, and are the basis of the monitoring and identification of river segments as impaired that is undertaken in the CRP.

Rio Grande water quality within Region M is evaluated in 4 segments over the Middle Rio Grande Sub-Basin, and three segments in the Lower Rio Grande Sub-Basin. From Amistad Dam south to the confluence with the Rio Salado from Mexico, the river is impaired for contact recreation due to high bacteria below, nitrates and low dissolved oxygen (DO), and concern for toxicity and bacteria near Laredo as a result of urban runoff and discharges outside of U.S. jurisdiction. Manadas Creek, an unclassified water body northwest of Laredo, has high bacteria and chlorophyll-a due to urban runoff and high metal content due to industrial activity. Falcon Reservoir is not impaired, but there is concern for toxicity near Zapata. San Felipe Creek is impaired for bacteria, but has a positive effect on the Rio Grande water quality. The Lower Rio Grande Sub-Basin is separated into the freshwater stream and the stream impacted by tidal flows. The freshwater portion, which runs from Falcon Reservoir to downstream of Brownsville, is

---

[1] International Boundary and Water Commission, US Section Texas Clean Rivers Program. 2015 Basin Highlights Report, Texas Rio Grande Basin Program Update, May 2015. Accessed online: http://www.ibwc.state.gov/CRP/Publications.html

[2] USEPA Clean Water Act website: http://www.epa.gov/agriculture/lcwa.html

impaired in small reaches from consistently high bacteria counts near urban areas. Additionally, there are concerns across the entire segment for fish consumption due to elevated mercury levels. The tidal stream portion has no impairments but there can be high chlorophyll-a levels.

The Arroyo Colorado is the major drainage-way for approximately two dozen cities in this area, and almost 300,000 acres of farmland. The Arroyo Colorado includes the TCEQ Classified Stream Segment 2201 and 2202, which are impaired for high bacteria, and experience high nutrient concentrations. Segment 2201 is also impaired for low DO.

Regular monitoring of water quality as a result of these programs draws attention to the need for continued assessment and evaluation of water data and integrated regional approaches to managing the watersheds to meet quality goals.

6.2.2 Groundwater Resources

The major aquifer that underlies Region M is the Gulf Coast, which runs the extent of the Texas coast and Hidalgo, Starr, Jim Hogg, and the western portions of Willacy and Cameron Counties. This aquifer is predominantly brackish, with irregular pockets of fresh and very saline water. The Carrizo – Wilcox Aquifer also spans Texas and extends through Webb and part of Maverick Counties. All of the recommended groundwater development was guided by the conservation goals established for each aquifer through the process of establishing desired future conditions.

The minor and alluvial aquifers in the region may produce significant quantities of water that supply relatively small areas, including the Rio Grande Alluvium, the Laredo Formation, and the Yegua-Jackson aquifer. In order to better manage the region's resource, the relationship between the region's surface water and groundwater should be investigated.

Table 6-9 Managed Available Groundwater for Significant Aquifers in Region M (Acre-feet/year)

Aquifer	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer	2,959	2,940	2,593	2,486	2,448	2,448
Gulf Coast Aquifer	147,441	147,441	147,441	147,441	147,441	147,441
Yegua-Jackson Aquifer	27,998	27,998	27,998	27,998	27,998	27,998
Total	**178,398**	**178,379**	**178,032**	**177,925**	**177,887**	**177,887**

6.3 Impacts on Water Resources of the State

The primary source of water in Region M, the Rio Grande, is shared with Mexico but predominantly isolated from users outside of the region, with the exception of a Val Verde and Kinney Counties near the Amistad Reservoir. In this area, there is some indication that groundwater development may impact spring flows that are critical to the reservoir.

Drilling and marketing of groundwater in locations which may impact surface water, especially near the Amistad Dam pose a threat to the Region's primary water source. Water marketing companies are actively seeking water sources to be sold to entities in need of new water sources. Recently there has been substantial interest in groundwater in and around Val Verde County. In this particular area, there is strong evidence of interaction between groundwater and surface water, as well as continued study. The pumping of groundwater in the Devils and Pecos river basins have been shown to directly impact these streamflows and the flows in Goodenough

Springs, which play a significant role in supplying water for Region M. Any reduction in the water supply in the Amistad Reservoir presents a threat to the whole region, but particularly to irrigators, which would absorb reductions in supply under current reservoir system operation.

The flows into the Laguna Madre have been modeled as separated between the upper portion (outside of Region M) and the lower portion (largely adjacent to Region M). Concerns with balancing the volume and salinity of inflows will need to be managed across the entire estuary, which will require coordination among the regions that discharge into the estuary and with TCEQ.

Groundwater supplies in Region M rely primarily on aquifers that may extend across the state, but have a limited degree of conductivity. The majority of the water use in Region M is along the Rio Grande, which is separated by a significant distance from the next major cities to the north. There are no known negative impacts on groundwater outside of Region M that would result from the strategies recommended in this Plan.

6.4 Impacts of Voluntary Redistribution of Water from Rural and Agricultural Areas

The recommended WMS in the 2016 RWP that involve voluntary redistribution of water from rural and agricultural areas are the strategies that include converting irrigation water rights to Domestic, Industrial, and Municipal (DMI) water rights. Water rights on the Rio Grande are divided into two major types: DMI rights, and irrigation and mining rights (which are sub-divided into Class A and B). The irrigation and mining rights are allocated after the DMI rights are fulfilled and a certain amount of water is held as an operating reserve. In times of drought, irrigation and mining water rights holders may only have portion of the maximum authorized diversion associated with their water rights. A reliability factor for Class A and B water rights determines the percentage of an irrigation and mining water right that will be fulfilled, based on the total amount of available water and the distribution of DMI, Class A, and Class B water rights. As more water rights are converted from irrigation to DMI, these reliability factors change. Table 6-10 compares the Class A and B reliabilities for the Drought of Record with the current distribution of water rights "Non-urbanization" and with the recommended conversions "Urbanization".

Table 6-10 Class A and B Water Rights Reliability Factors with and without Urbanization

Reliability Case	2020	2030	2040	2050	2060	2070
Class A Reliability (Non-Urbanization)	43.0%	42.9%	42.9%	42.8%	42.7%	42.6%
Class B Reliability (Non-Urbanization)	33.6%	33.6%	33.5%	33.5%	33.4%	33.3%
Class A Reliability (Urbanization)	42.9%	42.9%	42.7%	42.5%	42.4%	42.3%
Class B Reliability (Urbanization)	33.6%	33.5%	33.4%	33.3%	33.1%	33.0%

Additional impacts that would occur due to distribution of water from agricultural to municipal use may be seen by customers of the IDs. Because IDs are responsible for supplying irrigation water, if a smaller supply is sent to irrigators there may be less water in the ID distribution systems. This could reduce the amount of push water available to convey water to users farther away from the Rio Grande and may also change the timing of when water is supplied, if less irrigations are requested.

6.5 Socioeconomic Impacts of Shortages

The following WUGs have remaining water needs that are unmet by the recommended Water Management Strategies presented in Chapter 5:

- Cameron County Irrigation
- Hidalgo County Irrigation
- Hidalgo County Mining
- Maverick County Irrigation
- Maverick County Mining
- Starr County Irrigation
- Starr County Mining
- Webb County Irrigation
- Webb County Mining
- Willacy County Irrigation
- Zapata County Irrigation

A Socioeconomic Impact Analysis of unmet needs has been provided by TWDB and is included here.

Socioeconomic Impacts of Projected Water Shortages

for the Region M Regional Water Planning Area

Prepared in Support of the 2016 Region M Regional Water Plan

Texas Water
Development Board

Dr. John R. Ellis
Water Use Projections & Planning Division
Texas Water Development Board

Yun Cho, Team Lead
Water Use Projections & Planning Division
Texas Water Development Board

Kevin Kluge, Manager
Water Use Projections & Planning Division
Texas Water Development Board

September, 2015

Table of Contents

Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required part of the regional water planning process. The Texas Water Development Board (TWDB) estimates those impacts for regional water planning groups, and summarizes the impacts in the state water plan. The analysis presented is for the Region M Regional Water Planning Group.

Based on projected water demands and existing water supplies, the Region M planning group identified water needs (potential shortages) that would occur within its region under a repeat of the drought of record for six water use categories. The TWDB then estimated the socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The analysis was performed using an economic modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year during a drought of record within each of the planning decades. For each water use category, the evaluation focused on estimating income losses and job losses. The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts were estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

It is estimated that not meeting the identified water needs in Region M would result in an annually combined lost income impact of approximately $1 billion in 2020, increasing to $5.4 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 12,000 jobs, and by 2070 job losses would increase to approximately 85,500.

All impact estimates are in year 2013 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from the TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and Texas Municipal League.

Table ES-1: Region M Socioeconomic Impact Summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$954	$1,168	$1,762	$2,502	$3,771	$5,359
Job losses	12,034	14,838	23,391	36,426	58,434	85,529
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$106	$121	$170	$220	$313	$433
Water trucking costs ($ millions)*	-	$0	$0	$1	$0	$1
Utility revenue losses ($ millions)*	$89	$150	$224	$316	$372	$507
Utility tax revenue losses ($ millions)*	$1	$2	$4	$5	$6	$9
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$31	$55	$95	$160	$252	$376
Population losses	2,209	2,724	4,295	6,688	10,728	15,703
School enrollment losses	409	504	795	1,237	1,985	2,905

***** *Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.*

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on existing businesses and industry, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

Administrative rules (31 Texas Administrative Code §357.33 (c)) require that regional water planning groups evaluate the social and economic impacts of not meeting water needs as part of the regional water planning process, and rules direct the TWDB staff to provide technical assistance upon request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of the Region M Regional Water Planning Group.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 summarizes the water needs calculation performed by the TWDB based on the regional water planning group's data. Section 2 describes the methodology for the impact assessment and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 3 presents the results for each water use category with results summarized for the region as a whole. Appendix A presents details on the socioeconomic impacts by county.

1.1 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for each water user group (WUG) with input from the planning groups. WUGs are composed of cities, utilities, combined rural areas (designated as county-other), and the county-wide water use of irrigation, livestock, manufacturing, mining and steam-electric power. The demands are then compared to the existing water supplies of each WUG to determine potential shortages, or needs, by decade. Existing water supplies are legally and physically accessible for immediate use in the event of drought. Projected water demands and existing supplies are compared to identify either a surplus or a need for each WUG.

Table 1-1 summarizes the region's identified water needs in the event of a repeat of drought of the record. Demand management, such as conservation, or the development of new infrastructure to increase supplies are water management strategies that may be recommended by the planning group to meet those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population and economic growth. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are presented in aggregate in Table 1-1. Projected needs for individual water user groups within the aggregate vary greatly, and may reach 100% for a given WUG and water use category. Detailed water needs by WUG and county appear in Chapter 4 of the 2016 Region M Regional Water Plan.

Table 1-1 Regional Water Needs Summary by Water Use Category

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	Water Needs (acre-feet per year)	657,300	607,831	556,409	501,777	446,690	447,280
	% of the category's total water demand	57%	56%	53%	51%	48%	48%
Livestock	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Manufacturing	Water Needs (acre-feet per year)	2,539	3,398	4,253	5,004	6,002	7,077
	% of the category's total water demand	24%	30%	35%	39%	43%	47%
Mining	Water Needs (acre-feet per year)	5,290	4,641	5,488	5,565	5,758	6,337
	% of the category's total water demand	31%	28%	37%	43%	55%	61%
Municipal	Water Needs (acre-feet per year)	49,531	87,413	133,436	192,244	253,435	313,869
	% of the category's total water demand	16%	24%	31%	39%	46%	51%
Steam-electric power	Water Needs (acre-feet per year)	2,984	5,635	8,866	12,805	17,608	23,501
	% of the category's total water demand	18%	28%	38%	46%	54%	60%
Total water needs (acre-feet per year)		**717,644**	**708,918**	**708,452**	**717,395**	**729,493**	**798,064**

2 Economic Impact Assessment Methodology Summary

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate (volume), and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts were based on the overall composition of the economy using many underlying economic "sectors." Sectors in this analysis refer to one or more of the 440 specific production sectors of the economy designated within IMPLAN (Impact for Planning Analysis), the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 310 of those sectors, with the focus on the more water intense production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple related economic sectors.

2.1 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic impacts of shortages due to a drought of record. Consistent with previous water plans, several key variables were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic Impact Analysis Measures

Regional Economic Impacts	Description
Income losses - value added	The value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry, sector, or group of sectors within a year. For a shortage, value added is a measure of the income losses to the region, county, or WUG and includes the direct, indirect and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage.
Financial Transfer Impacts	**Description**
Tax losses on production and imports	Sales and excise taxes (not collected due to the shortage), customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies.
Water trucking costs	Estimate for shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social Impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying less water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1.1 Regional Economic Impacts

Two key measures were included within the regional economic impacts classification: income losses and job losses. Income losses presented consist of the sum of value added losses and additional purchase costs of electrical power. Job losses are also presented as a primary economic impact measure.

Income Losses - Value Added Losses

Value added is the value of total output less the value of the intermediate inputs also used in production of the final product. Value added is similar to Gross Domestic Product (GDP), a familiar measure of the productivity of an economy. The loss of value added due to water shortages was estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region.

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur, and were represented in this analysis by the additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employed additional power purchase costs as a proxy for the value added impacts for that water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it was assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas from the recent drought period in 2011.

Job Losses

The number of jobs lost due to the economic impact was estimated using IMPLAN output associated with the water use categories noted in Table 1-1. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates were not calculated for the steam-electric power production or for certain municipal water use categories.

2.1.2 Financial Transfer Impacts

Several of the impact measures estimated within the analysis are presented as supplemental information, providing additional detail concerning potential impacts on a sub-portion of the economy or government. Measures included in this category include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. Many of these measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model was used to estimate reduced tax collections associated with the reduced output in the economy.

Water Trucking Costs

In instances where water shortages for a municipal water user group were estimated to be 80 percent or more of water demands, it was assumed that water would be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed cost of $20,000 per acre-foot of water was calculated and presented as an economic cost. This water trucking cost was applied for both the residential and non-residential portions of municipal water needs and only impacted a small number of WUGs statewide.

Utility Revenue Losses

Lost utility income was calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates resulted from city-specific pricing data for both water and wastewater. These water rates were applied to the potential water shortage to determine estimates of lost utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses included estimates of uncollected miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

2.1.3 Social Impacts

Consumer Surplus Losses of Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for the commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer's wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. However, consumer's access to that water may be limited, and the associated consumer surplus loss is an estimate of the equivalent monetary value of the negative impact to the consumer's wellbeing, for example, associated with a diminished quality of their landscape (i.e., outdoor use). Lost consumer surplus estimates for reduced outdoor and indoor use, as well as residential and commercial/institutional demands, were included in this analysis. Consumer surplus is an attempt to measure effects on wellbeing by monetizing those effects; therefore, these values should not be added to the other monetary impacts estimated in the analysis.

Lost consumer surplus estimates varied widely by location and type. For a 50 percent shortage, the estimated statewide consumer surplus values ranged from $55 to $2,500 per household (residential use), and from $270 to $17,400 per firm (non-residential).

Population and School Enrollment Losses

Population losses due to water shortages, as well as the related loss of school enrollment, were based upon the job loss estimates and upon a recent study of job layoffs and the resulting adjustment of the labor market, including the change in population.[1] The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model an estimate of the change in the population as the result of a job layoff event. Layoffs impact both out-migration, as well as in-migration into an area, both of which can negatively affect the population of an area. In addition, the study found that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county. Based on this study, a simplified ratio of job and net population loses was calculated for the state as a whole: for every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses were estimated as a proportion of the population lost.

2.2 Analysis Context

The context of the economic impact analysis involves situations where there are physical shortages of surface or groundwater due to drought of record conditions. Anticipated shortages may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

2.2.1 IMPLAN Model and Data

Input-Output analysis using the IMPLAN (Impact for Planning Analysis) software package was the primary means of estimating value added, jobs, and taxes. This analysis employed county and regional level models to determine key impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2011 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 440 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their relevant planning water user categories (manufacturing, mining, irrigation, etc.). Estimates of value added for a water use category were obtained by summing value added estimates across the relevant IMPLAN sectors

---

[1] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015. http://paa2015.princeton.edu/uploads/150194

associated with that water use category. Similar calculations were performed for the job and tax losses on production and import impact estimates.

Note that the value added estimates, as well as the job and tax estimates from IMPLAN, include three components:

- *Direct effects* representing the initial change in the industry analyzed;
- *Indirect effects* that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- *Induced effects* that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

2.2.2 Elasticity of Economic Impacts

The economic impact of a water need is based on the relative size of the water need to the water demand for each water user group (Figure 2-1). Smaller water shortages, for example, less than 5 percent, were anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage deepens, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for such ability to adjust, an elasticity adjustment function was used in estimating impacts for several of the measures. Figure 2-1 illustrates the general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage percentage reaches the lower bound b1 (10 percent in Figure 2-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound for adjustment reaches the b2 level shortage (50 percent in Figure 2-1 example).

Initially, the combined total value of the three value added components (direct, indirect, and induced) was calculated and then converted into a per acre-foot economic value based on historical TWDB water use estimates within each particular water use category. As an example, if the total, annual value added for livestock in the region was $2 million and the reported annual volume of water used in that industry was 10,000 acre-feet, the estimated economic value per acre-foot of water shortage would be $200 per acre-foot. Negative economic impacts of shortages were then estimated using this value as the maximum impact estimate ($200 per acre-foot in the example) applied to the anticipated shortage volume in acre-feet and adjusted by the economic impact elasticity function. This adjustment varied with the severity as percentage of water demand of the anticipated shortage. If one employed the sample elasticity function shown in Figure 2-1, a 30% shortage in the water use category would imply an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments were not required in estimating consumer surplus, nor for the estimates of utility revenue losses or utility tax losses. Estimates of lost consumer surplus relied on city-specific demand curves with the specific lost consumer surplus estimate calculated based on the relative percentage of the city's water shortage. Estimated changes in population as well as changes in school enrollment were indirectly related to the elasticity of job losses.

Assumed values for the bounds b1 and b2 varied with water use category under examination and are presented in Table 2-2.

Figure 2-1 Example Economic Impact Elasticity Function (as applied to a single water user's shortage)

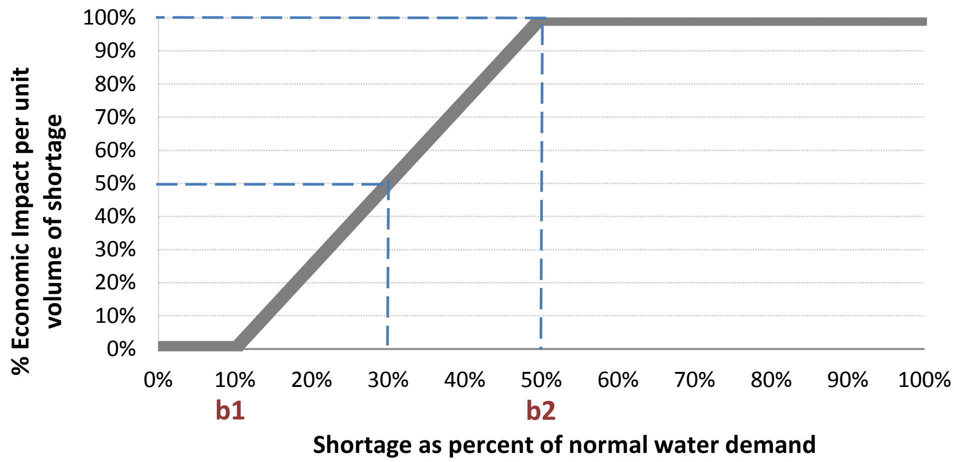

Table 2-2 Economic Impact Elasticity Function Lower and Upper Bounds

Water Use Category	Lower Bound (b1)	Upper Bound (b2)
Irrigation	**5%**	**50%**
Livestock	**5%**	**10%**
Manufacturing	**10%**	**50%**
Mining	**10%**	**50%**
Municipal (non-residential water intensive)	**50%**	**80%**
Steam-electric power	**20%**	**70%**

2.3 Analysis Assumptions and Limitations

Modeling of complex systems requires making assumptions and accepting limitations. This is particularly true when attempting to estimate a wide variety of economic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of the methodology include:

1. The foundation for estimating socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified as part of the regional water planning process. These needs have some uncertainty associated with them, but serve as a reasonable basis for evaluating potential economic impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshot estimates of impacts for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates 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. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs, future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented were not cumulative (i.e., summing up expected impacts from today up to the decade noted), but were simply an estimate of the magnitude of annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, supplies of limited resources, and other structural changes to the economy that may occur into the future. This was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This analysis is not a cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting procedures to weigh future costs differently through time.

5. Monetary figures are reported in constant year 2013 dollars.

6. Impacts are annual estimates. The estimated economic model does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

7. Value added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two categories (value added and consumer surplus) are both valid impacts but should not be summed.

8. The value added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects described in Section 2.2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

9. The majority of impacts estimated in this analysis may be considered smaller than those that might occur under drought of record conditions. Input-output models such as IMPLAN only capture "backward linkages" on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in these types of economic impact modeling efforts, it is important to note that "forward linkages" on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, which is one reason why the impact estimates are likely conservative.

10. The methodology did not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

11. The model did not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to the landscaping industry immediately following a drought;
    b. The cost and years to rebuild liquidated livestock herds (a major capital item in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not accurately reflect what might occur on a statewide basis.

13. The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers. Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

3 Analysis Results

This section presents a breakdown of the results of the regional analysis for Region M. Projected economic impacts for six water use categories (irrigation, livestock. municipal, manufacturing, mining, and steam-electric power) are also reported by decade.

3.1 Overview of the Regional Economy

Table 3-1 presents the 2011 economic baseline as represented by the IMPLAN model and adjusted to 2013 dollars for Region M. In year 2011, Region M generated about $42 billion in gross state product associated with 667,000 jobs based on the 2011 IMPLAN data. These values represent an approximation of the current regional economy for a reference point.

Table 3-1 Region M Economy

Income ($ millions)*	Jobs	Taxes on production and imports ($ millions)*
$41,531	**667,281**	**$3,392**

[1]*Year 2013 dollars based on 2011 IMPLAN model value added estimates for the region.*

The remainder of Section 3 presents estimates of potential economic impacts for each water use category that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented.

3.2 Impacts for Irrigation Water Shortages

All 8 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-2. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. Two factors led to excluding any reported tax impacts: 1) Federal support (subsidies) has lessened greatly since the year 2011 IMPLAN data was collected, and 2) It was not considered realistic to report increasing tax revenue collections for a drought of record.

Table 3-2 Impacts of Water Shortages on Irrigation in Region

Impact Measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$109	$101	$93	$82	$72	$72
Job losses	4,249	3,937	3,617	3,210	2,802	2,807

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.3 Impacts for Livestock Water Shortages

None of the 8 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-3. Note that tax impacts are not reported for this water use category for similar reasons that apply to the irrigation water use category described above.

Table 3-3 Impacts of Water Shortages on Livestock in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	-	-	-	-	-	-
Jobs losses	-	-	-	-	-	-

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

3.4 Impacts for Municipal Water Shortages

All 8 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon. Impact estimates were made for the two subtypes of use within municipal use: residential, and non-residential. The latter includes commercial and institutional users. Consumer surplus measures were made for both residential and non-residential demands. In addition, available data for the non-residential, water-intensive portion of municipal demand allowed use of IMPLAN and TWDB Water Use Survey data to estimate income loss, jobs, and taxes. Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed cost of $20,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 3-4.

Table 3-4 Impacts of Water Shortages on Municipal Water Users in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$130	$198	$517	$1,121	$2,122	$3,335
Job losses[1]	2,545	3,882	10,134	21,988	41,616	65,394
Tax losses on production and imports[1] ($ millions)*	$12	$18	$48	$103	$195	$307
Consumer surplus losses ($ millions)*	$31	$55	$95	$160	$252	$376
Trucking costs ($ millions)*	-	$0	$0	$1	$0	$1
Utility revenue losses ($ millions)*	$89	$150	$224	$316	$372	$507
Utility tax revenue losses ($ millions)*	$1	$2	$4	$5	$6	$9

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.5 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in 6 of the 8 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-5.

Table 3-5 Impacts of Water Shortages on Manufacturing in Region

Impacts Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$161	$301	$478	$659	$929	$1,214
Job losses	1,922	3,711	5,996	8,331	11,839	15,612
Tax losses on production and Imports ($ millions)*	$12	$23	$36	$49	$69	$89

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.6 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in 5 of the 8 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use type appear in Table 3-6.

Table 3-6 Impacts of Water Shortages on Mining in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$531	$524	$575	$450	$329	$249
Job losses	3,318	3,308	3,643	2,897	2,177	1,717
Tax losses on production and Imports ($ millions)*	$77	$75	$83	$64	$46	$34

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.7 Impacts of Steam-Electric Water Shortages

Steam-electric water shortages in the region are projected to occur in 3 of the 8 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-7.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of the estimated additional purchasing costs for power from the electrical grid that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Does not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 3-7 Impacts of Water Shortages on Steam-Electric Power in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	$24	$44	$100	$190	$319	$489

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.8 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 3-8.

Table 3-8 Region-wide Social Impacts of Water Shortages in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$31	$55	$95	$160	$252	$376
Population losses	2,209	2,724	4,295	6,688	10,728	15,703
School enrollment losses	409	504	795	1,237	1,985	2,905

***** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

Appendix A - County Level Summary of Estimated Economic Impacts for Region M

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2013 dollars, rounded). Values presented only for counties with projected economic impacts for at least one decade.

**** Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
CAMERON	IRRIGATION	$35	$32	$29	$25	$21	$21	1,324	1,214	1,105	934	769	773	-	-	-	-	-	-
CAMERON	MANUFACTURING	$25	$93	$189	$292	$452	$647	345	1,304	2,654	4,083	6,325	9,065	-	-	-	-	-	-
CAMERON	MUNICIPAL	$65	$89	$136	$198	$273	$356	1,284	1,736	2,667	3,889	5,349	6,989	$12	$16	$21	$31	$44	$65
CAMERON	STEAM ELECTRIC POWER	$24	$31	$39	$48	$60	$71	-	-	-	-	-	-	-	-	-	-	-	-
CAMERON Total		**$150**	**$245**	**$394**	**$563**	**$804**	**$1,096**	**2,952**	**4,254**	**6,425**	**8,906**	**12,443**	**16,827**	**$12**	**$16**	**$21**	**$31**	**$44**	**$65**
HIDALGO	IRRIGATION	$64	$59	$54	$48	$42	$42	2,541	2,351	2,145	1,910	1,666	1,669	-	-	-	-	-	-
HIDALGO	MANUFACTURING	$129	$200	$281	$358	$466	$554	1,494	2,318	3,246	4,145	5,398	6,414	-	-	-	-	-	-
HIDALGO	MINING	$14	$23	$29	$36	$44	$53	132	213	271	332	403	493	-	-	-	-	-	-
HIDALGO	MUNICIPAL	$0	$30	$284	$806	$1,716	$2,823	10	581	5,561	15,808	33,647	55,356	$6	$20	$49	$97	$170	$268
HIDALGO	STEAM ELECTRIC POWER	-	$13	$61	$141	$260	$418	-	-	-	-	-	-	-	-	-	-	-	-
HIDALGO Total		**$208**	**$325**	**$708**	**$1,390**	**$2,528**	**$3,890**	**4,177**	**5,463**	**11,223**	**22,195**	**41,114**	**63,931**	**$6**	**$20**	**$49**	**$97**	**$170**	**$268**
JIM HOGG	IRRIGATION	$0	$0	$0	$0	$0	$0	-	-	-	-	-	-	-	-	-	-	-	-
JIM HOGG	MUNICIPAL	-	-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0	$0	$0
JIM HOGG Total		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**$0**	**$0**	**$0**	**$0**	**$0**
MAVERICK	IRRIGATION	$0	$0	$0	$0	$0	$0	8	7	6	5	5	5	-	-	-	-	-	-
MAVERICK	MANUFACTURING	$7	$7	$8	$8	$9	$9	83	89	94	98	106	113	-	-	-	-	-	-
MAVERICK	MINING	$339	$499	$541	$407	$272	$175	2,094	3,085	3,346	2,513	1,684	1,081	-	-	-	-	-	-
MAVERICK	MUNICIPAL	-	-	-	-	-	-	-	-	-	-	-	-	-			$0	$0	$0
MAVERICK Total		**$346**	**$507**	**$549**	**$415**	**$281**	**$184**	**2,186**	**3,181**	**3,446**	**2,617**	**1,794**	**1,199**	**-**	**-**	**-**	**$0**	**$0**	**$0**
STARR	IRRIGATION	$0	$0	-	-	-	-	11	3	-	-	-	-	-	-	-	-	-	-
STARR	MANUFACTURING	-	-	$0	$0	$1	$1	-	-	-	2	3	6	-	-	-	-	-	-
STARR	MINING	-	$1	$4	$8	$13	$21	-	9	27	52	89	143	-	-	-	-	-	-
STARR	MUNICIPAL	$48	$59	$70	$84	$95	$104	943	1,150	1,379	1,646	1,856	2,036	$8	$11	$15	$20	$22	$24
STARR Total		**$48**	**$60**	**$74**	**$92**	**$108**	**$126**	**954**	**1,162**	**1,405**	**1,699**	**1,949**	**2,185**	**$8**	**$11**	**$15**	**$20**	**$22**	**$24**
WEBB	IRRIGATION	$0	$0	$0	$0	$0	$0	1	1	1	1	1	1	-	-	-	-	-	-
WEBB	MANUFACTURING	-	-	$0	$1	$2	$3	-	-	2	4	8	14	-	-	-	-	-	-
WEBB	MINING	$178	-	-	-	-	-	1,092	-	-	-	-	-	-	-	-	-	-	-

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
WEBB	MUNICIPAL	$15	$20	$23	$27	$31	$34	302	382	459	532	602	666	$6	$8	$9	$11	$13	$15
WEBB Total		**$193**	**$20**	**$24**	**$28**	**$32**	**$37**	**1,395**	**383**	**461**	**537**	**612**	**681**	**$6**	**$8**	**$9**	**$11**	**$13**	**$15**
WILLACY	IRRIGATION	$9	$9	$9	$9	$9	$9	362	361	360	359	361	359	-	-	-	-	-	-
WILLACY	MUNICIPAL	-	-	-	-	-	$2	-	-	-	-	-	38	$0	$0	$0	$0	$0	$0
WILLACY Total		**$9**	**$9**	**$9**	**$9**	**$9**	**$11**	**362**	**361**	**360**	**359**	**361**	**397**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
ZAPATA	IRRIGATION	$0	$0	$0	$0	$0	$0	1	1	-	-	-	-	-	-	-	-	-	-
ZAPATA	MUNICIPAL	$0	$2	$4	$6	$8	$16	6	33	69	113	161	309	$0	$0	$1	$1	$2	$3
ZAPATA Total		**$0**	**$2**	**$4**	**$6**	**$8**	**$16**	**8**	**34**	**69**	**113**	**161**	**309**	**$0**	**$0**	**$1**	**$1**	**$2**	**$3**
Regional Total		**$954**	**$1,168**	**$1,762**	**$2,502**	**$3,771**	**$5,359**	**12,034**	**14,838**	**23,391**	**36,426**	**58,434**	**85,529**	**$31**	**$55**	**$95**	**$160**	**$252**	**$376**

Texas Water Development Board

2016 Region M Water Plan

Chapter 7: Drought Preparations and Response

Table of Contents

Figures

Tables

List of Abbreviations

Acre-ft.	Acre-feet
Acre-ft./year	Acre-feet per year
DCP	Drought Contingency Plan
DMI	Domestic, Municipal and Industrial
DOR	Drought of Record
ERHWSC	East Rio Hondo Water Supply Corporation
IBWC	International Boundary Water Commission
NCRWP	North Cameron Regional Water Plant
No.	Number
PUB	Public Utilities Board
RWPG	Regional Water Planning Group
SRWA	Southmost Regional Water Supply Corporation
WAM	Water Availability Model
WMS	Water Management Strategy
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider

Chapter 7. Drought Preparations and Response

7.1 Introduction

Severe drought has affected Region M in the period that constitutes the current drought of record for the Rio Grande basin (1993-2000), and more recently in 2011-2013. Because of the unique mechanism for fulfillment of water rights of the Rio Grande system, and the heavy reliance on that source, drought impacts Region M somewhat differently than other regions. Also, a significant portion of the water used in Region M does not fall as rain on the region, but comes from the Mexican side of the Rio Grande Watershed.

Drought and other circumstances can contribute to a water shortage, which is any situation when there is less supply of water than there is demand for water. Shortages can be the result of low rainfall, operational decisions, higher than normal temperatures or growing populations causing increased demand. Drought preparation and response can help to mitigate the impacts of these shortages by finding ways to reduce demands and supplement supplies in response to water shortages.

The Texas Department of Public Safety submitted recommendations from the Drought Preparedness Council to all of the Regional Water Planning Groups (RWPG) on November 10, 2014. The Council advised the RWPG to follow the TWDB template for this chapter and to examine the impact of unanticipated population or industrial growth on the ability of the Region to prepare for drought. These recommendations have been considered in the development of this chapter.

This chapter is intended to consolidate what existing information there is on current drought preparation and response activities for Region M, and make recommendations where needed.

7.2 Drought of Record in Region M

The Drought of Record (DOR) is the basis of the Firm Yield projection for each surface water supply. The DOR identifies the worst drought on record and the Firm Yield is the supply that can be expected from that river or system in that most severe drought scenario.

The Rio Grande Basin and the Amistad-Falcon Reservoir System refer to the drought spanning from February 1993 to October of 2000 as the DOR. This 7.75 year period is the most severe hydrologic drought according to the Rio Grande Water Availability Model (WAM), and is used to predict firm yield over the planning horizon, as discussed in Chapter 3. The WAM takes into account reduced inflows from both Mexican and U.S. tributaries associated with the drought of record, volumes and locations of demands along the river, channel losses along the river, and other factors. The deliveries from Mexico are not modeled according to the 1944 Treaty, which establishes 350,000 acre-ft./year to be delivered to the US, but are modeled instead according to historical supplies and demands. Firm Yield decreases slightly each decade from reduced reservoir capacity due to sedimentation.

The naturalized flow data in the WAM only extends through the year 2000, which may have an impact on the DOR. The actual drought extended through approximately 2003, and if the WAM were updated to include those years, the severity of the DOR and therefore the firm yield of the Amistad-Falcon Reservoir system may be affected. Recent years have also seen severe drought in the region, and 2011 and 2012 data could similarly impact the drought of record. It was recommended in the 2011 Regional Water Plan, and is the opinion of the current RWPG, that the Rio Grande WAM should be updated regularly.

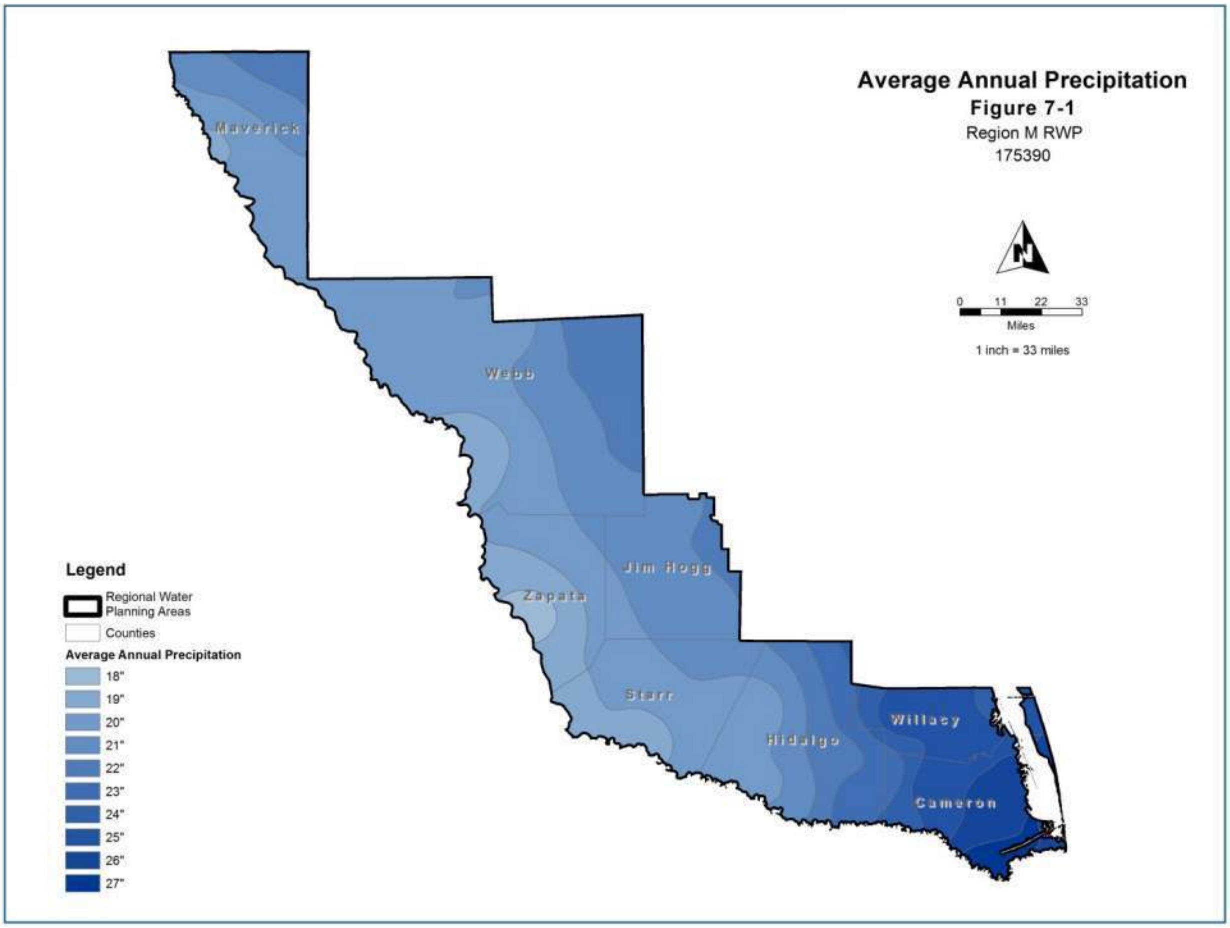

Figure 7-1 Average Annual Precipitation

Recently, the United States Bureau of Reclamation conducted a Basin Study for the Lower Rio Grande Valley, with the intent of understanding the potential impacts of climate change on the Rio Grande system.[1] The *Lower Rio Grande Basin Study* modeled a range of climate scenarios across the region, varying precipitation and temperature metrics. The Study conclusion was that the median climate scenario represented an average reduction in availability from the Amistad-Falcon Reservoir system of approximately 86,400 acre-ft./year by 2060. This reduction of average yield is not comparable to firm yield, but does give a sense of the potential impacts of increased temperatures and reduced flows. In addition to general predicted reduction of availability, most climate data indicate increased variability over the planning horizon, which presents another challenge to the region.

[1] Lower Rio Grande Basin Study, Under the Authority of the SECURE Water Act (Public Law 111-11) Great Plains Region, Oklahoma-Texas Area Office of the United States Bureau of Reclamation, December, 2013.

7.3 Current Drought Preparations and Response

Statewide, there have been increased efforts in recent years to establish both long-term drought management strategies to avoid shortages, and Drought Contingency Plans (DCP) to plan for temporary water supply shortages and other water supply emergencies.

TCEQ requires that anyone applying for a water right, irrigation districts, wholesale public water suppliers, and all retail public water suppliers serving 3,300 connections or more submit a DCP to the TCEQ. Public water suppliers serving less than 3,300 connections are required to have a DCP on file, but are not required to submit it to TCEQ. May 1, 2014 was the most recent deadline for DCP submittals.

All of the entities that are required to submit DCP, as well as all users of 1,000 acre-feet or more domestic, municipal, or industrial (DMI) surface water rights and 10,000 acre-feet or more of irrigation surface water rights, are required to submit a Water Conservation Plan (WCP) to TCEQ and TWDB.

Because of these requirements and recent drought conditions, many communities in the Rio Grande Region have addressed drought preparedness and water conservation planning. A complete list of the DCP and WCP that have been submitted to TCEQ at this time is shown in Table 7-1.

Drought contingency plans for retail or wholesale water suppliers are required to include the following:

- Specific, quantified targets for water use reductions
- Drought response stages
- Triggers to begin and end each stage
- Supply management measures
- Demand management measures
- Descriptions of drought indicators
- Notification procedures
- Enforcement procedures
- Procedures for granting exceptions
- Public input to the plan
- Ongoing public education
- Adoption of plan
- Coordination with regional water planning group

Table 7-1 Submitted Water Conservation and Drought Contingency Plans

Entity	Water Conservation Plan	Drought Contingency Plan
Adams Garden Irrigation District	✓	✓
Agua Special Utility District	✓	✓
City of Alamo		✓

Entity	Water Conservation Plan	Drought Contingency Plan
Brownsville Irrigation District	✓	✓
Brownsville Public Utilities Board	✓	✓
Cameron County Irrigation District No. 2	✓	
Cameron County Irrigation District No. 16		✓
Delta Lake Irrigation District	✓	✓
City of Donna		✓
Eagle Pass Water Works System	✓	✓
East Rio Hondo Water Supply Corporation	✓	✓
Harlingen Irrigation District	✓	✓
Harlingen Waterworks System	✓	✓
Hidalgo Co. Drainage District No. 1	✓	✓
Hidalgo Co. Irrigation District No. 1		✓
Hidalgo Co. Irrigation District No. 16	✓	✓
Hidalgo Co. Irrigation District No. 2	✓	✓
Hidalgo Co. Irrigation District No. 3	✓	✓
Hidalgo Co. Irrigation District No. 5	✓	✓
Hidalgo Co. Irrigation District No. 6	✓	✓
Hidalgo Water Improvement District No. 3	✓	✓
La Feria Irrigation District		✓
Laguna Madre Water District	✓	✓
City of Laredo	✓	✓
City of Lyford		✓
Maverick County Water Control and Improvement District No. 1	✓	✓
City of McAllen, McAllen Public Utility	✓	✓
Military Highway Water Supply Corporation	✓	✓
North Alamo Water Supply Corporation	✓	✓
North Cameron Regional Water Supply Corporation		✓
Pharr	✓	✓
Raymondville	✓	✓
City of Rio Grande City		✓
City of Roma	✓	✓
San Benito	✓	✓
San Juan	✓	
San Ygnacio Municipal Utility District		✓
Southmost Regional Water Authority	✓	✓
United Irrigation district	✓	✓
Union Water Supply Corporation		✓
Valley Municipal Utility District No. 2		✓
City of Weslaco	✓	✓
Zapata County Waterworks	✓	✓

7.3.1 Region M Drought Contingency Plans

The drought response varies from entity to entity, primarily between those who serve customers, including irrigators, with raw water, and those who deliver treated water. For Irrigation Districts, the response to drought is built into the allocation system, and how irrigation water rights are fulfilled by the Rio Grande Watermaster when supplies are limited. For treated water suppliers, triggers are specific to their users' demand in relation to treatment capacity or DMI water rights held.

Irrigation Districts

The TCEQ Rio Grande operating rules determine how the United States' share of surface water stored in Amistad and Falcon Reservoirs is apportioned among the various WUGs in the Region M planning area. A storage pool within the reservoir of 225,000 acre-ft. is replenished at the beginning of each month to fulfill Domestic, Municipal and Industrial (DMI) water rights, so an entity that holds a DMI water right can request water that remains in their water right account balance. Class A and B irrigation and mining water rights are allotted what remains on their account balances if there is sufficient water in the reservoir after the DMI storage pool and reservoir operating requirements are met. In the history of the Watermaster Program, the DMI reserves have always been replenished in full, but the pool of water available for Class A and B water rights is often significantly less than what would be required to fulfill the maximum authorization of all of those water rights. Class A and B water rights absorb the impacts of drought on the reservoir system by having water rights that are less than 100% reliable.

At the Irrigation District level, irrigation and mining (and multi-use water rights, which are allocated similarly but have the flexibility to be used for irrigation or mining uses) are delivered as requested to end users. The majority of Rio Grande irrigation water rights are owned by Irrigation Districts. Farmers pay an annual flat rate assessment which entitles them to receive irrigation water based on acreage. Each water district has slightly different rules on allocation, in some cases allowing water to be sold between farmers in their district or permitting a farmer to consolidate their allocation on a portion of their land, leaving other areas for dry land farming. These measures allow farmers to adjust their crop selection if water shortages are anticipated.

A summary of the drought triggers and responses as listed by the Irrigation Districts that had submitted DCPs at the time of writing is shown in Table 7-2.

Table 7-2 Summary of Irrigation District Drought Triggers and Responses

Entity	Date		
Adams Garden	11-Aug-09	TRIGGERS:	Water Allocations for irrigators go into effect as determined by the Board of the District.
		ACTIONS:	The total water allocated to the Irrigation District by the Watermaster will be divided among flat-rate customers according to their account balance.
Brownsville	23-Apr-14	TRIGGERS:	Water assignments are initiated upon approval of the Board.

Entity	Date		
Irrigation District		ACTIONS:	Each irrigation user shall be assigned 3 irrigations or 1 acre-foot of water for each acre planted in the previous year. As additional water supplies become available to the District, water will be equally distributed as described in Section 11.039 of the Texas Water Code.
Cameron County Irrigation District No. 2	25-Apr-14	TRIGGERS:	Water Allocations for irrigators go into effect as determined by the Board of the District.
		ACTIONS:	The total water allocated to the Irrigation District by the Watermaster will be divided among flat-rate customers evenly so that no one user can irrigate more than their portion.
Cameron County Irrigation District No. 16	7-May-14	TRIGGERS:	Upon approval of the board, water allocation will become effective when the storage balance in the district's irrigation water rights account reaches 1500 acre-feet.
		ACTIONS:	Each irrigation user shall be allocated 3 irrigations or 2 acre-feet of water for each flat rate acre. Additional water available to the District will be equally distributed, on a pro rata basis, to users having an account balance of less than 1 acre-feet of water for each flat rate acre. Transfers of allotments within the District are allowed.
Delta Lake Irrigation District	16-Apr-14	TRIGGERS:	Upon approval of the board, water allocation will become effective when the storage balance in the district's irrigation water rights account reaches 60,000 acre-feet.
		ACTIONS:	Each irrigation user shall be allocated 3 irrigations or 2 acre-feet of water for each flat rate acre. Additional water available to the District will be equally distributed, on a pro rata basis, to users having an account balance of less than 1 acre-feet of water for each flat rate acre. Transfers of allotments within the District are allowed.
Harlingen ID	11-Aug -09	TRIGGERS:	Water Allocations for irrigators go into effect when either a) the storage balance in the district's irrigation water rights account has declined to one irrigation-per-acre level, or b) the Board determines that there is not sufficient water to complete the traditional crop year.
		ACTIONS:	The total water allocated to the Irrigation District by the Watermaster will be divided among flat-rate customers evenly so that no one user can irrigate more than their portion.
Hidalgo Co. Irrigation District No. 1	22-Feb-07	TRIGGERS:	When the watermaster initiates diversions based on allocations, the District's Board of Directors determines the total allocation available to the District and stored in the Falcon/Amistad Reservoir System is less than 2.5 acre-feet/year of the estimated active parcels of land.

Entity	Date		
		ACTIONS:	The District initiates allocation of water to active irrigation users, on a pro-rata basis provided that no parcel receives an allocation which will result in an account balance exceeding 1.83 acre-feet per acre.
Hidalgo Co. Irrigation District No. 3	17-Oct-14		Upon approval of the Board, water allocation will go into effect when the District's total water right from the Rio Grande Watermaster amounts to less than one year supply as determined by the Board. Water is pro-rated to irrigable land on which all flat rate assessment is paid in accordance with the District's Water Allocation Program. Additional water will be equally distributed, on a pro-rata acreage basis. When the Water Allocation Program is in effect, the District will not supply Out of District water except in accordance with policy adopted as a result of U.S. Bureau of Reclamation WaterSMART Grant.
Hidalgo Co. Irrigation District No. 5	6-Jul-05	TRIGGERS:	Upon approval of the Board, water allocation will become effective when the water allocated to HCID#5 for irrigation by the Rio Grande Watermaster amounts to 2½ acre-feet per compliant acre or less.
		ACTIONS:	Water will be allocated on a pro rata per acre basis to the compliant acreage.
Hidalgo Co. Irrigation District No. 6	6-Jul-05	TRIGGERS:	Upon approval of the Board, water allocation will become effective when the water allocated to HCID#6 for irrigation by the Rio Grande Watermaster amounts to 2½ acre-feet per compliant acre or less.
		ACTIONS:	Water will be allocated on a pro rata per acre basis to the compliant acreage. Transfers of allotments within (but not outside) the District, with the consent of the allotted, will be permitted.
La Feria Irrigation District	1-Sep-14	TRIGGERS:	Upon approval of the Board, water allocation becomes effective when the storage balance in the water rights account reaches an amount less than or equal to 2 irrigations for each flat rate acre.
		ACTIONS:	Each user is allocated 1 irrigation or 1 acre foot of water, if metered, for each flat rate acre. Transfer within the District is allowed. Transfer from outside of the District to a user in the District is allowed.

Retail Public Water Suppliers

Although a few cities rely on groundwater exclusively or have groundwater comprising a part of their supply, most cities in Region M rely on surface water from the Rio Grande. Because the availability of municipal water rights are granted first priority from the Amistad-Falcon

Reservoir system, these water rights have historically been considered "guaranteed" in their full authorized diversion volume.

Those entities who deliver treated water generally developed triggers that were either based on the remaining municipal water rights available to the city for that year or the capacities of their treatment plants, such that high demands on the plants trigger a conservation stage. The conditions of the reservoirs are occasionally listed among triggers in public water supply DCPs, but have little bearing on the availability of municipal water. The conservation stages for cities included limitations on car washing and lawn watering, ranging from voluntary in early stages to assessed fines or other penalties in later stages.

A summary of the DCPs available for cities and water supply corporations at the time of writing is included as Appendix E, and summary tables for some of the larger systems are shown in Table 7-3 through Table 7-9. Additional information and model DCPs can be found on the TCEQ website at https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/contingency.html.

Table 7-3 East Rio Hondo Water Supply Corporation Drought Response

East Rio Hondo Water Supply Corporation		**1-May-14**
Basis of Drought	Reservoir level, irrigation district notice to disallow irrigation, water demand, system break/failure or contamination, distribution system pressure	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	Falcon and Amistad Reservoirs reach 40% of capacity as determined by the TCEQ	Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses.
Stage 2	a) Cameron County Irrigation District No. 2 or other IDs provide notice to ERHWSC that they will disallow farm irrigation water use within 60-90 days, b) distribution system pressures fall below 35 psi requirements for two consecutive days, c) ERHWSC consumer demand exceeds 85% of ERHWSC plant capacity for 15 days out of any consecutive 30 day period, or d) Falcon and Amistad Reservoirs reach 15% of capacity as determined by TCEQ.	Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses, such as irrigation, washing vehicles, and ornamental fountains and ponds.
Stage 3	a) Major water line breaks, or pump or system failures occur, which cause loss of capability to provide water service, b) natural or man-made contamination of the water supply source(s), c) rapidly occurring low-pressure conditions (less than 20 psi) due to any reason.	All requirements of Stage 2 shall remain in effect, except the following are prohibited: all irrigation of landscape, using water to wash any vehicle, and adding water to any type of pool.

Table 7-4 Brownsville Public Utilities Board Drought Response

Brownsville Public Utilities Board		**1-May-14**
Basis of Drought	Time of year, reservoir level, system break/failure or contamination, water demand/WTP capacity, projected water demand	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	Automatically initiated on May 1 of each year and for any of the following: a) Rio Grande Watermaster advises that a water shortage is possible due to low levels in Amistad and Falcon reservoirs, b) level of U.S.' water in Amistad and Falcon reservoirs reaches 51%, c) line break, pump, or system failure may result in unprecedented loss of capability to provide service, or d) peak demand on the distribution system and/or treatment plants is nearing capacity limits	Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses.
Stage 2	a) Level of U.S.' water in Amistad and Falcon reservoirs reaches 25%, b) analyses of water supply and demand indicate that the annual water allotment may be exhausted, c) line break or pump, or system failure will result in unprecedented loss of capability to provide service, d) peak demands on the distribution system and/or treatment plants are nearing capacity levels, or e) contamination of the water supply and/or transmission system may result in unprecedented loss of capability to provide service	Customers shall only be allowed to irrigate and wash vehicles following a certain schedule, golf courses shall follow restrictions in their approved water management plans, restaurants may only serve water to customers upon request, and the following are prohibited unless necessary for public health and safety: washing hard-surfaced areas, washing buildings or structures, using water for dust control, flushing gutters, and failing to repair controllable leaks within a reasonable period of time
Stage 3	a) Level of U.S.' water in Amistad and Falcon reservoirs reaches 15%, b) analyses of water supply and demand indicate the annual water allotment will be exhausted, c) major line break, or pump or system failure may result in unprecedented loss of capability to provide service, d) peak demand on the distribution system and/or treatment plants has exceeded capacity levels for three days, e) contamination of the water supply and/or transmission system will result in unprecedented loss of capability to provide service, or f) the inability to maintain or replenish adequate volumes of water in storage to provide for public health and safety	All requirements of Stage 2 shall remain in effect and in addition the schedule irrigation and vehicle washing will be further restricted, the use of water from hydrants is only allowed when necessary to maintain public health, safety, and/or welfare, and the following are prohibited: refilling outdoor pools (with some exceptions), operation of outdoor fountains or ponds without recirculation systems unless required to maintain aquatic life, hydrant and sewer flushing except for emergencies, and use of water from or pumping water into resacas
Stage 4	a) Major line breaks, or pump or system failures occur which cause unprecedented loss of capability to provide water service, or b) contamination of water supply and/or transmission system	All requirements of Stage 3 shall remain in effect and in addition the following are prohibited: all landscaping watering, use of water for construction purposes under special permit, adding water to swimming pools, adding water to any outdoor or indoor fountain or pond, except to maintain aquatic life

Table 7-5 City of Laredo Drought Response

City of Laredo		**1-May-14**
Basis of Drought	Water demand/WTP capacity, reservoir level	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	a) WTP flow is less than 85% capacity for 5 consecutive days, b) Amistad reservoir level reaches 51% capacity	Customer are asked to voluntarily reduce their water usage and the following are prohibited: allowing irrigation water to run off into a gutter, ditch, drain, street and failure to repair a controllable leak
Stage 2	a) WTP flow is at 85% capacity for 3 consecutive days, b) Amistad reservoir level reaches 25% capacity	All requirements for stage 1 remain in effect and the following are only allowed during certain scheduled times: irrigation with sprinkler systems, washing of vehicles, adding water to pools, irrigating parks/plazas/squares. The following are prohibited: operating any ornamental fountain or similar structure without a recycling system and washing paved areas, except to alleviate immediate fire hazards.
Stage 3	a) WTP flow is at 90% capacity for 1 day, b) Amistad reservoir level reaches 20% capacity	All requirements for stage 2 remain in effect, except the schedules to use water for certain activities are even stricter and irrigating athletic fields is also held to a certain schedule. No bulk water sales will be made by the City when the water will be transported outside of the City except for domestic/residential/livestock use. Fire hydrant water sales shall cease.
Stage 4	a) WTP flow is at 95% capacity for 1 day, b) Amistad reservoir level is less than 20% capacity	All requirements for stage 3 remain in effect and no applications for new or expanded water service connections will be approved without permission from the Utilities Director, water delivered to non-essential industrial and commercial customers will be reduced, and a maximum monthly water use allocation may be established for residential customers. The following are prohibited: irrigation, washing vehicles, adding water to pools.

Table 7-6 McAllen Public Utility Drought Response

McAllen Public Utility		**25-Feb-13**
Basis Of Drought	Water Treatment plant capacity being used, reservoir levels, system outages or failures.	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	In effect at all times	Customers asked to voluntarily limit water use to an amount absolutely necessary for health, business, and irrigation.
Stage 2	1. Demand reaches or exceeds 85% of capacity for 3 consecutive days 2. Amistad-Falcon reservoirs reach 40% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	The following are restricted: Irrigation, but drip method or hand-held buckets permitted at any time; washing motor vehicles, except commercial carwashes or service stations; washing or sprinkling foundations; adding water to swimming pools; operation of fountains or ponds, except with a recycling system; irrigation for golf courses, except those using wastewater effluent; hydrants restricted to firefighting and necessary activities. The following are absolutely prohibited: allowing irrigation water to run off into gutter, ditch, or drain; failure to repair controllable leaks; washing paved surfaces.
Stage 3	1. Demand reaches or exceeds 90% of capacity for 3 consecutive days 2. Amistad-Falcon reservoirs reach 25% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	All stage 2 restrictions except: further restrictions on means and schedule for irrigation, except by drip or hand-held buckets; watering of golf fairways is prohibited unless with wastewater effluent, reused water, or well water; customers to pay a water surcharge.
Stage 4	1. Demand reaches or exceeds 95% of capacity for 3 consecutive days 2. Amistad-Falcon reservoirs reach 20% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	All stage 2 and 3 restrictions except: further restrictions on means and schedule for irrigation; washing of motor vehicles not occurring on commercial carwashes and not in the immediate interest of public health and safety is prohibited; carwashes in the interest of public health and safety limited to 50% of monthly average; commercial nurseries, sod farmers, etc. limited to means and schedule restrictions; adding water to pools, except to maintain structural integrity, is prohibited; operation of fountains prohibited; customers to pay a water surcharge.
Stage 5	1. Demand reaches or exceeds 100% of capacity 2. Amistad-Falcon reservoirs reach 15% capacity 3. Including but not limited to: system outage, equipment failure, or supply contamination	All stage 2, 3, and 4 restrictions except: no applications for new, additional, or expanded water connections, lines, etc. are allowed except as approved by PUB; water allocations to non-essential customers reduced as established by the PUB; max monthly water allocation for residential customers established with revised rate schedules and penalties by the PUB; irrigation permitted only by handheld hoses, handheld faucet filled buckets; drip irrigation on set schedule; customers to pay a water surcharge.

Table 7-7 North Cameron Regional Water Supply Corporation Drought Response

North Cameron Regional Water Supply Corporation		**11-Sep-14**
Basis Of Drought	Water storage tank levels, production capacity.	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	North Cameron Regional Water Plant (NCRWP) ground storage tank falls below 50% capacity.	Request wholesale water customers initiate voluntary measure to reduce water use.
Stage 2	NCRWP ground storage tank falls to 25% capacity.	a) Discuss water supply/demand conditions with customers and request they initiate measures to reduce water use b) Implement pro rata curtailment of water diversions and/or deliveries to add 50,000 gallons per day to storage tank
Stage 3	NCRWP ground storage tank falls to 10% capacity.	a) Increase water blend ratios if possible, not exceeding 1000 ppm TDS b) Discuss water supply/demand conditions with customers and request they initiate measures to reduce water use and utilize alternative water supplies c) Implement pro rata curtailment of water diversions and/or deliveries to add 75,000 gallons per day to storage tank
Stage 4	NCRWP has no production capacity.	a) Notify customers of the need to switch to alternate water supplies b) If appropriate, notify member, county, and/or state emergency response officials c) Undertake necessary actions, including repairs and/or clean-up as needed. d) Prepare post-event assessment report on incident and critique of emergency response procedures

Table 7-8 Southmost Regional Water Authority Drought Response

Southmost Regional Water Authority		**1-May-14**
Basis Of Drought	Time of year, reservoir levels, system malfunction or failure, contamination of water.	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	Automatically initiated from May 1 to Sept. 30 of each year or if one or more of the following occur: 1. Watermaster advises the Brownsville PUB that a water shortage is possible. 2. Level of Amistad and Falcon Reservoirs reaches 51% or 1.66 million acre-feet. 3. Line breaks or system failures cause loss of service. 4. WTP is nearing capacity levels	Customers asked to voluntarily conserve water and adhere to the following restrictions: restrict means and/or schedule of irrigation of landscaped areas; minimize or discontinue use of non-essential purposes; and reduce fire hydrant and sewer line flushing.

Stage 2	1. Level of Amistad and Falcon Reservoirs reaches 25% or 834,600 acre-feet. 2. Line breaks or system failures cause loss of service. 3. Demands on Brownsville PUB distribution and/or WTPs near capacity levels. 4. Contamination of water supply or distribution system causes loss of service.	All Stage 1 restrictions in effect and any or all of the following restrictions: means and schedule of landscape irrigation restricted further; means and schedule of washing motor vehicles, boasts, planes, etc. restricted; water use for golf courses based on water mgmt. plan; restaurants prohibited from serving water unless requested; all non-essential uses prohibited.
Stage 3	1. Level of Amistad and Falcon reservoirs reaches 15% or 504,600 acre-feet 2. Line breaks or system failures cause loss of service 3. Demands on SRWA's distribution and/or WTP exceed capacity for 3 days 4. Contamination of water supply or distribution system causes loss of service 5. Inability to maintain or replenish water in storage for public health and safety.	All Stage 1 and 2 restrictions and any or all of the following: means and schedule of landscape irrigation and residential car washing restricted further; water from hydrants limited to firefighting or other activities necessary to maintain public health and safety or for construction under special permit; filling swimming pools prohibited; operation of fountain or pond prohibited except for aquatic life; hydrant and sewer line flushing permitted only for emergency; use of water for scenic and recreational ponds and lakes prohibited.
Stage 4	1. Line breaks or system failures cause loss of service 2. Contamination of water supply and/or distribution system.	All State 1, 2, and 3 restrictions remain in effect and any or all of the following: all landscape watering is prohibited; use of water for construction under special permit prohibited; washing of motor vehicles, boats, planes, etc. prohibited; filling of pools to a maintenance level is prohibited; water for maintenance level of fountains or ponds except to support aquatic life is prohibited. Water rationing can be initiated with any or all of Stage 4 restrictions

Table 7-9 City of Weslaco Drought Response

City of Weslaco		**1-May-09**
Basis Of Drought	Reservoir level, projected water demand, system break/failure	
Drought Stage	**TRIGGERS:**	**ACTIONS:**
Stage 1	a) Level of U.S. waters in Amistad and Falcon reservoirs reaches 51%, b) water demand projections for the year suggest available water rights may be used at 95%	Request customers to voluntarily reduce water usage
Stage 2	a) Level of U.S. water in Amistad and Falcon reservoirs reaches 25%, b) a condition causes system-wide problems so the normal level of water service may be diminished for a period of time, c) water demand projections for the year suggest available water rights may be used at 98%	The means and/or schedule for the following will be restricted: watering of grass and vegetation, washing of vehicles, adding water to pools, and irrigating golf courses. The following are prohibited: allowing water to run off into gutters or streets, washing of buildings, trailers, railroad cars, maintaining defective home plumbing, use of hydrants except for firefighting, ornamental fountain without recirculation, use of water to wash down hard surfaced area, and use of water for dust control.

Stage 3	a) Level of U.S. water in Amistad and Flacon reservoirs reaches 15%, b) a condition related to extraordinary circumstances severely and immediately diminish the ability to deliver a normal level of water, c) water demand projections for the year suggest available water rights may be used at 100%	The following are prohibited: new service connections to the water system if another water source is already used, serving restaurant customers water when they do not ask for it, use of water for scenic and recreational ponds or lakes, use of water for pools, use of water to put new agricultural land into production, use of water for new planting or landscaping, and acceptance of applications for new or extended water service connections without approval by City. Industrial and commercial users must implement an individual curtailment plan and residential customers will receive a maximum monthly usage amount.

7.3.2 Existing and Potential Emergency Interconnects

In accordance with Texas Administrative Code (31 TAC 357.42(d)) the RWPG has collected confidential information on existing interconnects. The majority of water users in Region M are located along the Rio Grande, or along canals that convey Rio Grande water. In a sense, the region is highly inter-connected. The distribution system for raw Rio Grande water includes the reservoir system and the 27 Irrigation Districts, many of which are either interconnected or have high potential to be connected. The RWPG has reached out through representatives of the Lower Rio Grande Valley Water District Managers Association to the District managers for information about interconnects between raw water systems.

Municipal utilities supplying treated water to retail customers are becoming more interconnected across the region. In order to evaluate current connections between systems, the Region M Planning Group appointed a selection of members to a Drought Response Committee. This committee met a number of times to collect and evaluate information about drought response plans and interconnects. Members of this committee requested information about interconnects from the South Texas Water Utilities Manager Association for entities in Cameron and Hidalgo Counties, and all utilities in the other six counties were contacted individually. Although utilization of emergency interconnects was not included in the DCP that were reviewed, Table 7-10 shows known interconnections between public water supply systems and whether the connections are used for regular service or only in emergencies. Detailed confidential information about these interconnections was submitted securely to the Executive Administrator of the TWDB.

Table 7-10 Emergency Interconnections between Public Water Supply Systems

Public Water Supply System	Interconnects	Type of Connection
Agua SUD	La Joya	One-way emergency interconnect
	Peñitas, Palmview, Sullivan City, Mission	All within Agua SUD service area
East Rio Hondo WSC	Harlingen WW	Connection for Regular Service with capacity to increase in emergencies
	City of Los Fresnos	Connection for Regular Service
	Olmito WSC	Connection for Regular Service with capacity to increase in emergencies
	North Cameron Regional	Connection for Regular Service

Public Water Supply System	Interconnects	Type of Connection
	Combes	Emergency Interconnect
Harlingen Waterworks	City of La Feria	Emergency Interconnect
	City of Combes	5 Connections for Regular Service
	City of Primera	2 Connections for Regular Service
	City of San Benito	Emergency Interconnect
	City of Palm Valley	2 Connections for Regular Service
	East Rio Hondo WSC	Connection for Regular Service
	Military Highway WSC	Connection for Regular Service
City of McAllen	Edinburg	Used only during times of high demand.
	Pharr	Used only during times of high demand.
	Mission	Used only during times of high demand.
	Hidalgo	Used only during times of high demand.
	HCID No. 2, HCWID No. 3, United ID	McAllen receives raw water from these Districts
Military Highway WSC	Harlingen WW (see above)	
	Los Indios, Progreso, San Juan	Military Highway serves these entities
North Alamo WSC	City of Mercedes	Emergency Interconnect
	Sebastian MUD	Emergency Interconnect
	City of Lyford	Emergency Interconnect
	City of Raymondville	Emergency Interconnect
	City of Edcouch	Emergency Interconnect
	City of Elsa	Emergency Interconnect
	City of La Villa	Emergency Interconnect
	City of Donna	Connection for Regular Service
	City of Edinburg	2 Connections for Regular Service
	Military Highway WSC	Connection for Regular Service
	Quiet Village Utilities	Connection for Regular Service
	Port Mansfield PUB	Connection for Regular Service
	Delta Lake ID, Donna ID, HCID No.2, HCID No. 1, ERHWSC	NAWSC receives raw water from these Districts
Olmito WSC	Los Fresnos	Two-Way Emergency Interconnect
	Valley MUD #2	Two-Way Emergency Interconnect
Zapata County Waterworks	Zapata Co. WCID #16	Connection for Regular Service
Brownsville PUB	Brownsville, El Jardin WSC	Connection for Regular Service
Laguna Madre Water District	Laguna Vista, Port Isabel, South Padre Island	All within Laguna Madre Water District's service area
Valley MUD #2	Military Highway WSC	Emergency Interconnect
	Olmito WSC	Emergency Interconnect
	Southmost Regional Water Authority	Connection for Regular Service
	Rancho Viejo	Connection for Regular Service
Rio Grande City	Rio WSC	Connection for Regular Service
City of Roma	Escobares	Connection for Regular Service
Weslaco	Mercedes	Emergency Interconnect

7.4 Emergency Responses to Local Drought or Loss of Municipal Supply

Municipal WUGs that are of particular concern for emergency drought response are identified as those that have a population of 7,500 or less and have a sole-source of water, even if that water is provided by a WWP or, in the case of the Rio Grande region, if those entities receive waters from the Rio Grande from multiple Irrigation Districts. Additionally, all County-Other WUGs are considered.

WUGs that meet these criteria are shown in Table 7-11, with the 2010 Census population and current suppliers. Most of these districts rely exclusively on water from the Rio Grande system, and have no secondary source available to them (the Districts that provide Rio Grande surface water are listed as the Current Supply). Those that indicate their sole supply is groundwater are generally geographically constrained, and limited to local groundwater supplies.

Table 7-11 WUGs Identified for Emergency Drought Response Evaluation

County	Entity	Census Population 2010	Current Supply (1)	Current Supply (2)
Cameron	Combes	2,895	La Feria ID	
Cameron	County-Other	44,311	Surface Water (various)	Groundwater (various)
Cameron	La Feria	7,302	La Feria ID	
Cameron	Laguna Vista	3,117	Laguna Madre WD	*limited non-potable reuse avail
Cameron	Olmito WSC	3,361	CCID 6	
Cameron	Palm Valley	1,304	Harlingen ID 1	
Cameron	Port Isabel	5,006	Laguna Madre WD	*limited non-potable reuse avail
Cameron	Rio Hondo	2,356	CCID 2	
Cameron	Santa Rosa	2,873	La Feria ID	
Cameron	South Padre Island	2,816	Laguna Madre WD	
Hidalgo	County-Other	32,223	Surface Water (various)	Groundwater (various)
Hidalgo	Edcouch	3,161	HCCID 9	
Hidalgo	Elsa	5,660	HCCID 9	
Hidalgo	Hidalgo County MUD #1	5,412	HCID 1	
Hidalgo	La Villa	1,957	HCCID 9	
Hidalgo	Palmhurst	2,607	Sharyland WSC	
Hidalgo	Palmview	5,460	Agua SUD	
Hidalgo	Penitas	4,403	Agua SUD	
Hidalgo	Sullivan City	4,002	Agua SUD	
Jim Hogg	County-Other	742	Local Groundwater	
Jim Hogg	Hebbronville	4,558	Gulf Coast GW	
Maverick	County-Other	28,010	Surface Water (various)	Groundwater (various)
Starr	Agua SUD	254	HCID 6	HCID 16
Starr	County-Other	24,657	Surface Water (various)	Groundwater (various)
Starr	Escobares	1,188	City of Roma	
Starr	La Grulla	1,622	Direct RG	
Starr	Rio WSC	3,298	Self-supplied SW	Rio Grande City
Starr	Union WSC	6,350	United ID	HCID 2
Webb	County-Other	6,146	Surface Water (various)	Groundwater (various)

County	Entity	Census Population 2010	Current Supply (1)	Current Supply (2)
Webb	El Cenizo	3,273	Webb CO Water Utility	
Webb	Rio Bravo	4,794	Webb CO Water Utility	
Willacy	County-Other	468	Surface Water (various)	Groundwater (various)
Willacy	Lyford	2,611	Delta Lake ID	
Willacy	Sebastian Mud	1,834	La Feria	
Zapata	County-Other	2,321	Surface Water (various)	Groundwater (various)
Zapata	San Ygnacio MUD	835	Self-supplied SW	

Emergency shortage response recommendations for the entities listed above are separated into those with surface water as the sole source, and those with groundwater as the sole source. County-Other users that do not qualify as WUGs individually, are likely to fall into either the groundwater or surface water dependent categories.

Sole Source: Surface Water

Entities that depend entirely on Surface water in Region M are very common. If shortages are experienced in one location as a result of insufficient water rights to meet demand or to deliver water, there is a water market and provisions that allow for entities in an emergency to purchase emergency water. Purchase of emergency water may be expensive and insufficient water rights may cause supply uncertainty in a city or utility service area. It is therefore recommended that entities purchase water rights when feasible.

Interconnections between utilities will build greater resilience into the Region's utilities by providing an alternate source of treated water if either system is damaged or fails. Entities that experience push-water requirements when irrigation deliveries are curtailed may also benefit from both raw and treated water interconnects, which could allow districts and utilities to coordinate and consolidate deliveries in a limited number of canals.

Any emergency that impacts the quality of the water in the Rio Grande has the potential to cause significant harm to the region. Because contamination could come from either the U.S. or Mexican side of the river, there is an additional level of uncertainty regarding potential contaminants. This limits the ability of the region to prepare for this kind of event and may also limit the ability to respond quickly. In the past, there have been releases into the Rio Grande that were only identified by a widespread fish kill. There is currently no emergency response plan in place to handle the release of contaminants into the Rio Grande.

A release in April of 2014 on the Rio Salado (a Rio Grande tributary in Mexico) was identified by the Mexican counterpart to the International Boundary Water Commission (IBWC), the Comision Internacional de Limites y Aguas, which reported that a release had occurred, but the quantity and the material were unknown.[2] Later information showed that the release was on April 8, but the notification was not until April 30th.

[2] Taylor, Steve. "Darling: Fish Kill Highlights Need For Rio Grande Emergency Plan" Rio Grande Guardian, March 14, 2014. http://riograndeguardian.com/darling-fish-kill-highlights-need-for-rio-grande-emergency-plan/, accessed April 6, 2015.

TCEQ conducted testing on the Rio Grande upstream and downstream of the inflows from the Rio Salado, which took five days to analyze. In this case, the results of broad-spectrum pollutant analysis showed that there were no contaminants that could endanger human health, and other contaminants of concern, like heavy metals, were beneath federal and state limits for drinking water. However, this incident drew attention to the lack of emergency planning for the Region.

Regular water quality testing and reporting is already in place in some locations to alert farmers of high Total Dissolved Solids (TDS) in the river. This type of system could be expanded upon to provide regular reports of water quality to utility managers and agencies like IBWC and TCEQ. This kind of water quality analysis is complicated by the fact that the potential contaminants are not known in many cases. Understanding the timing of contaminant transport through the system could allow entities to pump enough water to fill reservoirs before the contaminant has reached that location. However, the success of this approach is contingent on timely information about releases. At a minimum, information must be communicated to utilities and to the public in an accurate and timely manner so that safe drinking water can be provided immediately.

Long-term recommendations for entities that rely solely on surface water include expansion of alternate water supplies, including fresh and brackish groundwater where available. Emergency recommendations are listed below in Table 7-12.

Table 7-12 Emergency Water Shortage Responses: Surface Water Dependent WUGs

Emergency Shortage	Responses
Insufficient Surface Water Rights	Purchase surface water, highest stage drought restrictions
Water Treatment Plant Failure	Interconnects with other systems, truck in water, highest stage drought restrictions
Rio Grande Contamination	Immediate testing, Pumping and storage of safe water, interconnects with systems that have alternate supplies, truck in water, boil notice to customers, highest stage drought restrictions

Sole Source: Groundwater

Utilities that depend exclusively on groundwater tend to be more isolated from other sources and other cities. For instance, Hebbronville is over 30 miles from the nearest city, Falfurrias. For entities that are dependent on groundwater, it is encouraged that the entity actively monitor water levels in wells, especially in high-demand periods. Water levels can be used to trigger drought responses, and to guide expansion of wellfields or deepening of wells. Additionally, groundwater quality may be an indicator of decreasing availability from a well or wellfield.

Emergency responses for entities that rely solely on groundwater are shown in Table 7-13.

Table 7-13 Emergency Water Shortage Responses: Groundwater Dependent WUGs

Emergency Shortage	Responses
Insufficient Well Production	Highest stage drought restrictions Deepen wells (if possible) Interconnects with other systems (if possible) Truck in water
Water Treatment Plant Failure	Highest stage drought restrictions Interconnects with other systems (if possible) Truck in water
Groundwater Quality	Immediate testing Highest stage drought restrictions Additional emergency treatment (if possible) Truck in water

7.5 Region-Specific Drought Response Recommendations

Drought response recommendations are made for each water source below. Model Drought Contingency Plans are included for all WUG types in Appendix E.

7.5.1 Amistad-Falcon Reservoir System Drought Response Recommendations

Because DMI and Irrigation/Mining water rights are handled differently in the Amistad-Falcon Reservoir System, they are addressed separately here.

DMI Water Right Holders

Cities and industrial users in Region M experience drought under the following scenarios, described in Table 7-14 with recommendations specific to each.

Table 7-14 Municipal Shortage Scenarios and Recommendations

Shortage Scenario and Triggers	Recommended Responses
Insufficient water rights to meet demand. An entity may have sufficient treatment capacity to meet their demands, but have insufficient water rights to meet drought year demands. Triggers should be based on useable balance calculations and monthly/weekly demand projections. When the balance of water available for the remainder of the year doesn't exceed the demand projections by a reasonable margin, severe drought response should be implemented. When the projected demands exceed the balance of water, critical drought response should be implemented.	**Best Practices:** Use of water rights should be managed carefully, and cities should track their useable balance over the year compared with seasonal/monthly demand projections. This will allow a city to implement conservation measures early in the year to stay within their water budget. It is recommended that any city that projects a shortage should purchase water rights when feasible. **Severe Conditions:** Request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, purchase water as it is available **Critical Conditions:** Implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, purchase water as it is available

Shortage Scenario and Triggers	Recommended Responses
Water treatment plant capacity. Municipal utilities with sufficient water rights may experience a shortage if, during their peak demand months, the capacity of the water treatment plant is not sufficient to meet permit requirements Triggers should be based on daily treatment volumes and TCEQ WTP capacity rules. When 85% capacity is reached for three consecutive days, severe drought response should be implemented. When 95% capacity is reached, critical drought response should be implemented.	**Best Practices:** Conservation programs can reduce demands on the water treatment plant. The long-term solution is expansion of water treatment plant(s) capacity and inter-connections with other facilities. **Severe Conditions:** Request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, utilize emergency interconnects **Critical Conditions:** Implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, utilize emergency interconnects
Push water. Even with sufficient water rights to meet demands and to cover normal delivery losses, some municipalities, especially those who receive surface water from Irrigation Districts that serve mostly irrigation water users, may need additional water to meet minimum operational requirements in the District conveyance system if irrigation water is curtailed. Triggers should be based on 1) the requirement of irrigation water to deliver DMI water in a given District, 2) the useable balance available to irrigators in the District, and whether those irrigators are on allocation, and 3) the storage capacity available to the utility. Severe drought restrictions should be implemented if stored water is at or within a small margin of the projected demands before the next feasible delivery from the district. Critical drought restrictions should be implemented if water in storage is less than the projected demands before the next feasible delivery from the district.	**Best Practices:** First, utilities should have a clear communication plan in place with the Irrigation District that alerts the city when irrigation water users may be put on allocation. This may include a drought trigger associated with Amistad/Falcon reservoir storage levels and the useable balance of irrigation accounts in the District. Second, utilities should evaluate their current conveyance methods to see if there are alternate canals or districts which may be able to serve their systems in the case of a push water shortage. Third, where possible, entities should increase their raw water storage to allow for more time between deliveries that need to be timed to coincide with irrigation deliveries. Lastly, interconnections and emergency agreements with other utilities and other sources are recommended. **Severe Conditions:** Request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, utilize emergency interconnects, identify water that may be available for purchase as push water **Critical Conditions:** Implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, utilize emergency interconnects, identify water that may be available for purchase as push water

Irrigation and Mining Water Right Holders

Farmers can respond to drought through planning, crop selection, highly efficient operations, and on-farm demand reduction strategies (like narrow border citrus and drip irrigation). Farmers and Irrigation Districts should maintain useable balance calculations and monitor reservoir levels in order to facilitate planning. Selection of crops, in conjunction with available demand reduction strategies, can allow for farmers to maximize their yield in years of drought. Crop selection tools that take current costs and market values into account have been made available to farmers in the high plains, and could be updated with information specific to the Region.

Cooperation with the Irrigation Districts to increase the operational and conveyance efficiency could yield a significant amount of water to farmers. This is discussed as a Water Management Strategy in Chapter 5.

Mining water use, including oil and gas drilling, can be decreased by close controls of leaks and spills, on-site reuse, and new technology or approaches that require less water. Because mining water rights are subject to the same decrease in reliability in drought years, it is highly encouraged that mining water users identify and implement water conservation measures. Both Irrigation and Mining water demand can be scaled according to available water, and alternate sources, like reuse or groundwater, may be used when surface water is scarce.

7.5.2 Groundwater Supply Drought Response Recommendations

May users in Region M rely on groundwater as their main source of supply. The aquifers and subsections of aquifers within Region M exhibit a broad range of drought response characteristics, which require specific drought triggers and responses to be developed for each situation.

In general, groundwater wells may be impacted by increased pumping in the area and by decreasing recharge as a result of drought. Insufficient groundwater or groundwater of acceptable quality may result in a shortage.

For general drought preparedness, wells should regularly be monitored for changing water levels and changes in quality. If required, additional temporary treatment may need to be implemented in order to meet drinking water standards. It is important to understand what temporary treatment options may be used in the case of a shortage. Additional wells, and emergency rehabilitation or deepening of existing wells can help to increase supplies in a shortage.

Under **severe conditions**, established when supplies may not be sufficient to meet demands within 60 days or decrease in well productivity or quality, it is recommended that city utility managers request voluntary municipal and industrial conservation, limit unnecessary municipal usage, consider billing rate incentives for conservation in severe drought periods, and utilize any available emergency interconnects.

Under **critical conditions,** established when demands are expected to exceed supplies within 30 days, it is recommended that city utility managers implement mandatory municipal and industrial water use restrictions, restrict non-essential municipal water use, consider billing rate incentives for conservation in critical drought periods, and utilize emergency interconnects. In the most extreme cases, trucking in water may be the best alternative to meet immediate needs.

7.6 Drought Management WMS

The Water Management Strategies (WMS) that were considered for Region M included conservation strategies that are intended to reduce demand or reduce losses, and the development of new supplies, which is intended to make the region more resilient to drought. Drought Management WMS that were evaluated for all possible WUGs include the following:

i. Advanced Municipal Conservation. This strategy was recommended for all municipal WUGs with conservation goals and rates based on current and projected per-capita water use.

ii. Irrigation District Conservation. Irrigation District conveyance and operational efficiencies were estimated to range between 60% and 72%. Improvements specific to each district were recommended. The water savings achieved through the selected strategies were shared among all of the users supplied by each district. These strategies may also alleviate some push water concerns.

iii. Municipal potable reuse. This strategy was considered for all WUGs and recommended for those WUGs with sufficient wastewater effluent flows for cost-effective implementation.

iv. Municipal non-potable reuse. This strategy was recommended for select entities that had identified a potential user for non-potable effluent, thus reducing demand for potable water.

v. Mining conservation and reuse were recommended for all mining WUGs.

vi. Power generation water use can be decreased by close controls of leaks and spills, on-site reuse, and new technology or approaches that reduce demand for water. Contracts for effluent from nearby wastewater treatment plants can provide a reliable source of water that has fewer negative impacts on water availability in the Region. It is recommended that both on-site and off-site effluent be reused to minimize water demands for power generation. Steam-electric conservation and reuse were recommended for steam-electric WUGs.

vii. Manufacturing water use can be decreased by close controls of leaks and spills, on-site reuse, and new technology or approaches that reduce demand for water. Contracts for effluent from nearby wastewater treatment plants can provide a reliable source of water that has fewer negative impacts on water availability in the Region. It is recommended that both on-site and off-site effluent be reused to minimize water demands for manufacturing.

viii. Irrigation WMS were recommended as methods to alleviate the impacts of drought on farmers. On-farm conservation may not significantly reduce irrigation demand, but it does allow for continued operations of farmland in drought periods, which is critical to the regional economy.

ix. Livestock water supplies are from both groundwater and surface water in Region M. In a drought scenario, it is important that windmill pumps which stock ponds and tanks are only used when needed, rather than allowed to run at all times. Agricultural and livestock demands may be significantly increased in severe drought, which can impact groundwater supplies. In addition to careful management of water supplies, there are drought relief programs that may be pursued to assist with livestock demands in a severe drought, including the emergency Haying and Grazing Program.

Texas Water Development Board

RIO GRANDE
REGIONAL WATER PLANNING GROUP

2016 Region M Water Plan

Chapter 8: Legislative Recommendations and Unique Sites

BLACK & VEATCH
Building a world of difference.

Table of Contents

Figures

Tables

List of Abbreviations

Acre-ft./year	acre-feet per year
BPUB	Brownsville Public Utilities Board
BRACS	Brackish Resources Aquifer Characterization
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
IBWC	International Boundary Water Commission
PUB	Public Utilities Board
RWPG	Regional Water Planning Group
SB 1	Senate Bill 1
TAC	Texas Administrative Code
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
USDA	United States Department of Agriculture
WAC	Watermaster Advisory Committee
WAM	Water Availability Model
WMS	Water Management Strategy

Chapter 8. Legislative Recommendations and Unique Sites

8.1 Introduction

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 Region M Water Planning Group elected to consider recommendations in each of these areas, which are presented in this chapter.

8.2 Designation of Ecologically Unique Stream Segments

The Texas Legislature has provided clarification in Texas Water Code 16.051(f) that designation of a stream segment as having unique ecological value "solely means that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream segment designated by the legislature under this subsection."

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.

8.2.1 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.

8.2.2 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. Additional comments from TPWD on the 2016 Initially Prepared Plan for Region M states that “TPWD continues to see importance I recommending and designating significant stream segments” and offers support for the next planning cycle. The complete comments are included in Appendix H.

The Region M Planning Group 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.

Subsequent to the 2006 plan, a request for additional consideration of unique stream segments was made. An Environmental Subcommittee to the Region M Water Planning Group 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 to discuss 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 Region M Water Planning Group 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. No further appeals for designation of unique stream segments were made in the fifth cycle of planning.

Figure 8-1 shows the locations of the TPWD proposed ecologically significant stream segments and Table 8-1 provides further detail about the potentially unique stream segments.

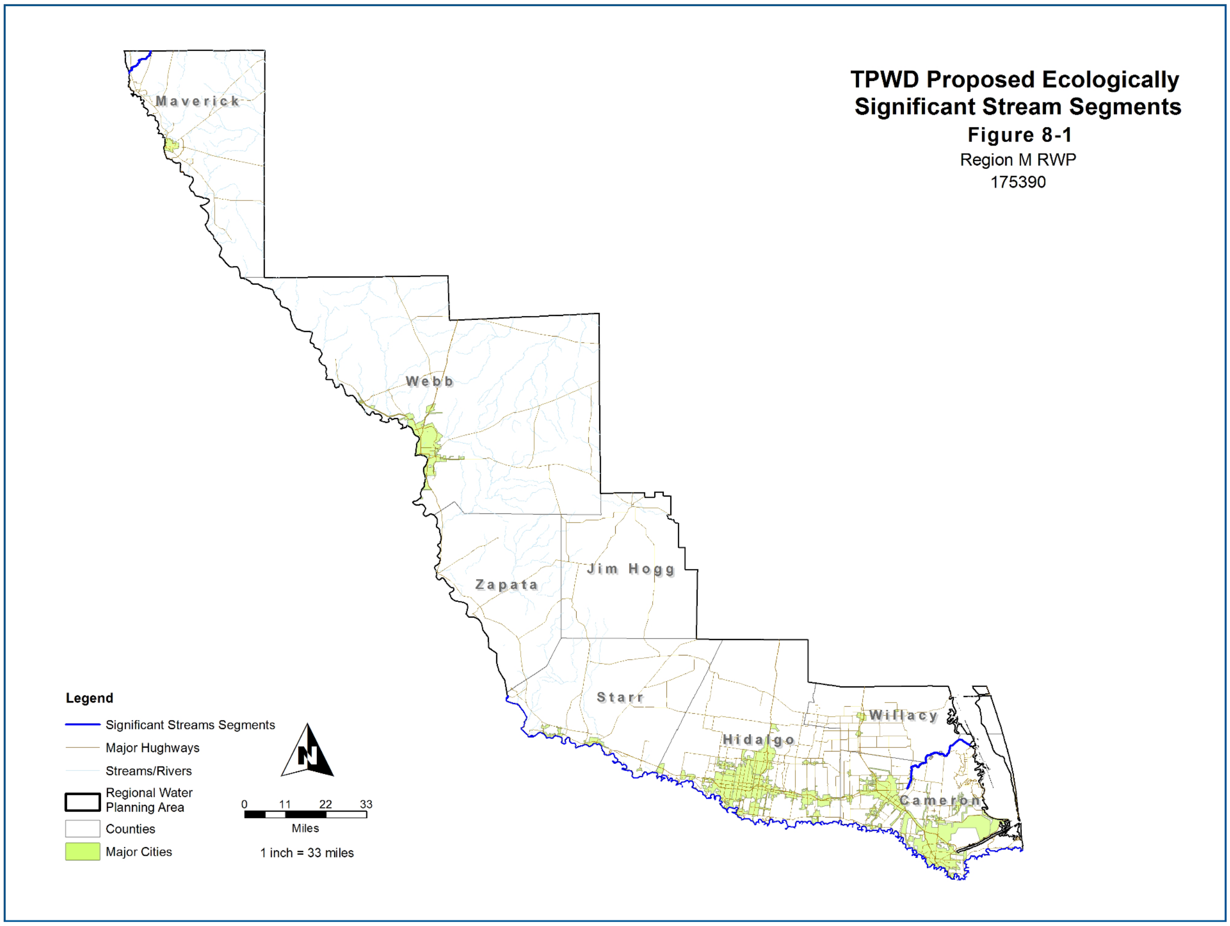

Figure 8-1 TPWD Proposed Ecologically Significant Stream Segments

8.2.3 Recommendation

The Region M Water Planning Group 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 Region M Water Planning Group 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 Region M Water Planning Group would be that a designation could be used to support further regulation of upstream development and environmental flows. Lack of action by the Region M Water Planning Group 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.

Table 8-1 Potential Ecologically Unique River and Stream Segments within the Rio Grande Region

River Segment Number	TCEQ Segment ID	Basin/ Waterway	Location/ Sublocation	Remarks and Nominating Entity	Function
Function Key: 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

River Segment Number	TCEQ Segment ID	Basin/ Waterway	Location/ Sublocation	Remarks and Nominating Entity	Function
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 Gulf of Mexico upstream to just east of Brownsville	No documentation submitted Nominated by: FWS – Lower Rio Grande National Wildlife Refuge	**S:** Unique marine organisms, including blue land crab & red land crab
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

River Segment Number	TCEQ Segment ID	Basin/ Waterway	Location/ Sublocation	Remarks and Nominating Entity	Function
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 Region M Planning Group 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	

8.3 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.

The reservoir sites discussed below have been considered by the Region M Planning Group.

8.3.1 Brownsville- Matamoros 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-ft./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 alternative water supply strategy for the City of Brownsville, and was recommended in the 2001 and 2011 Rio Grande Regional Water Plans.

8.3.2 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-ft./year 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 in this round of planning.

8.3.3 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 as presently structured will not develop additional water supply, and is therefore not recommended as a water management strategy. The goals of the project are to improve water quality, construct a new diversion location for a new regional water treatment plant, assist with flood control, 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-ft. of water. Laredo intends to lease water rights for the initial filling of the reservoir. The Laredo Low Water Weir project is included as a potentially feasible, considered but not recommended WMS in this plan.

8.3.4 Hidalgo County Drainage District Delta Watershed Project

The Hidalgo County Drainage District has proposed construction of two reservoirs in northeastern Hidalgo County to capture tailwaters and precipitation run-off for beneficial use, discussed in detail in Chapter 5. The Santa Cruz/Lake Edinburg reservoir (425 Acres) and the proposed Delta Region Reservoir (350 Acres) are both in the Delta Watershed, which is distinct from other portions of the Nueces Rio Grande Watershed, and impact no downstream water rights. Recently established environmental flow requirements for the Nueces Rio Grande basin do not place any limitations on the drainageways that will be impacted by this strategy. These reservoirs will allow for better control and management of flows in the drainage network, and will allow for the Drainage District to treat and distribute a portion of the flows for irrigation and as a raw water source for municipal treatment and distribution. The Edinburg reservoir requires construction of a ring dike around a 10 ft. depth reservoir. The existing Panchita Control Structure and associated weir would be raised for the Delta Reservoir, which is also proposed to be 10 ft. deep.

8.3.5 United Irrigation District Off-Channel Reservoir

A storage reservoir is proposed between the pump station on the Rio Grande River and the first pump station within the ID canal network which would have a 640 AF storage capacity, as opposed to the estimated 80 AF capacity that is currently available in the main canal. This would allow for general operational improvements within the district, but will also yield an estimated additional 2,000 AF of supply in a drought of record scenario without any additional water rights. This reservoir will allow United ID to better meet the needs of Region M over the planning horizon and beyond.

8.3.6 Recommendations

The Brownsville-Matamoros Weir and Reservoir has been considered a recommended alternative, based on cost, yield, and permitting concerns. The Laredo Low Water Weir may have considerable value as a flood control mechanism, but does not meet the requirements to be recommended in the plan because it does not provide an increase in supply. The Banco Morales Reservoir, Delta Watershed Project reservoirs, and the United Off-Channel Reservoir have all been recommended by the RWPG and are recommended as reservoir sites in order to ensure supplies to water users in Region M over the planning horizon.

8.4 Legislative 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)]

8.4.1 Recommendations on State Issues

1. The RWPG recommends continued evaluation of the connection between the pumping of groundwater and its impact on surface water, specifically the impact of pumping groundwater in the Pecos and Devils River valleys on the flows into the Rio Grande. For example, current studies indicate that up to one-third of the recharge flows into Amistad Reservoir depend on flow from the Pecos and Devils river valleys and Goodenough Springs, which are shown to be sensitive to groundwater pumping.[1] There is not an underground water district in the affected area, which could provide a mechanism for local management of these interconnected resources. The RWPG recommends enforcement of current laws and consideration of new laws establishing rules for permitting which acknowledge the impact of groundwater development on surface water.
2. The Lower Rio Grande Valley farmers, as a result of the uncertainty of surface water delivery and the fact that most farmers do not own their own Rio Grande water rights, are limited in their ability to provide collateral for loans for on-farm conservation and improvements. This makes many of the loan programs currently available to farmers in other regions of Texas difficult for farmers in the Rio Grande Valley to access. Additionally, in many cases the types of irrigation conservation measures used in the RGV are installed underground as opposed to above ground equipment like center pivot systems used in the High Plains. Financial entities prefer the salvage value of above ground equipment for collateral as compared to underground equipment, which can mean another barrier to accessing loans. TWDB and the State of Texas should work with farmers in the Region to develop loan programs that enable on-farm water conservation specific to this Region.

---

[1] Dr. Green, Devils and Pecos River Watershed Basin Study Proposal

3. Region M encourages collaboration between farmers in the Rio Grande Valley, local political subdivisions, and the TWDB to establish a mechanism or entity in the Rio Grande Valley to accept on farm irrigation conservation loans from the TWDB and to lend those funds to farmers for on-farm water conservation.
4. Changes in the purpose of use for water rights, as well as recent droughts make it imperative that the Rio Grande Water Availability Model is periodically updated. The current drought of record, as established by the current Rio Grande WAM, extends from 1993 through 2000, although the actual drought continued past that date and may have been exceeded since, which could significantly impact Water Availability, as the basis for planning. The State should fully fund appropriate revisions and updates to the WAM to include naturalized flows using the most current data available, allowing for a more comprehensive estimate of the drought of record.
5. The State should continue to consider the impacts of climate change in terms of Regional Water Planning and future water supplies. The US. Bureau of Reclamation's Lower Rio Grande Basin Study evaluated climate impacts on the availability, which should be considered in future planning efforts.
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. The State should investigate the true impact and treaty compliance factors associated with the potential construction in Mexico of an aqueduct from Falcon Reservoir to Matamoros, Tamaulipas, Mexico.
8. The State should assist in finding new technical and financial resources to help the region combat Arundo Donax, aquatic weeds, and salt cedar and thus protect its water supplies. The Region M Planning Group encourages funding for projects aimed at eradicating Arundo Donax, aquatic weeds and salt cedar in the Rio Grande watershed and for ongoing long-term brush management activities. The USDA has studied and implemented a biological controls program with costs and quantified water savings. [2]
9. The State should continue providing technical and financial resources to fully develop the regional GAM. The Brackish Resources Aquifer Characterization (BRACS) 2014 report for the Lower Rio Grande Valley is an essential resource as brackish groundwater desalination continues to be one of the recommended strategies to meet future needs.[3]
10. The TCEQ should provide assistance to the Region M Planning Group as it reviews rules on converting water rights from one use to another and considers appropriate rule amendments, if necessary. This includes reviewing the necessity to apply the conversion factor rule if it has the effect of reducing the water volume demand on the Rio Grande making the reservoir system less efficient. In this regard it is noted that the conversion rule is an administrative rule in that it was not required in the Court adjudication in the Valley Water Suit Judgment or in the Adjudication case covering the Middle Rio Grande.

---

[2] Goolsby, John. Biological Control of Arundo Donax; and invasive weed of the Rio Grande Basin. USDA, 2007.
[3] Meyer, John E. Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas, September 2014. Texas Water Development Board.

11. The RWPG encourages entities within the region to cooperate to resolve water issues through such means as regional water and wastewater utilities. The Rio Grande Regional Water Authority, Southmost Regional Water Authority, and other entities have pursued and in some cases constructed regional projects that supply water to multiple cities.
12. The formation of groundwater conservation districts should be encouraged as a means to protect groundwater supplies, which are increasingly being tapped as a new water supply for municipal, industrial, and mining use. As the aquifers in Region M are more extensively developed, the impact of pumping has started to be seen in spring flows and drawdown. Region M supports new and expanded groundwater districts to protect the regional groundwater resources, and recommends that the State provide continued technical assistance regarding formation, structure, and technical basis for GCDs to operate meaningfully.
13. The State should appropriate sufficient funds to the Texas Railroad Commission to allow for capping abandoned oil and gas wells that threaten groundwater supplies.
14. The Texas Legislature should provide technical and financial assistance to implement water management strategies identified in the regional water plans, including the development and implementation of Advanced Water Conservation measures with statewide public outreach and education.
15. Educational programs for farmers, Irrigation District Boards of Directors, and Irrigation District employees are recommended and should be supported by the TWDB, TCEQ, and the universities in Texas.
16. The Rio Grande Center for Ag Water Efficiency (Texas AWE) flow meter demonstration and calibration facility is intended to be available as an educational and testing and calibration resource for Districts looking to implement or expand their metering programs. Continued funding and expanded use of these facilities is recommended by the Region M Planning Group.
17. Continued evaluation of Irrigation District infrastructure is recommended, including the work that has been done by Texas A&M University through the Texas Water Resources Institute and the Irrigation District Engineering and Assistance Program (IDEA). This program has assisted districts in mapping and evaluating the current state of their conveyance systems and rates of urbanization. These measures can assist districts in prioritizing improvements so that the greatest gains are made with the least cost.

8.4.2 Recommendations on National and International Issues

18. The State of Texas and the U.S. Congress as well as 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. Mexico should plan in advance to meet the requirements of the 1944 Treaty. An important step would be for Mexico officially recognize the U.S. as a water user and allocate water to the U.S. as part of their annual water allocation process.

19. 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."
20. 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.
21. 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 the U. S. Congress should be encouraged to appropriate money to pay for approved projects.
22. 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-ft. (431,721,000 cubic meters) annually." A drought condition occurs when there is less than 1,050,000 acre-ft. 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, of which the U. S. 1/3 share is 350,000 acre-ft. 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 and at other points of diversion by Mexico users downstream of Anzalduas Dam.
23. 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.
24. IBWC should restore the Rio Grande below Fort Quitman, Texas.
25. The IBWC should assume all local and regional financial responsibility for upkeep and maintenance of El Morillo Drain.
26. 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.

27. 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.
28. 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.
29. U. S. Congressional legislation requires the U. S. State Department to report to Congress periodically on status of Mexico's deliveries of water to the Rio Grande for U. S. use and Region M supports the continuation of this effort.
30. The Region M Planning Group encourages funding for projects aimed at eradicating Arundo Donax, salt cedar, and aquatic weeds in the Rio Grande watershed and for ongoing long-term brush management activities. These activities are not constrained to the state or national boundaries, and would benefit from widespread support.

8.4.3 Issues Identified in Previous Planning Cycles

In the second round of regional water planning, the TWDB emphasized "input from RWPGs for the policy portion of the 2011 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 Region M Planning Group members fell into four major categories:

A. International compliance with the 1944 Treaty

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 Region M Planning Group 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", which has a significant amount of salt cedar without defined bed and banks. The water flowing downstream in this area, which could be put to beneficial use downstream, is spread over large area and experiences high losses.
- identifying and eradicating growing stands of salt cedar
- continue efforts to control and manage Arundo Donax
- supporting Valley Water Summits

The Region M Planning Group continues to believe that these issues are tightly interconnected and that they cannot be effectively evaluated, 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.

Currently, Mexico is in a deficit in the current five (5) year cycle under the 1944 Treaty, and 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 become a viable alternative for municipal suppliers including those located at a significant distance from the Rio Grande. Improvements in technology, coupled with the 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 and outdated 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 Conservation Investment Fund from the North American Development Bank is no longer available, and mechanisms for funding are in need of development.

The water debt has created both challenges and opportunities for municipal and irrigation users to work together. The Region M Planning Group 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 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-ft. 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 acre-ft./year to be held for domestic use and use by cities to support these allocations. Through a conversion rule adopted by the then Texas Water Rights Commission on July 2, 1986 that followed the conclusion of the Middle Rio Grande Adjudication the reserve has been increased to 225,000 acre-ft./yr. 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.

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 assumed complete responsibility for the U.S. share of the upkeep, including maintenance of levees. The Rio Grande Regional Water Planning Group supports this move.

Texas Water Development Board

RIO GRANDE
REGIONAL WATER PLANNING GROUP

2016 Region M Water Plan

Chapter 9: Infrastructure Financing Analysis

BLACK & VEATCH
Building a world of difference.

Table of Contents

List of Abbreviations

IFR	Infrastructure Financing Report
RWPG	Regional Water Planning Group
SWIFT	State Water Implementation Fund of Texas
TAC	Texas Administrative Code
TWDB	Texas Water Development Board
WMS	Water Management Strategies
WUG	Water User Group
WWP	Wholesale Water Provider

Chapter 9. Infrastructure Financing Analysis

9.1 Introduction

The Infrastructure Financing Analysis is important to ensure entities can receive funding to meet their water needs. Senate Bill 2 of the 77th Texas Legislature incorporated the Infrastructure Financing Report (IFR) requirement into the regional water planning process. For purposes of the IFR, each regional water planning group (RWPG) is required to determine proposed financing for all of the water management strategies (WMS) with capital costs that were proposed in this 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 entities with identified needs for additional water supplies that will be unable to pay for their water infrastructure needs without outside financial assistance;
- how much of the infrastructure costs in the RWPs cannot be paid for solely through local utility revenue sources;
- the financing options proposed by entities 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.

The Texas Water Development Board (TWDB) provided the RWPG's with an IFR survey used to obtain information about each Water User Group (WUG) entity's plan to finance the WMS recommended for them in the RWP.

The tabulated survey results are presented in Appendix F.

Texas Water Development Board

2016 Region M Water Plan
Chapter 10: Public Participation

Table of Contents

Tables

List of Abbreviations

IPP	Initially Prepared Plan
LRGVDC	Lower Rio Grande Valley Development Council
RGRWA	Rio Grande Regional Water Authority
RWPG	Regional Water Planning Group
SWIFT	State Water Implementation Fund of Texas
TAC	Texas Administrative Code
TWDB	Texas Water Development Board
WUG	Water User Group
WWP	Wholesale Water Provider

Chapter 10. Public Participation and Plan Implementation

10.1 Public Participation

Public participation is the basis of the regional water planning process initiated by Senate Bill 2 in 1997. Under the 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, 2015, are listed in Table 10-1.

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 (IPP). 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.

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 plan. The group also identified key groups of stakeholders that represent utilities, Irrigation Districts, farmers, and environmental organizations, beyond the individual stakeholders on the Planning Group, that have participated in development of the plan.

The Rio Grande RWPG held regular meetings throughout the planning process, generally on a monthly basis. Each meeting provided opportunity for public comment. Meeting schedules, agendas, and minutes were emailed to the planning group, posted on the Region M website, and the meeting dates were listed on the TWDB website. The Rio Grande RWPG's website: www.RioGrandeWaterPlan.org is a resource for the public on issues of concern to regional water planning and information on the planning process.

The Initially Prepared Plan was approved and certified for submittal by the voting members of the Rio Grande Regional Water Planning Group at the regularly scheduled meeting on April 15, 2015. The TWDB notified the RWPG on May 7, 2015 that the IPP was administratively complete.

The RWPG requested public comments on the IPP to be submitted between May 1 and September 1, 2015 to the LRGVDC. No public comments were received. The Texas Parks and Wildlife Department submitted comments on August 14, 2015.[1] The TWDB sent comments based on their review of the IPP on August 25, 2015.[2] Comments from both the TPWD and TWDB, including the RWPG response to TWDB comments, are included in Appendix H.

---

[1] *2016 Rio Grande Regional Water Planning Group Initially Prepared Plan,* Mr. Ross Melinchuk, Deputy Executive Director, Natural Resources. August 14, 2015.

[2] *Texas Water Development Board Comments on the Rio Grande (Region M) Initially Prepared Plan, Contract No. 1118301324.* Jeff Walker, August 25, 2015.

Table 10-1 Voting Members of the Region M Planning Group

Interest	Name	Resident County
Public	Mary Lou Campbell, Secretary/Treasurer * City of Mercedes	Hidalgo
Counties	Joe Rathmell County Judge, Zapata	Zapata
	Humberto Gonzalez County Judge, Jim Hogg	Jim Hogg
Municipalities	Jorge Barrera Eagle Pass Water Works, Eagle Pass	Maverick
	John Bruciak Brownsville PUB, Brownsville	Cameron
	Tomas Rodriguez, Vice-Chairman * 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	Jaime Flores The Arroyo Colorado Watershed	Hidalgo
Small Business	Carlos Garza AEC Engineering, LLC, Edinburg	Hidalgo
	Nick Benavides Nick Benavides Co.	Webb
Electric Generating Utilities	Robert Pena, Jr. Texas Energy Consultants, Edinburg	Hidalgo
River Authorities	James Darling Attorney, Doctors Hospital at Renaissance, Edinburg	Hidalgo
Water Districts	Sonny Hinojosa * HCID No. 2, San Juan	Hidalgo
	Sonia Lambert CCID No. 2, San Benito	Cameron
Water Utilities	Dennis Goldsberry North Alamo Water Supply Corporation	Hidalgo
Groundwater Management Area	Armando Vela Red Sands GCD	Hidalgo
Other	Glenn Jarvis, Chairman * Attorney, McAllen	Hidalgo
	Frank Schuster * Val Verde Vegetable Co.	Hidalgo

*Executive Committee

The Rio Grande RWPG and its consultant team actively solicited comment from local entities on the basic data used to develop the plan. Each entity was contacted to participate in a water infrastructure financing survey. The infrastructure survey was completed to determine the capability to pay for water management strategies listed in the plan and the amount of funding each entity planned to request from the State.

Members of the consultant team also made presentations to groups with an interest in water planning, including the Rio Grande Regional Water Authority.

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 (Table 10-2). Copies also were placed at the offices of councils of governments in the region, including the Lower Rio Grande Valley Development Council.

Table 10-2 Locations of Public Posting for the Initially Prepared Plan

County	Location
Cameron	Cameron County Clerk's Office, 964 E. Harrison, Brownsville, TX 78520
	Brownsville Public Library, 2600 Central Blvd., Brownsville, TX 78520
Hidalgo	Hidalgo County Clerk's Office, 100 N. Closner, Edinburg, TX 78539
	McAllen Public Library, 4001 N. 23rd St., McAllen, TX 78504
Jim Hogg	Jim Hogg County Clerk's Office, 102 E. Tilley, Hebbronville, TX 78361
	Jim Hogg County Library, 210 N. Smith, Hebbronville, TX 78361
Maverick	Maverick County Clerk's Office, 500 Quarry St. Suite 2, Eagle Pass, TX 78852
	Eagle Pass Public Library, 589 E. Main St., Eagle Pass, TX 78852
Starr	Starr County Clerk's Office, 401 N. Britton Ave., Room 201, Rio Grande City, TX 78582
	Rio Grande City Public 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

A public hearing on the Initially Prepared Plan was held in Weslaco on June 23, 2015 at the Valley Metro Transportation Center. Formal notices of the public hearing were placed in newspapers of general circulation in each county of the regional planning group.

An additional presentation was held at the Rio Grande Regional Water Authority on September 2, 2015. All public outreach on the Initially Prepared Plan includes information on procedures and deadlines for submitting comments.

The final plan was unanimously adopted by a quorum at a regularly scheduled Regional Water Planning Group meeting on November 4, 2015.

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). In addition to performing administrative duties relating to the management of State funds, the LRGVDC 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 recorded all Rio Grande RWPG meetings and prepared the official meeting minutes.

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. Some of the key issues to implementation are discussed below.

10.3.1 Additional Planning Studies

The recommendations presented in this regional water plan are based on planning-level evaluation of projected water demands, water supply, needs, and strategies for meeting future needs. It is important to note that additional, more detailed feasibility evaluations will be necessary prior to implementation of most recommended strategies. In many cases, feasibility evaluations will need to be followed by engineering design, permitting, environmental impacts assessment, and opportunities for public input. Additional planning and project development activities required for strategy implementation will be the responsibility of project sponsors, often with state and/or federal technical and financial assistance.

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 and assist the state in developing the State Water Plan. 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 Region M Planning Group 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.

10.3.3 Funding for Plan Implementation

The availability of funding and access to funding for the implementation of recommended water management strategies is crucial. The SWIFT program is enabling further state investment in water projects. As the initial rules are developed and the first rounds of loans are distributed, the Region M Planning Group intends to stay involved in the refinement process to advocate for the types of projects that are recommended for Region M.

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.

State and federal loan and grant programs have played a critical role 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, and farmers in the Lower Rio Grande Valley face some difficulty obtaining financing that is available to farmers elsewhere in the state because of the nature of water rights ownership. 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 Region M Planning Group recommends that new public funding sources be developed to assist irrigation districts and farmers with the implementation of conservation programs.

Texas Water Development Board

2016 Region M Water Plan

Chapter 11: Implementation and Comparison to the Previous Regional Water Plan

Table of Contents

Figures

\

Tables

\

List of Abbreviations

Acre-ft.	Acre-feet
DFC	Desired Future Condition
GAM	Groundwater Availability Model
GMA	Groundwater Management Area
MAG	Managed Available Groundwater
MGD	Million Gallons per Day
RWP	Regional Water Plan
RWPG	Regional Water Planning Group
SCADA	Supervisory Control and Data Acquisition
SWIFT	State Water Implementation Fund for Texas
SWP	State Water Plan
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
WAM	Water Availability Model
WMS	Water Management Strategy
WUG	Water User Group
WWTP	Wastewater Treatment Plant

Chapter 11. Implementation and Comparison to the Previous RWP

11.1 Introduction

Each update to the Regional Water Plan (RWP) is an opportunity for the Regional Water Planning Group (RWPG) to evaluate the changes in the region's water development and conservation goals, and to lay out a path toward meeting future water needs. Every five-year cycle of planning includes reevaluation of demands, current and future, an update of supplies currently being used, and development of a range of water management strategies (WMS) that can be used to meet projected needs. The revisions from the 2011 Rio Grande Regional Water Plan (Region M Plan) and the current, 2016 update to that plan are described below.

11.2 Demands

For each cycle of regional water planning the TWDB evaluates demographic data, and information on agricultural and industrial water usage. This information is used to develop the current demands (base year demands) and to develop an anticipated rate of change over the 50-year planning horizon. Municipal demands are developed for each entity with a population greater than 500, and rural, industrial, and irrigation demands are aggregated within each county and river basin. Demand projections are developed initially by the TWDB technical staff, and are then evaluated by the regional water planning groups for accuracy and revised if necessary. The demand projection methodology is discussed in detail in Chapter 2.

The Region M planning group approved the draft projections developed by the TWDB for municipal demand, manufacturing, livestock, and steam-electric power generation. The TWDB projections for irrigation and mining demands were revised based on local information. The total demand projections for all of Water User Groups (WUGs) over the planning horizon are shown aggregated for this Regional Water Plan (RWP) and the 2011 RWP in Figure 11-1.

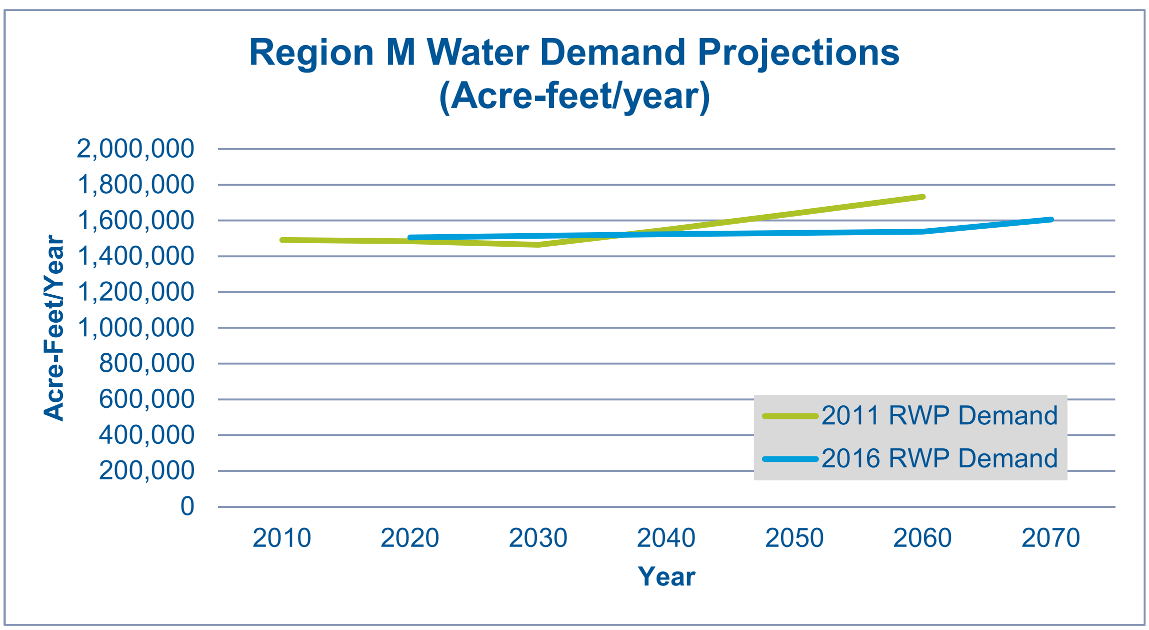

Figure 11-1 Comparison of Water Demand Projections, 2011 and 2016 RWPs

11.2.1 Population Projections

The population projections were developed with similar methodology in the third (2011) and fourth (2016) cycles of regional planning. The 2010 census is used as a basis, and population growth is estimated using demographics and projected birth, death and migration rates. The Region M Planning Group determined that the demand projections developed by TWDB for this plan were appropriate.

In the 2011 RWP development process, the Region M Planning Group made some revisions to the distribution of population from the initial TWDB recommendation. TWDB had recommended a 3% population increase above the 2006 SWP for each decade, and the planning group referenced the State Data Center which identified 23 cities that were growing faster than their anticipated growth rate in the 2006 SWP, and adjusted the growth rates for those cities.

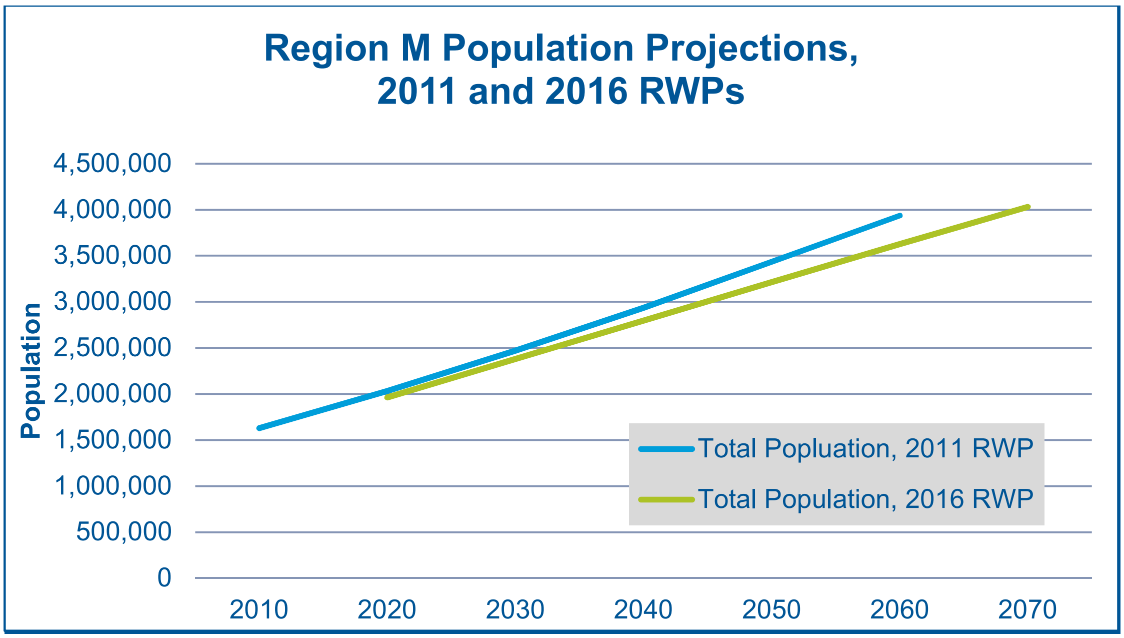

Figure 11-2 Comparison of Population Projections, 2011 and 2016 RWPs

The 2020 populations predicted in the two plans are very close, with a slightly less rapid rate of population growth anticipated in this plan (Figure 11-2). Only a small change is shown in the distribution of projected population on a county basis between the 2011 and 2016 plans, as shown in Figure 11-3 and Figure 11-4.

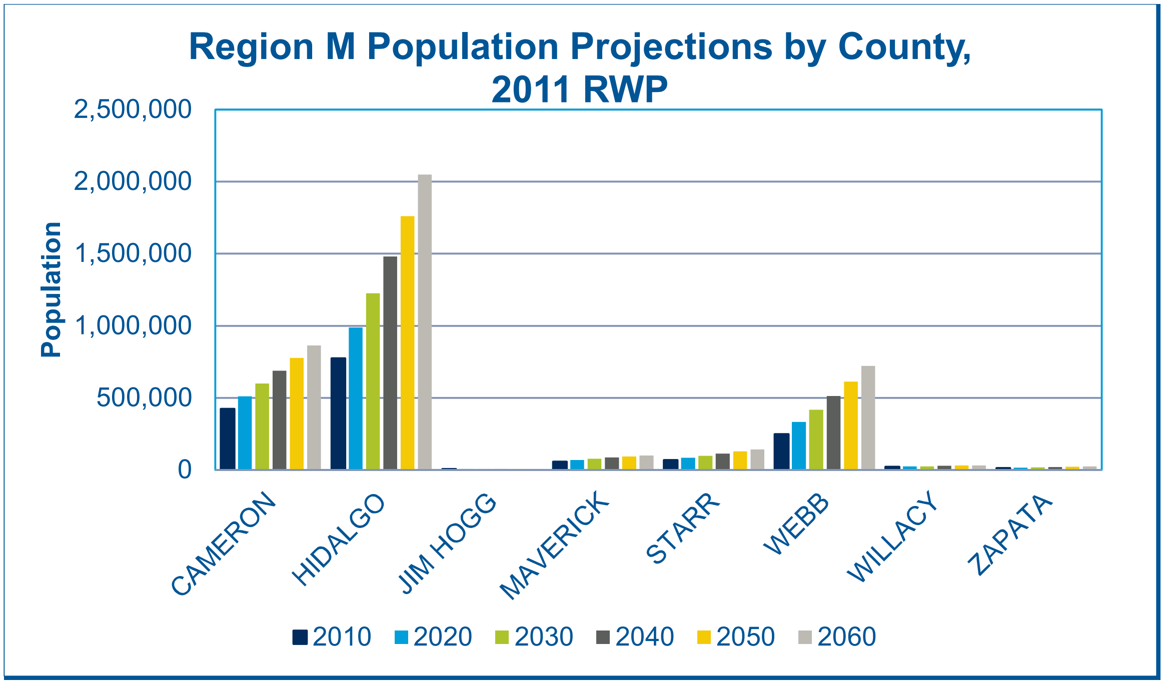

Figure 11-3 Population Projections by County, 2011 RWP

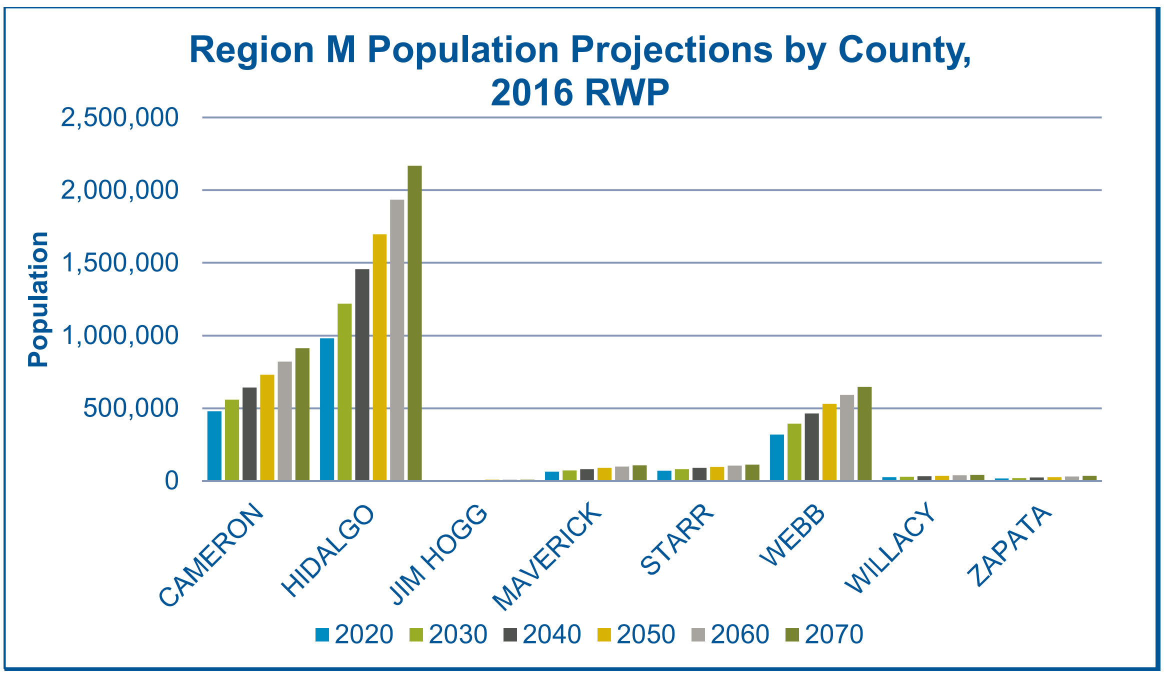

Figure 11-4 Population Projections by County, 2016 RWP

11.2.2 Municipal Water Demands

The municipal demand projections have been reduced in the 2016 RWP as compared to the 2011 RWP (Figure 11-5), based on a slightly lower projected population and lower measured and projected per-capita water use.

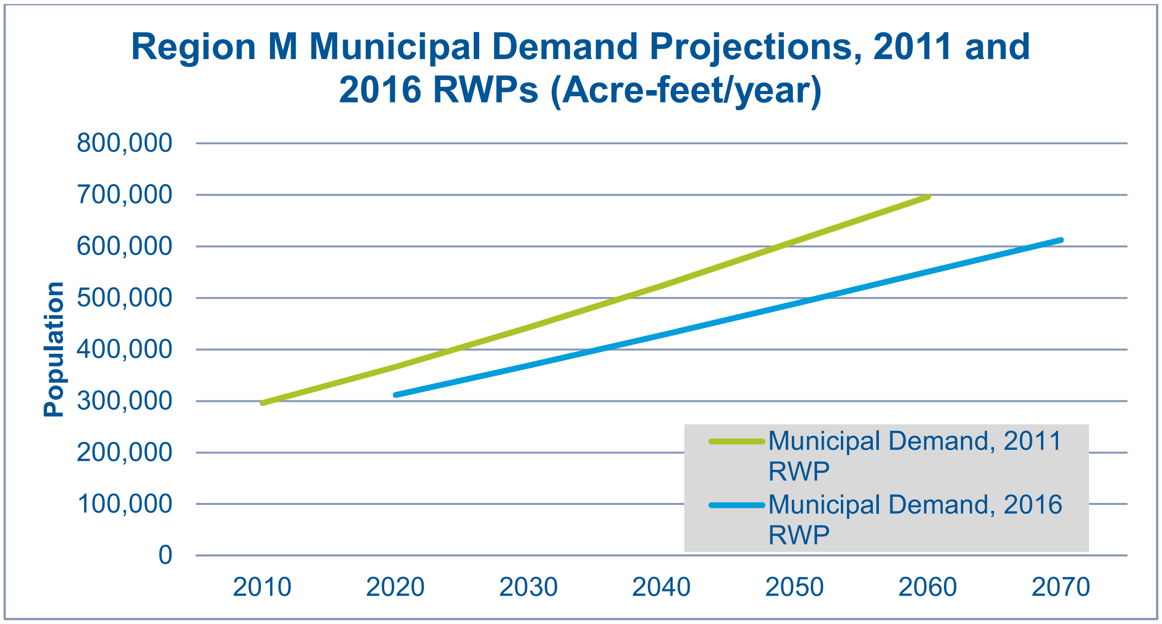

Figure 11-5 Comparison of Municipal Demand Projections, 2011 and 2016 RWPs

11.2.3 Irrigation Demands

Each cycle of planning in Region M has predicted decreasing demand for irrigation water, based on anticipated urbanization, particularly in Cameron and Hidalgo Counties (Figure 11-6). The Planning Group used recorded irrigation use from 2005-2009 and compiled the highest demand year for each county to predict a base year demand. The intent was to estimate demands in a year with less than average rainfall and full reservoirs, rather than show the use in a drought year when supplies are limited. This revised approach results in an increase of the updated base year estimate from 998,000 acre-ft. to 1,100,000 acre-ft., an increase of over 12%.

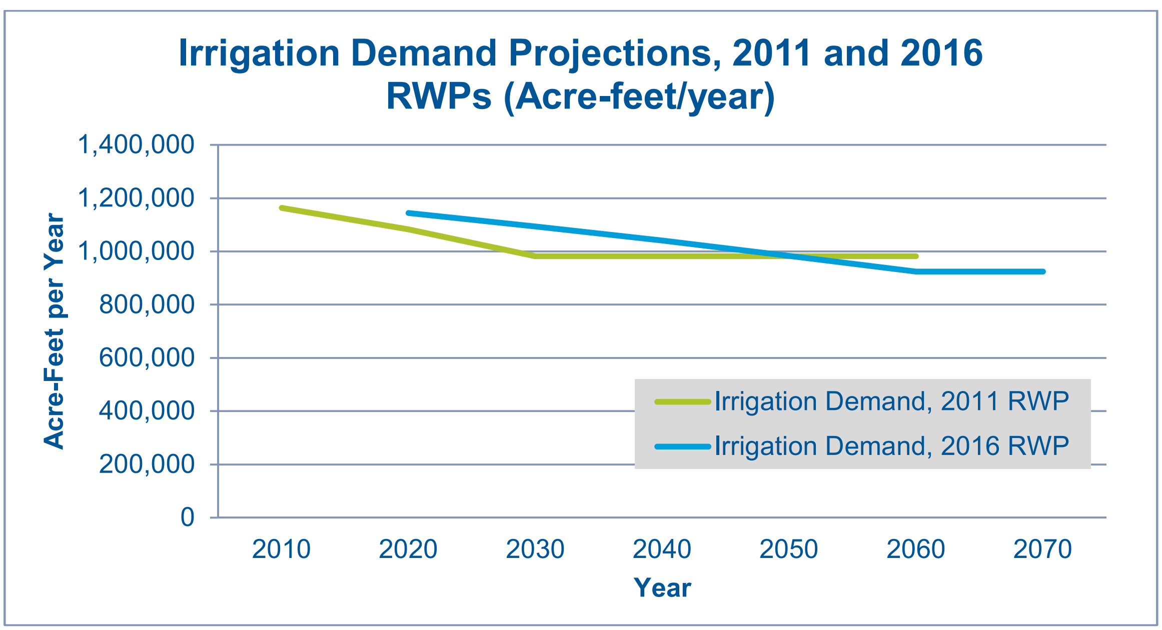

Figure 11-6 Comparison of Irrigation Demand Projections, 2011 and 2016 RWPs

The rate of change that was initially recommended by the TWDB was based on the 2001 RWP, and was determined by the Planning Group to be outdated. The projected increases in municipal demand relate to increasing development and urbanization, which should correlate to decreased irrigated land. It is assumed that water rights will be converted from irrigation use to municipal use. For the purposes of this study, the Planning Group estimated the rate of decreasing irrigation demand by the inverse of the rate at which municipal water demand increases.

In the 2006 RWP, irrigation water demand projections were determined by the Planning Group with assistance from TCEQ. In order to estimate demand in a year with normal rainfall and normal reservoir levels, a representative year with low rainfall and high reservoir levels was selected. In 1994, rainfall totaled 20 inches, 2.5 inches below the average rainfall from 1989 to 2004, and the Amistad/Falcon reservoir system was filled to 86.5% of total capacity. Total irrigation usage in that year, as reported by TCEQ, was 1,180,278 acre-ft. The RWPG revised the base year to reflect this increased demand.

The 2011 RWP used the same base year as the 2006 RWP (1,180,278 ac-ft.). The total demand was divided into by-county use based on the percentage of Amistad/Falcon water rights associated with each county. The rate of change from the 2001 RWP was used to project these demands over the planning horizon.

11.2.4 Manufacturing Demands

Manufacturing demands represent a very small portion of the overall regional water demands, and are revised upward slightly in this plan (Figure 11-7). The base year increased slightly due to reported water use, and the rate of change is tied to population growth in both planning cycles.

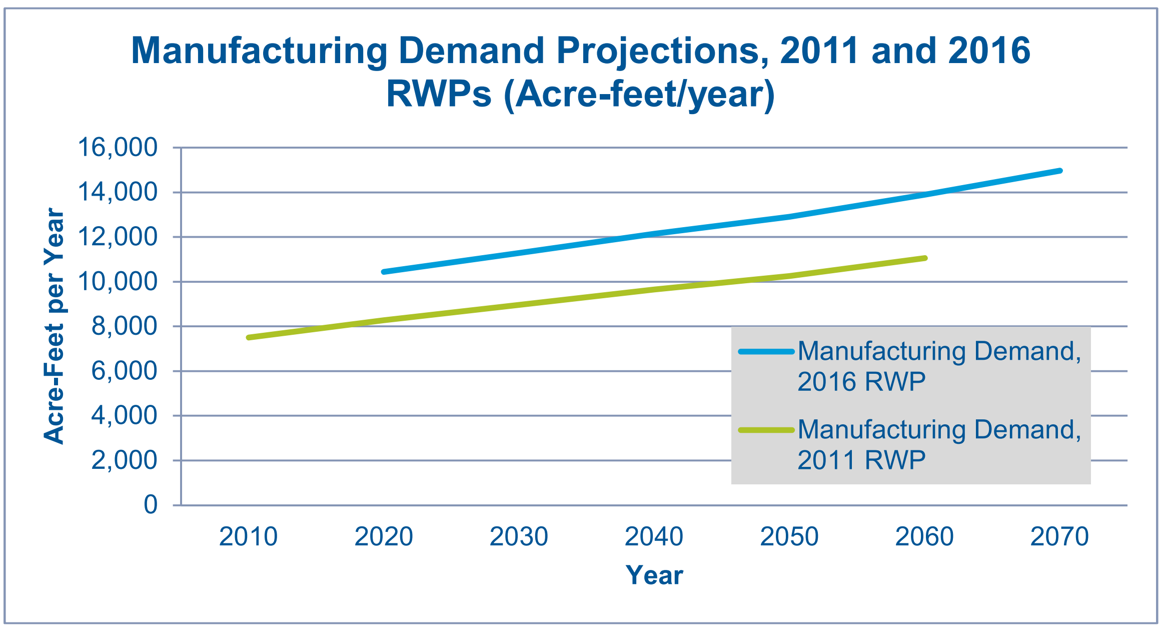

Figure 11-7 Comparison of Manufacturing Demand Projections, 2011 and 2016 RWPs

11.2.5 Mining Demands

The mining demand projections shifted radically from the 2011 RWP (Figure 11-8). The demands associated with aggregates and standard method oil and gas extraction were fairly consistent, but the introduction of hydraulic fracturing in Webb County increased the overall mining water demand projections and affected how these demands were expected to change over time.

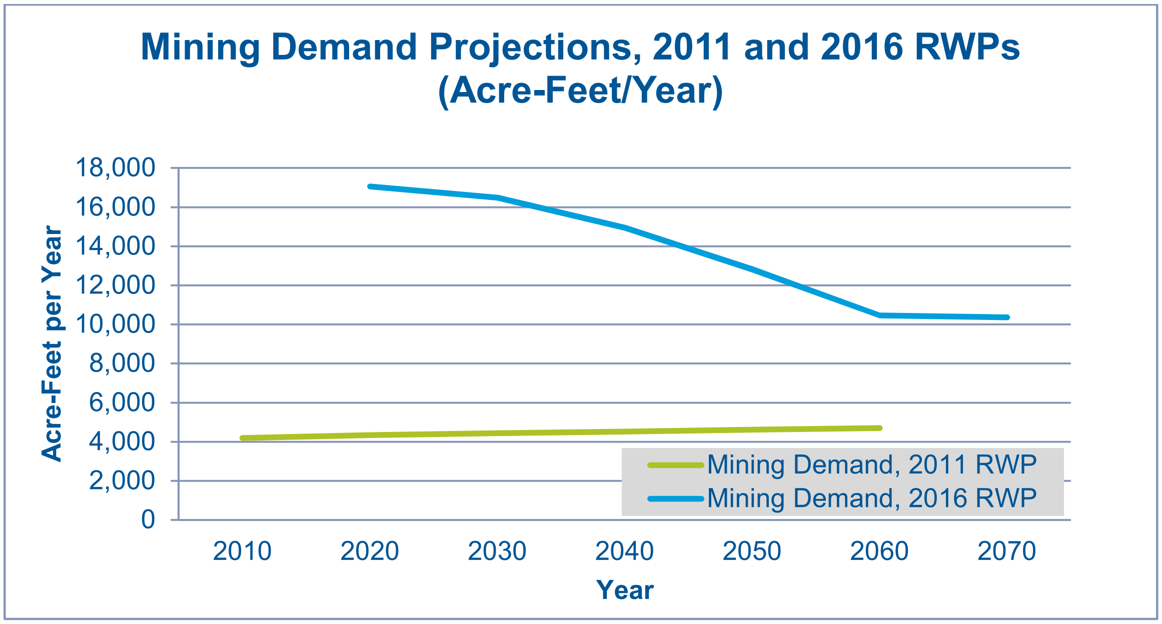

Figure 11-8 Comparison of Mining Demand Projections, 2011 and 2016 RWPs

The Planning Group used the Bureau of Economic Geology's most recent reports in conjunction with the TCEQ Watermaster's office records to estimate water use. Since the adoption of mining water demand projections used in this RWP, the price of oil has changed and the projections of mining water demands are likely to have changed in response. Mining demands are extremely difficult to estimate as a result of both the volatility of the mining industry as well as water use reporting exemptions in place for the industry.

11.2.6 Steam –Electric Power Generation Demand Projections

The Steam Electric Power Generation demand projections from both 2011 and this current plan are based on the 2008 TWDB report Water Demand Projections for Power Generation in Texas, as shown in Figure 11-9. These projections link population growth with an increased demand for power.

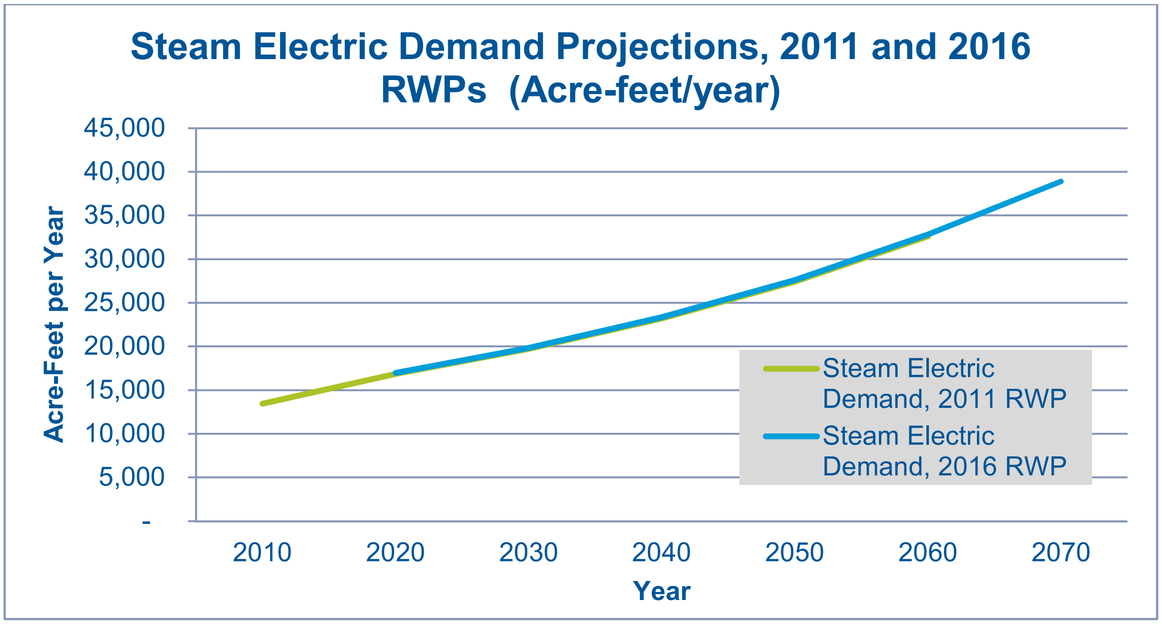

Figure 11-9 Comparison of Steam Electric Demand Projections, 2011 and 2016 RWPs

11.2.7 Livestock Demands

The RWPs since 2001 have estimated livestock demand using the numbers of each type of livestock and estimated water usage for each type. The demand has been assumed to be constant in both this plan and the 2011 RWP. Base year livestock demands in this plan are shown to be slightly lower than the projections from the 2011 RWP, as shown in Figure 11-10.

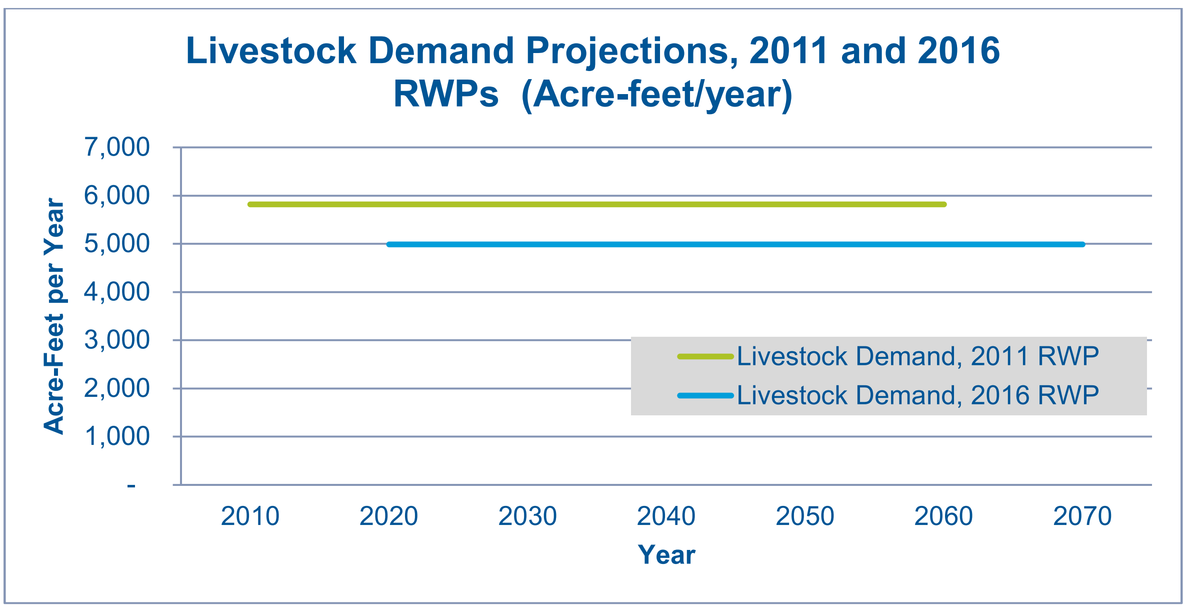

Figure 11-10 Comparison of Livestock Demand Projections, 2011 and 2016 RWPs

BLACK & VEATCH Building a world of difference.

11.3 Availability and Supply

The Rio Grande Water Availability Model (WAM) was revised as a part of the 4th cycle of planning for Region M, which impacted the firm yield values that are used in the planning process. Also, this is the first RWP cycle which requires all current and proposed groundwater development to align with the conservation goals proposed in the relevant Groundwater Management Areas (GMAs).

11.3.1 Rio Grande WAM

Black and Veatch contracted with Kennedy Resource Company (KRC) to review and revise the Rio Grande water availability model (WAM). Through the course of this effort, several problems with the existing WAM were noted that expanded the initial scope of the project. A summary of these WAM issues and their resolution and the basic results from the WAM simulations are addressed in Chapter 3. Some of the major changes are described here, specifically those that impact the firm yield.

First, the WAM was simplified so that many of the water rights are aggregated into a few control points, and adjusted until the river losses approximated those predicted in the more complex model. Second, the sedimentation rates for Amistad Reservoir were adjusted and corrected based on surveys done in 1980 and 2005, disregarding an erroneous survey from 1992, on which previous sedimentation rates had been based. This second change resulted in an increase in firm yield. The previous and updated Firm Yield projections are shown in Figure 11-11.

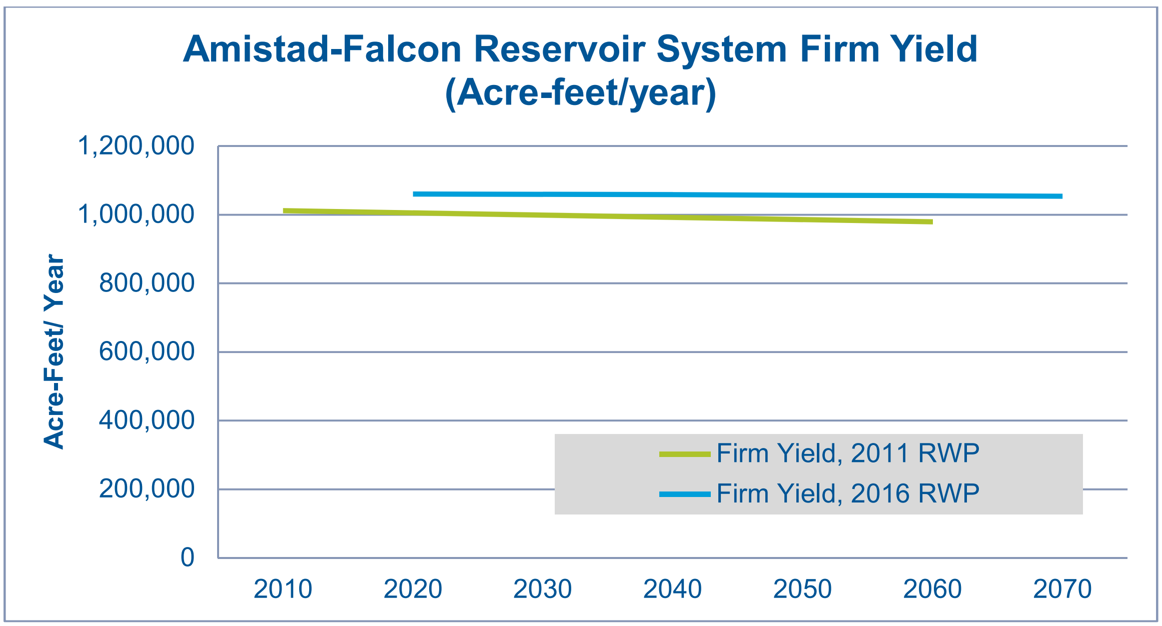

Figure 11-11 Firm Yield Projections for the Amistad-Falcon Reservoir System, 2011 and 2016 RWPs

The 2007 Rio Grande WAM, used to generate data for the 2011 RWP, references the same drought of record as the WAM update (1993-2000). The firm yield is considerably greater in the updated WAM due in part to the corrections of sedimentation rates. It is the recommendation of the Planning Group that the Rio Grande WAM naturalized flow data be updated regularly by TCEQ in order to provide the most accurate data as the basis for Regional Water Planning.

11.3.2 Role of Irrigation Districts

The 2011 RWP periodically refers to Irrigation Districts as Wholesale Water Providers, but does not consistently show the water that is delivered by each district to end users. This updated RWP attempts to quantify the water rights diverted by each irrigation district and delivered to end users. These districts play a critical infrastructure role in the region that is not limited to irrigation, but also the vast majority of municipal and industrial uses.

By showing the network of Irrigation Districts associated with their end users, it is possible to estimate how Irrigation District system losses impact supplies. Districts are all required to meter the water that is diverted from the Rio Grande, but there are limitations to the accuracy of metering water that is delivered to customers. Without significant improvements and costly metering, it is difficult to estimate the efficiency of any District.

The 2011 Plan and the current Region M Planning Group agree that improvements in the Districts are a high priority for increasing regional supplies. For these District improvements to be listed as conservation Water Management Strategies (WMS) there needs to be an identified system loss. The estimated system losses will guide an estimate of how much water can be conserved by implementing District improvements. Estimates of system losses for each district have been compiled by various sources, and current supplies estimated conservatively by selecting the lowest estimate for efficiency estimated within the last 10 years. Although the Districts operate much more efficiently in drought years, this conservative estimate allows the Region to plan for the worst case scenario.

11.3.3 Groundwater

The 2016 RWP is the first cycle of planning that requires that all current and future groundwater usage described in the plan to not exceed the Modeled Available Groundwater (MAG) values. Groundwater Management Areas (GMAs) have been established across the state to help facilitate local regulation of groundwater. Groundwater can be regulated locally by groundwater conservation districts where they have been formed, but most of Region M is not within a district. The groundwater conservation districts within a single groundwater management area determine the Desired Future Conditions (DFCs) for the aquifers in that area. DFCs are conservation goals associated with a quantifiable measure of aquifer conditions, like future water levels, water quality, or spring flows that are specified for certain times in the future, i.e. 12 feet of drawdown in 50 years. In the case of Region M, representatives from the existing GCDs in GMA 16 and GMA 13 established the DFCs.

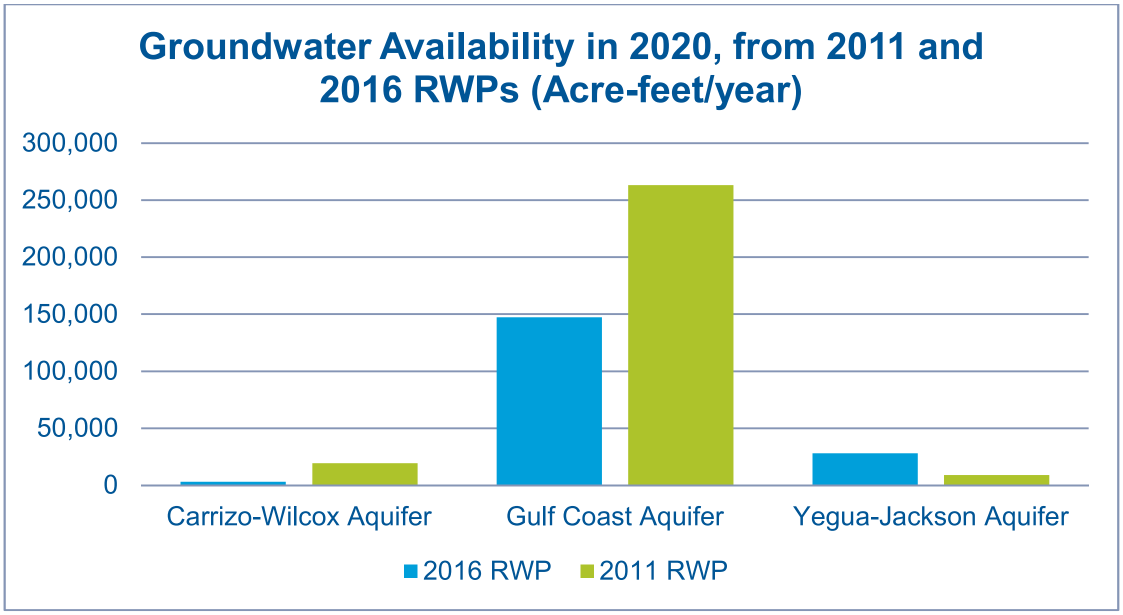

Figure 11-12 Modeled Available Groundwater Projections, 2011 and 2016 RWPs

A Groundwater Availability Model (GAM) allows the TWDB to evaluate what amount of groundwater production, on an average annual basis, that will achieve the stated DFCs for an aquifer. The current MAGs do not specify water quality, but the supplies are identified as fresh, fresh/brackish, or brackish based on the aquifer and the location within that aquifer (specified by county and river basin).

Region M has two major and one minor aquifer for which MAGs are available. Figure 11-12 shows the previous estimates of groundwater availability for each aquifer that were used in the 2011 RWP (in green/on the right), and the current MAGs in blue/on the left. The MAG reports used in this plan, with the associated assumptions, are shown in Table 11-1. More detailed information about regional groundwater availability is available in Chapter 3.

Table 11-1 GAM Reports Used for Current MAG Volumes

Aquifer	GAM Run	Date
Carrizo-Wilcox Aquifer, 2016 RWP	10-012 MAG	August 2, 2012
Gulf Coast Aquifer, 2016 RWP	10-047 MAG	December 8, 2011
Yegua-Jackson Aquifer, 2016 RWP	10-041 MAG	December 8, 2011

In the 2011 RWP there were a number of groundwater sources listed as “Other Aquifer” all of which were researched and associated with a specific aquifer appropriate for that area.

11.3.4 WUG Supplies

Supplies between the 2011 and 2016 RWP differed for various reasons. One of the most impactful reasons is because the 2016 RWP reduced the WUG Amistad-Falcon Reservoir System surface water supply by the amount of water that is lost through conveyance before it reaches the entities. The 2011 RWP did not reduce surface water supplies for distribution system losses.

Additionally, changes in the availability models for surface and groundwater affect WUG supplies.

Figure 11-13 through Figure 11-18 shows the difference between the supplies between the two RWPs by WUG Type.

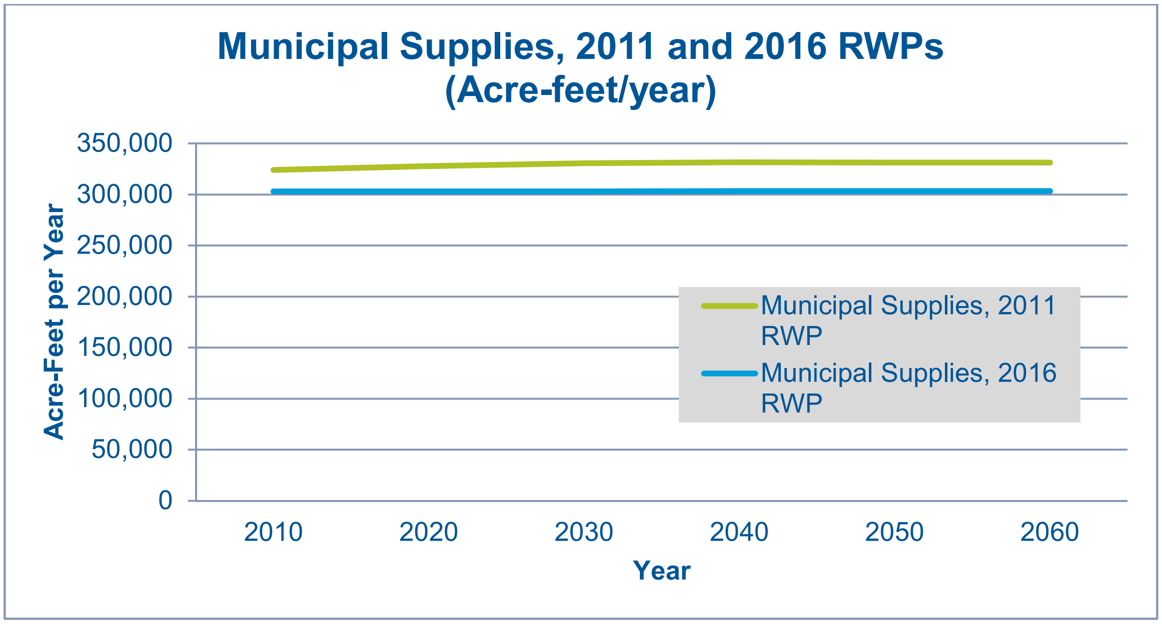

Figure 11-13 Comparison of Municipal Water Supplies, 2011 and 2016 RWPs

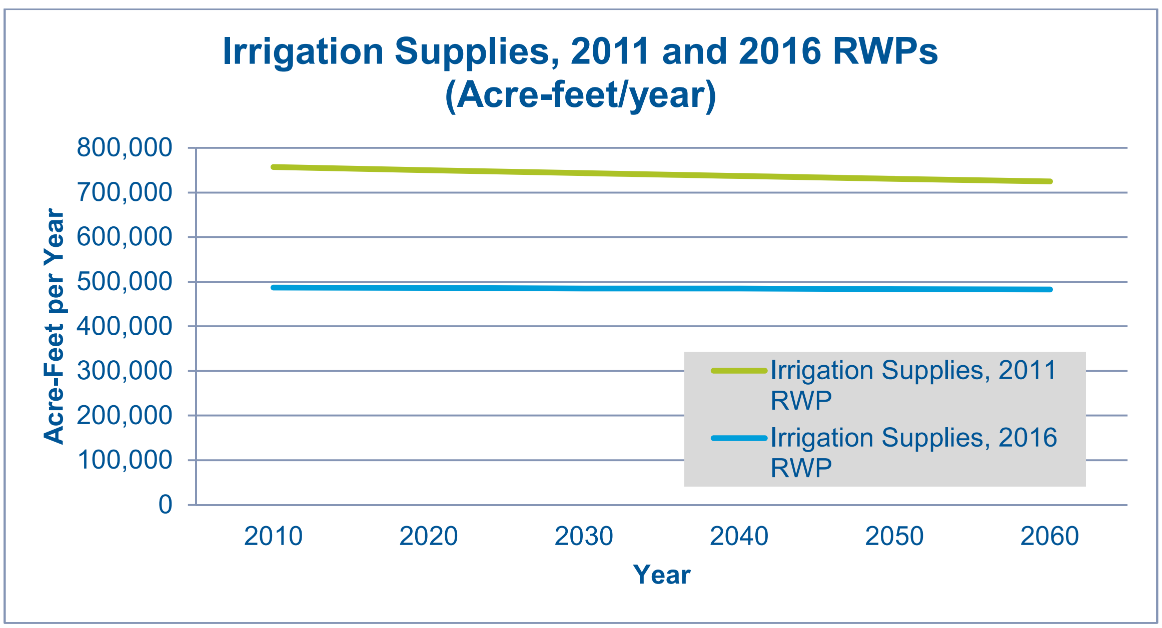

Figure 11-14 Comparison of Irrigation Water Supplies, 2011 and 2016 RWPs

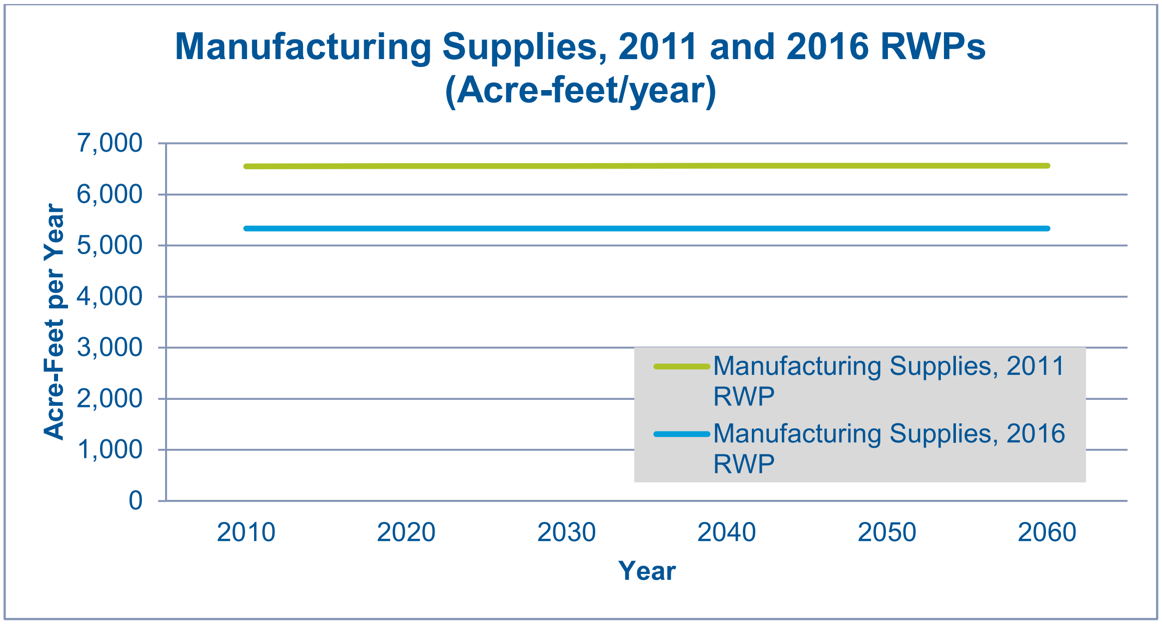

Figure 11-15 Comparison of Manufacturing Water Supplies, 2011 and 2016 RWPs

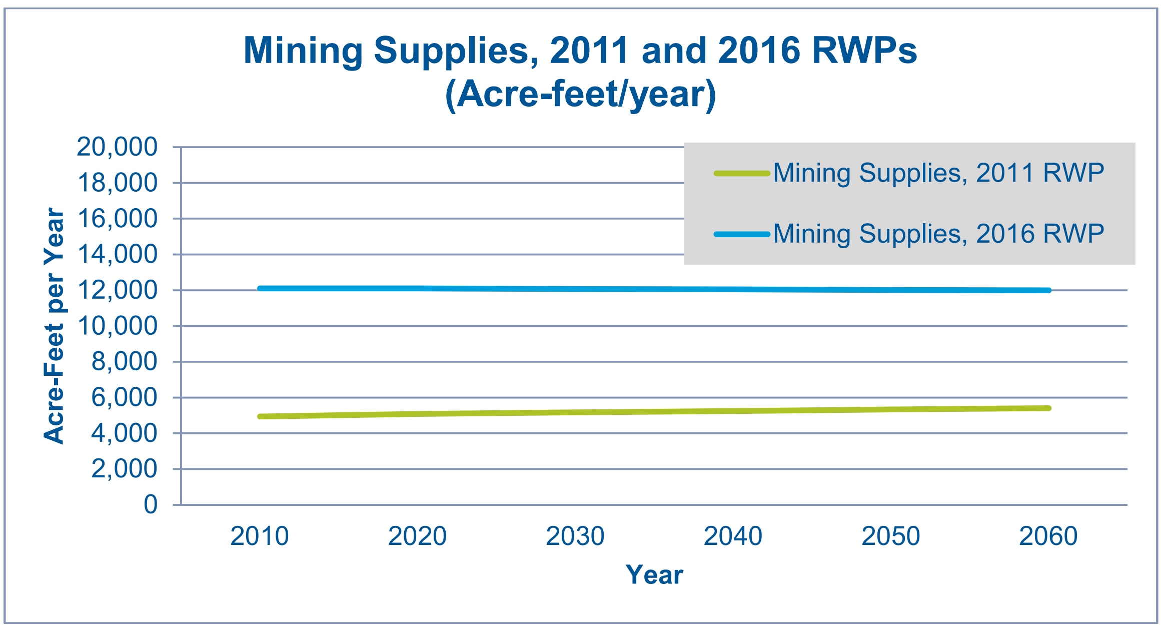

Figure 11-16 Comparison of Mining Water Supplies, 2011 and 2016 RWPs

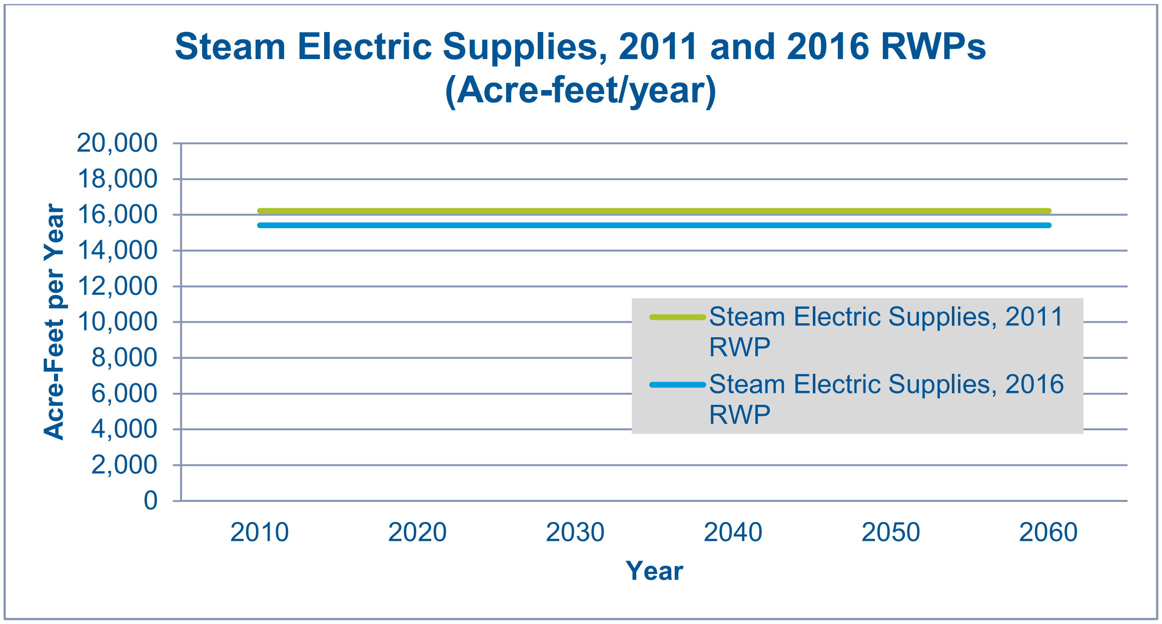

Figure 11-17 Comparison of Steam Electric Water Supplies, 2011 and 2016 RWPs

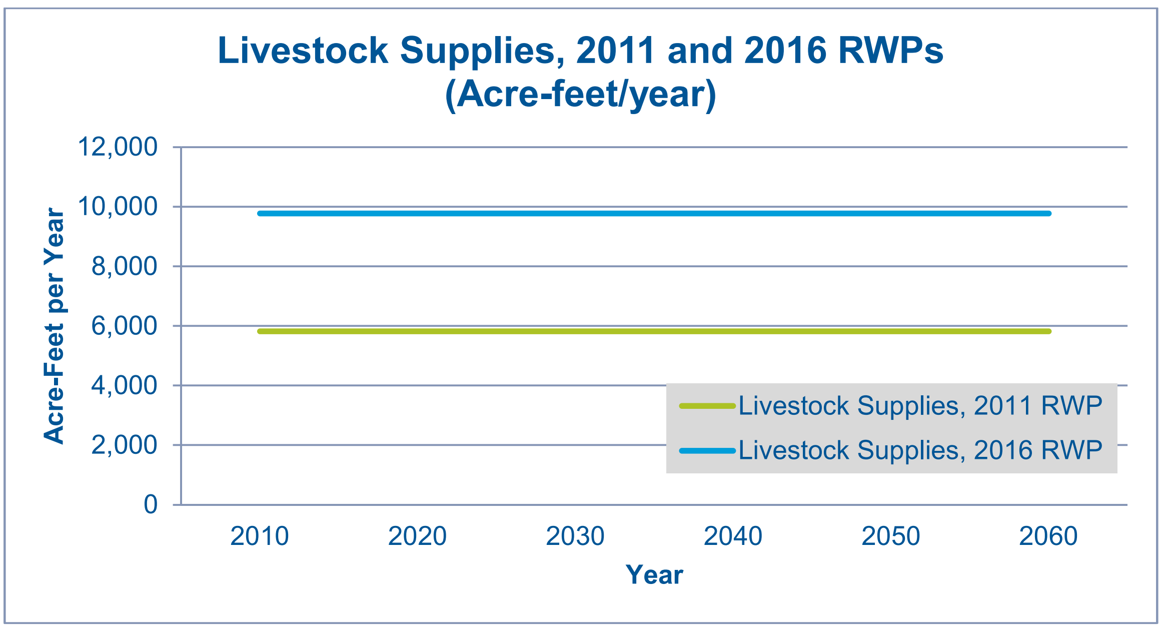

Figure 11-18 Comparison of Livestock Water Supplies, 2011 and 2016 RWPs

11.4 Needs

Because the demands and supplies differed between the 2011 and 2016 RWPs, there were variations in the needs. Figure 11-19 presents the difference between the total needs.

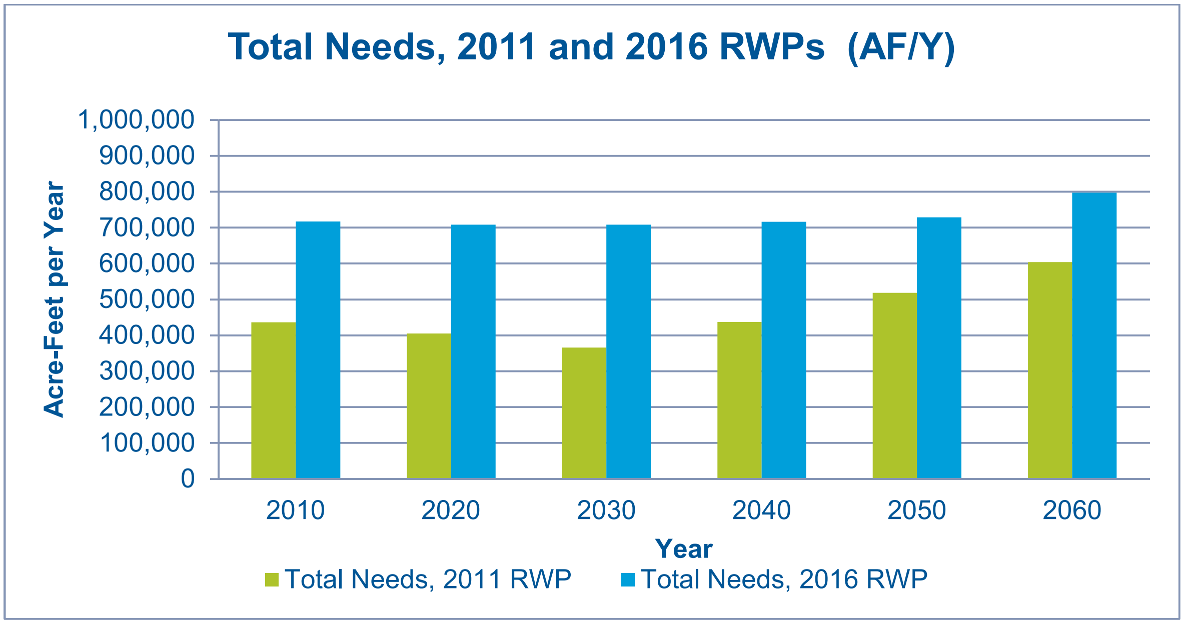

Figure 11-19 Comparison of Total Needs, 2011 and 2016 RWPs

Figure 11-20 through Figure 11-24 compare the needs per WUG Type between the two plans. Livestock was not projected to have any deficit needs in either the 2011 or 2016 RWP.

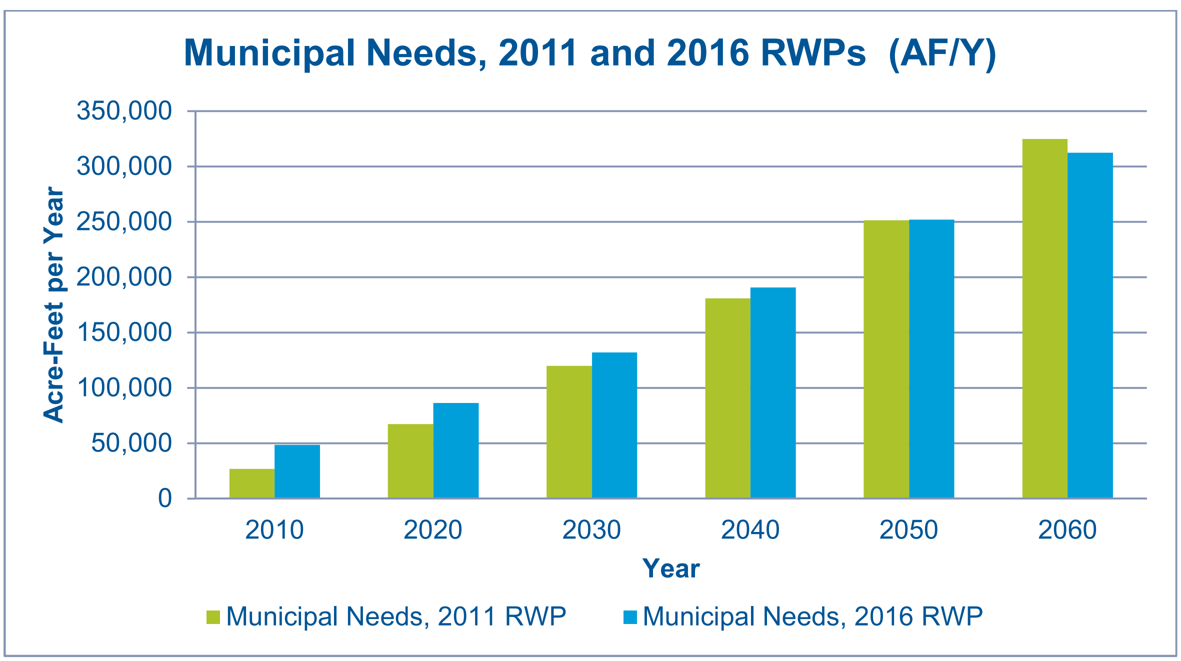

Figure 11-20 Comparison of Municipal Needs, 2011 and 2016 RWPs

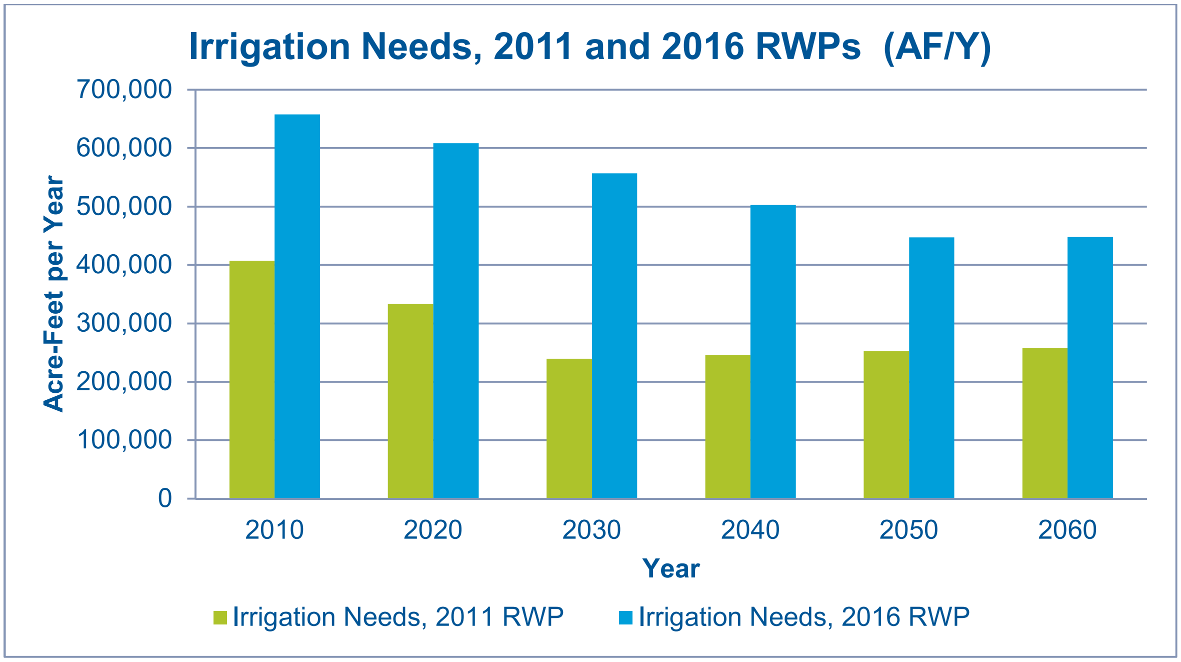

Figure 11-21 Comparison of Irrigation Needs, 2011 and 2016 RWPs

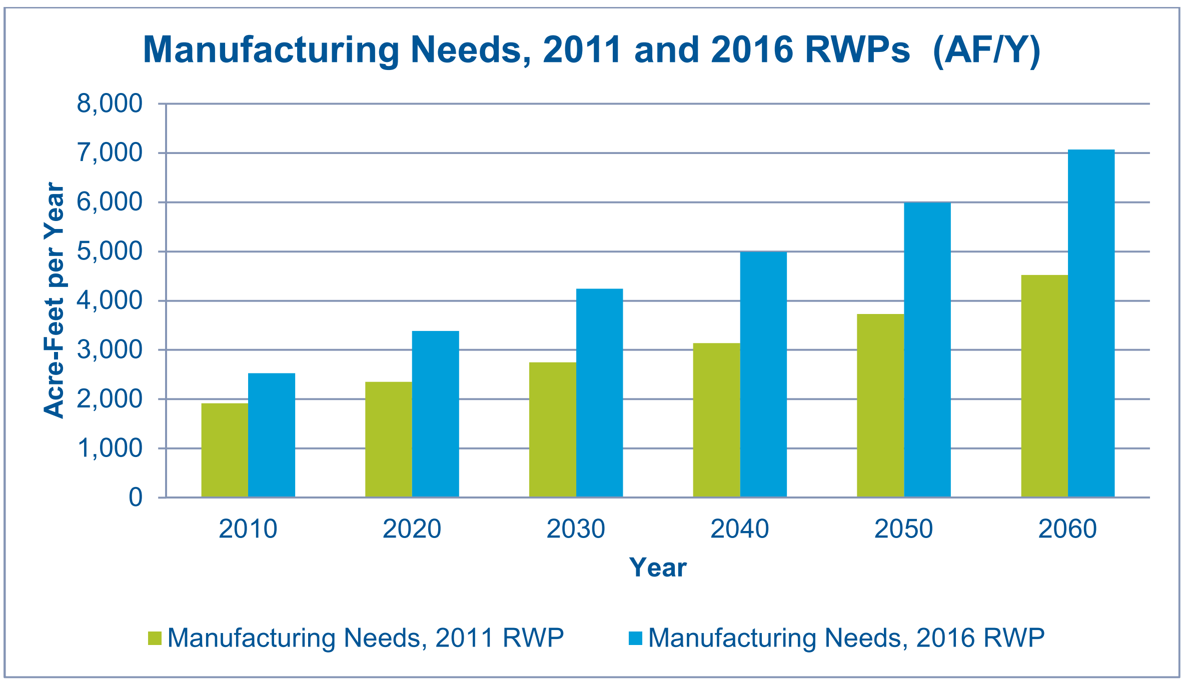

Figure 11-22 Comparison of Manufacturing Needs, 2011 and 2016 RWPs

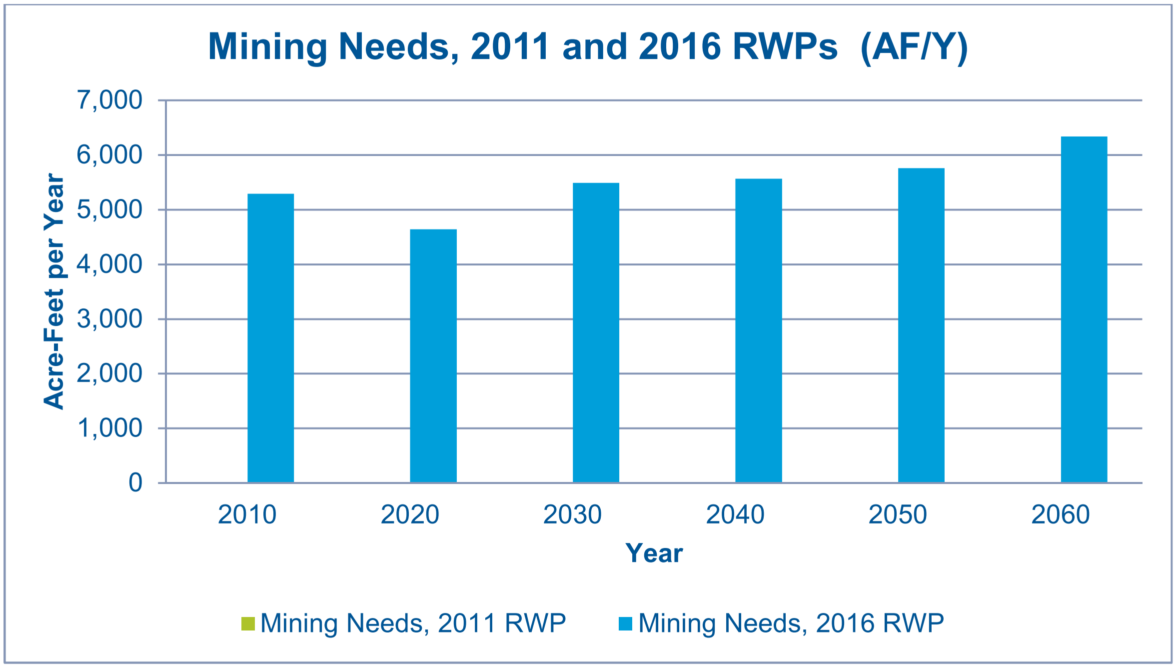

Figure 11-23 Comparison of Mining Needs, 2011 and 2016 RWPs

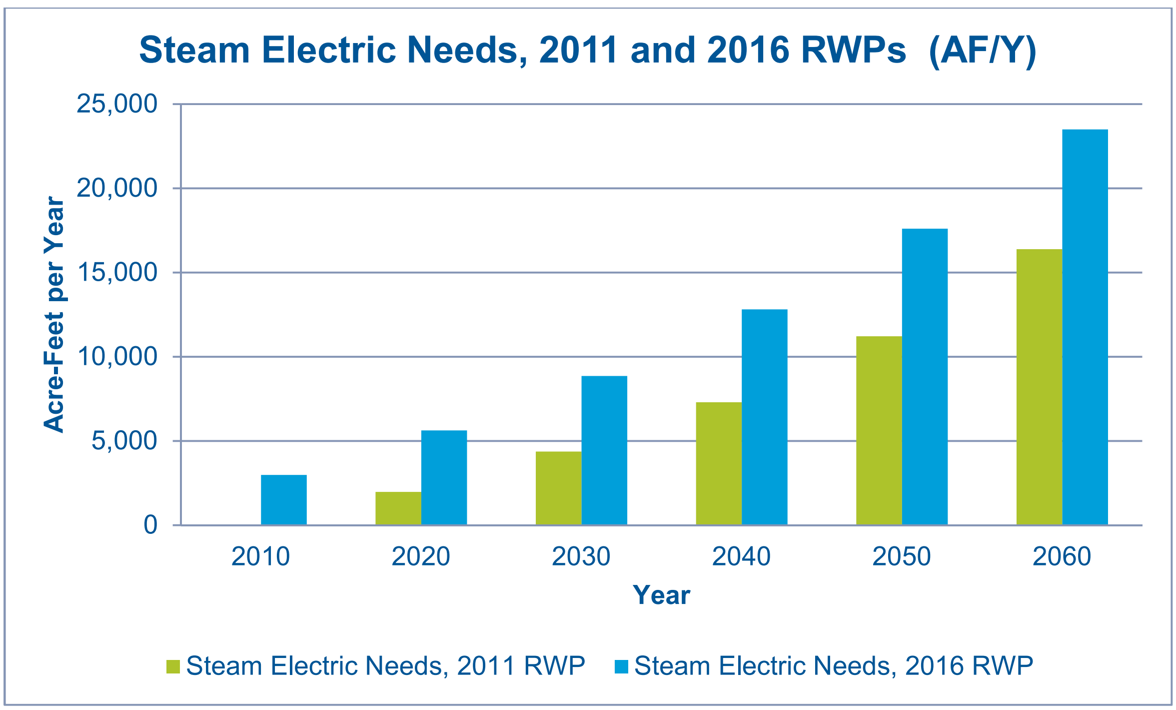

Figure 11-24 Comparison of Steam Electric Needs, 2011 and 2016 RWPs

11.5 Water Management Strategies

Concurrent with the development of this 2016 RWP, the Texas Legislature authorized, and Texas voters approved, transferring $2 billion from the state's "Rainy Day Fund" to create a new loan program to fund projects in the state water plan. The State Water Implementation Fund for Texas (SWIFT) is designed to fund water supply projects recommended in the state water plan over the next 50 years, which has increased awareness of regional water planning statewide.

Many of the WMS recommended in the 2011 Region M plan were generalized for multiple WUGs. This plan develops WMS in more detail, thereby presenting a clear plan with fundable water projects and programs. The process for gathering all Potentially Feasible WMS included WMS from three sources.

1. A data request was sent to all of the municipal WUGs, utilities, Irrigation Districts, and stakeholders representing farmers, environmental interests, and other water users. Over 120 WMS were submitted by 46 different entities. These submitted WMS were evaluated for compliance with TWDB rules, completeness and consistency.
2. WMS were developed where entities did not provide information to the Planning Group:
    a. Advanced conservation was evaluated for each municipal WUG,
    b. Reuse was evaluated for each WUG with a wastewater treatment plant that has an average annual effluent stream of 2 MGD or greater,
    c. An Irrigation District Improvements WMS was developed for each Irrigation District with aggregated costs and water savings based on the estimated efficiency, quantity of water, and existing components of each system (i.e. whether the district has storage capacity, whether the majority of the network is canal or pipeline, etc.)
    d. Acquisition of water rights will be considered for all WMS up to the firm yield of the Amistad-Falcon Reservoir system.
3. Recommended WMS from the 2011 RWP were considered when the WMS was still feasible and where there was sufficient information for the strategy to be evaluated. The advanced water conservation and water rights acquisition strategies were not carried over from the 2011 RWP, and were evaluated separately. All WMS from the 2011 RWP were updated to 2013 dollars or costs re-estimated.

Advanced municipal conservation, Irrigation District improvements, and industrial conservation WMS were applied to the WUGs and WWPs, and a secondary needs calculation was performed.

Potentially feasible WMS were considered to meet secondary needs. Staying within the bounds of water availability from each source, the WMS specific to each WUG were selected that could meet the projected need with the lowest cost and meet other evaluation criteria. A detailed description of the Needs Analysis is discussed in Chapter 4, and the WMS evaluation process is included in Chapter 5.

Table 11-2 compares the number of each type of specific WMS that was recommended in the 2011 RWP and the current RWP.

Table 11-2 Comparison of Recommended WMS from 2011 and 2016 RWPs

Category	Number of Recommended WMS	
	2011 RWP	2016 RWP
Acquisition of Water Rights	89	25
Biological Control of Arundo Donax	0	10
Brackish Groundwater	30	19
Distribution & Transmission	1	3
Fresh Groundwater	24	13
Industrial Conservation	0	23
Irrigation District Conservation	15	27
Municipal Conservation	73	67
On Farm Conservation	0	12
Reuse	17	17
Seawater Desalination	3	1
Storage	4	4
Surface Water Treatment	0	5

The 2011 RWP did not include specific alternative WMS, but instead listed possible alternative WMS that each WUG or WWP could implement in the event that the recommended strategies become infeasible. The list of possible alternative WMS include:

- Municipal Water Conservation
- Non-potable Reuse
- Acquisition of Additional Rio Grande Water Rights
- Desalination of Brackish Groundwater
- Desalination of Seawater
- Damns, Weirs, And Storage
- Improving Water Infrastructure and Distribution

The number of each type of alternative WMS in the 2016 RWP is listed in Table 11-3.

Table 11-3 2016 RWP Alternative WMS by Category

Category	Number of Alternative WMS
Acquisition of Water Rights	1
Brackish Groundwater	14
Fresh Groundwater	3
Reuse	10
Seawater Desalination	2
Storage	1
Surface Water Treatment	3

A number of WMS recommended in the 2011 RWP applied for and received TWDB funding. An implementation survey was completed as part of the final Regional Water Plan, which describes which of the WMS recommended in the 2011 Region M Water Plan have been implemented, and to what extent. The survey includes information regarding the WMS description, type of infrastructure, level of implementation achieved, initial (and final if phased) volume of water provided, funds to date, project cost, and year of implementation and completion. The survey is included in Appendix G.

11.6 Drought Response

In an effort to provide relevant information for drought preparations and response in one place, the scope of the RWPs has expanded to include a new chapter, Chapter 7, that is dedicated to a discussion of each region's preparations for and response to drought. The previous requirements for the RWPs have been retained, and aggregated into this chapter, and clarified, and new requirements have been added.

Previous requirements:

- Current preparations and responses to drought
- Evaluation of drought management WMS for needs
- Recommendation of other drought management measures

Modified requirements:

- More information on the Drought of Record
- Identification of existing and potential future interconnections
- Consolidation of this information into one chapter
- Detailed information on drought action triggers

New requirements:

- Recommendations for each existing source (triggers and responses)
- Emergency responses to local conditions, especially for all County-Other and cities with a sole water source and population of less than 7,500
- Region-specific model Drought Contingency Plans for each type of WUG
- Recommendations to the State Drought Preparedness Council