CITY OF PHARR AND SAN JUAN

Water Reuse Priority and Implementation Plan Report

FINAL

1004831080

STATE OF TEXAS
JAVIER GARCIA
83920
LICENSED
PROFESSIONAL ENGINEER

12/19/11

CONTRACT ADMINISTRATION
2011 DEC 28 AM 7:47

DECEMBER 2011

Prepared by:

Sherfey Engineering SA, L.L.C.
T.B.P.E. Firm No. 8038

In association with:

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS

CRUZ-HOGAN Consultants, Inc.

CITY OF PHARR AND SAN JUAN

Water Reuse Priority and Implementation Plan Report

FINAL

STATE OF TEXAS
JAVIER GARCIA
83920
LICENSED
PROFESSIONAL ENGINEER

12/19/11

DECEMBER 2011

Prepared by:

Sherfey Engineering SA, L.L.C.
T.B.P.E. Firm No. 8038

In association with:

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS AND SCIENTISTS

CRUZ - HOGAN Consultants, Inc.

CITY OF PHARR and SAN JUAN WATER REUSE PRIORITY & IMPLEMENTATION PLAN REPORT

FINAL

Date:

December 2011

Prepared by:

Sherfey Engineering SA, L.L.C.
T.B.P.E. Firm No. 8038

8400 Blanco Road, Ste. 201
San Antonio, Texas 78216
Ofc: (210) 493-9200
Fax: (210) 493-9205

This page intentionally left blank

Table of Contents

Section Page

APPENDICES

TABLES

FIGURES

This page intentionally left blank

Executive Summary

ES.1 Introduction

The purpose of this report is to provide the City with a 50-year plan that can be used to guide implementation of a water reclamation program for the beneficial use of reclaimed water to support future water supply needs. In addition, during development of this plan, and later its implementation, the City will need to work closely with its customers and surrounding areas to identify potential approaches to a reclamation program that could include regional support and cooperation.

The Cities of Pharr and San Juan are projected to experience significant growth in population and that growth will generate an increase in water demand. Furthermore, these two communities will require a reliable water supply to attract new businesses to create new jobs to support the growing population. To help meet those future water supply needs, these two Cities are committed to finding beneficial and efficient use of water resources through education, sound science, and technology. This report will provide information that will assist the Cities of Pharr and San Juan in pursuing opportunities to meet their respective future water needs.

On a larger scale, the Rio Grande Valley is facing water supply challenges due to increasing demand, depletion, and dependence upon a single source of supply, the Rio Grande. These challenges are magnified during years of below average rainfall and in the last decade have become a critical issue during drought conditions. Water restrictions and other conservation methods have become increasingly important over the last decade. However, such practices alone are insufficient to solve the water supply challenge.

Originally mandated in 1997 by the 75th Texas Legislature in Senate Bill (SB) 1, the regional water supply planning process identified a number of future water management strategies for the region. The primary emphasis of the planning process was to identify current and future water needs and the development of water management strategies to meet those needs. Designated by Texas Water Development Board (TWDB) as “Region M,” the Rio Grande Regional Water Planning Area consists of the eight counties adjacent to or in proximity to the middle and lower Rio Grande. These counties include: Cameron, Starr, Maverick, Zapata, Hidalgo, Webb, Jim Hogg, and Willacy.

The Region M water planning area has its own planning group that represents the various interests within the planning area and is responsible for developing a regional water plan. The Rio Grande Regional Water Plan was approved by the TWDB on December 16, 2010[1]. Future water management strategies identified in the Region M Water Plan include water conservation, water reclamation, seawater desalination,

[1] Texas Water Development Board, Region M Regional Water Plan, NRS Consulting Engineers, Final Plan dated October 1, 2010.

brackish water desalination, groundwater wells, and the Brownsville Weir and Reservoir.

Water reclamation was also identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature under SB 1094[2]. In addition to water conservation efforts, development of a water reclamation program will provide for greater efficiency in the use of the City's water resources and will help these communities address their water supply challenges. Specifically, water reclamation, the use of highly treated reclaimed water, will directly reduce the City's raw water need from the Rio Grande and thereby assist the City in securing necessary future water supplies to meet its anticipated population growth.

Pharr is currently discharging approximately 5-million gallons of wastewater effluent per day of which approximately 0.5-mgd is used to irrigate a nearby golf course. San Juan is currently discharging approximately 2.2-million gallons of wastewater effluent per day. Wastewater is discharged by both communities into a drainage ditch managed by Hidalgo Irrigation District No. 1, which ultimately discharges into the Arroyo Colorado and then the Laguna Madre near the Cameron-Willacy County line. Once treated wastewater is discharged from the Wastewater Treatment Plant (WWTP), ownership of the water is transferred to the State of Texas and is instantly converted from wastewater effluent to raw water. The 2010 Region M Regional Water Plan estimated the value of raw water in the planning area at about $450 per acre foot ($1.38/thousand gallons) per year and this cost will certainly rise annually as water demand increases. Therefore, if a lease value of $1.38/thousand gallons/year is assigned, hypothetically the annual revenue lost discharging into the Arroyo Colorado, is approximately $2 million and $1 million for Pharr and San Juan respectively.

ES.2 Population Projections

It is expected that the population of both Pharr and San Juan will continue to grow. As the population in these two (2) cities increases so will potable water demands. Therefore the need to identify alternative raw water supplies to augment the Rio Grande water source will become crucial to these communities. Water recycling is one such method that is viable and proven to offset increasing raw water needs. In order to best identify the appropriate distribution of reclaimed water use potential, it is important to project future water demands by establishing population projections. Population projections will be used to determine future raw water demand needs as well as the availability of reclaimed water.

Implementation of a water reuse plan is a long term process extending several decades and thus requires projections farther into the future to provide sufficient input to estimate water needs and availability. Only TWDB population projections extend over a time frame that matches that anticipated for a reclamation plan's implementation process. Therefore, the population projections established by the TWDB will be

[2] Texas Water Development Board, Report 362, Water Conservation Implementation Task Force, *Water Conservation Best Management Practices Guide*, November 2004.

employed for this report. Refer to **Table ES.1** for TWDB 2007 population projections through the year 2060.

TABLE ES.1
TWDB 2007 Population Projections through the Year 2060
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

TWDB Population Projections (Thousands)									
Year	2000[1]	2006[1]	2010[2]	2015	2020	2030	2040	2050	2060
Pharr	46.7	61.4	66.0	n/a	82.6	101.3	121.4	143.3	165.8
San Juan	26.2	32.3	39.1	n/a	54.1	70.9	89.1	109.0	129.3

[1]U.S. Census
[2]U.S. Census Estimate

ES.3 Water Demand, Wastewater Flows, and Treated Wastewater Availability

To assess the extent to which water reclamation can be used by the City, an estimate of future water demands and future wastewater flows was computed. The wastewater flow projections will establish amount of water available for reclamation and future water demands will indicate required raw water supply.

The 2007 Population projections by the TWDB were used to extrapolate the historical water demand and wastewater flows out to the year 2060. Such knowledge of the future water demands and wastewater flows are essential in determining the viability of individual projects, as well as how and when to best implement them as a component of the water reuse plan.

The historical water demand data provided by Pharr covered six (6) years from January 2005 to December 2010. Pharr provides water service for the majority of the City with the exception of a small fully developed area in the City's northeast quadrant. This area is served by North Alamo Water Supply Corporation. The water demand for Pharr is approximately 114-gpd/person based on historical water data using this same usage rate.

The demand at Year 2060 was estimated at 19-mgd (165,800 people x 114-gpd = 19-mgd).

- Year 2010 Pharr Potable Water Demand- 7.5-mgd
- Year 2060 Pharr Potable Water Demand- 19-mgd

The historical water demand data provided by San Juan also covered the same six (6) year period from January 2005 to December 2010. San Juan provides water service to approximately 60-percent of the City or approximately 23,500 people. North Alamo Water Supply Corporation provides water service to the remaining 40 percent. The water demand for the San Juan service area is slightly less than Pharr 105-gpd/person.

The 2007 TWDB population projection for the Year 2060 is 129,300. The 2010 Region M Regional Water Plan projects the City will provide water service to approximately 88,950 people. North Alamo Water Supply Corporation would serve the remaining balance (40,350 people). The demand at Year 2060 is therefore estimated at 9.3-mgd (88,950 people x 105-gpd = 9.3-mgd).

- Year 2010 San Juan Potable Water Demand- 2.5-mgd
- Year 2060 San Juan Potable Water Demand- 9.3-mgd

There is an appreciable difference in wastewater flow per capita for each City. Both Cities provide wastewater service to its entire communities. Wastewater flows for Pharr is 75-gpd/person and San Juan is 56-gpd/person. The wastewater flows are projected to increase by approximately one (1) million gallons per day (1-mgd) every six (6) years in Pharr and every ten (10) years in San Juan. Utilizing these flows per capita, wastewater flows for Pharr are projected to grow from 5-mgd to 13-mgd, and in San Juan from 2.2-mgd to 7-mgd.

The 2010 Region M Regional Water Plan indicates that future water demand by Pharr and San Juan as well as other communities throughout the Rio Grande Valley will exceed the available water supply from the Rio Grande. Therefore, it is crucial to identify alternate water sources. Reclaimed water from the wastewater treatment plant is one such source.

ES.4 Water Availability

Texas

Population in Texas is expected to more than double between 2000 and 2060, growing from 21-million to 46-million and the demand for water is expected to increase by 27 percent, from 17-million acre-feet to 21.6 million acre-feet for the same period according to the 2007 State Water Plan. If Texas does not implement the 2007 State Water Plan, 85-percent of the State’s projected population will not have enough water in drought conditions.

Rio Grande Valley

Optimizing the available water supply from the Rio Grande is a vital aspect of protecting the state’s water resources as the river is the primary water source for both municipal and irrigation use in the Rio Grande Region. The 2010 Region M Water Plan reports that the Rio Grande Region’s population will more than double in the next 50 years from 1.62 to 3.94-million. Logically, a large portion of the region’s future municipal water supply will come from the Rio Grande. Municipalities can acquire Rio Grande water rights through purchase, urbanization, and contract. However, as discussed further in this report, there is not enough water in the Rio Grande to meet all future water needs in the region.

As a result of the water supply shortage identified in the 2010 Region M Regional Water Plan, diversifying water supply sources for municipal use will be essential to the Rio Grande Valley.

Pharr and San Juan

The 2010 Region M Regional Water Plan evaluated the use of groundwater in Pharr, San Juan, and surrounding areas to meet future water demands. Historically, groundwater has been used for municipal, irrigation, livestock, and industrial purposes. The only viable aquifer that exists in the Region is the Gulf Coast aquifer which underlies the entire Texas Coastal Region. The Gulf Coast Aquifer groundwater in the region is generally brackish (i.e., above 1,000 mg/L of total dissolved solids). Beneficial use of the Gulf Coast brackish groundwater for municipal purposes would require further treatment or blending with the Rio Grande water to reduce dissolved solids concentrations to make suitable for municipal use.

San Juan and Pharr already utilize the Gulf Coast Aquifer to augment their water supply. Each community has a single 1-mgd Gulf Coast Aquifer well in service. Pharr plans to install a second 1-mgd well later this year. Long term implementation issues associated with the Gulf Coast Aquifer include the uncertainty of the aquifer's yield and water quality. Due to this uncertainty, the Region M Water Plan estimated the contribution from this source at the planned 2,000 acre-feet per year for Pharr and 1,000 acre feet per year for San Juan. It is clear that Pharr and San Juan cannot solely rely on the Gulf Coast Aquifer to meet long-term water supply needs.

By 2030, 13 of Hidalgo County's 25 municipal water suppliers including Pharr and San Juan, plus its rural areas, will experience water supply deficits. Water needs for the county are projected to increase more than 40-fold in 50 years, from approximately 3,200 acre-feet/year in 2010 to more than 139,000 acre-feet/year in 2060. As shown in the table below, Pharr will need an additional 12,695 acre-feet of water per year and San Juan will require an additional 7,697 acre-feet of water per year by 2060. Refer to **Table ES.2** for current water surplus/needs through the year 2060.

TABLE ES.2
Municipal Water Surplus/Needs for Pharr and San Juan for 2060
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Municipal Water Surplus/Needs for Pharr and San Juan						
City	2010 (ac-ft)	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)
Pharr	376	-1,754	-4,152	-6,799	-9,649	-12,695
San Juan	-478	-1,642	-2,933	-4,361	-6,008	-7,697

(+) Positive indicates Surplus and (-) Negative indicates Shortfall

Due to the limited availability of future Rio Grande water rights, it is estimated that approximately half (6,350 acre-feet) for Pharr and (3,850 acre-feet) for San Juan will need to come from a separate water source other than the Rio Grande. As previously noted, the Gulf Coast Aquifer is projected to supply approximately 2,000 acre feet of the estimated 6,350 acre-feet shortfall for Pharr and 1,000 acre-feet of the estimated 3,850 shortfall for San Juan. Therefore, the total volume of water that needs to come from a water source other than the Rio Grande or the Gulf Coast Aquifer is 4,350 and 2,850 acre-feet per year for Pharr and San Juan, Respectively. Refer to **Table ES.3** for total water needs for each City through the year 2060.

TABLE ES.3
Total Projected Water Needs for Pharr and San Juan for 2060
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Total Projected Water Needs for Pharr and San Juan for 2060 (acre-feet)					
City	Current Rio Grande Water Rights	Projected Rio Grande Water Right Acquisitions	Projected Gulf Coast Aquifer Rights	Other	Total
Pharr	8,676	6,350	2,000	4,350	21,375
San Juan	2,762	3,850	1,000	2,850	10,462*

*Total only includes the water service area served by the City San Juan

The information contained in this study clearly indicates the need to identify a reliable alternate water supply source. The City will soon need to acquire additional water to meet demands. It is also evident that by the Year 2060 there will not be sufficient Rio Grande Water Rights available to meet projected demands. Therefore, the need to identify an alternative water supply source is vital. One possible means to address this deficiency is by augmenting the City's water supply via indirect potable reuse. This would effectively consist of incorporating tertiary treatment, storing the polished wastewater for a designated period of time, and then conveying it to City's Raw Water Reservoir to augment its water supply.

ES.5 Reclaimed Water Use Options and Historical Effluent Water Quality

Reclaimed Water (Non-Potable Uses)

The simple definition of Reclaimed Water is the beneficial use of treated wastewater for irrigation, industrial cooling, or other non-potable uses. The end product or water that has gone through the various treatment processes to meet specific water quality criteria with the intent to being used in a beneficial manner (i.e. irrigation, cooling, etc) is defined as Reclaimed Water. In the state of Texas, the Texas Commission on Environmental Quality (TCEQ) regulates the use of reclaimed water for non-potable uses after notification by a water producer of the intent to provide reclaimed water for specified purposes. Regulations are found in Title 30, Chapter 210 of the Texas Administrative Code, which defines two (2) types of reuse water. Quality requirements are based on the intended use and the potential for human contact with the water:

- Type 1 requirements apply for those uses in which there is a high potential for public contact (e.g. parks or school ground irrigation).
- Type II requirements apply for those uses which there is controlled access to the usage site (cooling, etc).

Sources of Reclaimed Water

The source of reclaimed water for the City is treated effluent from each respective WWTP. Pharr owns and operates a single WWTP, which currently treats an average of 5-mgd (5,600 acre-feet per year). San Juan also owns and operates a single WWTP and treats 2.2-mgd (2,464-acre-ft). The effluent quality of both WWTPs is appropriate for either Type I or Type II uses.

It is difficult to predict how new federal or state requirements will be applied to discharge permits in the future. As the number of reclaimed water projects increases, total dissolved solids (TDS) levels, or salts, may become an issue, and there are already some Texas Pollution Discharge Elimination System (TPDES) permits with TDS limits. *Pharmaceuticals and Personal Care Products* (*PPCPs*) are as well an issue. PPCPs are a large class of organic chemicals that have been classified as emerging contaminants as they are disposed of on a continual basis from both domestic and industrial sewage. PPCPs include pharmaceutical drugs, cosmetics, household and industrial chemicals, and nutritional supplements. Some of these components are very persistent and difficult to remove from a waste stream.

The Environmental Protection Agency (EPA) has also required all states to incorporate some form of nutrient removal standard into the surface water quality standards. Thus, in the future, discharge permits will likely include a phosphorous limit, and possibly a nitrogen limit; however this has more of an impact on conventional discharge than on most reuse applications. As these regulations are implemented, there are several types of treatment technologies that maybe readily available for use at either of the treatment plants discussed. It is important to note that direct reuse programs reduce the volume of flow discharged into the receiving stream and hence reduce the overall nutrient loading to the same receiving streams.

Direct and Indirect Potable Reuse

Direct Potable Reuse is the introduction of highly treated reclaimed water as a raw water source for a water treatment plant without entering a stream or reservoir. Currently, in the United States, Direct Potable Reuse of reclaimed water for human consumption is limited. However, Indirect Potable Reuse or the planned incorporation of reclaimed water into a raw water supply, such as in a raw water reservoir or groundwater aquifer, resulting in mixing, dilution, and assimilation, thus providing an environmental barrier prior to treatment is an established practice in Texas.

Many communities, such as Pharr and San Juan use surface water sources of varying quality for their drinking water supply. These sources are subject to a number of upstream discharges of treated wastewater. Both Pharr and San Juan experience incidental indirect potable reuse since both cities are dependent upon the Rio Grande which in turn receives both regulated and unregulated wastewater discharges upstream of the City's raw water intake.

Planned potable reuse systems in which wastewater is processed to a quality suitable for water supply has historically been deemed too controversial as a result of negative public perceptions and a reduced number of barriers for protection of public health. The detractors refer to this as "toilet to tap". As water supplies become more limited in the future, and the public becomes increasingly aware of the exact nature and history of their local raw water supply, it is anticipated that increased emphasis will be placed on the planned augmentation of supplies with highly treated wastewater effluent. The proponents of such a recycling program refer to this as "showers to flowers".

Fundamental to the practice of planned potable reuse is the use of multiple barriers to improve system reliability and ensure the quality of the product water. The treatment systems discussed are consistent with the multiple barrier concepts which are a cornerstone of safe drinking water programs for protection of public health. This concept consists of sequential physical barriers and monitoring points that help prevent contamination at the customer source and enhance treatment at the plant, thereby assisting in ensuring a safe supply of drinking water for consumers.

The source of reclaimed water for the City is treated effluent from each respective wastewater treatment plant (WWTP). Pharr owns and operates a single WWTP, which currently treats an average of approximately 5-mgd (5,600 acre-feet per year). This volume is adequate to supply all of the projected reclaimed water demand of 4,350 acre feet per year in Pharr up to the year 2060. San Juan also owns and operates a single WWTP, which currently treats an average of approximately 2.2-mgd (2,460 acre feet per year). This volume is as well adequate to supply all of the projected reclaimed water demand of 2,850 acre feet per year in San Juan up to the year 2060. This does not take into account losses due to evaporation which based on preliminary calculations amount to approximately 2% on an annual basis.

ES.6 Reclaimed Water Users, Service Areas, and Potential Projects

An initial screening-level evaluation was performed to identify potential reclaimed water use customers as well as conceptual treatment improvement and conveyance projects for each potential customer. The purpose was to determine if the potential customer group is compatible with the Plant's current effluent quality.

Potential users of reclaimed water include industrial users, commercial irrigation accounts, city parks and city sports facilities, schools and their associated athletic fields and administrative facilities, golf courses, and agricultural uses, specifically citrus groves. Reclaimed water used for irrigation by these customers will require the City to meet Type I effluent criteria plus chlorination.

Based on our evaluation, the water demand from traditional water use customers in the City is low. Only a minor portion of the reclaimed water is needed for irrigation purposes. The most significant beneficial use identified is by the respective water utilities to augment its potable raw water supply. This consists of polishing the effluent to near drinking water standards, holding it in a reservoir for a minimum detention time, and then diverting the reclaimed water to the water plant's raw water reservoirs for blending. Raw water for both Cities is provided by the Hidalgo County Irrigation Water District No. 2.

The treatment requirements for irrigation users versus water utilities (City) are markedly different. Therefore, the service delivery for irrigation and for the augmentation of raw water was developed separately in our report.

Reclaimed Water Users- Irrigation/Commercial, Schools and Parks, and Citrus Groves

The top ten (10) irrigation accounts were reviewed. It was apparent that very few industrial/commercial irrigation users exist in the area. The top ten (10) accounts included motels, fast-food establishments, RV Parks, apartment complexes, "big box" stores, and professional office buildings. As an example, the top six Pharr Irrigation Accounts included Palm Valley Memorial Park (Cemetery), Valley View Apartments, Lowe's Home Center (garden area), two (2) First National Banks, and Sonic Drive-in. The top six (6) City of San Juan industrial and irrigation accounts included Central Ready Mix (concrete batch plant), San Juan Shrine, San Juan Nursing Home, Memorial Funeral Home, HEB, and Rio Bank. The use was low and the location of the irrigation/commercial users were geographically scattered across the entire City. Due to the low water use, geographic scattering of the end users, and the difficulty of accurately distinguishing between potable and non-potable use it was decided that these customers were not viable reclaimed water use candidates.

The School District [Pharr San Juan Alamo (PSJA) Independent School District] campuses as well as City public parks were given serious consideration as potential reclaim water customers as they represent the largest percentage of green spaces in the planning area. Refer to **Figure 6.1 and 6.2** which depicts the location of top irrigation accounts, schools, athletic fields, and parks throughout the City.

Another potential reclaimed water customer identified during our study is the Citrus Grove Farmers. Citrus Groves are farms that are dedicated to growing citrus fruits such as oranges, tangerines, grapefruits, lemons, and limes. A significant area within the planning area includes Citrus Groves which could be a significant reclaimed customer. However, the TDS levels will need to be checked to ensure that citrus can tolerate.

Service Areas- Geographical grouping of potential Reclaimed Water Customers

Potential reclaimed water customers were grouped based on their geographical location within the planning area. The planning area was subdivided as follows:

- *Pharr and San Juan Political Boundaries*. Pharr and San Juan will be responsible for supplying reclaimed water respectively to customers within its boundaries.
- *Expressway 83 which extends east-west*. The area north of the Expressway was defined as the Northern District, the area to the South the Central District. The Expressway provides a logical divide both geographically and financially due to the potential construction cost associated with crossing this wide TxDOT Right-of-Way. Furthermore, this split also divides users on either side of the freeway.
- *The Arroyo Colorado Floodway also extends east-west direction and forms another logical geographical divide, this one to the south*. Pharr is the only community that has potential reclaimed water users south of the Arroyo, thus a southern service area was created exclusively for Pharr.

Five (5) service areas were established: (1) Pharr– Central District; (2) Pharr– Northern District; (3) Pharr– Southern District; (4) San Juan– Central District; and (5) San Juan– Northern District. The citrus groves were handled as an add-on to the service district within which they are located; the northern district for Pharr and the central district for San Juan. **Figure 6.3** depicts the aforementioned service areas.

Refer to **Section 8.0** for a detailed breakdown of all potential reclaimed water use customers identified in the planning area.

Water Utility (Pharr and San Juan)

Reclaimed water that is delivered to its raw water reservoirs is a water source the City has full control over even in extreme drought conditions. Reclaimed water provides a firm, continuous, and relatively constant source regardless of the fluctuations in weather conditions.

Assuming that the schools, parks, and other potential reclaimed water customers (excluding the citrus groves) were to use reclaimed water based on the demand quantities noted above. Approximately 74% of the reclaimed water from the Pharr WWTP (5-mgd) and 50% of the reclaimed water from San Juan (2.2-mgd) would be available for augmentation.

The use of reclaimed water for augmentation directly reduces the need to obtain additional water rights. The reuse of 1-acre-ft of effluent water reduces the need to acquire 1-acre-ft in water rights. Furthermore, during drought conditions, the City is not guaranteed to receive its full allocation of water rights. Refer to **Section 4.5 and 4.6** for additional information related to the Water Rights.

Based on an average daily reclaimed water flow rate of 3.7-mgd from Pharr and 1.1-mgd from San Juan, the reclaimed water that could be available for augmentation is equivalent to adding approximately 3,920 acre-feet to Pharr's water rights and 1,230 acre-feet to San Juan's water rights.

ES.7 Conceptual Projects

Reclaimed Water Distribution System (Direct Non-Potable)

The implementation of a direct non-potable reclaimed water reuse program requires the City to incorporate a reclaimed water distribution network. This is similar to the City's Potable Water Distribution Network but on a much smaller scale. The reclaimed network would include an elevated storage tank, booster pump station, and separate water main. The water main alignment would be strategic to accommodate potential reclaimed water customers as well as to attract future industrial users. **Figure 6.2** shows the location of potential water reuse customers as well associated projected demands.

The associated cost of implementing a direct non-potable reclaimed water reuse system was found to be cost prohibitive. This was due to the lack of high-demand customers identified within the planning area. The cost to implement a reclaimed water reuse system for direct non-potable is $3.96/1,000-gal and $1.93/1,000-gal for Pharr and San Juan, respectively. Refer to **Section 8.0** and **Section 9.0** for additional information related to this project and associated costs.

Raw Water Reservoir Augmentation (Indirect Potable Reuse)

The first step in developing a system to use reclaimed water to augment the City's raw water supply consists of incorporating a new advanced treatment system. Reclaimed water used for irrigation purposes or that is discharged into the receiving stream (Arroyo Colorado) would not receive the advanced treatment. It is our recommendation the City considers reusing the entire volume of reclaimed water. However, this should be accomplished in incremental steps.

Pharr

Phase 1

Prepare a conceptual master plan to reuse all reclaimed water produced at the Plant. The initial Phase would consist of constructing a plant to treat 2-mgd to near drinking water standards, constructing a conversion pond for buffering, and booster pump station to deliver the reclaimed water to the City's Raw Water Reservoir for blending.

If the City is proactive and successful in securing necessary funding to develop this project, it is possible to have the plant operational by the Year 2015.

Phase 2

Phase 2 consists of expanding the advanced treatment system from 2 to 4-mgd. A new pump would be added to increase the capacity of the booster pump station to meet higher demand.

Phase 3

Phase 3 would consist of expanding the advance treatment system from 4 to 6-mgd. Two (2) new pumps would be required as well as a second parallel line. The City could consider removing and replacing the first transmission main as well.

If the City continues to irrigate the Tierra Del Sol Golf Course at the same rate (0.5-mgd) and fully implements the phases noted above, the plant would likely reach zero discharge condition by the Year 2025. Thereafter, the City can decide to simultaneously expand both facilities (WWTP and Advanced WWTP System). A significant advantage to the City is the proximity of the WWTP to the Water Treatment Plant (WTP). These facilities are less than 2.5-miles apart.

San Juan

Phase 1, 2 and 3

The steps for the City of San Juan would be similar to Pharr and would consist of constructing a plant to treat 2-mgd to near drinking water standards, constructing a conversion pond for buffering, and booster pump station to deliver the reclaimed water to the City's Raw Water Reservoir for blending.

ES.8 Opinion of Probable Cost and Benefit Analysis

Provided below is a summary breakdown of the various conceptual projects developed as part of this study.

TABLE ES.4
Pharr Reclaimed Water Distribution System Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Description	Cost
Phase 1- Central District	500,000 gallon ground storage tank, 250,000 elevated storage tank, high service pump station, 47,000-lf of 6 to 16-inch Reclaimed Water Main.	$9.4-Million
Phase 2- Northern District [a]	26,000-lf of 6 to 16-inch Reclaimed Water Main	$3.6-Million
Phase 3- Southern District	33,000-lf of 6 to 10-inch Reclaimed Water Mains	$4.4-Million
	Total	$17.4-Million

a- An additional $1.0-million would be required during Phases 1 and 2 if provisions were included to serve the citrus groves in north Pharr. This would cover the cost to extend recycled water main an extra 4,000-lf as well as upsizing the main reclaimed main along the central and northern districts.

TABLE ES.5
San Juan Reclaimed Water Distribution System Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Description	Cost
Phase 1- Central District	500,000 gallon ground storage tank, 250,000 elevated storage tank, high service pump station, 42,000-lf of 6 to 16-inch Reclaimed Water Main.	$7.5-Million
Phase 2- Northern District	25,000-lf of 6 to 16-inch Reclaimed Water Main	$3.5-Million
Phase 3- Citrus Groves	7,000-lf of 8 to 12-inch Reclaimed Water Mains	$0.9-Million
	Total	$11.9-Million

TABLE ES.6
Pharr Indirect Potable Reuse System (2-mgd) Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Description	Cost
Advanced Treatment System	Membrane Filtration, Reverse Osmosis, and UV Disinfection.	$16.7-Million
Engineered Buffer Storage Pond	14-MG Storage Pond	$2.0-Million
Delivery System	High Service Pump Station and 20-inch Transmission Main	$3.2-Million

Item	Description	Cost
	Total	$21.9-Million

TABLE ES.7
San Juan Indirect Potable Reuse System (2-mgd) Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Description	Cost
Advanced Treatment System	Membrane Filtration, Reverse Osmosis, and UV Disinfection.	$16.7-Million
Engineered Buffer Storage Pond	14-MG Storage Pond	$2.0-Million
Delivery System	High Service Pump Station and 20-inch Transmission Main	$3.7-Million
	Total	$22.4-Million

ES.9 Public Relations and Meetings

The City has conducted three (3) public meetings related to the Reuse Water Implementation Plan. The first public meeting was held early in the study and provided information about the project team and the scope of work to be performed. The second meeting was held following development of the initial project alternatives and provided information about proposed service areas. The third public meeting was held following submission of the draft report and presented a summary of the final recommended alternatives, feasibility evaluation and implementation plan.

In order to facilitate communications with community leaders about the proposed reclaimed water program, a public information committee (PIC) was established. City staff and its consultant met with the committee during the course of this study. The PIC discussed the potential projects, reclaimed water system policies and procedures and potential financing and rate structures.

Proposed Public Information Program

Since well-designed public outreach programs have been demonstrated to contribute to the success of reclaimed water projects, an important component of the City's implementation plan will be the development of an effective public outreach program. Such a program would identify key stakeholder groups and use a phased approach to informing these groups, soliciting input and gaining trust and support.

Reclaimed Water Implementation Plan

The primary objectives of this project are to provide recommendations and evaluate the feasibility of reclaimed water projects for the City and to develop an implementation plan for the viable reclaimed water projects. Advancement of the Reclaimed Water Program will involve the development of a number of policies and procedures and establishment or modification of ordinances supporting the program. The development of the program will also build upon the experience of the Tierra del Sol Golf Course reclaimed water project, which is currently in operation. Additionally, an organizational structure will need to be established to provide the leadership, marketing, and operations infrastructure necessary for a successful program.

The various actions for further developing the City Reclaimed Water Program and pursuing the implementation of recommended reclaimed water projects are summarized at the end of this section.

Administrative Actions

The following are recommended administrative actions that are fundamental to the reclaimed water program. It would be beneficial to implement these actions early in the program.

Reclaimed Water Program Organization

In order to implement a reclaimed water program, the City will need to establish a program organization with a designated manager, limited administrative staff, functional support from Water Operations and Wastewater Operations, and interdepartmental support. This approach will utilize the experience of the existing water/wastewater operations staff and will minimize the initial costs of establishing a reclaimed water program.

Policies and Procedures

The Reclaimed Water Program will require the development and implementation of a number of policies and procedures. These may relate to design specifications, cross-connection control, funding sources and rules, rate structure, site inspection authority, enforcement policies, operations and maintenance manuals, reclaimed water user manuals and emergency response plans.

Update City Ordinances to Include Reclaimed Water Provisions

Several aspects of the reclaimed water program may require modification of existing ordinances or creation of new ordinances. Potential considerations include:

- Establishment of pricing structure and pricing policies for reclaimed water.
- Potential restrictions on the use of raw water within the targeted reclaimed water service areas.
- Potential requirements for the use of reclaimed water for specific user groups within the targeted reclaimed water service areas.
- Potential requirements for developers to install dual distribution systems in new developments within the targeted reclaimed water service areas.

Reclaimed Water Customer Contract

A standard contract to be executed with reclaimed water customers should be developed and adopted. The contract should include provisions necessary to address issues uniquely related to reclaimed water as well as other considerations typically included in City water customer contracts. It is important that the contract includes provisions that protect the potable water system from cross connection with the reclaimed water.

Other Actions

Tierra del Sol Golf Course Reclaimed Water Project Experience

Pharr is currently providing reclaimed water to the Tierra del Sol Golf Course. The City can use this project as a development tool and building block for future reclaimed water projects. Much has been learned during the development and implementation of this project, and many of the assumptions and policies can be reviewed and refined based on this experience and provide beneficial knowledge for future operations and maintenance practices.

Wastewater Treatment Plant Testing Program

Based on a review of historical effluent data from both cities, both wastewater treatment plants have demonstrated the ability to meet the quality requirements for both Type I and Type II reclaimed water applications. However, San Juan will need to consider making additional modifications to reliably meet Type I Standards. This would consist of incorporating effluent filters. In Type I applications, there is likely public contact in areas irrigated with reclaimed water. In Type II projects, public contact is controlled. However, as flows from these plants increase, and approach their rated design capacities, careful observations should be made of the CBOD and turbidity levels. Any trends of increased concentrations should be addressed, possibly with optimization of operations or additional treatment capacity. Under the current flow and loading conditions, the effluent from either plant could be used for Type I or Type II reclaimed water projects.

Public Information/Public Awareness Campaign

Since well-designed public outreach programs have been demonstrated to play a significant role in the success of reclaimed water projects, an important component of the City's implementation plan will be developing an effective public outreach program. Such a program would inform stakeholders, solicit their input, and develop and enhance their support for the beneficial use of reclaimed water. It is anticipated that this effort would continue the use of a Public Information Committee (PIC), specific to reclaimed water, as has already been established for this project.

Reclaimed Water Workgroup Goals and Accomplishments

A reclaimed water workgroup will be established in order to begin the process of developing the appropriate administrative framework to support the reclaimed water program. The primary goals of the workgroup were as follows:

1. Identify and develop a general description of administrative documents necessary for the reclaimed water program;
2. Development of draft administrative documents identified in item 1, above. Draft documents developed by the workgroup include:

   a. A reclaimed water ordinance that defines the purpose of the program, application procedures, user and provider responsibilities, and prohibitions;

   b. A standard service agreement for reclaimed water users;

   c. The rate and fee structure for the reclaimed water program.

3. Identify existing City documents that require modification to incorporate aspects of the reclaimed water program. Establish a procedure and timeline for modification of these documents.

ES.10 Summary-Recommended Reclaimed Water Projects

Reclaimed water projects provide a number of benefits, many of which are difficult to quantify in terms of a direct financial benefit. Based on the financial evaluation of the individual projects and the reclaimed water system as a whole the following conclusions can be made:

- The City does not have sufficient water rights to account for future growth.
- The Rio Grande will not meet all of the regions' future water demands.
- The City needs to identify other reliable sources to meet future water needs.
- Water management strategies defined in the Region M Water Plan are cost prohibitive.
- The cost of the non-potable water system was found to be cost prohibitive. Primarily because no major commercial clients were identified. Furthermore, the potential customers identified such as the schools and parks historically irrigate at very low rates.
- The unit pricing for the indirect potable reuse clearly indicates that this may be a viable option for the City to meet or supplement its future potable demands. Reclaimed water is a reliable source that is drought proof and each community has full control over. The largest obstacle in implementing such a program is public perception. This will require educating the public.

Based on this evaluation, it is recommended that Pharr and San Juan proceed with implementation of a reclaimed water program for indirect potable reuse. The City should continue to explore alternative financing approaches, including federal or state grant or loan programs, and participation from customers and/or developers. It should be noted that the cost analysis performed here was based on the projected demands presented in Section 5.0. Experience with other established reclaimed water systems suggests that once facilities are in place, demand for reclaimed water often exceeds projected values. Although the "if we build it, they will come" strategy does not come without risk, most reclaimed water systems must, to some extent, rely on uncommitted future demands to justify initial implementation.

SECTION 1.0

Introduction and Data Collection

1.1 Background

The Cities of Pharr and San Juan are projected to experience significant growth in population during the coming decades and that growth will in turn generate an increase in water usage. Additionally, these two communities will need a reliable water supply to attract new businesses to support the growing population. To help meet those future water supply needs, Pharr and San Juan are committed to finding beneficial and efficient use of water resources through education, sound science, and technology. The Water Reuse Priority and Implementation Plan will provide information that will assist Pharr and San Juan in pursuing opportunities to meet their respective future water needs. Generally, all references to "City" within the report shall be understood include both the City of Pharr and the City of San Juan.

On a larger scale, the Rio Grande Valley as a whole is facing water supply challenges due to increasing demand, depletion, and dependence upon a single source of supply, the Rio Grande. These challenges are magnified during years of below average rainfall and in the last decade have become a critical issue during years of drought. The practice of water restrictions and other conservation methods have become increasingly important over the last couple of decades. However, such practices alone cannot be expected to remain the sole solution to this water supply challenge.

Originally mandated by the 75th Texas Legislature in Senate Bill 1[3], the regional water supply planning process has identified a number of future water management strategies for the region. In addition to conservation, future water management strategies in the 2006 Region M Water Plan[4] included water reuse, seawater desalination, brackish "groundwater" desalination, and the Brownsville weir and reservoir.

Water reuse was identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature under Senate Bill 1094. In addition to water conservation efforts, development of a water reuse program will provide for greater efficiency in the use of the City's water resources and will help these communities address their water supply challenges. Specifically, water reuse, the use of highly treated wastewater effluent, will directly reduce the City's raw water needs from the river at the water treatment plant intake and thereby assist the City in securing necessary future water supplies to meet its anticipated population growth. Refer to **Appendix A** for Glossary of Terms Related to Water Reuse.

[3] Texas Water Development Board, Report 362, Water Conservation Implementation Task Force, *Water Conservation Best Management Practices Guide*, November 2004.

[4] Texas Water Development Board, Region M Regional Water Plan, NRS Consulting Engineers, Final Plan dated October 1, 2010.

1.2 Purpose

The purpose of this study is to provide the City with a plan that can be used to guide implementation of a water reuse program. Furthermore, during development of this plan, and later its implementation, the City will need to work closely with its wholesale customers and surrounding areas to identify potential approaches to a reuse program that could include regional support and cooperation among various entities.

This study will also include the evaluation of alternatives for direct non-potable reuse and indirect potable reuse. San Juan is currently diverting reclaimed water from the San Juan Wastewater Treatment Plant (WWTP) to a recently constructed wetland system. Pharr is currently operating a reclaimed water reuse system to irrigate the Tierra Del Sol Golf Course. This golf course is relatively close to the Pharr WWTP. Implementation of a water reuse program for the City will be intended to complement these ongoing reuse efforts.

1.3 Scope

The goal is to develop a priority for the implementation of a plan by identifying appropriate uses for highly treated effluent from the Pharr and San Juan Wastewater Treatment Plants. The study is to include the development of conceptual plans and an evaluation of costs and benefits for providing reclaimed water to several identified service areas within Pharr and San Juan planning area.

The study's scope includes tasks which are intended to provide a review of available information associated with the study, identify potential reclaimed water service areas, develop conceptual treatment projects and conveyance plans, evaluate their costs and associated benefits and feasibility, and identify necessary steps for implementation. Specifically, the tasks include the following:

- Review previous City of Pharr and San Juan reports or studies related to reclaimed water;
- Review of population, water demand, and water and wastewater flow projections;
- Evaluate quality of WWTP effluent relative to potential recycled water quality requirements;
- Identify top water users within the City and develop a list of potential recycled water customers;
- Identify other potential reclaimed water uses and options;
- Identify service areas, demands, and potential locations for reclaimed water projects;
- Conceptualize potential projects and develop alternatives;
- Perform cost verse benefit and feasibility analysis for the list of potential users and alternatives and identify the more viable projects;

- Support the City in establishing a Public Information Committee and recommended steps for development of a public information plan;
- Identify administrative or regulatory actions necessary to support a reclaimed water program;
- Develop a reclaimed water implementation plan that includes recommended projects, implementation steps and an implementation schedule.

These project objectives will be achieved by reviewing previous studies, meeting with City staff, and potential customers if needed, evaluating potential current and future recycled water needs and service areas, and assessing costs verse benefits associated with each project. The potential projects will then be analyzed based on engineering and economic feasibility to identify and define the recommended recycled water options and to develop an implementation plan and strategy.

1.4 Data Collection

The data collection phase consisted of collaborating with the City to procure critical data to initiate our study.

Provided below is a list of the data requests made to each community:

1. Wastewater:
    - Wastewater Treatment Plant Daily Monthly Reports (DMR) from 2005 through 2010;
    - Wastewater Treatment Plant Record Drawings;
    - Technical Reports, previous Studies, and Applications for permits;
    - TCEQ Discharge Permit and any other miscellaneous TCEQ correspondence;
    - Sanitary Sewer collection system Block Maps;
2. Water:
    - Water Treatment Plant Daily Monthly Reports (DMR) from 2005 through 2010;
    - Water Distribution system Operating Data and Revenue Reports;
    - Water Treatment Plant Record Drawings;
    - Technical Reports, previous Studies, and Applications for permits;
    - TCEQ correspondence;
    - Water Quality Reports;
    - Water Distribution system Block Maps;
    - Information regarding existing Water Distribution system facilities (booster pumps, storage tanks, standpipes, etc.)
3. Provide a detailed list of all Schools, Parks, and Athletic Facilities within the City;
4. Electronic copies of maps from the Hidalgo County GIS web site including any Aerial Photography;

5. Map defining Limits of City and ETJ;
6. Zoning Maps and any Exhibits regarding future development within City or the ETJ;
7. Reports or documents regarding population projection forecasts;
8. Water Conservation Plan.

The information listed above was received and reviewed. The one exception was Item 6 (Zoning Maps) from San Juan.

SECTION 2.0

Population Projections

2.1 Introduction

It is expected that the population of both Pharr and San Juan will continue to grow. As the population in these two (2) cities increases so will potable water demands. Therefore the need to identify alternative raw water supplies to augment the Rio Grande water source will become crucial to these communities. Water recycling is one such method that is viable and proven to offset increasing raw water needs. In order to best identify the appropriate distribution of reclaimed water use potential, it is important to project future water demands by establishing population projections. Population projections will be used to determine future raw water demand needs as well as the availability of reclaimed water.

This section of the report examines population projections for Pharr and San Juan. The implementation of a water reuse plan is a long range process that requires several decades to address the social and technical issues, as well as plan, and design and construct the necessary infrastructure.

2.2 Population Projections

Three (3) sources for population projections were identified for potential use in this Study. This includes the following: (1) Lower Rio Grande Valley Development Council (LRGVDC), (2) Water Master Plans for the Cities of Pharr and San Juan, and the (3) Texas Water Development Board (TWDB). To address future water needs, it was decided that population projections should be extended to the Year 2060. Any source that did not extend to the Year 2060 was not generally used. The limitations and/or advantages of each source are considered below.

2.2.1 Lower Rio Grande Valley Development Council Population Projections

The LRGVDC population projections use data acquired through traffic survey zones and land-use models that rely on household numbers and employment rates. LRGVDC projections extend only to the Year 2030.

2.2.2 City of Pharr and San Juan Water Master Plan Population Projections

Pharr and San Juan use a number of sources for their final estimates of population in their respective Water Master Plans. These projections of future populations start with historical data and are adjusted based upon review of the plats and other available developers' plans. This source was limited as the projections presented extend only to the Year 2030. Refer to **Table 2.1**.

TABLE 2.1
Cities of Pharr and San Juan Population Projections
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

	Cities of Pharr and San Juan Population Projections (Thousands)								
Year	2000	2005	2010	2015	2020	2030	2040	2050	2060
Pharr	44.3	52.3	61.1	71.1	82.5	n/a	n/a	n/a	n/a
San Juan	26.2	n/a	39.1	n/a	54.1	70.9	n/a	n/a	n/a

2.2.3 Texas Water Development Board Population Projections

The TWDB was tasked with developing a water plan in accordance with Texas Senate Bill 1, and it is this task which guides their development of a population assessment.

The Region M Water Planning Group, under the guidance of the TWDB, was responsible for the development of population estimates for use in the resource planning for the Rio Grande Valley designated as Region M. This group, under the TWDB, used U.S. Census data, such as birth and death rates and migration estimates, along with South Texas Development Council (STDC) data, and input from water customers, to develop a representation of potential future residents. Current TWDB projections are made through the year 2060. Refer to **Table 2.2**.

TABLE 2.2
TWDB Population Projections
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

	TWDB Population Projections (Thousands)								
Year	2000[1]	2006[2]	2010	2015	2020	2030	2040	2050	2060
Pharr	46.7	61.4	66.0	n/a	82.6	101.3	121.4	143.3	165.8
San Juan	26.2	32.3	39.1	n/a	54.1	70.9	89.1	109.0	129.3

[1]U.S. Census
[2]U.S. Census Estimate

2.3 Comparison of Population Projections

The population projections by the LRGVDC and the Water Master Plans for Pharr and San Juan are limited as they extend at most 20 years (Year 2030). The short range projections in the master plan and LRGVDC were prepared for the planning of shorter range infrastructure needs. It is anticipated that the implementation of a water reuse plan will be a long range process covering several decades and thus equally requires long range population projections to reasonably estimate water needs and availability. Only the TWDB population projections extend over a time frame that matches that anticipated for a reuse plan's implementation process. Therefore, for the purposes of this study, the projections generated by the TWDB were used.

This page intentionally left blank.

SECTION 3.0

Water Demand, Wastewater Flows, and Reclaimed Water Availability

3.1 Introduction

To assess the extent to which water reclamation can be used by the City, an estimate of future water demands and future wastewater flows was computed. Wastewater flow projections will establish the maximum amount of water available for reclamation and future water demands will indicate required raw water supply. The Year 2007 Population projections established by the TWDB were used to extrapolate the historical water demands and wastewater flows out to the Year 2060. Such knowledge of the future water demands and wastewater flows will be essential in determining the viability of individual projects, as well as how and when to best implement them as a component of the reuse plan.

3.2 Water Demand

Figures 3.1 and **3.2** shows both the historical (6-Years) and projected water demand (2010 to 2060) for each community. The Plant Daily Monitoring Reports (DMR's) provided from the City from each respective Water Treatment Plant were used to develop these graphs.

3.2.1 Historic Water Demand

The historical data for water demand for the City, presented in **Figure 3.1 and 3.2**, covered six (6) years from January 2005 to December 2010. Two (2) observations were made based on review of the historical data.

3.2.1.1 Observation No. 1

Pharr water usage is slightly higher as compared to San Juan (approximately 10% higher) on a per capita basis. The usage is 114-gpd/gal and 105-gpd/peron for Pharr and San Juan, respectively.

Pharr

- 2010 Annual Average Day Demand= 7.5-million gallons per day (mgd)
- Population= 66,000
- 7.5-mgd/66,000 Population= 114-gpd/person

San Juan

- 2010 Annual Average Day Demand= 2.5-million gallons per day (mgd)
- Population= 23,500
- 2.5-mgd/23,500 Population= 105-gpd/person

FIGURE 3.1
City of Pharr Historical and Projected Water Demands
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

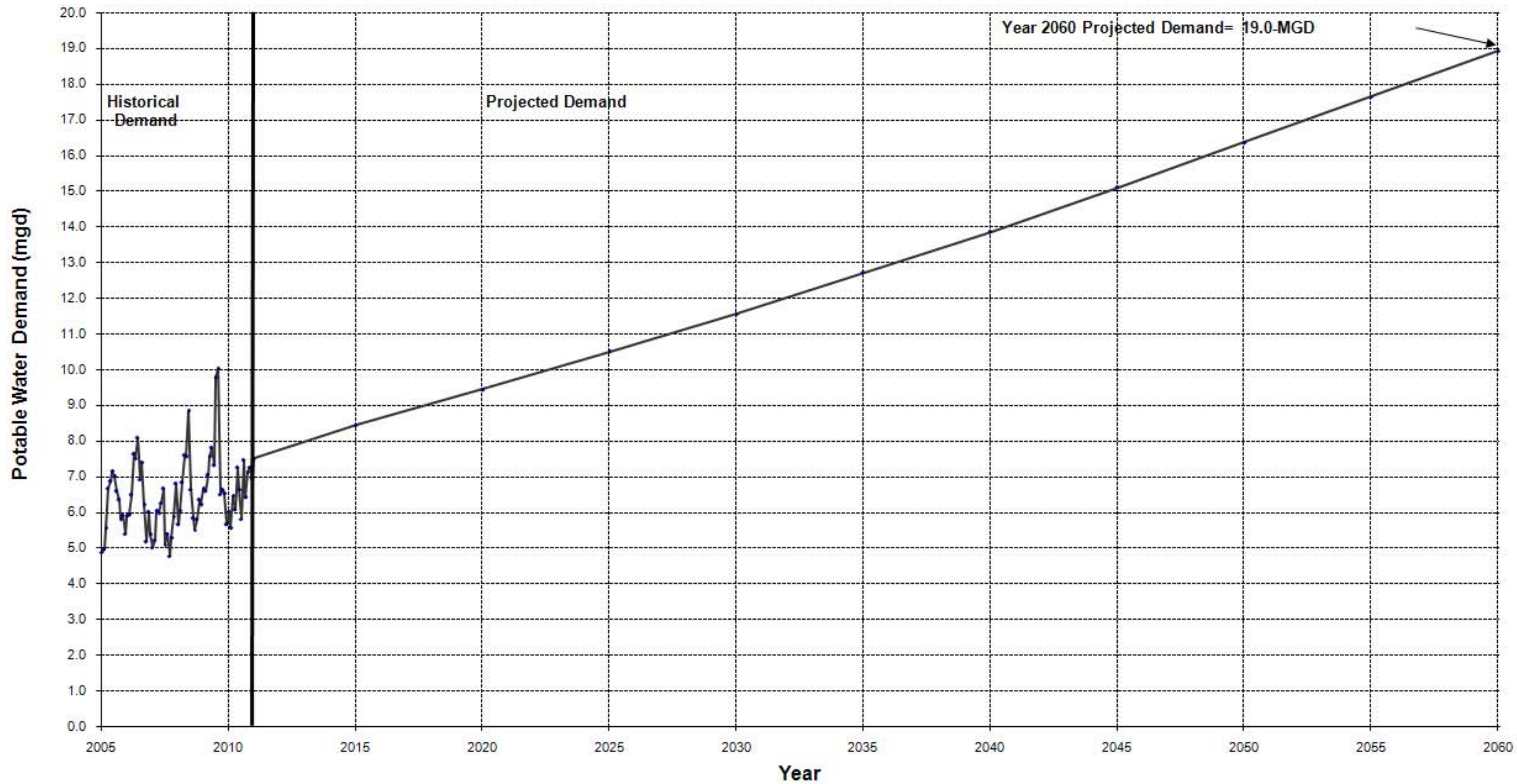
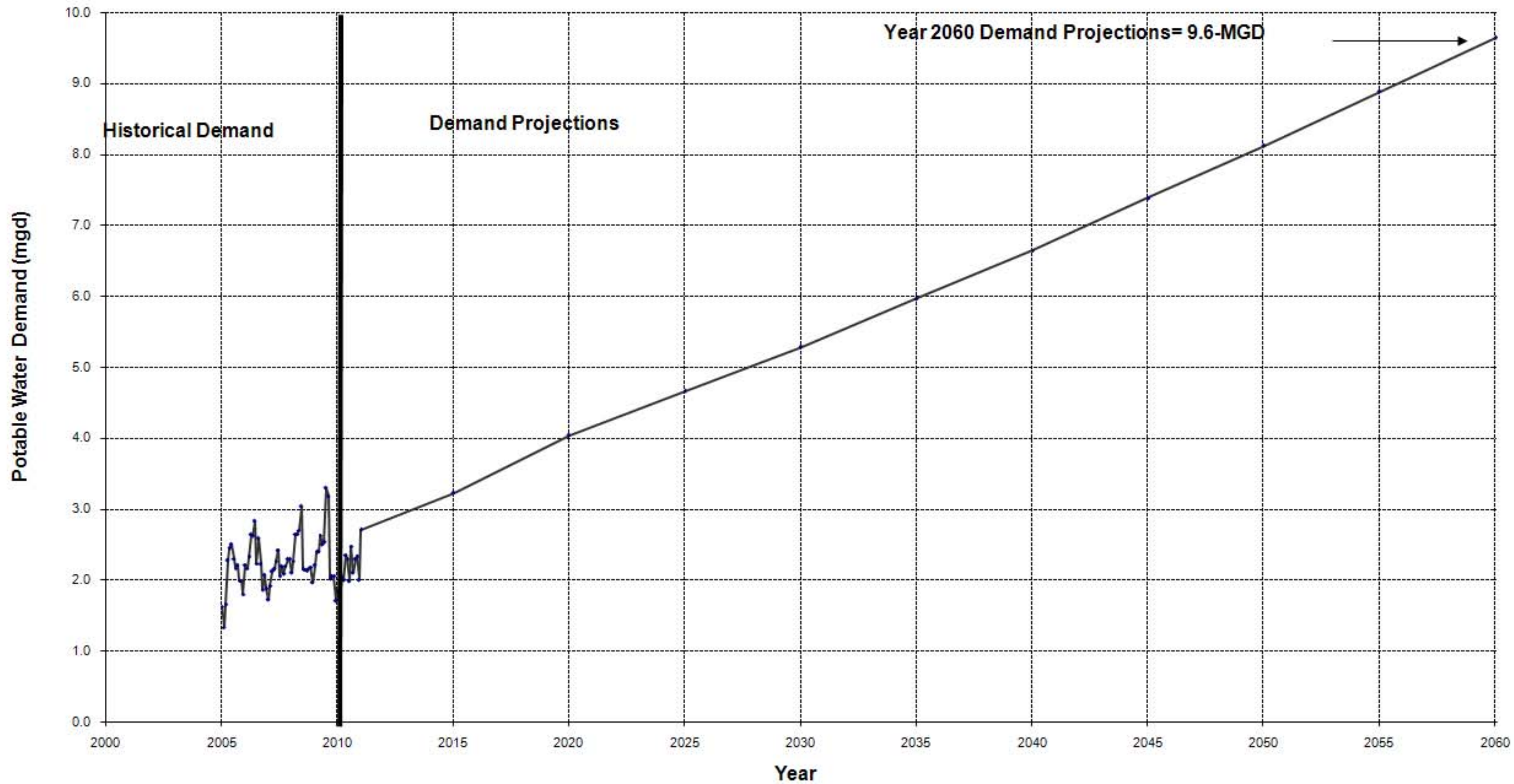


FIGURE 3.2
City of San Juan Historical and Projected Water Demands
City of Pharr and San Juan Water Reuse Priority and Implementation Plan



3.2.1.2 Observation No. 2

The highest demand typically occurs in June, after which demand drops off by approximately 35% in July and August. Furthermore, July and August have radical demand swings. For example, from the months of July and August in 2007 to those same two months in 2009 there is an increase of 60% in San Juan and 90% in Pharr. The residents of Pharr used about twice as much water during July and August of 2009 as they did in July and August of 2007. Meanwhile, during the remaining 10-months fluctuations typically range from 25% to 35%. Apparently demand during the months of July and August is greatly affected by some significant factors. Review of area precipitation records indicates no correlation between area rainfall and the sharp drop in demand. A more detailed analysis may be required to better understanding those factors to refine water demand projections.

3.2.2 Projected Future Water Demand

Figures 3.1 and **3.2** depict both historical and future water demands for Pharr and San Juan respectively. The demand projections are based on the population projections presented in Section 2 and applying the computed average per capita usage for the City. Refer to Section 3.2.1.1. The projected demands are based on a linear interpolation between decades. The computed demands for the Year 2020, 2030, 2040, etc represent the projected demand for that particular year. The demand for Year 2021, 2022, etc was based on a linear interpolation between corresponding decades.

Figures 3.1 and **3.2** show that water demand will increase approximately 1-million gallons per day (mgd) every four (4) years in Pharr and every seven (7) years in San Juan. Ultimately, it is expected that demand by the Year 2060 will increase by 250% in Pharr from 7.5-mgd to approximately 19-mgd and 350% from 2.2 to 10-mgd in San Juan.

- **Pharr 2060 Projected Water Demand- 19-mgd**
- **San Juan 2060 Projected Water Demand- 10-mgd**

The City's water demand similar to other communities in the Rio Grande Valley will exceed the available supply in the Rio Grande. Therefore, it is vital to find an alternative means to meet future demands. The use of reclaimed water is one such option.

3.3 Wastewater Flow

Figure 3.3 and **3.4** show the historical and projected wastewater flows for each community.

3.3.1 Historic Wastewater Flow

Historical data for wastewater flows for Pharr covered eleven (11) years, from January 2000 to December 2010. Data for San Juan covered six (6) years from January 2005 to December 2010. This was sufficient to establish historical trends for both communities. Historical data is depicted in **Figure 3.3 and 3.4**.

Similar to observations made related to the water demand, there is a noticeable difference in flows for each City. Flows, expressed in gallons per day (gpd) per person are 75-gpd and 56-gpd for Pharr and San Juan, respectively.

FIGURE 3.3
City of Pharr Historical and Projected Wastewater Flows
Pharr and San Juan Water Reuse and Implementation Plan

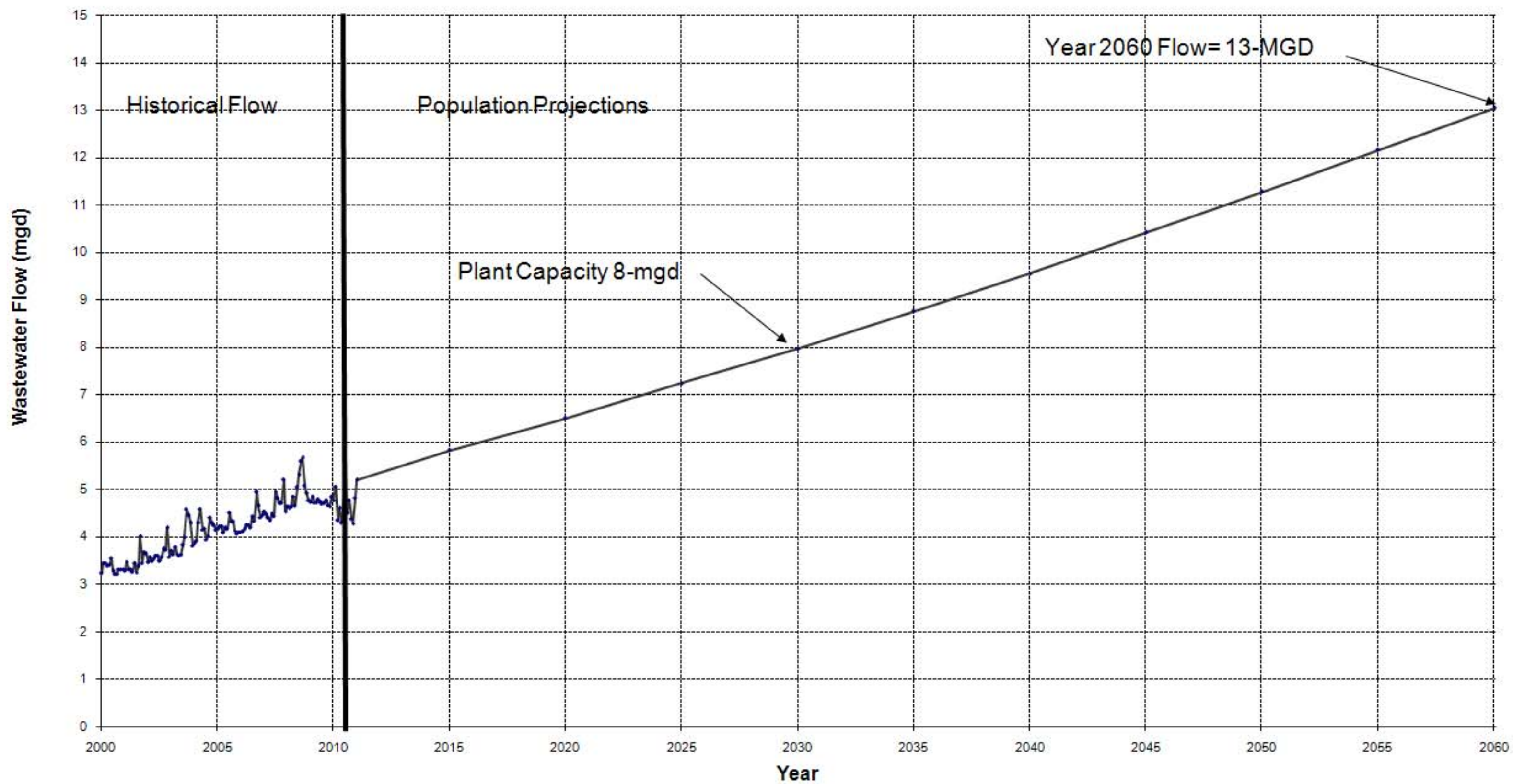
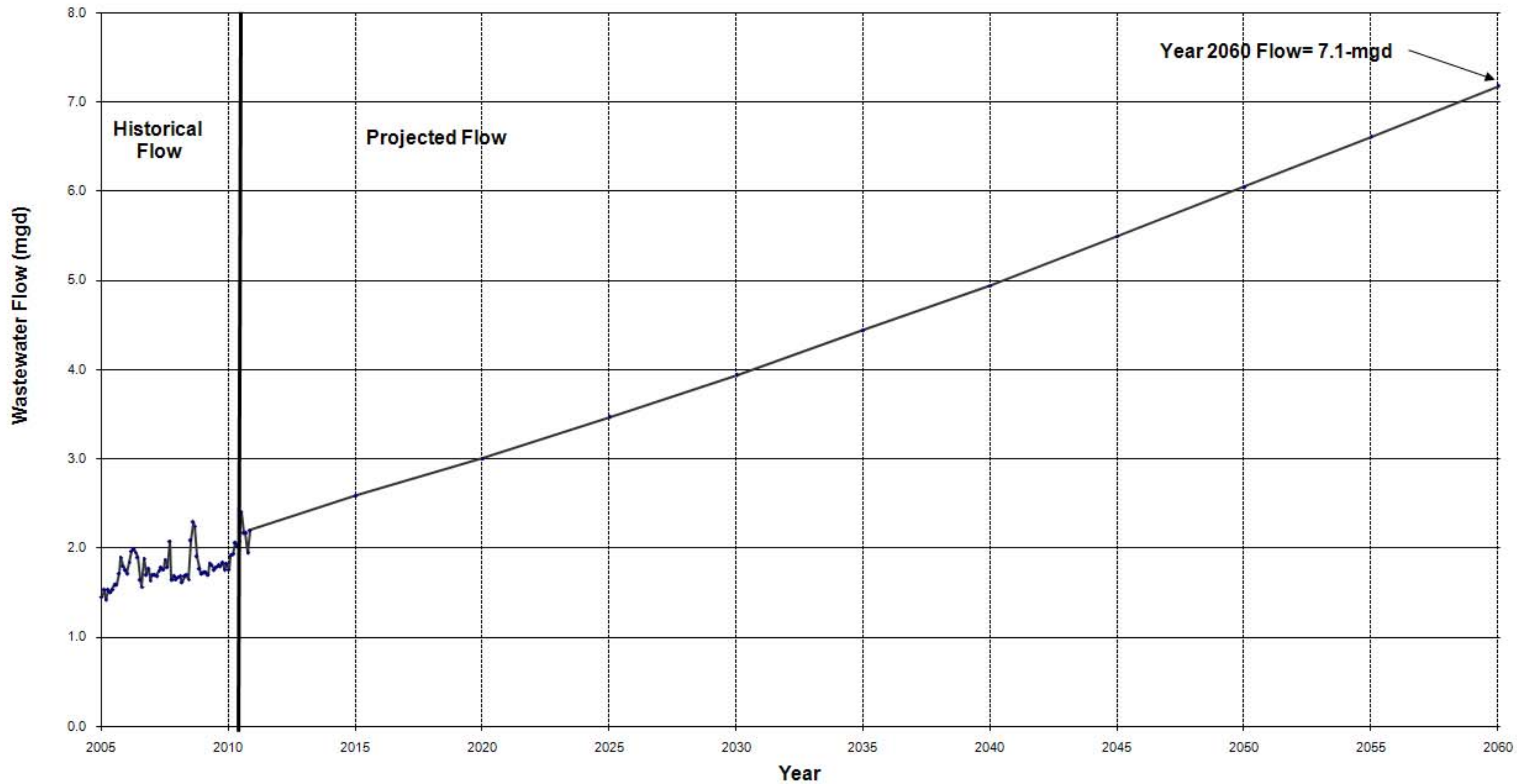


FIGURE 3.4
City of San Juan Historical and Projected Wastewater Flows
City of Pharr and San Juan Water Implementation Plan



Wastewater flows for the City remain relatively constant throughout the year. The monthly average daily flows fluctuate less than ten percent (10%) from the annual average daily flow.

3.3.2 Projected Future Wastewater Flow

Figures 3.3 and **3.4** indicate that wastewater flows will increase approximately 1-mgd every six (6) years in Pharr and every ten (10) years in San Juan. Year 2060 Wastewater Flows from Pharr will grow by 250% to about 13-mgd, and by 300% to approximately 7-mgd in San Juan.

- **Pharr 2060 Projected Water Demand- 13-mgd**
- **San Juan 2060 Projected Water Demand- 7-mgd**

3.4 Reclaimed Water Availability

To evaluate the viability of future water reclamation projects for the City, the potential supply of reclaimed water needs to be established. It is evident from **Figures 3.3** and **3.4** that there is a significant supply of reclaimed water available for reuse.

Detailed discussion of potential future reclaimed water uses and projects are presented in other parts of this Study. Depending upon use and project specifics, the degree to which fluctuations of flows, whether considered on an annual, monthly, or daily basis, may or may not be of consequence.

This page intentionally left blank

SECTION 4.0

Water Availability

4.1 State Water Plan

Population in Texas is expected to more than double between 2000 and 2060, growing from 21- million to 46-million and the demand for water is expected to increase by 27 percent, from 17-million acre-feet to 21.6 million acre-feet for the same period according to the 2007 State Water Plan. Even if the States projected 13.5 percent water saving from conservation in the next fifty (50) years is included, water supply from existing sources will only meet 75 percent of the Year 2060 projected water demands. We must use our precious water resources more efficiently or we will have more frequent and severe water shortages, especially during droughts and periods of peak demand. Using water more efficiently will not only save money, but more importantly help protect the quality of life of future generations. The primary emphasis of the regional water supply planning process established by Senate Bill (SB) 1 was the identification of current and future water needs and the development of strategies for meeting those needs. Initially designated by the Texas Water Development Board (TWDB) as "Region M," the Rio Grande Regional Water Planning Area consists of the eight counties adjacent to or in proximity to the middle and lower Rio Grande. These are: Cameron, Starr, Maverick, Zapata, Hidalgo, Webb, Jim Hogg, and Willacy. Refer to **Figure 4.1** for a map of Region M. This section presents the results of the evaluation of various water management strategies to meet the identified water supply shortages for the City.

4.2 Region M Rio Grande Regional Water Planning Group

Optimizing the supply of water available from the Rio Grande is an important aspect of protecting the state's water resources since the river is the main source of water for both municipal and irrigation use in the Rio Grande Region. The regional water plan projects the Rio Grande Region's population to almost triple over the next 50 years, increasing from approximately 1.62 to 3.94 million by 2060. Logically, a large portion of the region's future municipal water supply will come from the Rio Grande. Municipalities can acquire Rio Grande water rights through purchase, urbanization, and contract. However, as noted below, there simply is not enough water in the Rio Grande to meet all the future water needs of the region.

As populations grow, irrigable land is lost and the associated irrigation water demand is also reduced. The 2010 Region M Regional Water Plan indicated that irrigation demands are expected to decrease by approximately 200,000 acre-feet by 2060. Since Class A Irrigation Water Rights are converted to municipal on a two-to-one basis, an additional 100,000-acre-ft of Rio Grande water will be available for municipal use. However, not all of this irrigation water will be available for municipal use since a portion must be retained to meet projected irrigation shortage of approximately 400,000 acre-feet. The

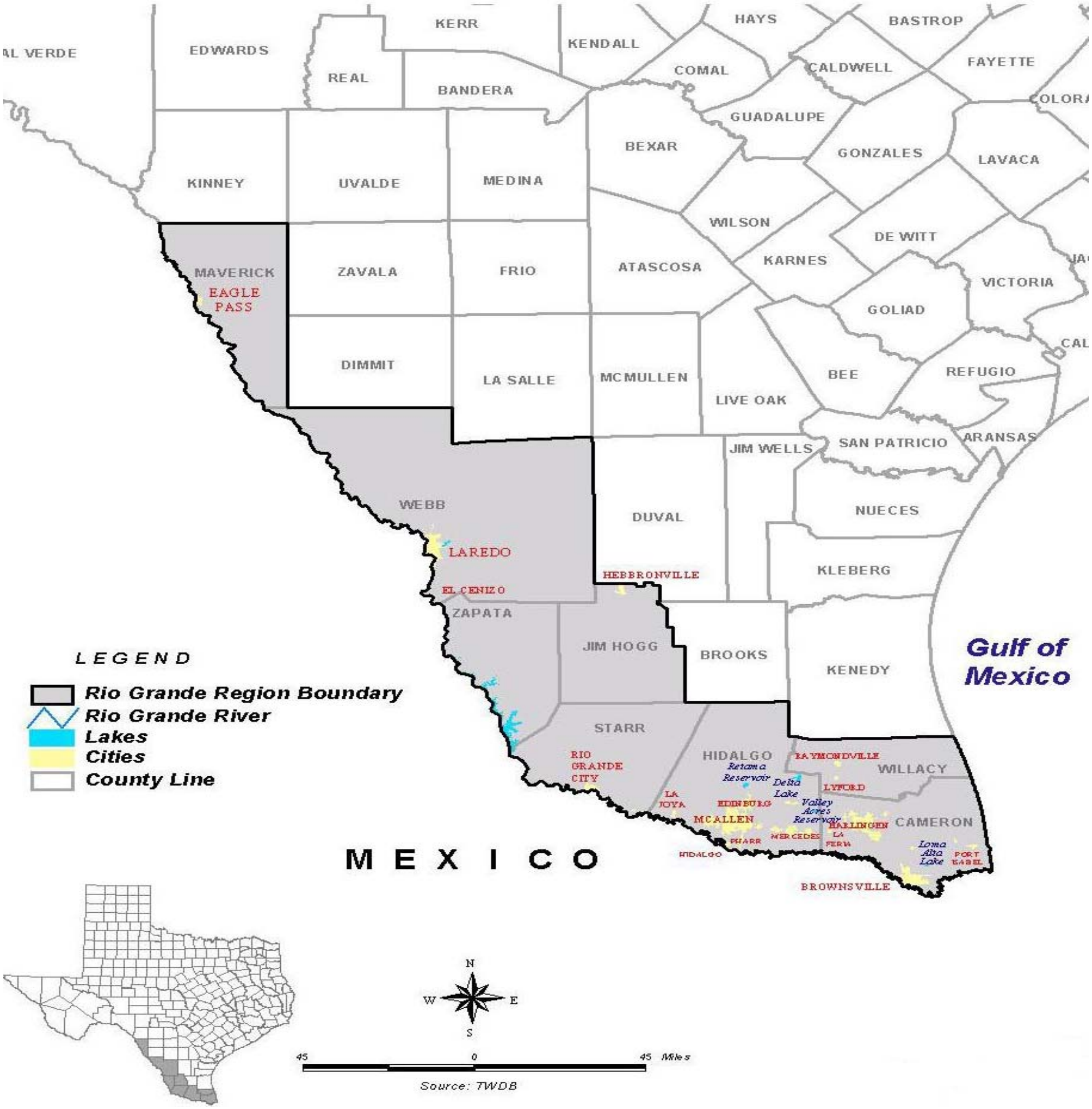


Figure 4.1 – Region M Map

overall volume of these water supply shortages are projected to remain relatively constant over the planning period. This deficit (4000,000 acre-feet) is based on normal levels of projected irrigation demand under drought conditions with adequate water available in storage in Amistad and Falcon Reservoirs to meet the irrigation demands. The planning documents also indicated that the additional municipal water needs in Hidalgo County for 2060 will be approximately 140,000 acre-feet. Existing irrigation water right conversions should be available to meet approximately half of the municipal water shortage but the remaining approximately 70,000 acre-feet for Hidalgo County will have to come from new water sources.

Diversifying water supply sources for municipal use will be essential to meet the identified shortage (70,000 acre-ft). Water management strategies such as brackish and seawater desalination, potable and non-potable reuse, and groundwater development all have the potential to reduce the impact on existing water sources for municipal use, especially the Rio Grande. The 2010 Region M Regional Water Plan identified a regional brackish and seawater desalination project but the estimated $260 million capital cost makes the project unfeasible. The planning document also evaluated several groundwater projects but none were economically feasible. Later sections will focus on potable and non-potable reuse as a source to help diversify the municipal water demands for the City.

4.3 Hidalgo County

Five cities in Hidalgo County including San Juan are projected to have an immediate need for additional water. By 2030, 13 of the county's 25 municipal water suppliers including Pharr and San Juan, plus the rural areas, will experience deficits. Water needs for the unincorporated areas of the county are projected to increase more than 40-fold over the next 50 years from 3,200-ac-ft/yr in 2010 to over 139,000-ac-ft/yr in 2060. **Table 4.1** shows that Pharr will need an additional 12,695 acre-feet (11.3 MGD) and San Juan 7,697 acre-feet (6.9 MGD) by 2060. As indicated previously, due to the limited availability of future Rio Grande water rights, approximately half or about 6,350 acre-feet (5.7 MGD) for Pharr and 3,850 acre-feet (3.4 MGD) for San Juan will need to be supplied from a separate source.

TABLE 4.1
Municipal Water Surplus/Needs for Pharr and San Juan
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

City	2010 (ac-ft)	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)
Pharr	376	-1,754	-4,152	-6,799	-9,649	-12,695
San Juan	-478	-1,642	-2,933	-4,361	-6,008	-7,697

(+) Positive indicates Surplus
(-) Negative indicates Shortfall

4.4 Hidalgo County Irrigation District No. 2

The Hidalgo County Irrigation District No. 2 (HCID2 or the "District") is a political subdivision of the state of Texas operating under the provisions of Chapter 58, Title 4 of the Texas Water Code and Article XVI, Section 59 of the Texas Constitution. The District supplies raw water from the Rio Grande to the City of Pharr and San Juan.

The primary purposes of the District is to supply an adequate, reliable source of water for irrigation, municipal, industrial and domestic uses, and to afford drainage insofar as reasonably possible to the lands located within the District boundaries. Refer to **Figure 4.2** for a map of the district. The District strives at all times to pump and deliver water as timely and efficiently as possible to its patrons, and will cooperate in rendering any other service which it is authorized to render.

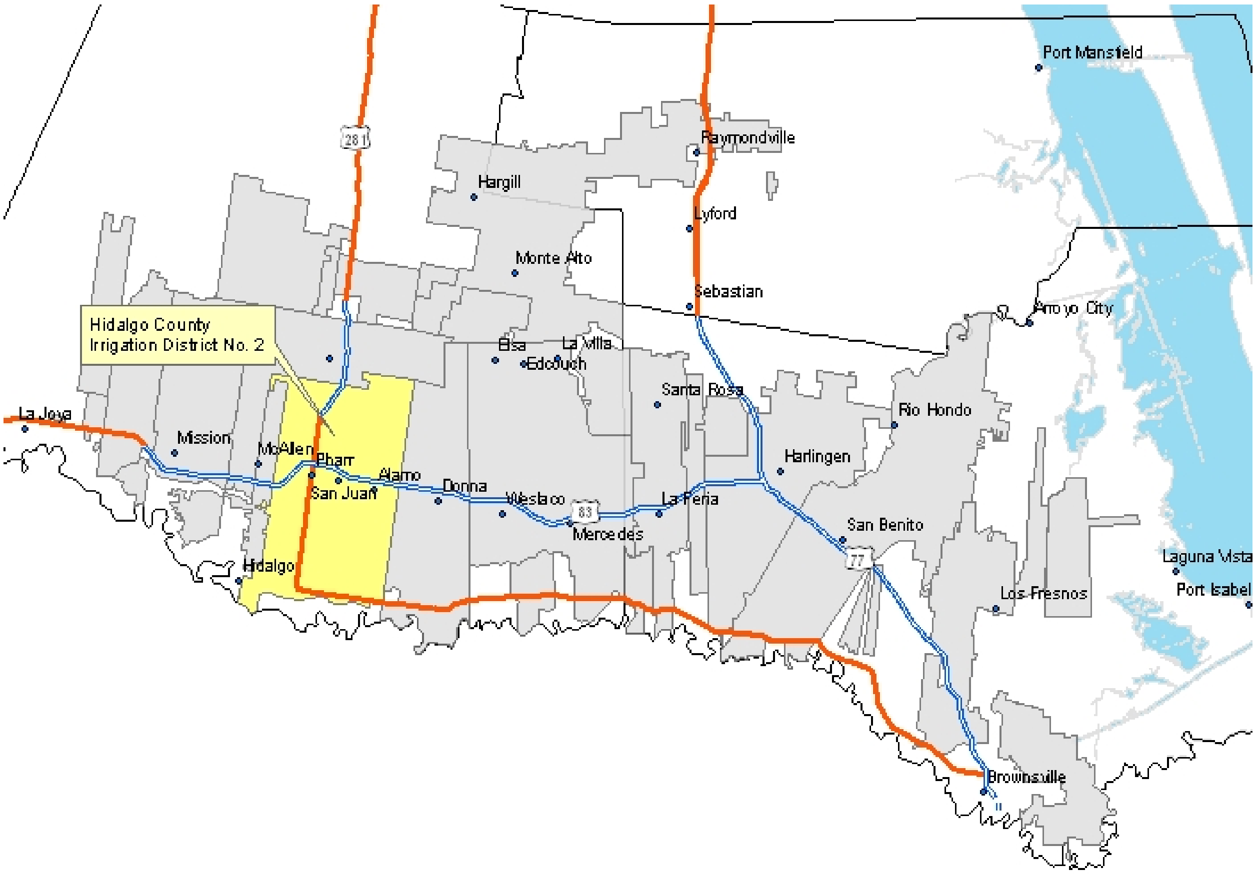


Figure 4.2 - Hidalgo County Irrigation District No. 2 Map

The existing facilities of the District consist of a river pumping plant from which water is transported 7-miles in an oversized earthen canal along the West side of the District to a pumping station located on South 2nd Street in McAllen, Texas. The raw water is then delivered to the City through various size canals and pipelines. The District's system has 46-miles of earthen canals, 21-miles of lined canals and 227-miles of concrete pipelines for a total of 294-miles of waterway. There are 74-miles of open drainage ditches and 80-miles of underground drainage pipeline. Privately owned field drains within the District are estimated at 260-miles.

The District provides water to 46,709 irrigable acres and owns water rights of 137,675 acre-feet. The District owns 2,946.00 acre-feet on the City of Pharr's behalf and the City of Pharr also owns 2,932.88 acre-feet. In addition, the City of Pharr owns an additional 2,797.102 acre-feet of water right derived from excluded subdivisions for a total of 8,675.982 acre-feet (Refer to **Table 4.2**). The City of San Juan owns 2,762 acre-feet of water rights. This equates to approximately 7.75-MGD and 2.47-MGD for Pharr and San

Juan respectively. Pursuant to data presented, the annual average day demand for Pharr and San Juan is 6.58-MGD and 2.12-MGD respectively. Therefore, the need to acquire additional water rights is imminent.

TABLE 4.2
City of Pharr Water Rights Inventory
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Description	Volume (ac-ft/year)
Irrigation District on City's Behalf	2,946.00
City of Pharr	2,932.88
Excluded Subdivision	2,797.102
Total	8,675.982

4.5 Water Right Conversion Bill

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

The Texas Legislature in 2007 passed a law on the conversion of irrigation rights to municipal use rights. It only applies to the Lower Rio Grande, but impacts the Middle Rio Grande as well. The statute establishes a method by which agricultural water rights are converted to municipal and the terms of the conversion transaction (Acts 2007, 8th Leg., Ch. 1430, Vernon's Texas Civil Statutes, Water Code, Subchapter O, Sections 49.501, et seq.) The statute only covers water districts and municipal water suppliers in counties that border the Gulf of Mexico or Mexico, or are adjacent to such a county. This basically encompasses the four-county area in the Lower Rio Grande Valley: Starr, Hidalgo, Cameron, and Willacy.

Release of agricultural water rights from Falcon Lake is interruptible. That is, the release of water may be reduced or suspended in response to lower water levels in Falcon Lake. However, municipal water rights are considered firm and must be released independent of water level. In recognition of the distinction in management between interruptible and firm water rights, a conversion ratio was established. The conversion between agricultural and municipal water rights is as follows:

- Class A Water Rights 2:1
- Class B Water Rights 2.5:1

Approximately 90% of the current agricultural water rights are Class A and the remaining 10% are Class B. No distinction is made between these two classes of rights elsewhere in this report. Therefore, all references to irrigation water rights are assumed to be Class A.

When a subdivision is platted and recorded, the municipal water supplier responsible for serving the subdivision with potable water has two (2) years to petition the water district to convert the water rights from agricultural usage to municipal usage or to contract over a 40-year period for the delivery of the equivalent amount of water. If the municipal supplier fails to file a petition to convert the water rights within the two (2) year period, then after notice to other water suppliers in these counties, other water suppliers in the four county areas may opt to purchase the rights at the same terms and conditions as a purchaser from outside the county areas. If no entity within the area opts to purchase the rights within 90-days, then the sale may be made to the purchaser located outside the four-county area.

The amount of water rights which are associated with a subdivision is based upon the number of previously irrigated acres within the subdivision and its prorated share of the district's water rights. The law provides that a district can provide for the water rights out of its existing municipal use water rights or convert the previous irrigation rights of the district to municipal use through an amendment to its water rights as provided by TCEQ rules.

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

The water district must agree to designate at least 75% of the proceeds from the sale of water rights for capital improvements of the district. As of January 2010, no petitions have been filed under this statute, but the RGRWA established the market value according to the statute as $2,218 per acre foot of municipal use rights after conversion from irrigation rights for the year 2009.

4.6 Lower Rio Grande Municipal Deliveries During Severe Droughts

The vast majority of the water used in the RGRWPA is diverted from the Rio Grande. For the most part, this water originates as releases from Amistad and Falcon Reservoirs, both of which are located on the main stem of the river. For this reason, it is important to understand the operation of the Amistad-Falcon reservoir system and to quantify the amount of water that potentially could be provided by these reservoirs during the drought of record. A total of 2,226,495 acre-feet per year of surface water diversion rights currently exist within the region. Of this amount, about 14% (305,997 acre-feet per year) is for municipal uses and about 3% (64,626 acre-feet per year) is for industrial uses. The vast majority of the surface water rights in the region (1,853,179 acre-feet per year or about 83%) are authorized for irrigation. Most of the surface water rights in the region are located in Hidalgo County (1,244,037 acre-feet of diversions per year or about 56%) and in Cameron County (681,043 acre-feet of diversions per year or about 31%). Approximately 96% of the total diversions authorized by the water rights in the

RGRWPA are in the Rio Grande Basin, and practically all of these are associated with Amistad and Falcon Reservoirs.

One of the concerns regarding the availability of water in the Lower Rio Grande Valley pertains to the delivery of water to municipal users during severe drought periods when irrigation water use may be curtailed or ceased all together as the total supply of United States controlled water stored in Amistad and Falcon Reservoirs falls to low levels. Over time the available supply of water in the reservoirs dedicated to irrigation use is gradually depleted as irrigation diversions are made during periods when the inflows to the reservoirs are low. During extended periods of continued irrigation use and low reservoir inflows, the available quantity of irrigation water stored in the reservoirs could be reduced to zero. Under the current Rio Grande operating rules, should such conditions occur, no releases of irrigation water would be made from Falcon Reservoir. This would mean that deliveries of municipal water from the reservoir to entities in the Lower Rio Grande Valley would have to be made without the normal carrying water provided by the irrigation water deliveries. Under these circumstances, the water losses, due to such factors as seepage and evaporation, that may be experienced either along the river channel or within the irrigation district delivery systems that are used to convey raw water from the river to the municipal water users could be substantial. The losses of the delivery system have been estimated in the Region M study at about 20% under this condition. Also of concern under these conditions is whether or not the existing diversion facilities on the lower Rio Grande would be able to physically withdraw water from the river because of the potentially lower river levels.

Another consideration regarding municipal water rights from the Rio Grande is the potential for a need to reduce the release out of Falcon of the “firm” rights due to extremely low reservoir levels during an extended and extreme drought. The more that a city is dependent upon Rio Grande water rights as a water supply source, the more vulnerable that city becomes too such an extreme climate condition.

4.7 Potable Reuse Strategy Description

There are two (2) types of potable reuse, indirect and direct. Both refer to the intentional use of highly treated reclaimed water as a supplemental water supply source for potable uses. In direct reuse, reclaimed water is used as a raw water source for a water treatment plant without entering a stream or reservoir. In the past, the option of direct potable reuse was technically demanding and socially contentious. However, due to advancements in treatment and the limited availability of water supplies the options are much less technically demanding and are becoming more socially acceptable.

Citizen group reactions in areas where direct potable reuse has been proposed tend to require more community input. While some of the initial issues with direct reuse can be attributed to general ignorance of the realities of water treatment, direct potable reuse does require educating the community regarding health and hygiene issues. The dilution of pollutants by receiving bodies of water in traditional water plays a significant role in cleaning the water. A system that loops back a large quantity of its water volume has the risk of concentrating pollutants over time. While EPA-limited pollutants and pathogens are closely monitored, there are other potential problem chemicals whose effects are unknown. For example, many medications are excreted from the body and are detectable in wastewater. Such chemicals are not on the list of monitored pollutants, but would certainly be present in recycled wastewater. Regardless of the advancements in water treatment, in our opinion, direct potable reuse is not yet an acceptable practice.

Indirect potable reuse which also involves the intentional reuse of highly treated reclaimed water but is instead buffered and blended with the City's raw water supply is becoming an acceptable practice. Many communities already practice indirect potable reuse because their drinking water lies downstream of another municipality's wastewater plant. This is commonly referred to as incidental indirect potable reuse. The construction of the first indirect potable reuse project is just beginning in Big Spring, Texas.

The blended water in an indirect water reuse application is subsequently diverted to a water treatment plant for sedimentation, filtration, and disinfection before it is distributed. The mixing and travel time through the natural environment provides several benefits: (1) sufficient time to ensure that the treatment system has performed as designed with no failures, (2) opportunity for additional treatment through natural processes such as sunlight and filtration through soil, and (3) increased public confidence that the water source is safe. Unplanned indirect potable reuse is occurring in virtually every major river system in the United States today.

A study conducted in 1997 which evaluated the feasibility of indirect potable reuse in the McAllen-Edinburg area was reviewed for as part of this study. McAllen and Edinburg are communities immediately north of Pharr and San Juan. Based on the results of this 1997 Study, a potable reuse option was evaluated that involved modification of the existing wastewater treatment plant to incorporate biological nutrient removal, microfiltration, reverse osmosis, and ultraviolet disinfection. The plan consisted of taking reclaimed water and blending it with raw water from the Rio Grande in a reservoir from which the blended supply would then be treated by the existing water treatment plant processes, disinfected with ozone, and then delivered to the potable water distribution system after adding chlorine. To more accurately assess the feasibility of potable reuse for the City of McAllen, a pilot study was performed as a separate project to assess the use of an integrated bioreactor and reverse osmosis treatment train to reclaim municipal wastewater for potable reuse. The results of the pilot study indicated that reverse osmosis filtration is capable of producing reclaimed water that meets all state and federal drinking water and reuse standards.

A national indirect potable reuse example can be found in Virginia. The Upper Occoquan Sewage Authority (UOSA) Regional Water Reclamation Plant has been discharging to the Occoquan Reservoir, a principal water supply source for approximately one million people in northern Virginia. Because of the plant's reliable, state-of-the art performance and the high-quality of water produced, regulatory authorities have endorsed UOSA plant expansion over the years to increase the safe yield of the reservoir. UOSA recycled water is now an integral part of the water supply plans for the Washington metropolitan area. Other major projects with proven track records are in Los Angeles County and Orange County, California, and in El Paso, Texas. After decades of research, pilot studies, and demonstration, the City of San Diego is designing a 20-MGD indirect potable reuse project.

4.7.1 City of Weslaco

Currently, the City of Weslaco has also expressed interest in pursuing indirect potable water reuse in Region M. By 2010, their goal is to use 1-million gallons/day (1,120 ac-ft/yr) of reuse water to facilitate potable water demand by blending it with raw water before it enters a treatment facility.

4.7.2 Colorado River Municipal Water District (Big Springs, Texas)

The Colorado River Municipal Water District (CRMWD) has initiated construction of its first regional water reclamation plant (2011). The Reclamation Plant will be membrane-based and located in Big Spring, Texas. It will have a capacity of 2-MGD (7,500 m^3/d) of reclaimed water and will use membrane filtration, reverse-osmosis and ultraviolet oxidation. Start-up is expected in spring 2012. The project cost is estimated at approximately $12-million.

This Reclamation Project will capture reclaimed water from the Big Spring Wastewater Treatment Plant before it is discharged and using an advanced treatment process to municipal water quality standards. Several industries and business in the Big Spring area are interested in the water because of its quality. Any reclaimed water not used for industrial purposes will be blended with CRMWD's raw water supplies for municipal use.

Reclaimed water from Big Springs will be blended with raw water from the EV Spence Reservoir and Lake JB Thomas and then delivered to the following communities: Big Spring, Stanton, Midland and Odessa. The treated water will then be treated and processed through each respective WTP. CRMWD has studied other locations for regional water-reclamation plants including Snyder and the Odessa-Midland area. The Big Spring location was chosen as the first site because it had the lowest cost of the three sites.

If all three (3) facilities were in operation (Big Spring, Odessa-Midland and Snyder), it is estimated that approximately 12,000 acre-feet (14.8 million m^3) of water could be reclaimed each year. This is about 20% of the water currently used by those four cities.

4.8 Water Supply Yield

Conceptually, a large percentage of water available through potable reuse would be equal to the total amount of available reclaimed water. However, due to economic and regulatory constraints, it would likely represent a major impediment to the implementation of potable reuse without blending reclaimed water with raw water from the Rio Grande.

A water supply and demand analysis was performed. In this analysis, the total water demand was compared to the total water supply over the extent of the planning period (2010 to 2060). Given the projected water supply deficit previously identified for the City, potable reuse could provide an immediate relief to the supply shortage. The water supply deficit for Pharr and San Juan would require one gallon of reclaimed water for three (3) gallons of Rio Grande water for a blending ratio of approximately 30 percent. As previously noted, there is enough reclaimed water available to both communities to meet its projected potable water demands.

4.8.3 City of Pharr and San Juan Alternative Water Supply Options

The data clearly indicates the need to identify a reliable alternate water supply source. Both communities need to acquire additional water rights to meet demands. It is also evident that by the Year 2060 there will not be sufficient water rights available to meet demand. Therefore, the need to identify an alternative water supply source is vital. One possible means to address this deficiency is by augmenting the City's water supply via indirect potable reuse. This consists of incorporating an advanced treatment system at both wastewater treatment plants; storing the polished wastewater for a designated period of time, and then conveying it to City's Raw Water Reservoir for blending. This potable reuse alternative as well as non-potable water reuse options will be more fully developed in the following report sections.

SECTION 5.0

Reclaimed Water Use Options and Historical Effluent Water Quality

5.1 Summary of Texas Reclaimed Water Regulations

There are currently no regulations specific to indirect potable reuse. However, there are parameters for direct non-potable reuse. In the State of Texas, the Texas Commission on Environmental Quality (TCEQ) regulates the use of reclaimed water for non-potable uses providing written approval after notification by a water producer of the intent to provide reclaimed water for specified purposes. Regulations are found in Title 30, Chapter 210 of the Texas Administrative Code, which defines two (2) types of reuse. Quality requirements are based on the intended use and the potential for human contact with the water. For those uses in which there is a high potential for public contact (e.g. parks or school ground irrigation), Type I requirements apply. Reclaimed uses for which there is controlled access to the usage site are classified as Type II (Refer to **Table 5.1**). More specific uses and the requisite water quality parameters are defined below.

<u>Type I Potential Uses</u>

- Irrigation of residential lawns, public parks, golf courses, and athletic fields
- Fire protection
- Irrigation of food crops and pastures for milking animals
- Maintenance of natural water bodies where recreational activities drinking water intakes are anticipated
- Toilet or urinal flush water

<u>Type II Potential Uses</u>

- Irrigation of sod farms, silviculture, limited access and ROWs
- Irrigation of animal feed crops and food crops without contact with edible part or with pasteurization
- Maintenance of impoundments or water bodies where direct human contact is unlikely
- Soil compaction or dust control
- Irrigation or other non-potable uses at a WWTP
- Cooling tower make-up water

Indirect Potable Water Reuse

- Local Water Supply Augmentation

TABLE 5.1
Water Quality Parameters for Different Water Reuse Applications
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

	Type I	Type II	Local Water Supply Augmentation
Quality Standards (30 day average)	$BOD_5/CBOD_5$ = 5mg/L Turbidity = 3 NTU Fecal coliform or e-coli < 20 CFU/100 mL (Geometric mean) or < 75 CFU/100 mL (single grab) Enterococci less than 4 CFU/100 mL	BOD_5 = 20 mg/L $CBOD_5$ = 15 mg/L Fecal coliform or e-coli < 200 CFI/100 mL (Geometric Mean) or < 800 CFU/100 mL (single grab) Enterococci less than 35 CFU/100 mL For a pond system: BOD_5 = 30 mg/L, Fecal Coliform < 200 CFU/100 mL (Geometric mean) or < 800 CFU/100 mL (single grab)	No Current State Standards exists. TCEQ reviews such requests on a case by case basis.
Sampling/Analysis Frequency	Twice per week	Once per week	N/A

5.2 Effluent Water Quality

5.2.1 The City of Pharr Wastewater Treatment Plant (WWTP)

The Pharr WWTP utilizes a complete mix variation process. The process is defined as a complete mix variation because an extended aeration process is operated in a complete mix mode. A carousel/oxidation ditch is typically synonymous with extended aeration system (20 to 22-day Solids Retention Time (SRT)). However, the Plant is operated at a 14 to 15-day SRT which defines the actual treatment process as complete mix. The City is expanding the Pharr WWTP from 5 to 8-mgd by adding a third treatment train to address capacity concerns and as well meet more stringent effluent discharge standards. **Table 5.2** shows the new permit limits.

TABLE 5.2
TCEQ Wastewater Discharge Limits
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Parameter	TCEQ Effluent Permit Limits
BOD_5	7
TSS	12
NH_3-N	2

The current liquid stream include screening and grit removal, two (2) oxidation ditches, four (4) secondary clarifiers, two (2) chlorine basins, and one (1) effluent de-chlorination /post-aeration tank. The solids handling processes include a gravity thickener, two (2) aerobic digesters and a belt filter press. These processes produce a Class B bio-solid product, which is transported by a private company (TRS Enviroganics, Inc.) to a permitted landfill or land application site for beneficial use. A process flow diagram for both the liquid and solids stream system is shown in **Appendix B**.

5.2.2 The City of Pharr WWTP Improvement Project

Appendix C shows an overall site plan for the upgraded Pharr WWTP. The two (2) existing oxidation ditch systems were retained and not changed as part of the expansion project.

The biological treatment processes were designed to reduce biochemical oxygen demand, suspended solids, ammonia and organic nitrogen in the influent wastewater. Ammonia will be nitrified and denitrified in the Modified Ludzack Ettinger (MLE) process.

Effluent from all treatment trains will pass through new effluent filters. The filters will reduce residual suspended solids, which will produce an effluent quality suitable for reuse.

One of the existing chlorine contact basins was converted into two (2) UV disinfection channels, each with two (2) banks of lamps. This modification eliminates the use of chlorine for effluent disinfection and the sulfur dioxide used for de-chlorination.

Effluent that is reused at the WWTP or offsite will be chlorinated in the adjacent basin to achieve high level disinfection and maintain a chlorine residual to prevent bacterial re-growth. Smaller 150-lb gas cylinders will be used for this purpose.

The sludge management system at the plant was also upgraded. The existing gravity thickener was converted into a waste activated sludge (WAS) storage tank. WAS will be thickened by a new gravity belt thickener prior to aerobic digestion. The existing belt filter press (BFP) will be relocated to a new dewatering building at the southern end of the site. This building will have space for a second BFP, which will increase sludge processing capacity and provide redundancy for the dewatering process.

Water quality data for other parameters, including carbonaceous biological oxygen demand (CBOD) and fecal coliform, are plotted in **Figures 5.1** and **5.2** for the discharged effluent from the City of Pharr WWTP.

5.2.3 The City of San Juan WWTP

San Juan uses a modified complete mix process very similar to Pharr. The process consists of a headworks, oxidation ditch, circular clarifiers, chlorine disinfection, and de-chlorination. Recently, the City completed a wetlands project in which seven (7) cells were constructed for a total treatment capacity of 0.2-mgd. Flow is diverted to the wetlands for polishing purposes and the balance is discharged to the receiving stream.

FIGURE 5.1
City of Pharr Effluent Water Quality
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

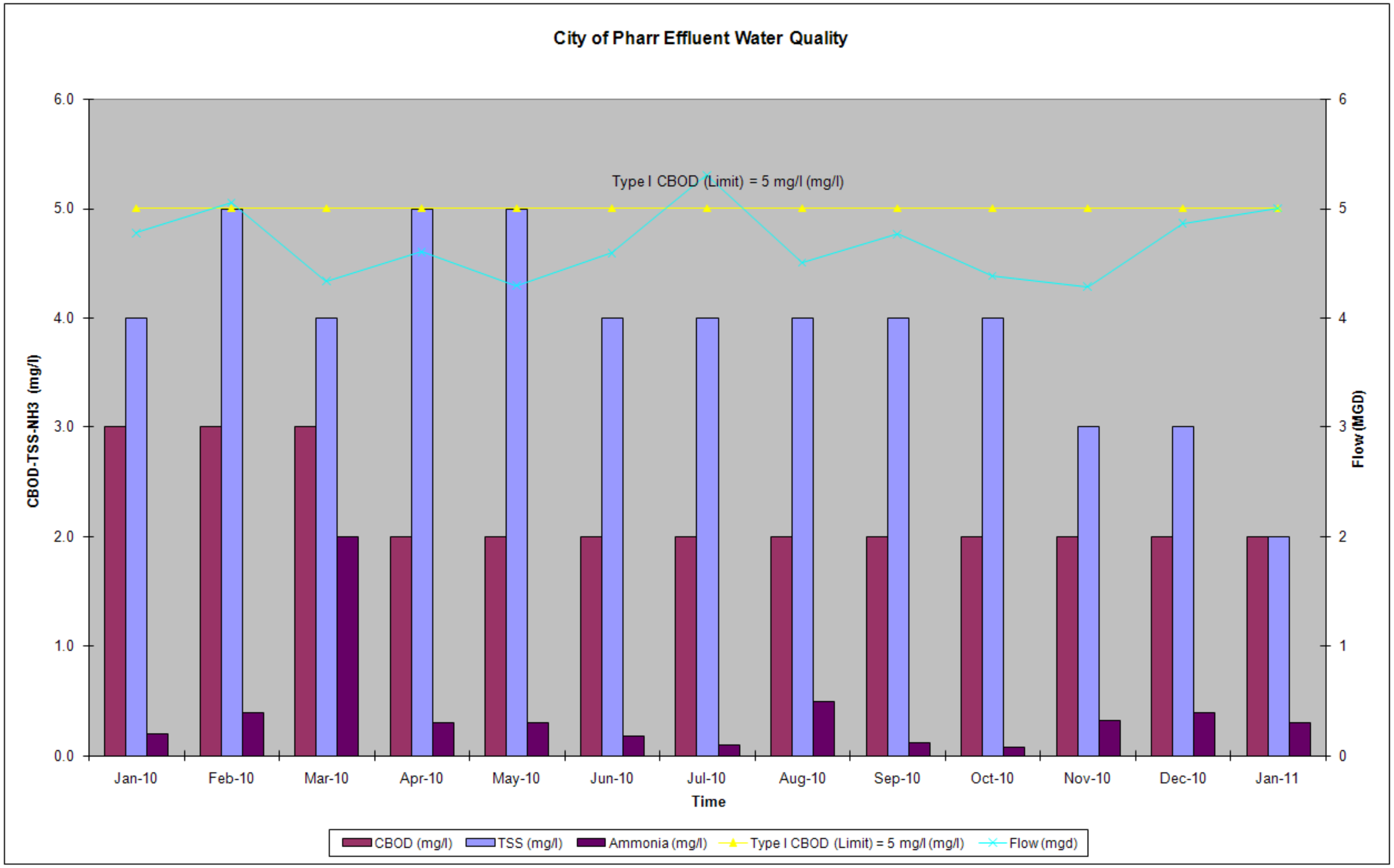
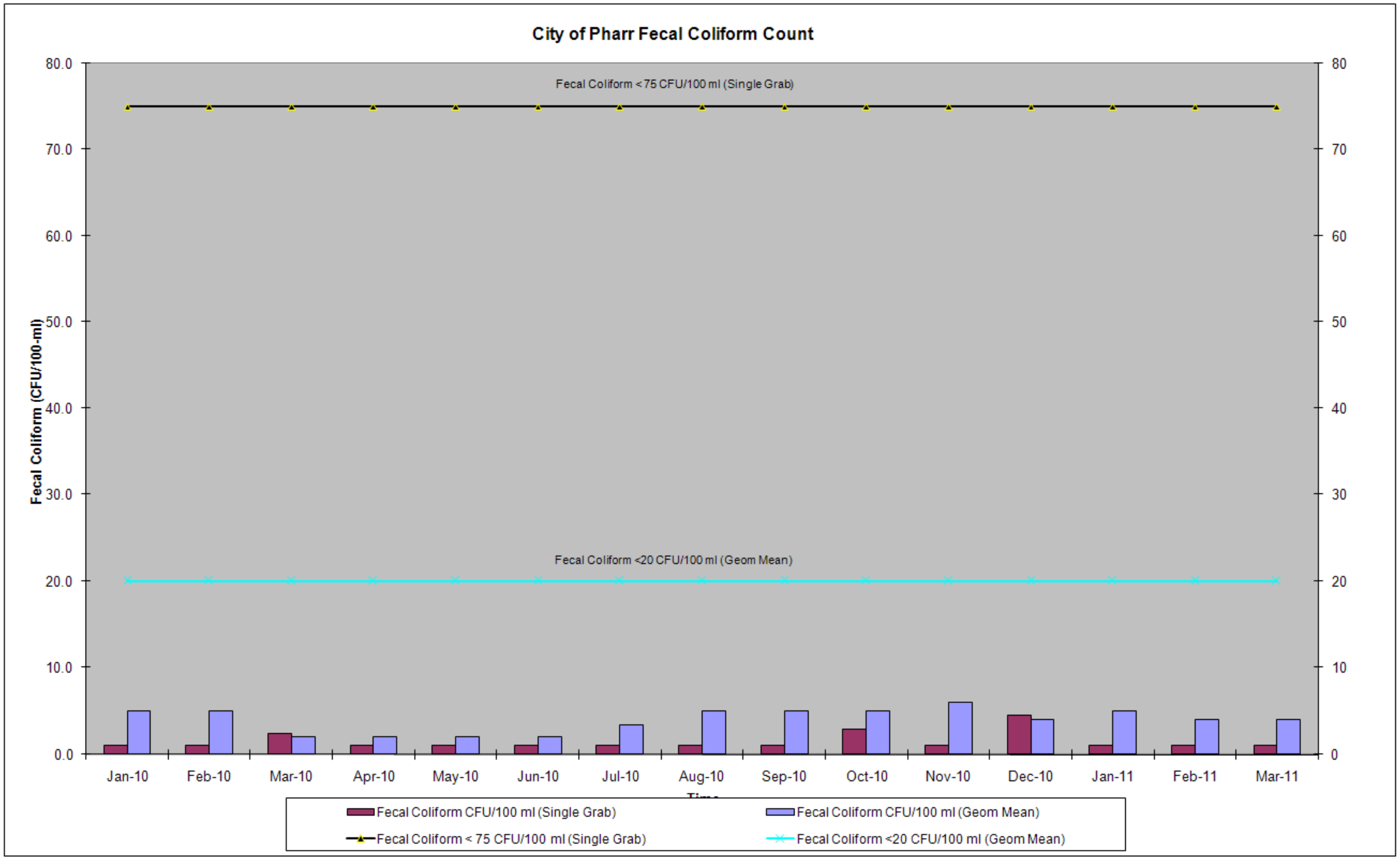


FIGURE 5.2
City of Pharr Fecal Coliform Count
City of Pharr and San Juan Water Reuse Priority and Implementation Plan



Water quality data for other parameters, including carbonaceous biological oxygen demand (CBOD) and fecal coliform, are plotted in **Figures 5.3** and **5.4** for the discharged effluent from the San Juan WWTP.

5.2.4 Pharr and San Juan WWTP Effluent Lab Analysis

Pharr and San Juan plant effluent data indicates that CBOD and fecal coliform concentrations are consistently below the Type I Water Reuse limits. A single fecal coliform excursion for single grab was noted at the San Juan WWTP in August 2010.

5.3 Additional Quality Parameters for Specific Uses of Recycled Water

5.3.1 Irrigation

Many reuse applications involve using reclaimed water to irrigate parks, residences, golf courses and crops. In these instances, it is beneficial and desirable that the effluent contains a level of nutritive constituents, such as nitrogen and phosphorous, this contributes positively to the health of lawns and green spaces. Unfortunately, data for Pharr and San Juan's reclaimed water for these constitutes were not available. There are additional parameters such as total dissolved solids (TDS) that, in high concentrations, have adverse effects on vegetation. Dissolved solids can inhibit the uptake of water in plants, or contribute to the inadvertent uptake of high concentrations of salts, which damage plant tissues. A commonly used surrogate for the level of salts that comprise the overall TDS is chloride, which can begin to adversely affect the health of plants at levels approximating the 200-300 mg/L range. Other dissolved solids include emerging constituents such as pharmaceuticals and personal care products (PPCP's). TDS data for Pharr and San Juan were not available. Because of the concerns surrounding solids and salts, restrictions can be placed on golf course irrigation water when TDS concentrations reach greater than 450 mg/L. At concentrations greater than 2,000 mg/L, the use of reclaimed water may be discontinued altogether until TDS levels are reduced.

5.3.2 Direct and Indirect Potable Reuse

The direct use of reclaimed water as a raw water supply source for a water treatment plant without entering a stream of reservoir in the US is limited. However, indirect potable reuse or the planned incorporation of reclaimed water into a raw water supply, such as a raw water reservoir or groundwater aquifer, resulting in mixing, dilution, and assimilation, thus providing an environmental barrier prior to treatment is an established practice in Texas. Currently there is no chapter in the Texas Administrative Code (TAC) governing potable municipal reuse. However, a draft application for domestic water reuse is now available from TCEQ.

A compatibility evaluation is required when blending reclaimed water to the local water supply. The water supply quality is subject to TCEQ water quality standards which will include limits in terms of the amount of nutrients that can be added to the water supply. Some permit limits are driven by concerns of potential lake eutrophication. Determining the quality of the reclaimed water based on achieving the targeted receiving water quality should

FIGURE 5.3
City of San Juan Effluent Water Quality
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

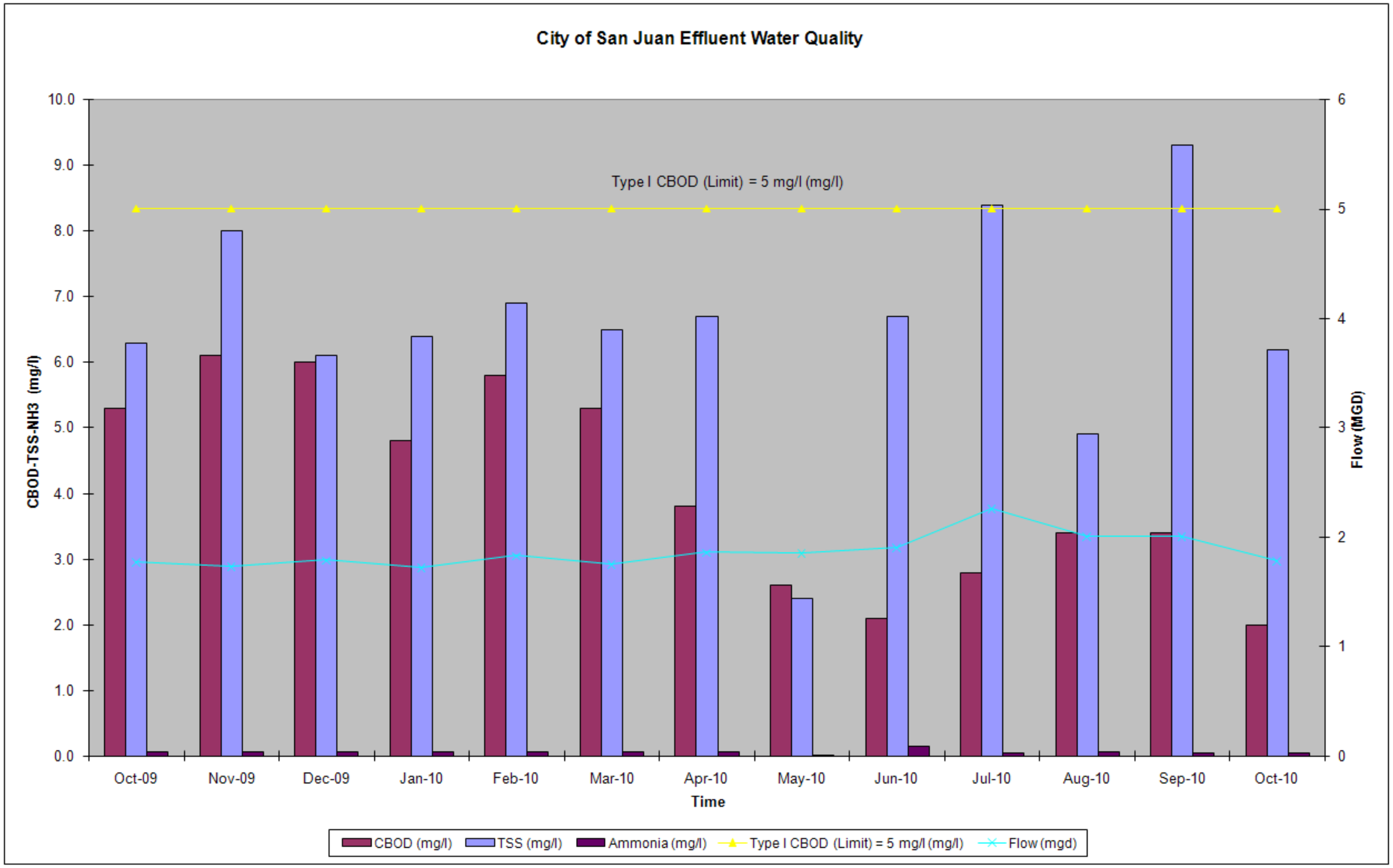
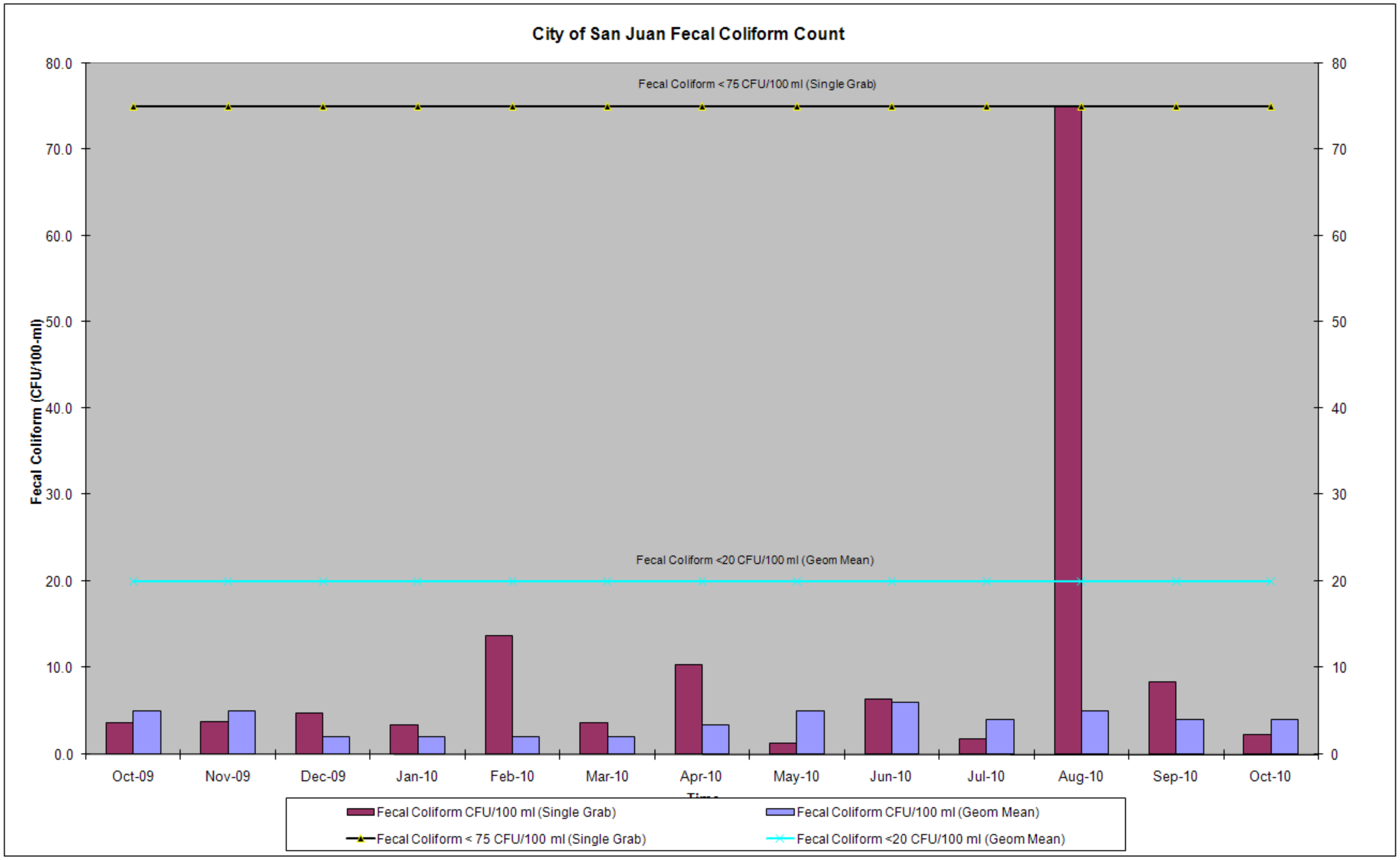


FIGURE 5.4
City of San Juan Fecal Coliform Count
City of Pharr and San Juan Water Reuse Priority and Implementation Plan



be based on an examination of the cause-and-effect relationship between the discharge of reclaimed water and the water quality of the receiving water body.

Refer to Section 7.0 for a more detailed discussion regarding Direct and Indirect Potable Reuse.

5.3.3 Evaluate Unacceptable Parameters

There are many possible uses for reclaimed water. Car washes, wetland augmentation, and athletic field irrigation have also been identified as possible users of reclaimed water. Some industrial uses require a highly treated product which would exceed Type I standards; other uses may have to be evaluated individually in order to ascertain acceptable levels for use. Nevertheless, Type I standards provide a public health and environmental standard that meets most reuse needs. Some additional parameters monitored for recycled water for direct reuse are cryptosporidium, total organic compound (TOC), nitrogen, phosphorus, and ammonia-nitrogen.

5.4 Potential Future Water Quality Requirements for City of Pharr and San Juan WWTP Effluent

It is difficult to predict how new federal or state requirements will be applied to discharge permits in the future. As the number of recycled water projects increases, total dissolved solids (TDS) levels, or salts, may become an issue, and there are already some Texas Pollution Discharge Elimination System (TPDES) permits with TDS limits. *Pharmaceuticals and Personal Care Products* (*PPCPs*) are as well an issue. PPCP's are a large class of organic chemicals that have been classified as emerging contaminants as they are disposed of on a continual basis from both domestic and industrial sewage. PPCP's include pharmaceutical drugs, cosmetics, household and industrial chemicals, and nutritional supplements. Some of these components are very persistent and difficult to remove from a waste stream.

The Environmental Protection Agency (EPA) has also required all states to incorporate some form of nutrient removal standard into the surface water quality standards. Thus, in the future, discharge permits will likely include a phosphorous limit, and possibly a nitrogen limit; however this has more of an impact on conventional discharge than on most reuse applications. As these regulations are implemented, there are several types of treatment technologies that maybe readily available for use at either of the treatment plants discussed. It is important to note that direct reuse programs reduce the volume of flow discharged into the receiving stream and hence reduce the overall nutrient loading to the same receiving streams.

This page intentionally left blank

SECTION 6.0

Reclaimed Water Potential Customers

6.1 Introduction

This section includes a list of potential reclaimed water customers identified, their location within the planning area, and projected demands.

6.2 Reclaimed Water

As new water resources become more costly and difficult to obtain, the benefits of using reclaimed water are being increasingly recognized by cities and utilities. Although negative public perception of reclaimed water use can sometimes hinder efforts to implement reclaimed water programs, these perceptions are often alleviated with public education and information programs which emphasize safety and the benefits of reclaimed water use to the community.

Water reuse has also been identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature. Demonstrated efforts to implement these best management practices are critical to the development of other water supplies. Therefore, in addition to other water conservation efforts, development of a water reuse programs will provide for efficient use of the City's water resources

6.3 Sources of Reclaimed Water

The source of reclaimed water is treated effluent from each respective wastewater treatment plant (WWTP).

Pharr owns and operates a single WWTP, which currently treats an average of approximately 5.0-mgd. This flow is adequate to supply all of the reclaimed water demands identified within Pharr.

San Juan owns and operates a single WWTP, which currently treats an average of approximately 2.2-mgd. This current flow is as well adequate to supply all of the reclaimed water demands identified within San Juan.

As previously discussed, the effluent quality at both facilities is appropriate for either Type I or Type II uses.

6.4 Potential Users of Reclaimed Water

One leading driver for the implementation of reuse projects is the impact reuse has on potable water demand. The Replacement of potable water with reuse water for irrigation of crops, parks, golf courses, and other green spaces results in a savings of potable water for more critical uses. This is particularly relevant in states such as Texas, when summer usage can be significantly greater than that of winter consumption due to irrigation demands.

An initial screening-level evaluation was performed to identify potential reclaimed water use customers as well as conceptual treatment improvement and conveyance projects for each potential customer. The purpose was to determine if the potential customer group is compatible with the Plant's current effluent quality.

Potential users of reclaimed water include:

- Industrial users
- Commercial irrigation accounts
- City parks and sports facilities,
- Schools and their associated athletic fields
- Administrative facilities,
- Golf courses, and agricultural uses, specifically citrus groves, which represent long term investments by an owner.

Reclaimed water used for irrigation needs to meet Type I Effluent Standards and must as well be chlorinated. The use of reclaimed water for irrigation purposes is addressed in Sections 6.5.

A second use of reclaimed water is potable reuse to augment the City's raw water supply. This consists of treating reclaimed water to a higher standard, holding it for a preset number of days in a reservoir, and then pumping it to the existing raw water reservoir for blending. The blended water is then process through the City's Water Treatment Plant. Such a strategy will reduce the need to acquire additional water rights. Raw water collected at each respective reservoir is supplied by the Hidalgo County Irrigation District (HCID) No. 2. The improvements required to implement an indirect potable reuse system is discussed in **Section 8.0 and 9.0**.

The treatment requirements for direct non-potable (irrigation) versus indirect potable to augment the City's raw water supply are markedly different. Therefore, the service systems for irrigation and raw water augmentation will be presented separately in this section.

6.5 Non-Potable Reclaimed Water Customers

The section includes a list of potential non-potable reclaimed water customers identified within the planning area. Based on our analysis, we identified the immediate use of approximately 1.3-mgd and 1.1-mgd of non-potable reclaimed water for Pharr and San Juan, respectively. However, on our evaluation indicates that the water demand for potential irrigation customers in the planning area is low. Only a minor portion of the reclaimed water is needed for irrigation.

6.5.1 Industrial Users

The only industrial user of significance identified from the list of top water users in the City was Central Ready Mix, a concrete batch plant located in San Juan.

6.5.2 Commercial Irrigation Accounts

It was readily apparent upon review of the top water users for the City that commercial irrigation accounts dominate the list. The top water uses are essentially:

- motels,
- fast-food establishments,
- RV parks,
- apartment complexes,
- "box" stores, and
- Professional office buildings.

Factoring the relatively low individual water usage of these entities, their geographic location relative to the reclaimed water source, and the difficulty in separating their potable needs from potential reclaimed water uses, it was deemed that they were poor reclaimed water use candidates. As a result they did not receive further consideration.

The top six (6) City of Pharr irrigation accounts considered as potential reclaimed water use customers are:

- Palm Valley Memorial Park (Cemetery),
- Valley View Apartments,
- Lowe's Home Center (garden area),
- two First National Banks, and
- Sonic Drive-in.

The top five (5) City of San Juan irrigation accounts considered as potential reclaimed water use customers are:

- San Juan Shrine,
- San Juan Nursing Home,
- Memorial Funeral Home,
- HEB, and
- Rio Bank.

The list shows only one industrial user and three commercial irrigation accounts of any significance. The potential commercial and industrial users account for than 15% and 10% of the irrigation demand in Pharr and San Juan, respectively.

The geographical location of the six (6) commercial irrigation accounts in Pharr and the five (5) commercial irrigation accounts plus the one industrial account in San Juan are shown on **Figure 6.1**, "Potential Recycled Water End-Users". The relative usage of each account is shown in **Figure 6.2**, "Relative Demand of Reclaimed Water Usage". **Figure 6.1** is used to provide a pictorial representation of the location of potential Reclaimed Water End Users within the planning area and projected relative usage with respect to each other. The size, or diameter of the circle, represents a demand range. Therefore, the larger the circle diameter, the higher the reclaimed water use demand; the smaller the circle diameter, the smaller the reclaimed water demand. There is no exact translation between the size of the diameter and a specific volume of reclaimed water demand/usage.

6.5.3 City Parks and Sports Facilities

The next set of potential reclaimed water users examined were the parks and sports facilities owned and operated by the City. In the case of San Juan, several parks that are in the planning stage were included along with existing parks. The City of Pharr Police Training Academy, which is another City owned facility, was as well added as a potential user/customer.

The City Parks were identified as the second largest potential user of reclaimed water for irrigation purposes. Assuming that the grounds are well irrigated, the parks of Pharr and San Juan account for 15% and 30% of the irrigation demand respectively. Unlike the school district grounds, visual inspection of the park grounds indicates that the Parks are well irrigated. The geographical location of the Parks and Sports facilities are shown on **Figure 6.1**. The relative usage of each account is shown by **Figure 6.2**.

6.5.4 Schools and Athletic Fields

Another potential non-potable reclaimed water customer is the Pharr-San Juan-Alamo Independent School District (PSJA ISD). The school district owns and operates a number of athletic fields and open spaces across both communities.

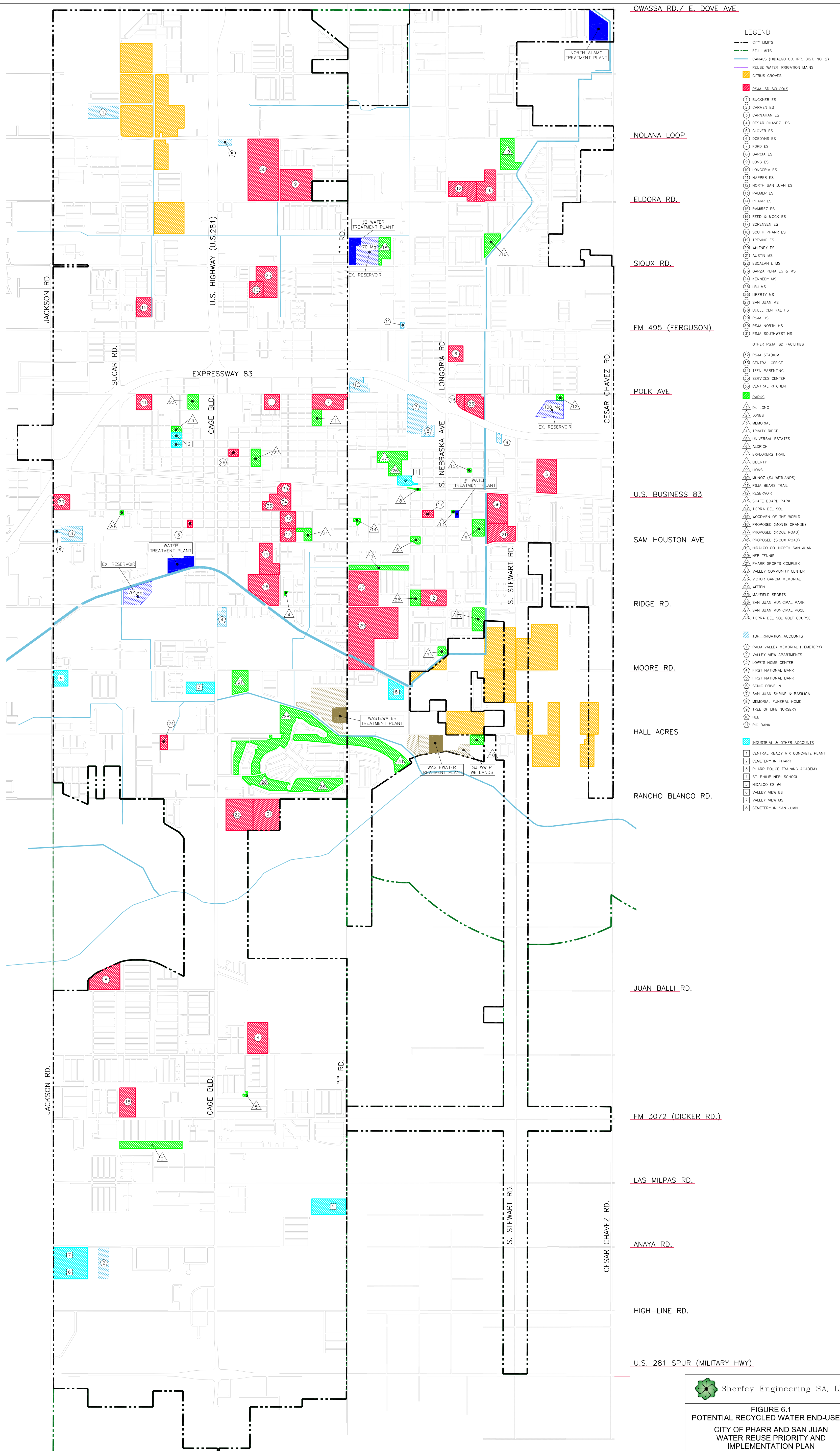
PSJA ISD is by far the largest potential user of reclaimed water identified. The school district facilities in Pharr account for 70% of the potential reclaimed water usage identified while in San Juan they account for 60%.

Visual inspection indicates that the schools grounds as well as other school district facilities are only irrigated immediately adjacent to the buildings. Water bills from PSJA ISD indicate that irrigation usage is only about 10% of our assume usage. Non-potable reclaimed water demand for the schools districts is based on an irrigation rate of 3-inches/month. This rate is generally accepted to maintain a green grass/field. PSJA ISD water bills indicate that usage is approximately 0.3-inches/month.

Since PSJA ISD accounts for approximately two-third of non-potable reclaimed water demand, significant participation by PSJA ISD is necessity in water reuse program is necessary. Furthermore, it's important to note that to delivery of non-potable reclaimed water to the school district and parks would occur at night or early in the morning. A shorter application timeframe results in a higher peak demand which will increase the size of the reuse water distribution system (reuse water main, storage tank, booster pump station, etc.).

School district facilities were located and are shown on **Figure 6.1**. In addition, two (2) school sites that are of adjoining school districts (Valley View ISD and Hidalgo ISD), but situated within the southern part of Pharr were identified and also shown on in **Figure 6.1**.

The "green space" or impervious cover for each school district site was estimated based on a visual inspection of aerial photographs. We assumed that all of the pervious

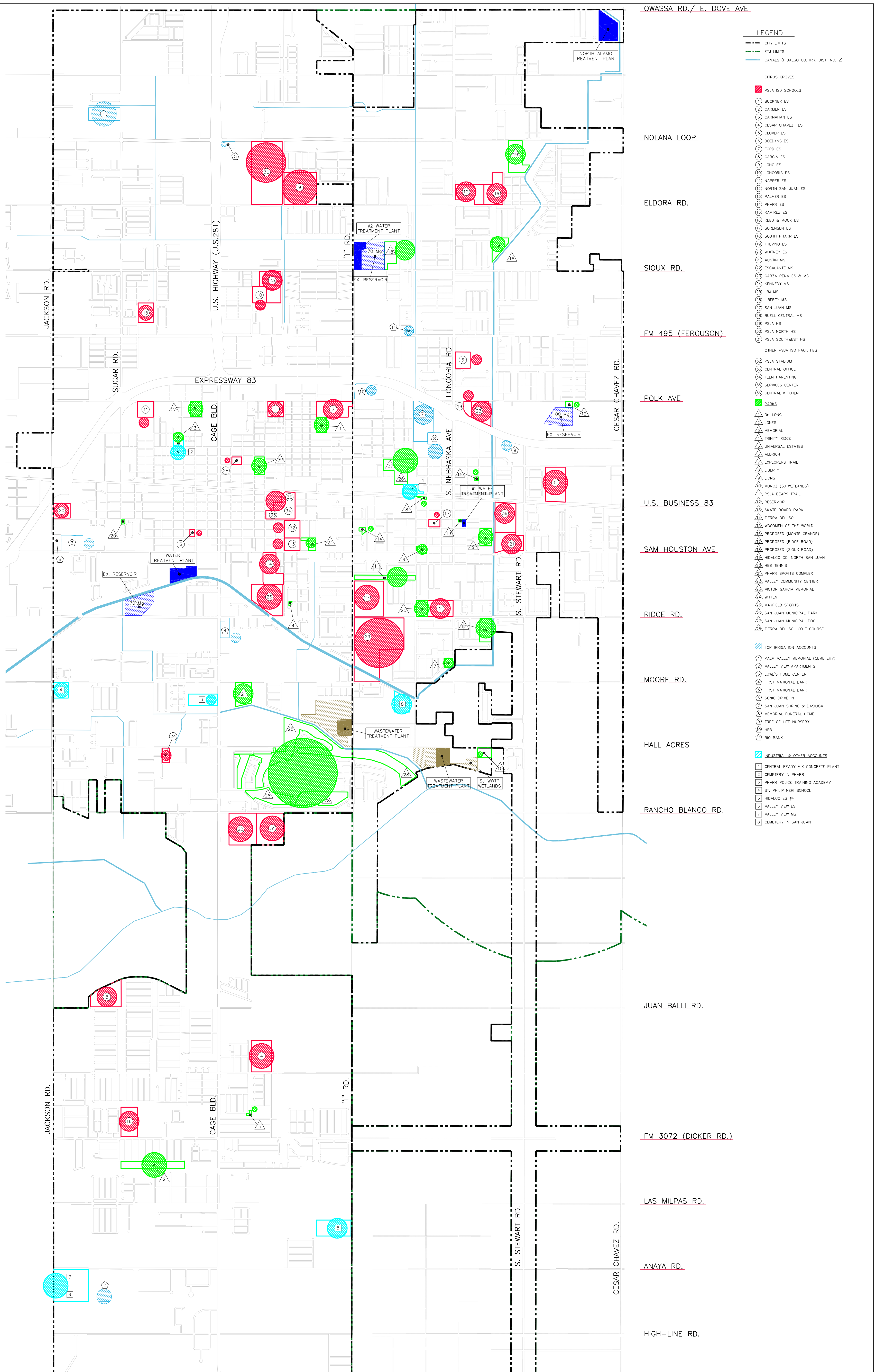


Sherfey Engineering SA, LLC

FIGURE 6.1
POTENTIAL RECYCLED WATER END-USERS

CITY OF PHARR AND SAN JUAN
WATER REUSE PRIORITY AND
IMPLEMENTATION PLAN

Drawn By: RM	Checked By: RJA/JG	Scale: N.T.S.	Sheet
Date: 08/25/11	Project No.: 5448	File Name: Fig 6.1	Of



Sherfey Engineering SA, LLC

FIGURE 6.2
RELATIVE DEMAND OF RECYCLED WATER USAGE

CITY OF PHARR AND SAN JUAN
WATER REUSE PRIORITY AND IMPLEMENTATION PLAN

Drawn By: RM	Checked By: RJA/JG	Scale: N.T.S.	Sheet
Date: 08/25/11	Project No.: 5448	File Name: Fig 6.2	Of

grassed area would be irrigated. An application rate of three (3) inches per month was used to estimate irrigation demand. A few schools were deemed too distant from other potential customers and thus were not considered. The estimated irrigation demand for each potential user is shown on **Figure 6.2**.

6.5.5 Golf Courses

Pharr owns and operates a golf course next to the Pharr WWTP (Tierra del Sol Golf Course). Currently, the golf course receives approximately 0.5-mgd of reclaimed water for irrigation purposes. The 0.5-mgd-equates to an application rate of four (4) inches per month. The planned usage by the golf course is shown on **Figure 6.2**.

Since the required infrastructure to provide reclaimed water to the Golf Course is already in place and operational, we effectively ignored it for the purposes of this report.

6.5.6 Citrus Groves

The citrus groves are also a potential user of non-potable reclaimed water for irrigation purposes. To meet current TCEQ Requirements, reclaimed water may not come in direct contact with any part of the edible parts to the crop. In this case that would constitute the fruit itself. Depending on how the growers are currently applying irrigation water to their crops this may not be an issue.

The amount of reclaimed water that could be used is approximately 0.61-gpd and 0.90-gpd for north Pharr and south San Juan, respectively. This is based on an application rate of three (3) inches per month. Though not constituting the same level of demand, the groves could be a significant customer. However, both communities continue to grow so it is very reasonable to expect that the groves will eventually be converted from agricultural to municipal use. As such the groves will become part of the developed City and this potential consumer will no longer exist.

These groves may offer an opportunity for the City to negotiate an exchange of non-potable reclaimed water for water rights with the farmers. The benefit to each City is the acquisition of additional water rights that may be used to meet the increased demand created by future growth. The benefit to the grove owner is a guaranteed supply of water for irrigation even in times of extreme drought during which the local irrigation district could deny water for irrigation.

The citrus groves in Pharr and San Juan should be considered only as a temporary customer that will cease to exist during the planning period (50 years). At that time, regardless of whether the groves participated in the irrigation project or not, the situation for each City regarding availability of water supply will be the same. Therefore, any long term benefit of participation from the groves is doubtful.

Citrus trees may be exhibit greater sensitivity to TDS levels in reclaimed water than is typically displayed by turf grasses and ornamental trees. Therefore, further investigation into the acceptability of reclaimed water for this specific use is required.

6.6 Indirect Potable Reuse Customers

Reclaimed water is a water source the City has full control over even in extreme drought conditions. If we assume full participation by the schools, parks, and other potential non-potable reclaimed water customers (excluding the citrus groves) in the program. Using the current annual average daily flow rates at each Plant, approximately 74 and 50% respectively would be available to each community to augment its raw water supply.

The use of reclaimed water for raw water augmentation reduces the need to obtain additional water rights. The reuse of 1-acre-ft of effluent water reduces the need to acquire 1-acre-ft in water rights. Furthermore, as previously discussed, during drought conditions, the City is not guaranteed to receive its full allotment of water rights.

Based on an average daily flow rate of 3.7-mgd and 1.1-mgd from Pharr and San Juan, respectively, the volume of reclaimed water available to augment the raw water supply is equivalent to adding approximately 3,920 acre-feet and 1,230 acre-feet to Pharr and San Juan's water rights.

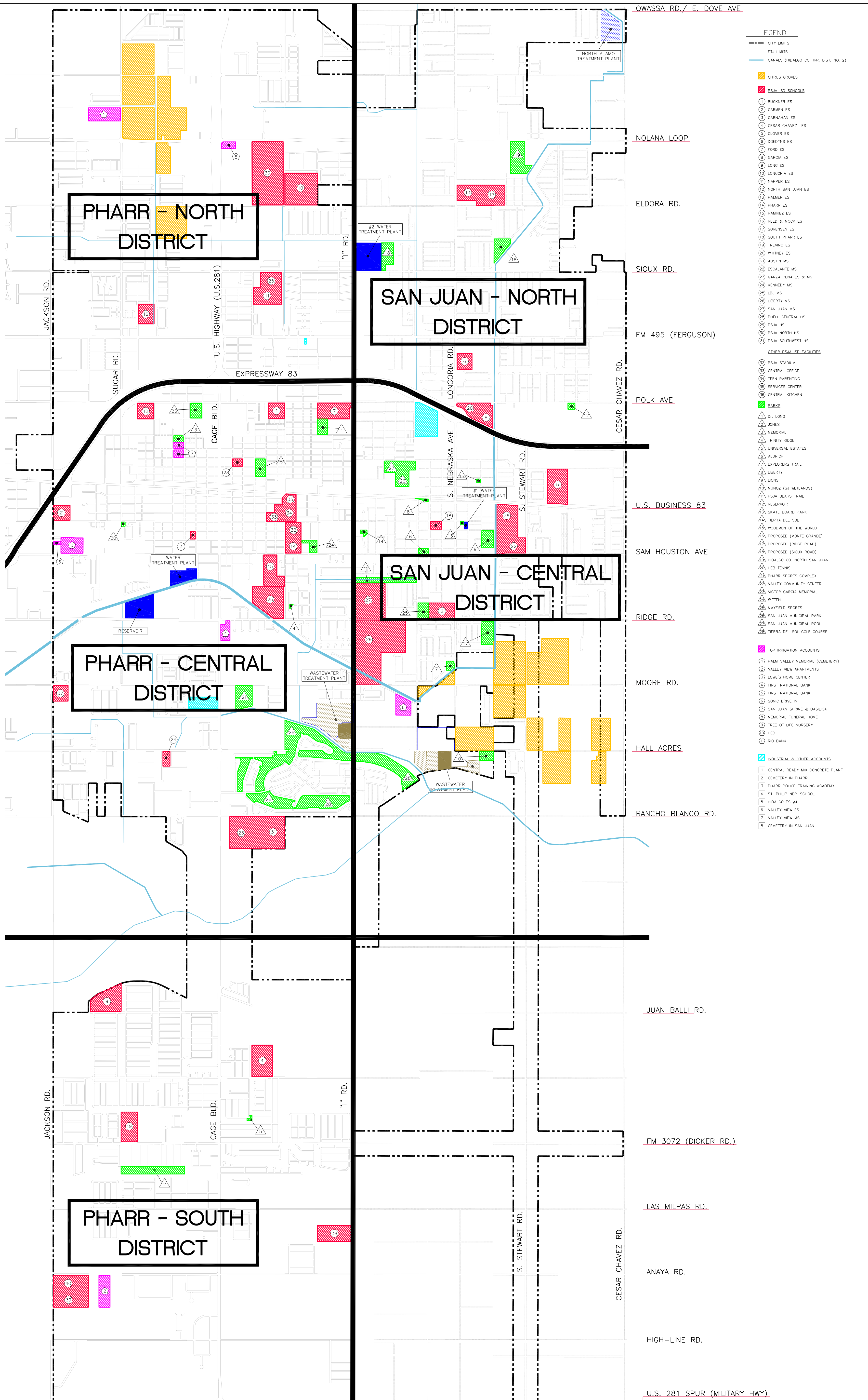
Therefore, the most significant beneficial use identified in this report for reclaimed water is for each community to augment its potable raw water supply. This consists of polishing the effluent to near drinking water standards, holding it in a reservoir for a preset time, and then conveying it to the water treatment plant's raw water reservoirs for blending.

6.7 Reclaimed Water Service Areas

Potential reclaimed water customers were grouped based on their geographical location within the planning area. The planning area was subdivided as follows:

- *Pharr and San Juan Political Boundaries*. Pharr and San Juan will be responsible for supplying reclaimed water respectively to customers within its boundaries.
- *Expressway 83 which extends east-west*. The area north of the Expressway was defined as the Northern District, the area to the South the Central District. The Expressway provides a logical divide both geographically and financially due to the potential construction cost associated with crossing this wide TxDOT Right-of-Way. Furthermore, this split also divides users on either side of the freeway.
- *The Arroyo Colorado Floodway also extends east-west direction and forms another logical geographical divide, this one to the south*. Pharr is the only community that has potential reclaimed water users south of the Arroyo, thus a southern service area was created exclusively for Pharr.

Five (5) service areas were established: (1) Pharr– Central District; (2) Pharr– Northern District; (3) Pharr– Southern District; (4) San Juan– Central District; and (5) San Juan– Northern District. The citrus groves were handled as an add-on to the service district within which they are located; the northern district for Pharr and the central district for San Juan. **Figure 6.3** depicts the aforementioned service areas.



Sherfey Engineering SA, LLC

FIGURE 6.3
PLANNING AREA DISTRICTS

CITY OF PHARR AND SAN JUAN
WATER REUSE PRIORITY AND
IMPLEMENTATION PLAN

Drawn By: RM	Checked By: RJA/JG	Scale: N.T.S.	Sheet
Date: 08/25/11	Project No.: 5448	File Name: Fig 6.3	Of

This page intentionally left blank

SECTION 7.0

Direct and Indirect Potable Reuse

7.1 Introduction

Direct and Indirect Potable Reuse in general terms is the use of reclaimed water for potable or domestic purposes. As previously discussed, indirect potable reuse or the planned incorporation of reclaimed water into a raw water supply for blending has recently become an acceptable practice in Texas.

7.2 Incidental, Direct, and Indirect Reuse Potable Reuse

Multiple communities, such as Pharr and San Juan use surface water from a stream or river as their primary water supply source. These streams and rivers are subject to numerous upstream discharges of reclaimed water. Pharr and San Juan currently utilize what is considered "incidental indirect potable reuse" since both is dependent on the Rio Grande which receives regulated and unregulated reclaimed water upstream of the City's raw water intake.

Direct Potable Reuse is the introduction of highly treated reclaimed water as a raw water source for a water treatment plant without entering a stream or reservoir. Currently, in the United States, Direct Reuse of reclaimed water for human consumption is limited.

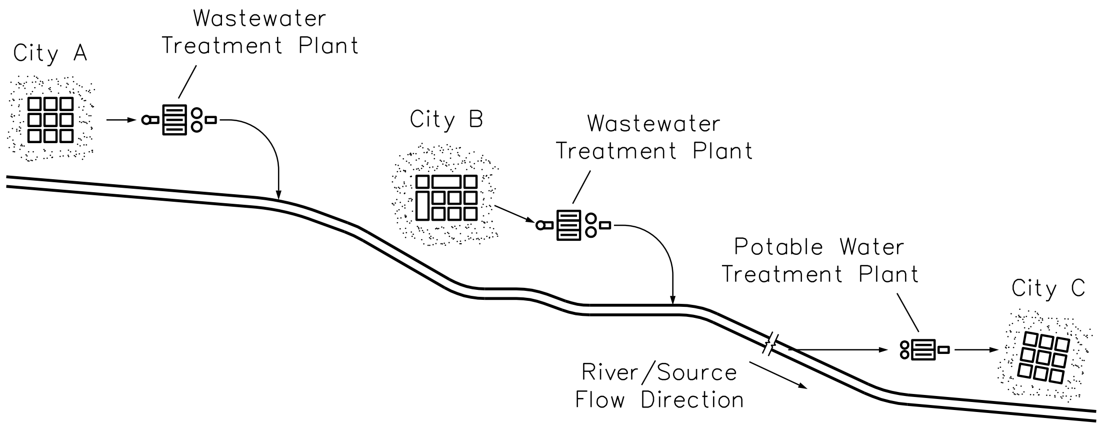
Indirect potable reuse is the planned incorporation of reclaimed water into a raw water supply, such as in a raw water reservoir or groundwater aquifer, resulting in mixing, dilution, and assimilation, thus providing an environmental barrier prior to treatment.

Refer to **Figure 7.1** for a graphical depiction of incidental indirect potable reuse, planned indirect potable reuse, and direct potable reuse.

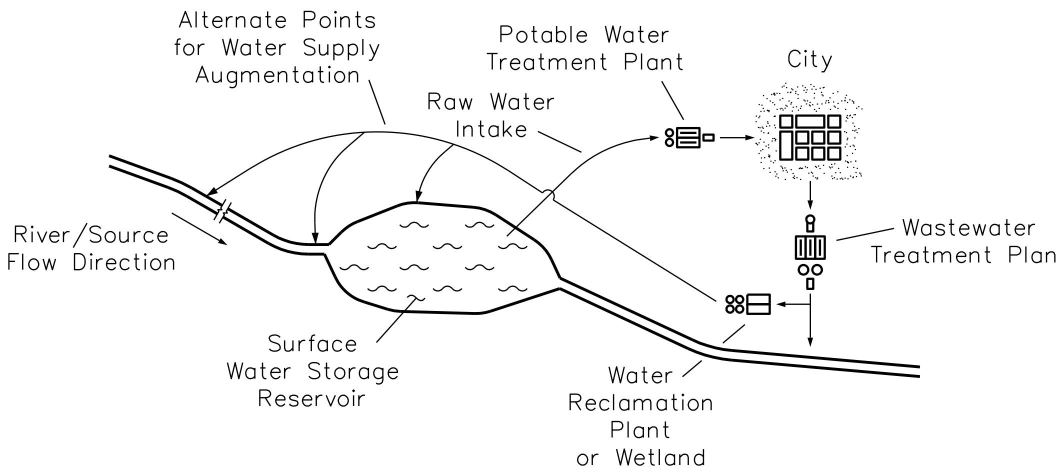
The principle elements that comprise an indirect potable reuse system include (1) an advanced wastewater treatment processes, (2) facilities for balancing water chemistry, (3) engineered barrier for flow retention and quality assurance, and (4) the blending of purified water with other natural raw waters. The advanced treatment system processes used for direct and indirect potable reuse are effectively the same.

Pharr and San Juan, similar to most communities in Texas, must identify water supply sources to meet future demand. The leading choices available to the City include aggressively acquiring additional water rights, participation in the Regional Brownsville Desalinization Project, participation in the Brackish Groundwater desalinization project and the implement a direct or indirect potable reuse program to augment their future water supply. The most expensive option is to do nothing and await a crises situation to occur before taking action.

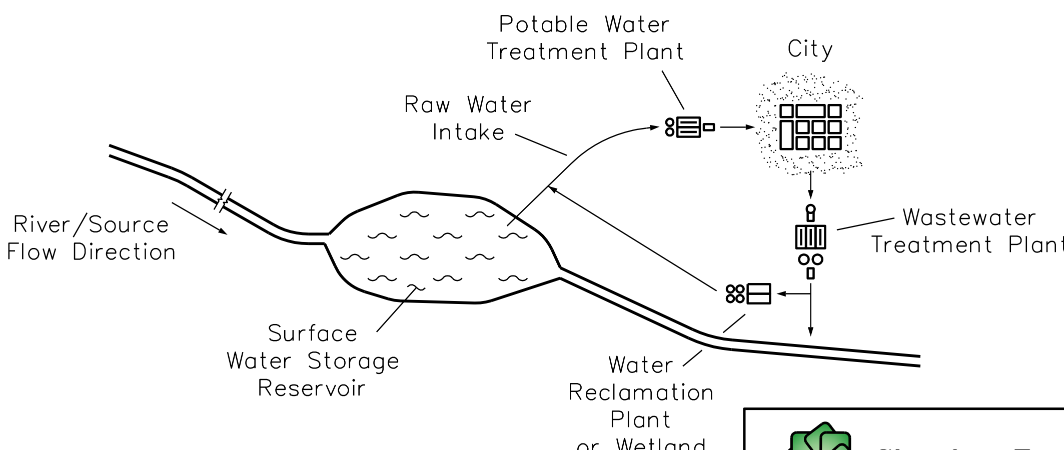
Presently, Pharr and San Juan show a deficiency of approximately 21,300 acre-ft and 10,800 acre-ft of water rights respectively to meet Year 2060 demands. The main purpose of this section is to present general information related to the technical issues related to



(A) INCIDENTAL INDIRECT POTABLE REUSE



(B) PLANNED INDIRECT POTABLE REUSE



(C) PLANNNED DIRECT POTABLE REUSE

Sherfey Engineering SA, LLC

FIGURE 7.1

INCIDENTAL INDIRECT, PLANNED INDIRECT, AND PLANNED DIRECT POTABLE REUSE

CITY OF PHARR & SAN JUAN
WATER REUSE PRIORITY
AND IMPLEMENTATION PLAN

Drawn By: RM	Checked By: JG	Scale: N.T.S.	Sheet
Date: 08/22/11	Project No.: ____	File Name: Fig 7.1	Of

Indirect Potable Reuse. Parts of the section are based on a 2011 document entitled "Direct Potable Reuse, A Path Forward" prepared by Dr. George Tchobanoglous, et. al. [5]

Reclaimed water that is discharged into the environment is invariably used as the raw water supply by downstream users. This is referred to as unplanned potable reuse or incidental indirect potable reuse. The time between discharge and uptake is completely random and arbitrary. The effects of treatment, dilution, time and commingling with environmental waters is considered to be adequate for the loss of its identity and conversion of the reclaimed water into a suitable and publically accepted potable water supply source.

There are a number of possibilities for potable reuse ranging from direct injection into a potable water distribution system to the long-term storage in the environment prior to reuse. As a result of treatment technology improvements and the development of full-scale advanced processes, the use of purified water that has been recovered from municipal wastewater for potable purposes is receiving increasing interest as a viable alternative.

Planned potable reuse systems in which wastewater is processed to a quality suitable for water supply has historically been deemed too controversial as a result of negative public perceptions. As water supplies become more limited in the future, and the public becomes increasingly aware of the exact nature and history of their local raw water supply, it is anticipated that increased emphasis will be placed on the planned augmentation with highly treated wastewater effluent.

Planned potable reuse, whether direct or indirect, will need to be well presented to the general public if it is to avoid controversy. Pursuing the indirect method, where the reclaimed water from the advanced treatment process is held first in a storage buffer reservoir before being mixed with the raw water from the Rio Grande in a regular storage reservoir, will contribute to the loss of identity issue thereby creating a more positive public perception. This indirect method can readily be shown to be for all intents the same as the present incidental method. Further, the indirect method has a buffer reservoir in the event that treatment by the advanced processes should ever be out of compliance. With the additional time in the system before being taken up by the water treatment plant, combined with the mixing with raw water from the Rio Grande, any temporary or minor compliance issues would be rendered meaningless. Therefore, to aid in public perception of the project, only the planned indirect potable reuse will be pursued further.

As new water resources become more costly and difficult to obtain, the benefits of using reclaimed water will and are becoming more widely recognized by cities and utilities. Although negative public perception of reclaimed water use for raw water augmentation can sometimes hinder or delay efforts to implement such programs, these

[5] Direct Potable Reuse, A Path Forward, George Tchobanoglous, Ph.D, P.E., Harold Leverenz, Ph.D., P.E., Margaret H. Nellor, P.E., James Crook, Ph.D., P.E. with contributions by Takashi Asano, Ph.D., P.E., Jeff Mosher, David Smith, Ph.D, P.E., Report sponsored by the Water Reuse Research Foundation and Water Reuse California.

perceptions are often alleviated with public education that emphasize safety and the benefits of raw water augmentation .

The following sections include both general and specific information related to indirect potable reuse. It includes the basic elements that would comprise an indirect potable reuse system.

7.3 Indirect Potable Reuse Systems

Fundamental to the practice of planned potable reuse is the use of multiple barriers to improve system reliability and ensure the quality of the product water. The treatment systems discussed are consistent with the multiple barrier concepts which are a cornerstone of safe drinking water programs. This concept consists of coordinated technical, operational, and managerial barriers that help prevent contamination at the customer source and enhance treatment at the plant, thereby assisting in ensuring a safe supply of drinking water for consumers. While any one of these barriers may not be perfect, improved protection is achieved when these independent barriers are applied in series. The use of this multiple barrier concept improves the overall reliability, thus providing increased protection from the system being out of compliance.

For potable reuse applications, the multiple barriers include: consumer education; source control for discharge into the wastewater collection system; equalization of flow and constituent concentrations; monitoring for and detection of select constituents; redundancy within the conventional and tertiary treatment processes; redundancy within the advance treatment processes; and an engineered buffer for quality assurance.

7.3.1 Advanced Wastewater Treatment

There has been tremendous progress in process technology for the purification of water, including systems such as reverse osmosis, electro-dialysis, and distillation for demineralization and the removal of trace constituents, as well as in processes to accomplish advanced oxidation by ozonation and/or ultra-violet light. Due to the difficulties associated with managing brines from a reverse osmosis systems at inland locations, there is an interest in developing other treatment processes to either remove or convert trace constituents without physically separating them from the water.

Subsequent to any demineralization process, purified water will need to be re-mineralized for health concerns, to enhance taste, prevent corrosion, and minimize damage to soils and plants. Balancing can be accomplished by re-carbonization and the addition of trace minerals conducted at strategic locations within the water system, or by blending the purified water with natural raw water sources.

The level of chemical balancing required depends on the characteristics of the product reuse water, the blending ratio with other raw water sources, and the chemistry of the other raw waters. Any necessary balancing of the water chemistry in a potable reuse system could occur at several locations in the water system, including prior to the storage buffer, during storage in the buffer, after blending with the other raw water sources, or during the treatment of the combined waters.

7.3.2 Storage Buffers

Storage buffers can either be a natural or constructed facilities situated between a wastewater treatment and potable water treatment facility to compensate for process variability, reliability, and unknowns.

Natural buffers can include reservoirs, lakes, and rivers and/or groundwater aquifers that receive and store water. A large natural buffer promotes the loss of source identity of the reuse water, which minimizes the psychological impact while providing time for the natural breakdown of remaining constituents present in partially or poorly treated reclaimed water as well a barrier to react mitigate a particular constituent of concern that is detected in the water. There are no criteria governing the length of time that reuse water should remain in a natural environmental buffer before being removed for use as a raw water source.

An engineered barrier is typically a stand-alone facility situated after the advanced treatment processes and before blending with other raw water sources. The technology and performance of current wastewater treatment processes and their reliability has improved in recent decades as well as the capability to detect and measure selected chemical constituents at lower concentrations. The storage capacity needed in the engineered buffer is directly related to the frequency of monitoring, the reliability of the conventional plant with its added advanced processes, and to the degree of variability in the product water quality.

7.3.3 Blending of Water Sources

The degree to which reclaimed water is blended with other raw water supply sources will depend on a number of site-specific factors, mainly the availability of raw water, regulatory requirements, and public acceptance.

As with the natural environmental buffer, blending of reuse water in an engineered facility helps in losing the identity of the product water, thereby diminishing some of the public opposition. In terms of quality, the treated reclaimed water will exceed most water quality standards as compared to water from the Rio Grande with the exception of pathogens and TDS. It is essentially that TDS levels as well as PPCP's are closely monitored to maintain levels within acceptable limits.

7.4 Advanced Wastewater Treatment Processes

7.4.1 Membrane Filtration

Membrane filtration is a process used to separate particles from liquids for purification. This process has a number of applications, ranging from treating wastewater to filtering milk used for cheese production. In all cases, the goal is to create a filtered solvent. A number of different types of systems are available from companies which specialize in filtration products, along with replacement membranes and other parts and equipment.

In membrane filtration, a solvent is passed through a semi-permeable membrane. The membrane's permeability is determined by the size of the pores in the membrane, and it will act as a barrier to particles which are larger than the pores, while the rest of the solvent can pass freely through the membrane. The result is a cleaned and filtered fluid on one side of the membrane and the removed solute on the other side.

Nanofiltration, ultrafiltration, microfiltration, and reverse osmosis are all membrane filtration techniques. In all cases, the size of the pores has to be carefully selected to exclude undesirable particles, and the size of the membrane has to be designed for optimal operating efficiency.

7.4.2 Reverse Osmosis

Reverse osmosis (RO), also known as hyper filtration, is used by municipalities to purify water by removing salts and other impurities. It is also capable of rejecting bacteria, sugars, proteins, particles, dyes, and other constituents that have a molecular weight of greater than 150-250 daltons (One dalton is *approximately* equal to the mass of one proton or one neutron).

7.4.3 UV Oxidation

Ultraviolet (UV) Oxidation which should not be confused with UV Disinfection is an extremely important purification technology used in the production of high-purity water for the chemical, food and beverage, pharmaceutical and semiconductor industries. When strategically combined with other purification technologies in a complete water system, UV oxidation provides unique benefits in the reduction of dissolved organics and microorganisms.

UV Disinfection involves exposing contaminated water to radiation from UV Light. The UV light penetrates an organism's cell wall and disrupts the cell's genetic material making reproduction impossible.

UV oxidation is a destruction process that oxidizes organic and constituents in water by the addition of strong oxidizers and radiation with UV light. Oxidation of target contaminants is caused by direct reaction with the oxidizers, UV photolysis, and through the synergistic action of UV light, in combination with ozone (O_3) and/or hydrogen peroxide (H_2O_2). If complete mineralization is achieved, the final products of oxidation are carbon dioxide, water, and salts. The main advantage of UV oxidation is that it is a destruction process, as opposed to air stripping or carbon adsorption, for which contaminants are extracted and concentrated in a separate phase.

Practically any organic contaminant that is reactive with the hydroxyl radical can potentially be treated. A wide variety of organic and contaminants are susceptible to destruction by UV/oxidation, including petroleum hydrocarbons; chlorinated hydrocarbons used as industrial solvents and cleaners; and ordnance compounds such as TNT, RDX, and HMX. In many cases, chlorinated hydrocarbons that are resistant to biodegradation may be effectively treated by UV/oxidation. Typically, easily oxidized organic compounds, such as those with double bonds (e.g., TCE, PCE, and vinyl chloride), as well as simple aromatic compounds (e.g., toluene, benzene, xylene, and phenol), are rapidly destroyed in UV/oxidation processes.

7.5 Engineered Storage Buffer

There are many unknowns and issues to treatment reliability and product water quality. Traditionally, it is common to hold treated water in a natural environmental buffer for a period of time to allow time for natural treatment in the event product water fails to meet all regulatory requirements. This holding period in a natural environmental buffer contributes to the loss in the identity of the water.

When water is treated to an advanced level and then placed in an environmental buffer or system it does not necessarily improve water quality. In contrast, the treated water may be inadvertently exposed to contamination such as the commingling with urban and agricultural stormwater runoff, potential pollutants, and the dissolution of undesirable compounds potentially present in sediments or aquifer formations. On the other hand, placement of the treated water in an engineered storage buffer that provides adequate and appropriate safety measures will allow the City to maintain significant control of the treated water's quality before it is blended with the raw water source.

Treated water produced in a treatment process with proven performance and reliability, and in which the quality can be rapidly validated, requires a system of relatively small engineered storage buffers. Such storage facilities allow for the water to be temporarily detained while awaiting confirmation of quality prior to it being blended with other sources.

An engineered buffer consists of a well defined, constructed, and confined storage facility whose features include a controlled and contained environment to minimize contamination from outside, the ability to direct and divert flow as needed, and the accommodation of monitoring and sampling equipment.

The storage capacity will be dictated by the time needed for constituent analysis and the overall reliability of the monitoring system. Purified water must be retained in this buffer for a sufficient length of time to allow validation of the quality for specified constituents prior to the blending with other sources in the potable water system. Thus there is a need to expediently evaluate key monitoring parameters to verify the wastewater treatment system's performance through the product water's quality. In the event that out of specification product water is detected in the buffer, it is necessary to divert the off-speculation batch to an alternate discharge location or return it back to the appropriate point in the conventional or advanced treatment process. A buffer system composed of multiple small tanks or ponds provides greater flexibility and control than one that employs a single large tank or pond.

7.6 Measures to Enhance Reliability

Incorporating an indirect potable reuse program may as well require the City to upgrade its wastewater management infrastructure. The system may need to be modified to optimize overall performance and enhance the reliability of the water purification process. Measures that are recommended to enhance the reliability of an indirect potable reuse system include: enhanced source controls, enhanced physical screening, upstream flow equalization, elimination of untreated return flows, and switching mode of operation of biological treatment processes.

7.6.1 Source Control

The control of substances that are not compatible with the reclaimed water systems is an important aspect of water reuse projects. Some wastewater constituents, including a variety of radioactive particles, industrial chemicals, pesticides, pharmaceuticals and compounds found in consumer products have been found to pass through conventional wastewater treatment systems with little to no removal. The presence of these substances in reclaimed water, though typically in trace amounts, will continue to be a significant factor in public and regulatory acceptance. These constituents also limit the applicability of reclaimed water or require a significant investment to remove during treatment at the plant.

The City should establish source control programs that include outreach programs to educate customers and the business community to minimize the initial discharge of contaminants of concern into the collection system, establish monitoring to rapidly identify and address contaminates of concern that are discharged, and impose industry specific onsite pretreatment systems that limit the discharge of difficult to treat constituents. Presently, the City does not have any industrial facilities within its service area.

7.6.2 Enhanced Fine Screening

The benefits of enhanced screening include the improved removal of constituents that can impede the treatment process and the alteration of the wastewater particle size distribution which improves the kinetics of the biological treatment process. Examples would include screening of the influent wastewater prior to any conventional activated sludge process or the membrane bioreactors. Both communities currently have adequate screening facilities prior to the treatment facility. However, the addition of a second fine screen at the Pharr WWTP is recommended.

7.6.3 Flow Equalization

Flow equalization is a method used to improve the performance and control the variability of the downstream treatment processes and to reduce the size and cost of the treatment facilities. Flow equalization can occur in the secondary treatment process or later preceding the advanced treatment processes.

Among the benefits from flow equalization for biological wastewater treatment systems is the enhancement of biological treatment through the minimization of shock loadings and spikes of concentrations of inhibiting substances and the stabilization of pH levels. This in turn results in reduced process variability, the improved removal of trace constituents, and the improved performance of secondary sedimentation tanks following the biological treatment through improved consistency in solids loading.

In advanced wastewater treatment some of the benefits are the reduced variability of incoming water quality, enhanced performance from constant flow operation, and reduced wear on membranes caused by fluctuation flows and loads.

Flow equalization will be difficult to achieve upstream of the existing wastewater treatment plants. However, reclaimed water diverted to the advanced treatment plant to blend with the raw water reservoir provides an excellent opportunity to feed reclaimed water at constant rate to minimize shock loading.

7.6.4 Elimination of Untreated Return Flows

Currently return flows from sludge thickeners, sludge dewatering, sludge stabilization, and sludge drying facilities are returned to the wastewater treatment plant headworks for reprocessing. In many instances these return flows contain constituents that deteriorate overall plant performance. The presence of nitrogenous compounds in return flows often impacts the ability of the biological treatment process to achieve low levels of nitrogen, which in turn, affects the performance of microfiltration membranes.

In biological treatment plants that are to be used in conjunction with advanced treatment facilities for indirect potable reuse, return flows should be processed separately. Separate systems for the treatment of return flows can be installed at the plants that will meet the need for the more stringent discharge requirements.

7.6.5 Operational Mode for Biological Treatment

To enhance the performance of advanced treatment facilities employing membranes and reverse osmosis, the biological treatment process should be operated in a nitrification or nitrification/ denitrification mode. The performance of microfiltration membranes is significantly improved when wastewater has been treated in an activated sludge process operated such that nitrogen in the form of ammonia is oxidized. Operationally, for a membrane bioreactor to function properly the activated sludge process must be operated to nitrify completely, if not, biological clogging of the membrane can occur resulting in decrease performance and increase operating costs.

Both Plants, Pharr and San Juan, were designed to nitrify and denitrify. No additional improvements are anticipated.

7.7 Monitoring and Constituent Detection

While there have been improvements in online monitoring and constituent detection, it is not feasible to provide real-time monitoring of all constituents of concern. However, the identification of surrogate and indicator constituents that can be used to assess performance reliability of key unit processes can be used in place of direct measurements for all constituents of interest.

7.7.1 Types of Monitoring

The two basic types of monitoring systems that are applied ate real-time and off-line. Real-time measurements are used for the constant acquisition of water quality data or other process parameters and are used extensively in tracking the performance and operation of individual unit processes. Off-line measurements are conducted in a laboratory to verify and calibrate the measurements made by real-time monitoring equipment and for detailed characterizations of individual constituents and for different classes of constituents.

7.7.2 Monitoring Strategies

An indicator compound is an individual constituent that represents certain physiochemical and biodegradable characteristics that are representative of a family of constituents of concern. Therefore, indicators can be used to predict the presence or absence of other constituents provided that the indicator is removed by similar mechanisms and to the same degree as the other constituents.

A surrogate compound is a bulk parameter that can serve as a measure of performance for individual unit processes or operations. Some surrogate parameters that are measured continuously can be correlated with the removal of individual or groups of constituents.

The use of indicators and surrogates is somewhat site specific and is established for individual treatment operations, however once established they can be used to improve the monitoring program through rapid detection. The ability to detect constituents of concern rapidly and tract levels of concentration will reduce the overall size or storage capacity of the engineered buffer facilities that are used for quality assurance.

7.7.3 Monitoring at Engineered Storage Buffer

The engineered storage buffer is a key monitoring location because it is the final safeguard prior to the distribution of reclaimed product water into the potable water system. Thus the development of the monitoring program needs to ensure that all constituents of importance can be assessed in the product water with sufficient speed and accuracy to justify the size and capacity of the buffer facilities. It is at this point that the off-speculation water would be diverted to an alternate location for discharge or redirected back to a specific point within the conventional treatment plant or the advanced purification processes.

SECTION 8.0

Conceptual Projects and Opinion of Probable Construction Cost

8.1 Introduction

This section presents conceptual projects developed as part of our investigation. Generally, two ideas were developed. The first consists of developing projects to deliver non-potable reclaimed water for irrigation purposes and the second is to implement an indirect potable reuse system to blend treated reclaimed water to augment the City's raw water supply.

8.2 Irrigation Customers and Projected Demands

Potential reclaimed water use customers and their respective location within the planning area are identified in **Tables 8.1 through 8.5.** These customers were as well subdivided within each of the five (5) reclaimed water service areas. Reclaimed water demand for each potential customer is listed in these tables as well. Reclaimed water demand for the citrus groves is provided in **Table 8.6**.

8.2.1 Irrigation Demand Methodology

This section outlines the assumptions used to determine school and park irrigation demands. The estimated irrigation demand for each potential end-user is shown in **Figures 6.1 and 6.2**.

The green space or impervious cover of each school district site was estimated using aerial photographs. We assumed that all pervious grassed area would be irrigated. An application rate of three (3) inches per month was used. This rate was used based on the usage by Palm Valley Memorial Park Cemetery in northeast Pharr. The peak monthly usage of 1.218-MG over a 30-day period and 14.7-acres translates to 3-inches/month. In addition, this application rate was considered appropriate since the Tierra del Sol Golf Course uses approximately four (4) inches per month.

The irrigation demands noted in **Tables 8.1 through 8.5** for the schools are conservative. Review of the City's water utility's billing records indicates that the actual usage for irrigation is less than our assumed 3-inches/month. An inspection of the schools grounds indicate that the green spaces are not being adequately irrigated.

TABLE 8.1
City of Pharr Service Area, Central District
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Site No.[a]	Site Name	Site Acreage (Acres)	Percent of Site Open	Irrigated Acreage (Acres)	Irrigation Demand (1K gpd)
City Parks:					
1	D. R. Long	5.8	80%	4.6	19
3	Memorial	2.3	90%	2.1	8
4	Trinity Ridge	0.2	100%	0.2	<1 [c]
20	HEB Tennis	0.5	20%	0.1	<1 [c]
21	Pharr Sports Complex	13.7	80%	11.0	45
22	Valley Community Center	6.6	60%	4.0	16
23	Victor Garcia	6.1	70%	4.3	17
24	Witten	4.2	50%	2.1	9
PSJA ISD:					
1	Buckner ES	8.9	60%	5.3	22
3	Carnahan ES	1.3	30%	0.4	2 [c]
7	Ford ES	19.5	40%	7.8	32
11	Napper ES	9.3	30%	2.8	11
13	Palmer ES	7.4	40%	3.0	12
14	Pharr ES	18.3	60%	11.0	45
20	Whitney ES	9.2	50%	4.6	19 [c]
22	Escalante MS	32.9	60%	19.7	80
24	Kennedy MS	3.9	50%	2.0	8 [c]
26	Liberty MS	30.9	60%	18.5	76
28	Buell Central HS	2.7	30%	0.8	3 [c]
31	PSJA Southwest HS	32.9	60%	19.7	80
32	PSJA Stadium (Artificial Turf)	10.1	20%	2.0	8
33, 34, 35	PSJA Central Office & Service	20.9	40%	8.4	34
Commercial:					
3	Lowe's Home Center	12.8	10%	1.3	13 [b c]
4	First National Bank	6.0	30%	1.8	17 [b]
6	Sonic Drive-in	0.8	10%	0.1	7 [b c]
Others:					
2	Cemetery in Pharr	15.9	95%	14.7	19 [b]
3	Pharr Police Training Academy	12.7	n/a	n/a	12 [b]
4	St. Philip Neri [a]	8.6	60%	5.2	21 [c]

a-The Site Number corresponds to the Site Number on Exhibit 6.1 and 6.2.
b- Private School
c- Demand per records for summer 2009
d- No proposed reclaimed water service to potential customer

TABLE 8.2
City of Pharr Service Area, Northern District
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Site No.[a]	Site Name	Site Acreage (Acres)	Percent of Site Open	Irrigated Acreage (Acres)	Irrigation Demand (1K gpd)
City Parks:					
	No Parks in District				
PSJA ISD:					
9	Long ES	38.7	80%	31.0	126
10	Longoria ES	8.7	40%	3.5	14
15	Ramirez ES	11.4	40%	4.6	19
25	LB Johnson MS	21.0	50%	10.5	43
30	PSJA North HS	72.9	50%	36.5	148
Commercial:					
1	Palm Valley Memorial Park (Cemetery)	15.5	95%	14.7	41 [b]
5	First National Bank	3.5	30%	1.1	14 [b c]

a-The Site Number corresponds to the Site Number on Exhibit 6.1 and 6.2.
b- Demand per records for summer 2009
c- No proposed reclaimed water service to potential customer

TABLE 8.3
City of Pharr Service Area, Southern District
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Site No.[a]	Site Name	Site Acreage (Acres)	Percent of Site Open	Irrigated Acreage (Acres)	Irrigation Demand (1K gpd)
City Parks:					
2	Jones	18.0	90%	16.2	66
5	Universal Estates	0.5	100%	0.5	2 [d]
PSJA ISD:					
4	Chavez ES	24.0	60%	14.4	59
8	Garcia ES	23.7	40%	9.5	39
18	South Pharr ES	18.1	60%	10.9	44
Commercial:					
2	Valley View Apartments	13.1	30%	3.9	32 [c]
Others:					
5*	Hidalgo ES #4 [b]	20.8	50%	10.4	42
6*	Valley View ES [b]	41.5	40%	16.6	68
7*	Valley View MS [b]				

a-The Site Number corresponds to the Site Number on Exhibit 6.1 and 6.2.
b- Public Schools not in PSJA ISD
c- Demand per records for summer 2009
d- No proposed reclaimed water service to potential customer

TABLE 8.4
City of Juan Service Area, Central District
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Site No.[a]	Site Name	Site Acreage (Acres)	Percent of Site Open	Irrigated Acreage (Acres)	Irrigation Demand (1K gpd)
City Parks:					
6	Aldridge	2.3	70%	1.6	7
7	Explorers Trail	2.7	60%	1.6	7
8	Liberty	0.5	60%	0.3	1
9	Lions	7.6	80%	6.1	25
10	Munoz	5.8	80%	4.6	19
11	PSJA Bears Trail	10.9	90%	9.8	40
13	Skate Board Park	0.3	10%	0.0	<1 [b]
14	Tierra del Sol	1.1	90%	1.0	4 [b]
15	Woodmen of the World	0.4	80%	0.3	1 [b]
17	Proposed Ridge Road	10.7	80%	8.6	35
25	Mayfield	6.5	70%	4.6	19
26	San Juan Municipal Park	19.5	70%	13.7	56
27	San Juan Municipal Pool				
PSJA ISD:					
2	Carman ES	15.7	70%	11.0	45
5	Clover ES	25.8	60%	15.5	63
17	Sorensen ES	3.1	40%	1.2	5
21	Austin MS	19.0	50%	11.4	46
27	San Juan MS	39.3	40%	15.7	64
29	PSJA HS	90.2	70%	63.1	257
36	PSJA Central Kitchen	23.2	40%	9.3	38
Commercial:					
7	San Juan Shrine & Basilica				32
8	Memorial Funeral Home				19
10	HEB				9 [b]
Industrial:					
1	Central Ready Mix Concrete Plant	n/a	n/a	n/a	23
Others:					
8	Cemetery in San Juan	9.7	90%	8.7	36

a-The Site Number corresponds to the Site Number on Exhibit 6.1 and 6.2.
b- No proposed reclaimed water service to potential customer

TABLE 8.5
City of Juan Service Area, Northern District
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Site No.[a]	Site Name	Site Acreage (Acres)	Percent of Site Open	Irrigated Acreage (Acres)	Irrigation Demand (1K gpd)
City Parks:					
12	Reservoir	1.6	50%	0.8	3 [b]
16	Proposed Monte Grande	8.9	80%	7.1	29
18	Proposed Sioux Road	10.6	80%	8.5	35
19	North San Juan County Park	18.1	60%	10.9	44
PSJA ISD:					
6	Doedyns ES	9.1	30%	2.7	11
12	North San Juan ES	18.3	60%	11.0	45
16	Reed-Mock ES	19.0	60%	11.4	46
19	Trevino ES	4.0	40%	1.6	7
23	Garza-Pena MS	14.6	60%	8.8	36
Commercial:					
9	Tree of Life Nursery				7
11	Rio Bank	1.1	n/a	n/a	10 [b]

a-The Site Number corresponds to the Site Number on Exhibit 6.1 and 6.2.
b- No proposed reclaimed water service to potential customer

TABLE 8.6
Citrus Groves
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Service Area (City)	Service District	Site Acreage (Acres)	Percent of Site Open	Irrigated Acreage (Acres)	Irrigation Demand (1K gpd)
Pharr	Northern District	206	100%	206	599
San Juan	Central District	300	100%	300	873

8.3 Reclaimed Water Distribution System (Direct Non-Potable Reuse)

The implementation of a non-potable reuse program will require the City to incorporate a separate reclaimed water distribution network. This is similar to the City's Potable Water Distribution Network but on a smaller scale. The new reclaimed network would include an elevated storage tank, booster pump station, and separate water main. The alignment of the water main would be strategic to accommodate potential reclaimed water customers as well as to attract future industrial users. The construction of such a network would occur in phases (i.e. Phase 1, 2, etc.).

The reclaimed water demands were based on the assumed application rates previously noted. For all accounts, except the single industrial account, we assumed a four (4) hour application period.

In the case of the citrus groves costumers, the total demand was approximately twice that of the Pharr service area irrigation accounts (parks, schools, and commercial). Similarly, the citrus groves in San Juan as well account for approximately twice the potential irrigation customer demand.

For the single industrial user in San Juan, Central Ready Mix, a concrete batch plant, the length of delivery time was assumed to be a normal work day (eight (8) hours) and would also occur only on the weekdays. Thus we assumed delivery of reclaimed water to the Ready Mix Plant would occur simultaneously with the service to the San Juan Parks and Schools.

The computed demand and customer location was then used to develop a conceptual reclaimed water distribution system for Pharr and San Juan. The system network was developed to deliver reclaimed water at a minimum system pressure of 30-psi.

Figures 6.1 and 6.2 shows the location of potential water reuse customers as well associated projected demands.

8.3.1 Pharr Service Area

Phase 1-

The first phase consists of the following: (1) constructing an effluent diversion structure, (2) chlorination of the effluent, (2) storage facility, and (3) pump station at the existing plant site. The distribution main would extend along South I Road and end at Napper Elementary School near the intersection of Sugar Road and Expressway 83. The proposed route is along a strategic corridor in which multiple lines could be used to serve a number of schools and parks. Phase 1 would also include the construction of a south main line along South I Road and Rancho Blanco Road to the new schools near Cage Boulevard. Refer to **Figure 8.1.**

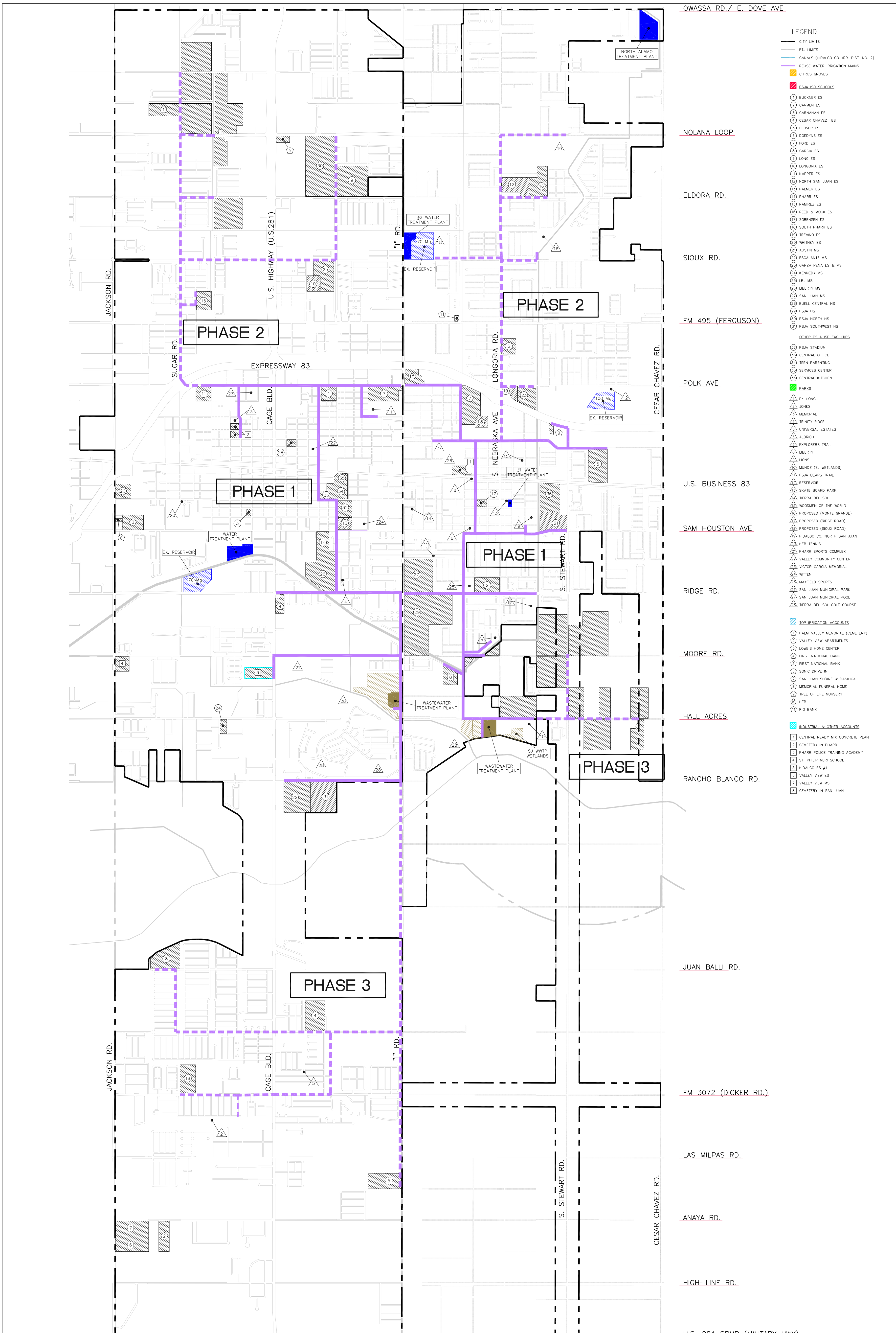
Phase 2-

Phase 2 would consist of extending the recycled water main across Expressway 83 and into the north region of the City. The main would be along Sugar Road to the Palm Valley Memorial Park Cemetery then east on Sioux Road to serve several schools on the opposite side of US Highway 281. Refer to **Figure 8.1**.

The mains were sized based on the assumptions that Phase 2 would follow Phase 1. Phase 1 mains were therefore sized to handle the Phase 2 Customer demands.

The inclusion of the citrus groves as customers of reclaimed water for irrigation is presently unknown. The size of the main would likely increase in size on Sugar Road from Sioux Road to the Valley Memorial Park Cemetery if the citrus groves customer choose to participate.

Phase 3



Sherfey Engineering SA, LLC

FIGURE 8.1
PHARR REUSE PROJECTS PHASING MAP

CITY OF PHARR AND SAN JUAN WATER REUSE PRIORITY AND IMPLEMENTATION PLAN

Drawn By: RM	Checked By: RJA/JG	Scale: 1"=1000'	Sheet
Date: 05/18/11	Project No.: 5448	File Name: Fig 8.1	Of

This page intentionally left blank

Phase 3 consists of extending recycled water main south along South I Road across the Arroyo Colorado floodway then west along Anaya Road to Jackson Road. Refer to **Figure 8.1**.

A reclaimed water distribution model using EPANET was developed for Pharr based on the potential customers and projected demands established. Three (3) models were simulated: the Central District only (Phase 1), the Central District plus the North District (Phases 1 and 2), and the South District (Phase 3). The system included a 250,000 gallon elevated storage tank and high service pump station at the Pharr WWTP Site. The recycled water distribution network consists of mains that range in size between 6 and 16-inch. The model was simulated to provide a residual pressure of no less than 30-psi. Demands were based on the assumed application rates (3-inches/month) as well as the assumption that customers would irrigate over a 12-hour period starting in the evening Monday through Friday.

A skeletonized model of the proposed Pharr Reclaimed Water Distribution Network is shown in **Figure 8.2** and **Appendix D.**

8.3.2 Pharr Reclaimed Water Distribution System Opinion of Probable Construction Costs

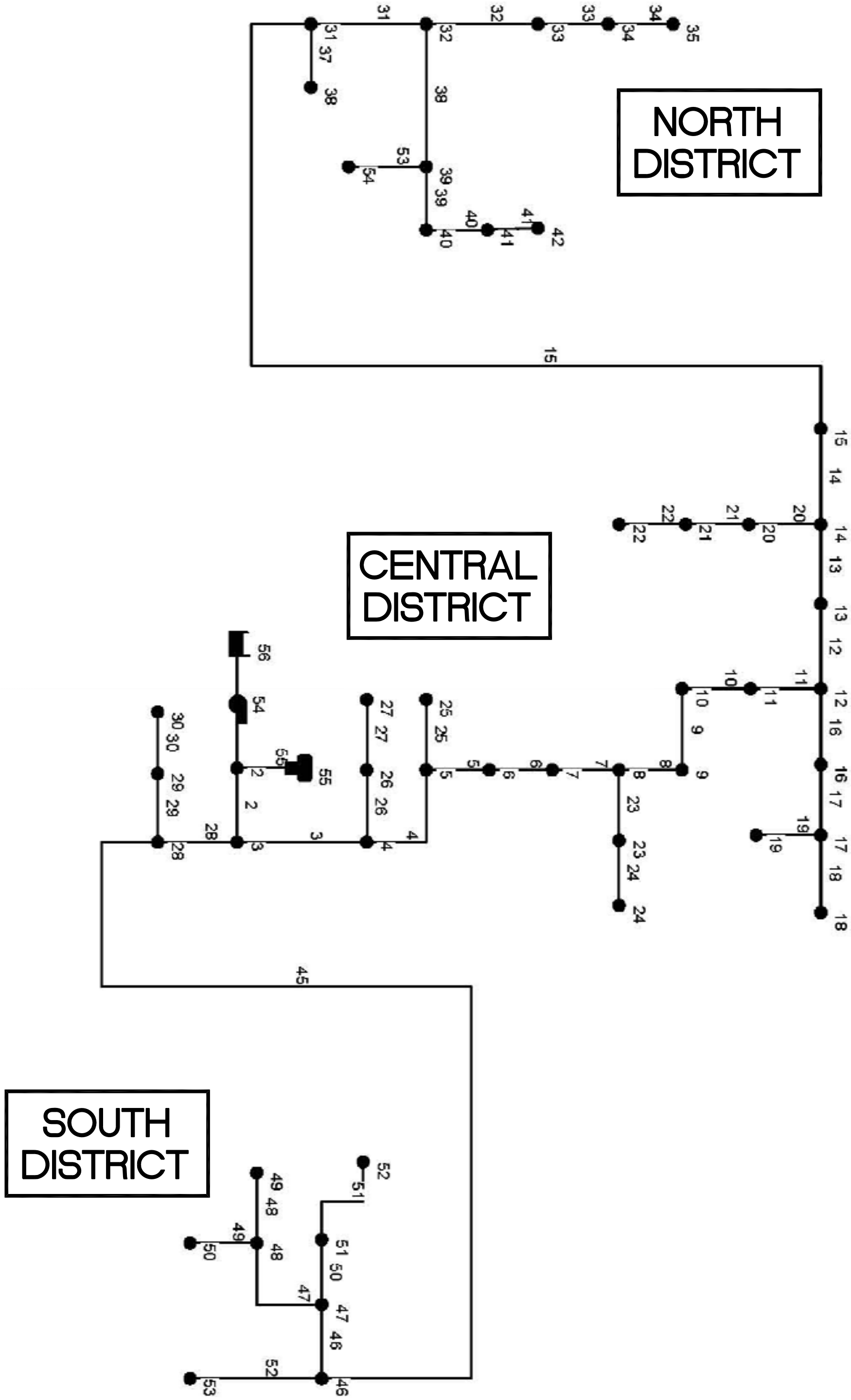
Table 8.7 shows a summary breakdown of the opinion of probable constructions cost of the Pharr Recycled Water Distribution System.

TABLE 8.7
Pharr Recycled Water Distribution System Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Description	Cost
Phase 1- Central District	500,000 gallon ground storage tank, 250,000 elevated storage tank, high service pump station, 47,000-lf of 6 to 16-inch Recycled Water Main.	$9.4-Million
Phase 2- Northern District [a]	26,000-lf of 6 to 16-inch Recycled Water Main	$3.6-Million
Phase 3- Southern District	33,000-lf of 6 to 10-inch Recycled Water Mains	$4.4-Million
	Total	$17.4-Million

a- An additional $1.0-million would be required during Phases 1 and 2 if provisions were included to serve the citrus groves in north Pharr. This would cover the cost to extend recycled water main an extra 4,000-lf as well as upsizing the main recycled main along the central and northern districts.

A detailed opinion of probable construction costs for the recycled water distribution system in Pharr is presented in **Appendix E**.



Sherfey Engineering SA, LLC

FIGURE 8.2
EPA NET MODEL
PHARR SKELATIZED NETWORK

CITY OF PHARR AND SAN JUAN
WATER REUSE PRIORITY AND
IMPLEMENTATION PLAN

Drawn By: RM	Checked By: JG	Scale: N.T.S.	Sheet
Date: 08/22/11	Project No.: ____	File Name: Fig 8.2	Of

8.3.3 San Juan Service Area

Phase 1-

The first phase consists of the following: (1) constructing an effluent diversion structure, (2) chlorination of the effluent, (2) storage facility, and (3) pump station at the existing plant site. The distribution main would extend along San Antonio and Standard Avenues north through the center of town to the San Juan Middle School and Shrine Basilica. The route is along a strategic corridor in which multiple lines could be used to serve a number of schools and parks. A short lateral would as well be included to serve Munoz Park. Refer to **Figure 8.1**.

Phase 2-

Phase 2 would consist of extending the recycled water main across Expressway 83 and into the north region of the City. The main would extend north along South Nebraska Avenue and Longoria Road to the North San Juan Elementary School and North San Juan County Park. The route is as well along a strategic corridor in which multiple laterals could be used to serve a number of schools and parks. Given the length of the recycled water main and demand projections, consideration was given to include an intermediate storage tank and pump station to serve costumers north of Expressway 83. Refer to **Figure 8.1**.

Phase 3

Phase 3 consists of extending recycled water main south along Hall Acres Road and north along South Stewart Road to the citrus groves in this area. Due to the proximity of the groves to the San Juan WWTP, this Phase could occur at any time independent of Phases 1 and 2. Refer to **Figure 8.1**.

A recycled water distribution model using EPANET was developed for the City of San Juan based on the potential customers and projected demands established. Three (3) models were simulated: the Central District only (Phase 1), the Central District plus the North District (Phases 1 and 2), and the citrus groves to the south (Phase 3). The system included a 250,000 gallon elevated storage tank and high service pump station at the San Juan WWTP Site. The recycled water distribution network consists of mains that range in size between 6 and 16-inch. The model was simulated to provide a residual pressure of no less than 30-psi. Demands were based on the assumed application rates (3-inches/month) as well as the assumption that customers would irrigate over a 12-hour period starting in the evening Monday through Friday.

A skeletonized model of the proposed San Juan Recycled Water Distribution Network is shown in **Figure 8.3** and **Appendix D.**

8.3.4 San Juan Irrigation Distribution System Costs

Table 8.8 shows a summary breakdown of the opinion of probable constructions cost of the San Juan Recycled Water Distribution System.

TABLE 8.8
San Juan Recycled Water Distribution System Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	**Description**	**Cost**
Phase 1- Central District	500,000 gallon ground storage tank, 250,000 elevated storage tank, high service pump station, 42,000-lf of 6 to 16-inch Recycled Water Main.	$7.5-Million
Phase 2- Northern District	25,000-lf of 6 to 16-inch Recycled Water Main	$3.5-Million
Phase 3- Citrus Groves	7,000-lf of 8 to 12-inch Recycled Water Mains	$0.9-Million
	Total	$11.9-Million

A detailed breakdown of this Opinion of Probable Construction Costs for an irrigation distribution system in San Juan is presented in **Appendix E**.

8.4 Raw Water Augmentation (Indirect Potable Reuse)

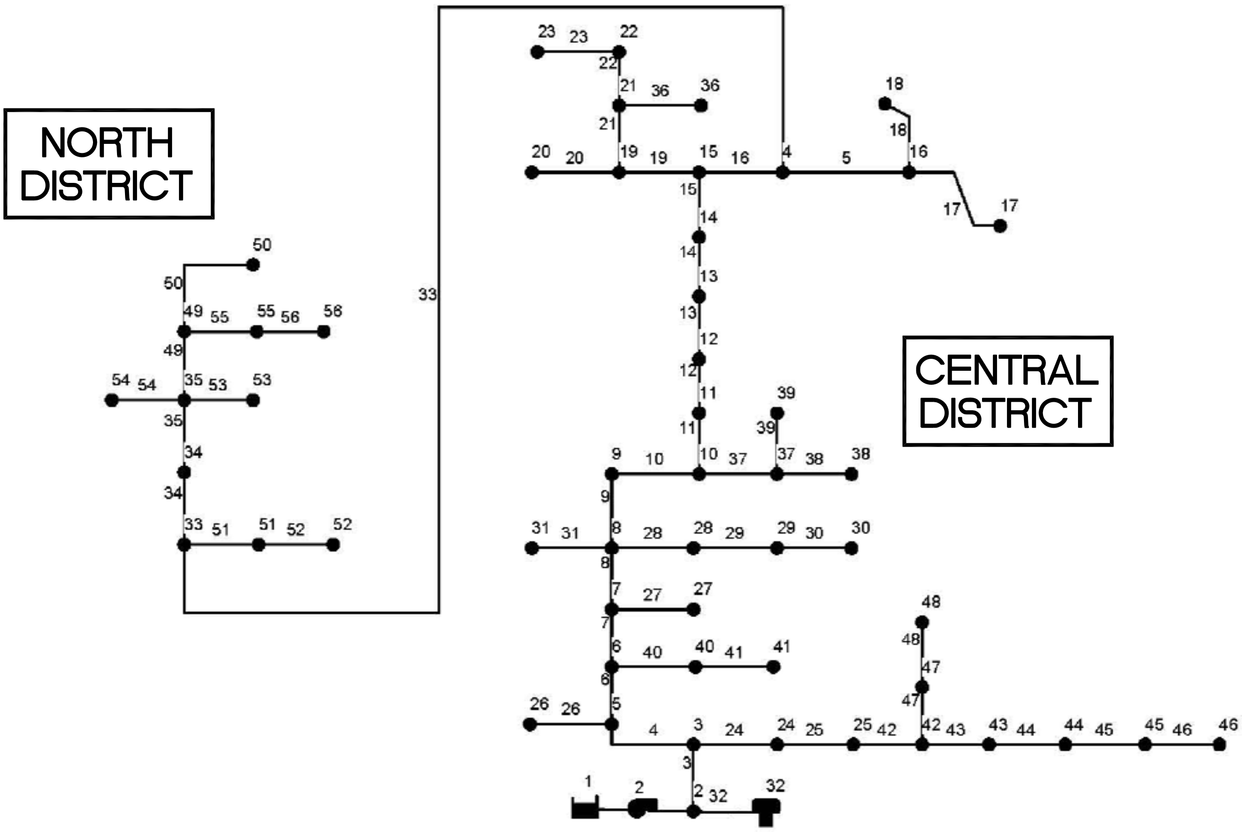
This section describes the improvements required and phasing plan for augmentation of the raw water reservoir for each City.

8.4.1 City of Pharr Raw Water Augmentation

Treatment Improvements

The Texas Commission on Environmental Quality (TCEQ) doesn't publish any specific treatment standards for indirect potable reuse. TCEQ considers these permits on a case by case basis. The general accepted practice is to treat reclaimed water to near drinking water standards to eliminate pathogens. Therefore, an advance treatment system would include Membrane Filtration, Reverse Osmosis, and UV Oxidation. The advanced treatment applies only to reclaimed water that will be blended with raw water from the Rio Grande. Reclaimed water used for irrigation or discharged directly into the Arroyo Colorado would not receive additional treatment.

It is recommended the City consider building an 8-mgd advanced treatment plant in 2-mgd increments. **Table 8.9** shows a proposed phasing plan. The ultimate goal is to reclaim all available effluent water for irrigation and raw water augmentation.



Sherfey Engineering SA, LLC

FIGURE 8.3
EPA NET MODEL
SAN JUAN SKELATIZED NETWORK

CITY OF PHARR AND SAN JUAN
WATER REUSE PRIORITY AND
IMPLEMENTATION PLAN

Drawn By: RM	Checked By: JG	Scale: N.T.S.	Sheet
Date: 08/22/11	Project No.: ____	File Name: Fig 8.3	Of

TABLE 8.9
Reuse Water Advanced Process Treatment Plant – City of Pharr
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Year	Advanced Process Capacity (mgd)	WTP Average Daily Demand (mgd)	Reclaimed Water Blending Percentage (%)
2016	2	8.8	23
2032	4	12.2	33
2047	6	15.6	38
2060	6	19.0	32

In addition to the advanced treatment system described, a pond is required to store the treated reclaimed water for a preset number of days at the pump station prior to being delivered as treated water to the raw water reservoir.

Storage Pond

The storage pond was sized to provide a buffer to mitigate fluctuations in water quality as well as increase the City's storage capacity. The pond with a surface area approximately 28.5-acres and a depth of 15-feet would store 375 acre-feet (120-MG) of reclaimed water. Constructing a 5-foot high berm around the perimeter of the pond increases the pond depth to 20-ft and increase the storage capacity to 520 acre-feet (170-MG).

Pharr currently has approximately 7to 10-days of raw water storage at the 70-MG reservoir adjacent to its Water Treatment Plant (WTP). The proposed 120-MG buffer and storage pond increases the total storage to 190-MG providing approximately 19 to 27-days at current demand rates. Using 2060 demands (19-mgd), the same two reservoirs would provide approximately 10 days of storage.

Booster Pump Station and Recycled Water Main (Delivery System)

A booster pump station and recycled water main is needed to deliver treated reclaimed water to the raw water reservoir. The station and associated piping would be sized based on the volume of reclaimed water delivered according to the phasing plan presented above (Refer to **Table 8.9**)

The ultimate goal is to reach zero discharge and reclaim 100% of the reclaimed water. Using the 0.5-mgd currently dedicated to irrigate the Tierra del Sol Golf Course combined with the proposed 8.0-mgd raw water augmentation, the Plant would be at or near zero discharge.

Proposed Process Flow Diagram and Site Plan are presented and shown in **Appendix F.**

Table 8.10 shows a summary breakdown of the opinion of probable constructions cost of the Pharr Indirect Potable Reuse System. A detailed breakdown is presented in **Appendix E**.

TABLE 8.10
Pharr Indirect Potable Reuse System (2-mgd) Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Description	Cost
Advanced Treatment System	Membrane Filtration, Reverse Osmosis, and UV Disinfection.	$16.7-Million
Engineered Buffer Storage Pond	14-MG Storage Pond	$2.0-Million
Delivery System	High Service Pump Station and 20-inch Transmission Main	$3.2-Million
	Total	$21.9-Million

8.4.2 City of San Juan

Treatment Improvements

It is recommended the City consider building an 6-mgd advanced treatment plant in 2-mgd increments. **Table 8.11** shows a proposed phasing plan. The ultimate goal is to reclaim all available effluent water for irrigation and raw water augmentation.

TABLE 8.11
Reuse Water Advanced Process Treatment Plant – City of San Juan
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Year	Advanced Process Capacity (mgd)	WTP Average Daily Demand (mgd)	Reclaimed Water Blending Percentage (%)
2016	2	3.4	59
2039	4	6.5	62
2060	4	9.6	42

The ultimate goal again is to reclaim all available effluent water for irrigation and augmentation of the raw water supply.

In addition to the advanced treatment system described, a pond is required to store the treated reclaimed water for a preset number of days at the pump station prior to being delivered as treated water to the raw water reservoir.

Storage Pond

The storage pond was sized to provide a buffer to mitigate fluctuations in water quality as well as increase the City’s storage capacity. The pond with a surface area approximately 11.5-acres and a depth of 15-feet would store 140-acre-feet (45-MG) of reclaimed water. Constructing a 5-foot high berm around the perimeter of the pond increases the pond depth to 20-ft and increases the storage capacity to 200-acre-feet (65-MG).

San Juan currently has approximately 70-days of raw water storage between their two reservoirs, the original 100-MG and the new 70-MG facility at the Water Treatment Plant (WTP). The proposed 45-MG buffer and storage pond increases the total storage to 215-MG providing approximately 85-days at current demand rates. Using 2060 demands (9.6-mgd), the same three reservoirs would provide approximately 22-days of storage.

Booster Pump Station and Recycled Water Main (Delivery System)

A booster pump station and recycled water main is needed to deliver treated reclaimed water to the raw water reservoir. The station and associated piping would be sized based on the volume of reclaimed water delivered according to phasing plan presented above (Refer to **Table 8.11**)

The ultimate goal would be to reach zero discharge and reclaim 100% of the effluent wastewater.

Proposed Process Flow Diagram and Site Plan are presented and shown in **Appendix F.**

Table 8.12 shows a summary breakdown of the opinion of probable constructions cost of the San Juan Indirect Potable Reuse System. A detailed breakdown is presented in **Appendix E**.

TABLE 8.12
San Juan Indirect Potable Reuse System (2-mgd) Opinion of Probable Construction Cost
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	**Description**	**Cost**
Advanced Treatment System	Membrane Filtration, Reverse Osmosis, and UV Disinfection.	$16.7-Million
Engineered Buffer Storage Pond	14-MG Storage Pond	$2.0-Million
Delivery System	High Service Pump Station and 20-inch Transmission Main	$3.7-Million
	Total	$22.4-Million

8.4.3 Raw Water Augmentation Blending and Total Dissolved Solids (TDS) Levels

As reclaimed water is used to augment the raw water supply, there is a potential for TDS levels to escalate to point above acceptable limits. Therefore, further study will be needed during design of an advanced treatment plant and the buffer storage pond. This will need to include testing of the reclaimed water and raw water source and perhaps pilot testing.

One potential operational procedure that could readily employ is to flush the entire system. This would consist of temporarily halting the transfer of treated reclaimed water for a period of time. This allows the City to effectively flush the system or cleansing.

8.5 Raw Water Reservoirs

A raw water reservoir provides storage capacity to mitigate fluctuations and/or disruption of raw water service. There are multiple scenarios under which complete or partial disruption of raw water delivery could occur. These include extreme drought, other natural occurrences, maintenance of facilities by the City, man-made disasters, or acts of terrorism along the border involving the Amistad or Falcon Reservoirs.

The most likely scenario causing a disruption to the raw water supply is an extreme drought. In such an event, discharge from Amistad and Falcon Reservoirs for irrigation purposes could at some point be completely suspended. According to Water Right agreements along the Rio Grande, all water needs to be used strictly for municipal purposes. However, in such a condition, it is estimated that we would experience a twenty percent (20%) loss due to evaporation. Since water is released from the two (2) aforementioned reservoirs based on the exact volume of water rights of the downstream users, Pharr and San Juan would at best receive only approximately eighty percent (80%) of its Water Rights. Other conditions could further diminish the volume of water available during an extreme drought. This may include “over pumping” by upstream users which is a real concern given the relative distance of Pharr and San Juan from Amistad and Falcon Reservoirs.

The City should have, as a minimum, sufficient raw water storage to maintain normal operations for at least 60-days. There are two options available. The first is a traditional open water reservoir; the second is using the Gulf Coast Aquifer employing a technique known as Aquifer Storage Recovery (ASR). Further discussion regarding ASR is included in Section 8.6.

Based on our review of TWDB data on evaporation rates for the Hidalgo County area over the last 70 years, a typical rate of annual evaporation is between 60 and 66-inches. Annual rainfall, also based on TWDB data over the same period is approximately 24-inches. Conservatively, the difference between evaporation and rainfall can be set at 4-feet per year. At that rate, each acre of reservoir surface would lose about 3,600-gpd. For a group of reservoirs storing 400 MG of raw water, covering about 60 acres with a depth of 20 feet, the loose of water to evaporation would be equal to approximately 0.22-mgd.

The ASR process also has losses during storage. The losses associated with ASR without field testing are difficult to quantify and generally considered to be outside the scope of this study. However, Section 8.6 includes additional information regarding this process.

8.5.1 Pharr Storage

As previously stated, Pharr has approximately 7-days of raw water storage and if the reservoir has not been dredged it may be less. The proposed storage pond provides an additional 120-million gallons and increases storage from 7 to 20-days. Based on the proposed phasing plan the City would increase its storage capacity in each phase as follows:

Phase 1- 20- days

Phase 2- 25-days

Phase 3- 50-days

Based on the 190 million gallons of total storage, Pharr's water supply will decrease from 50 days to 30 days over the next 35 years to the year 2060. We project that the City will need between 400 to 500-MG of storage capacity to maintain a 60-day raw water supply.

Presently three (3) tracts of land surrounding the 70-MG reservoir are available. Any two (2) of those three (3) tracts could be used to construct a new reservoir that would add sufficient storage to meet the 400-MG goal. If the City were to acquire all three (3) tracts, the City would be able to store approximately 500-MG. However, the immediate area next to the available land has experienced significant growth and this land would likely be developed commercially. The City recently inquired the landowners and the price per acre is in the $210,000/Acre.

8.5.2 San Juan Storage

The City of San Juan currently has ample storage capacity. The City has two (2) raw water reservoirs; the original reservoir has a capacity of 100 MG and a second reservoir, located near the second water treatment plant, has a capacity of 70 MG. Given the current demand of approximately 2.5-mgd, San Juan has about 70-days of raw water storage capacity. This is sufficient under current demand and only slightly above our recommended two (2) month, or 60-day storage.

As the City's population and water demand continues to grow, storage will naturally decrease. If the City does not add any additional storage, the storage capacity will decrease to 60-days in 2013, 42-days in 2020, and 28-days in 2035. The proposed 45-MG storage buffer reservoir for the indirect potable reuse project adds approximately 15-days of storage.

If San Juan wishes to maintain its current level of storage capacity, the City will need to add approximately 400 MG of storage by 2060. Incorporating indirect potable reuse would almost eliminate the need to add additional storage and still maintained the desired 60-day storage. A 2-mgd advanced treatment plant provides 120-MG gallons of storage and a 4-mgd plant provides 240 MG.

8.6 ASR Alternative

Aquifer Storage Recovery (ARS) is a water management technique that employs an aquifer to store water underground. ASR facilities can potentially reduce the need to expand treatment facilities by providing seasonal and possibly long-term storage of treated water. The method is useful to water utilities that experience seasonal variations in their water supplies and demand. Typically, a utility can store water during the lower demand months of winter for recovery and use during the higher demand months of the summer. It is also possible with some aquifers to provide storage of treated water for longer durations than over one annual season. Because aquifers are typically very extensive, the storage of large volumes is possible. Thus by using ASR, a water utility can store vast quantities of water when water is abundant for later use. Potential ASR applications include the storage of raw water, reclaimed water, and treated potable water. The Gulf Coast Aquifer may offer Pharr and San Juan an opportunity to use ASR as a feasible alternative to expansion of their surface reservoir capacity to meet their raw water storage needs.

An ASR system stores water by pumping the water into the aquifer through a series of drilled wells. It is typical to pump water into an ASR for several months, then later to recover the same water over a similar period of time. The rates at which water can be stored and recovered from an aquifer are largely dependent on the number of ASR wells and their capacity. The length of time that water may be left in storage varies depending primarily upon the native quality of the aquifer (brackish water verses fresh water), the aquifer's physical characteristics or properties, and the regional movement of the water within the aquifer.

Since an ASR system operates by storing fresh water in the existing aquifer, it is important to consider the quality of the native waters that exist in the aquifer. During storage and removal of fresh water some degree of mixing between the native and stored waters. Many ASR facilities are in brackish water aquifers. When the native water in the aquifer is of poor quality, the ASR wells location and storage zone must be selected so as to minimize the mixing between the native and injected waters. Mixing of waters also typically decreases with successive storage and removal cycles such that in most operating ASR facilities the degree of mixing observed does not render the recovered water non-potable.

It is also important to realize that although groundwater in aquifers generally moves slowly, it still does move. As water is pumped into an ASR it moves out into the aquifer radially creating a fresh water lens. During recovery, the stored water moves back toward the well and the lens contracts. Over time, the regional flow of groundwater within the aquifer works to move the lens of stored fresh water away from the well. If the groundwater flow velocity is high enough, or the fresh water storage time is long enough, movement of the lens may be such that noticeable volumes of the stored water may become irretrievable. If movement of the lens within the aquifer is such that the system can recover essentially the same water that was injected, or with a minimal amount of mixing with the native water, long-term storage of treated water can work even in brackish aquifers.

The injection of raw water with high levels of turbidity can pose significant problems because the high particle content tends to quickly plug the aquifer around the well. Additionally, injection of raw water with dissolved minerals can pose problems as small changes to the aquifer pH levels may cause the minerals to precipitate out of solution. Therefore, in the ASR application of raw water, some form of pretreatment before storage may be necessary.

A report[6] was prepared for the City of Brownsville investigating the potential of using the Gulf Coast Aquifer as an ASR. That report concluded that a system of six (6) wells could operate at average injection and recovery rates of 10-mgd and 12-mgd

[6] Aquifer Storage and Recovery System, Brownsville Public Utilities Board, Brownsville, Texas. CH2M HILL. January 1996.

respectively. The preliminary estimated cost for developing that system was approximately $11 million in 1995.

At this time it is not possible to determine a realistic length of time that treated water could be stored in the Gulf Coast Aquifer in the Pharr and San Juan area. In order to determine the feasibility of using this aquifer further study, including a test program to determine the effects of time on the stored water, would have to be conducted.

SECTION 9.0

Feasibility and Benefit Analysis

9.1 Introduction

This section is an analysis of the feasibility associated with implementing the conceptual projects developed in this study. The conceptual projects include the use of reclaimed water for non-potable use (irrigation) and indirect potable reuse to blend treated reclaimed water with the City's raw water supply from the Rio Grande. The feasibility evaluation includes an assessment of probable construction costs, operation and maintenance costs, and an evaluation of the potential benefits. It also includes a review of potential financing strategies. In addition, this chapter includes a discussion of administrative, regulatory and public relations issues that may impact project feasibility.

9.2 Opinion of Probable Costs

The Opinion of Probable Construction Costs for the various conceptual projects was presented in Section 8.0. **Table 9.1 and 9.2** presents the costs associated with the conceptual projects to deliver reclaimed water for non-potable use (irrigation). **Table 9.3 and 9.4** presents costs associated with the indirect potable reuse. A detailed cost breakdown of each project is included in **Appendix E**. The costs shown in these tables also include estimated operation and maintenance cost for each project.

9.2.1 Reclaimed Water for Irrigation (Non-Potable)

TABLE 9.1
Summary of Costs, City of Pharr (Non-Potable Reclaimed Water)
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

City	Service District	Phase	Demand (mgd)	Capital Cost* ($M)	Debt Service ($M)	O&M ($M)	Energy ($M)	Overall Annual Cost ($M/yr)	Overall Unit Cost ($/1K Gal)
Pharr:	Central	1	0.56	$9.41	0.81	0.12	0.08	1.01	$4.94
	Central +North	1 & 2	0.97	$12.97	1.12	0.17	0.13	1.42	$4.01
	South	3	0.35	$4.39	0.38	0.06	0.05	0.49	$3.84
Total:		**1, 2, & 3**	**1.32**	**$17.36**	**1.50**	**0.23**	**0.18**	**1.91**	**$3.96**

*Refer to Appendix E, Tables E-1, E-2, and E-3 for Capital Cost documentation.

TABLE 9.2
Summary of Costs, City of San Juan (Reclaimed Water for Non-Potable Reuse)
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

City	Service District	Phase	Demand (mgd)	Capital Cost* ($M)	Debt Service ($M)	O&M ($M)	Energy ($M)	Overall Annual Cost ($M/yr)	Overall Unit Cost ($/1K Gal)
San Juan:	Central	1	0.91	$7.47	0.64	0.10	0.12	0.86	$2.59
	Central +North	1 & 2	1.16	$10.96	0.94	0.14	0.15	1.23	$2.91
	Citrus	3	0.87	$0.90	0.08	0.01	0.11	0.20	$0.63
Total:		**1, 2, & 3**	**2.03**	**$11.86**	**1.02**	**0.15**	**0.26**	**1.43**	**$1.93**

*Refer to Appendix E, Table E-4, E-5, and E-6 for Capital Cost documentation.

9.2.2 Reclaimed Water for Indirect Potable Use

TABLE 9.3
Summary of Costs, City of Pharr (Reclaimed Water for Indirect Potable Reuse)
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

	Demand (MGD)	Capital Cost*[1] ($M)	Debt Service ($M)	O&M ($M)	Treatment ($M)	Energy ($M)	Overall Annual Cost ($M/yr)	Overall Unit Cost ($/1K Gal.)
Advanced Treatment Processes	2	15.83	1.36	0.08*[2]	0.26*[2]	*[3]	1.70	2.32
14 MG Buffer Reservoir	2	1.90	0.16	0.02	n/a	n/a	0.18	0.25
Transmission to Ex. Raw Water 70 MG Reservoir	6*[4]	3.25	0.28	0.01	n/a	0.10	0.39	0.18
Total:	**2.0**	**20.98**	**1.80**	**0.11**	**0.26**	**0.10**	**2.27**	**2.75**

*[1] Refer to Appendix E, Tables E-7, E-8, and E-9 for Capital Cost documentation.
*[2] Based on 2010 Region M Report, Appendix 7, Table PWR-1.
*[3] Energy Cost in table PWR-1 are included in O&M Costs.
*[4] Transmission Main sized to convey Three 2 MGD Plant Expansion (Total of 6 MGD).

TABLE 9.4
Summary of Costs, City of San Juan (Reclaimed Water for Indirect Potable)
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

	Demand (mgd)	Capital Cost*[1] ($M)	Debt Service ($M)	O&M ($M)	Treatment ($M)	Energy ($M)	Overall Annual Cost ($M/yr)	Overall Unit Cost ($/1K Gal.)
Advanced Treatment Processes	2	15.83	1.36	0.08*[2]	0.26*[2]	*[3]	1.70	2.32
14 MG Buffer Reservoir	2	1.90	0.16	0.02	n/a	n/a	0.18	0.25
Transmission to Ex. Raw Water 100 MG Reservoir	4*[4]	4.21	0.36	0.02	n/a	0.13	0.51	0.35
Total:	**2.0**	**21.94**	**1.88**	**0.12**	**0.26**	**0.13**	**2.39**	**2.92**

*Refer to Appendix E, Tables E-7, E-8, and E-10 for Capital Cost documentation.
*[2] Based on 2010 Region M Report, Appendix 7, Table PWR-1.
*[3] Energy Cost in table PWR-1 are included in O&M Costs.
*[4] Transmission Main sized to convey Two 2 MGD Plant Expansion (Total of 4 MGD).

9.3 Benefits of Reclaimed Water Projects

As new water resources become more costly and difficult to obtain, the benefits of using reclaimed water are becoming more widely recognized by cities and utilities. Although negative public perception of reclaimed water use for raw water augmentation can sometimes hinder or delay efforts to implement such programs, these perceptions are often alleviated with public education and information programs that emphasize safety and the benefits of raw water augmentation to the community. The following sections describe some of these benefits in terms both general and specific to both City's and their current and future water supply requirements.

9.3.1 Reduction of Potable Water Demand

One leading driver for the implementation of reuse projects is the impact reuse has on potable water demand. Replacing potable water with reuse water for irrigation of schools, parks plus golf courses, and other green spaces may result in a savings of potable water for more critical uses. Typically, this is particularly relevant in states such as Texas, when summer usage can be significantly greater than that of winter consumption due to irrigation demands. Water reuse has been identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature.

Due to economic and cultural differences between the Rio Grande Valley and other parts of Texas the potential savings of potable water due to the use of reclaimed water for irrigation is not significant.

9.3.2 Reclaimed Water as a Water Supply Source

It is often overlooked when introducing reuse programs to the public that reuse water provides a new water supply source that should be compared on an equal basis to other potential surface and groundwater sources, including new reservoirs. As a water supply source, reclaimed water is particularly attractive because the supply is relatively consistent, even during periods of drought, and actually increases as population increases. Additionally, the City retains complete control over the source thereby greatly enhancing the sources reliability.

9.3.3 Reduction in Load to Receiving Streams

By diverting wastewater effluent prior to discharge for reuse, nutrient and BOD loads to receiving streams are reduced. This reduction in loading can have permitting implications for dischargers, who may be able to defer future permit requirements that are more stringent. This impact is particularly important in light of the EPA's current effort to begin incorporating nutrient criteria into surface water quality standards. Although the TCEQ is still exploring different strategies for the development of nutrient criteria, it is likely that these criteria will be established in the near future and will likely become more stringent.

9.3.4 Reduction in Raw Water Requirements

One of the primary benefits of reuse projects is the reduction of overall new raw water supplies that are necessary to meet future demands. Reclaimed water provides a "new" and reliable water supply or source to meet the growing demands as new customers are added. By meeting the needs of water users, reuse water defers the need for the acquisition of other supplies elsewhere. While the Regional Water Plan referenced several options that may become necessary to augment raw water supply, reuse projects would reduce the volume of water that would need to be imported or acquired in the future. In addition, the operational costs of pumping raw water from those future water sources that are further away can be significant and will need to be passed on to all customers. Consequently, reuse will result in the reduction of both capital expenditures and operational costs for raw water conveyance.

9.4 Reclaim Water (Non-Potable)

In many metropolitan areas in Texas, the development of water reuse programs, in conjunction with other water conservation efforts, will provide for efficient use of the City's water resources. However, in both Pharr and San Juan, there were no significant industrial or commercial end users identified and the cost of constructing the required infrastructure is cost prohibitive. Furthermore, our review clearly shows that the schools and parks historically are not irrigating to the extent found in other communities. As previously mentioned, this may be due to the economic and cultural differences between the Rio Grande Valley and other parts of Texas.

9.5 Reclaim Water (Indirect Potable)

Reclaimed water that is used to augment the City's raw water reservoirs is a source the City has full control over even during extreme drought conditions. Reclaim water provides a firm, continuous, and relatively constant source regardless of the fluctuations in weather conditions.

The use of reclaimed water for augmentation directly reduces the need to obtain additional water rights. The reuse of 1-acre-ft of effluent water reduces the need to acquire 1-acre-ft in water rights. Furthermore, as previously mentioned, during drought conditions, the City is not guaranteed to receive its full Water Right allocation.

The costs to implement the following alternatives were compared:

1. Acquisition of Rio Grande Water Rights
2. Seawater Desalination
3. Brackish Groundwater Desalination

Table 9.5 shows the costs per 1,000-gallon for each options.

TABLE 9.5
Net Cost of Reclaimed Water Alternatives
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Item	Alternatives	Cost ($/1,000-gal)
A	Purchase Additional Water Rights	$3.83
B	**Indirect Potable (Reservoir Augmentation)**	
	Pharr:	**$2.86**
	San Juan:	**$3.03**
C	Saltwater Desalination	$6.43
D	Brackish Groundwater Desalination [a]	$2.41
E	Additional Groundwater (Freshwater) [b]	$0.25
F	Brownsville Weir & Reservoir	$1.78

a- The unit pricing for brackish groundwater includes only the cost of the well. It does not include land cost, additional pumping costs, or storage.

b- The unit pricing for additional groundwater (freshwater) includes only the cost of the well. It does not include land cost, additional pumping costs, or storage. In addition, the expectation is that the City only has a 20% chance of finding a freshwater source in the Gulf Coast Aquifer.

9.6 Financing Strategies and Funding Opportunities

As a consequence of the increased appreciation of the benefits of reclaimed water, there are several funding opportunities being made available to cities and utilities who seek to implement reuse programs. A number of existing water reuse programs that have been implemented around the country were researched with particular attention paid to how the programs were financed. Generally, three methods of financing these sorts of projects, which are often employed in combination, emerged from this investigation: federal or state grants, federal or state loans, and rate/fee restructuring. A general discussion of financing strategies is presented below, followed by a summary of potential grant and loan programs that may be available.

9.6.1 Capital Cost Financing

In most of the case studies evaluated, a combination of federal and state grants and loans funded the up-front capital expenditures. With these sorts of sources, eligibility requirements have to be met, and most of these programs explicitly state that funds cannot be employed for any O&M needs. Some loan programs, such as the Drinking Water State Revolving Fund, allow resources to be used for dual distribution pipeline installation, but not explicitly for satellite plants that may be treating reuse water. Agreements between developers, industries, and cities may be struck whereby part of the initial cost of construction is absorbed by impact fees or other asset contributions; this is chiefly possible when the industry or developer is the primary beneficiary of the reuse water. In one instance, the developer fully funded the capital costs, including distribution lines, to facilitate the construction of one of its planned golf course communities. Water and wastewater revenue bonds can also serve to spread the capital costs over a considerable amount of time. The following sections examine some of the more common federal and state programs used to finance capital costs and research of reuse projects.

9.6.2 Federal Funding Programs

The US Department of Agriculture (USDA) has loan and grant programs for rural development projects, under which reuse programs may obtain funding. The Water and Waste Loan and Grant Program offer assistance for the development of water and wastewater infrastructure. Interest rates on these loans are determined by the population income of the service area, and grants are employed to bring user rates low enough for the population in question. This particular source of funding, however, is not appropriate for either cities reuse projects, as the financial assistance is specifically reserved for rural and unincorporated areas. Other federal agencies, such as Housing and Urban Development, have worked in conjunction with the USDA to provide assistance for water reuse projects but those types of grants are not specifically set aside for reuse and are therefore more difficult to obtain.

The Bureau of Reclamation may also provide funding through Title XVI water reuse grants, which finance project construction in the 17 western states after congressional review and approval. The award to construct reclaimed water treatment facilities etc. is often preceded by funding for appropriate studies and research regarding the best reuse program for the area. These monies are given to economically and environmentally sound projects that are not eligible for other types of federal funding.

9.6.3 State Funding Programs

Texas has developed several programs to facilitate the implementation of reuse projects, many of which are sponsored by the Texas Water Development Board (TWDB). There are Agricultural Water Conservation Grants and Loans, which promote spending on various water conservation initiatives; interest rates on the Agricultural Loans are competitive, lower than those obtainable through commercial markets, and related to the TWDB's cost of funds. The Water Research Grant Program provides grants to the pragmatic investigation of topics published by the TWDB; these examinations seek to solve existing problems rather than explore new arenas of science. There are also financing opportunities for smaller, rural utilities through the Rural Water Assistance Fund, which offers loans at competitive interest rates for the support of water-related projects and construction of water-related infrastructure.

Another program available through the TWDB is the State Participation Program, which enables the TWDB to assume a temporary ownership interest in regional projects when the local sponsors are unable to assume debt for the optimally sized facility. While this program has typically been used for water system construction, the TWDB has indicated that it can also be applied to reuse projects if excess capacity is provided in the reuse facilities to meet anticipated future demands. The goal of this program is to allow for the "right sizing" of projects in consideration of future growth. For new water supply projects, the TWDB will fund up to 80% of the costs and for other projects up to 50% of the costs. Only excess capacity can be funded through this program.

Aside from TWDB's initiatives, the EPA guides the management of another state-managed source of financing, the State Revolving Fund (SRF). Under this program, low-interest loans, 80% of which are federally funded, are offered to entities for use in upgrading existing facilities, installing water-efficient devices, and supporting tax incentives for water conservation programs. Under the broader umbrella of the SRF are the Clean Water SRF and the Drinking Water SRF; the former focuses more on improvements for wastewater or reuse projects, while the latter funds are intended for water improvements that address health and compliance issues for existing water utilities. SRF funds can also be used for development of water conservation plans or the development of water conservation regulations.

9.6.4 Debt Repayment and Operations and Maintenance Financing

Debt recovery and operations and maintenance costs can be recovered through monthly water or sewer rates and/or through direct charges for the reclaimed water. Many utilities have struggled with how to set volume rates for direct non-potable reclaimed water. Often, in order to insure that the water is marketable, the reclaimed water rate is set as a percentage of the potable water rate. In other instances, elimination of effluent discharges to receiving streams was the goal of the program and reclaimed water was provided to customers at a very minimal cost. However, as experience with reclaimed water rate systems develops, it is becoming recognized that the best method of allocating costs is through a cost-of-service evaluation that is consistent and defensible. Often sharing costs among the wastewater, water and reclaimed water users is justified and can minimize the burden on any one group of users.

9.6.5 Preliminary Reclaimed Water Rates

There are several approaches to establishing a rate for users of direct non-potable reclaimed water. The following guidelines have been established:

- The reclaimed water rate should be low enough to be marketable and to attract new customers to the system;
- The reclaimed water rate should not be lower than the going cost of raw water and should not be higher than the going rate for potable water;

- The reclaimed water rate should be based on a cost-of-service evaluation of the entire reclaimed water system as a whole;
- City customers (hereafter referred to as "in-system" customers) should pay a lower rate for reclaimed water than other "out-of-system" customers.
- Sales contracts with reclaimed water users should be formulated in a way that allows for modification of the rates annually, based on updates to the cost-of-service evaluation.

In order to determine the basis and range of rates being used in Texas and nationally, a review of reclaimed water rates was carried out and is summarized in **Table 9.5**. As can be seen, there is a wide range of rates nationally as well as a variety of methods for establishing a given rate. In Texas, for those cities that have relatively large established reclaimed water programs the reclaimed water rates range between $0.86 and $1.20 per thousand gallons.

A water reuse rate study completed by the American Water Works Association in 2000 determined that, on average, reuse rates around the country were 69% of potable rates. These charges do not necessarily reflect the practice of purposely setting reuse rates relative to potable rates, however. In many instances, cost of production, capital expenditures, etc. that were a consequence of reclaimed water programs were taken into consideration. El Paso does set its rates as a percentage of potable water, but the utility also varies the percentage based on the level of reclaimed water treatment, so as to commensurately recover the cost (see "Comments" in **Table 9.6**).

TABLE 9.6
Summary of Reclaimed Water Rates for Selected Utilities
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

Utility	$/1000 gal unless otherwise noted	Comments
Austin Water Utility	$0.95	Higher than 1st tier potable water; lower than all other tiers
San Antonio Water System	$0.86 - $1.00	Rate is higher during summer; also function of Edwards Aquifer "Exchange"; monthly fee based on meter size.
City of El Paso	$0.93 or $1.20	Lower rate applies to secondary treatment; higher rate to tertiary treatment; based on 60%/80% of potable rates
City of Odessa	$0.59-$1.00	Metered; lower rates apply to earlier users
Tuscon Water	$1.87	Also includes monthly service charge based on meter size
Cary, NC	$3.28	
Hillsborough County, FL	$0.25 - $0.55	Rates apply to single-family residential meters greater than 1-inch
City of DeLand, FL	$0.30 or $0.60	Based on block usage and meter size
Orlando Utlities Commission	$0.69 or $0.81	Lower rate applies to "bulk" rate (meters 2 in. and greater); higher rate applies to residential meters (< 2 in.)
Toho Water Authority	$0.44 or $0.72	Lower rate for up to 9,000 gallons; higher rate for 10,000 gallons and above
Denver Water	$0.44 - $0.83	Tiered rates
Burbank Water and Power	$1.80	
Irvine Ranch, CA	$0.87 - $8.45	Tiered rates
City of San Diego, CA	$1.07	57% of potable rate
San Jose, CA	$0.65 - $1.63	Based on type of usage- see attached table
South Coast Water District (CA)	$2.61	80% of potable rate
Raleigh, NC	Free	Customers must be able to bulk pick up minimum of 250 gallons.
Brevard County, FL	$9.62/month	Independent of volume used

9.7 Feasibility Evaluation Summary

As presented in this section, reclaimed water projects provide a number of benefits, many of which are difficult to quantify in terms of a direct financial benefit. Based on the financial evaluation of the individual projects and the reclaimed water system as a whole the following conclusions can be made:

- The City does not have sufficient water rights to account for future growth.
- The Rio Grande will not meet all of the regions' future water demands.
- The City needs to identify other reliable sources to meet future water needs.
- The cost of the non-potable water system was found to be cost prohibitive. This is primarily because no major commercial clients could be identified. Furthermore, the potential customers that were identified, mainly the schools and parks, historically irrigate at very low rates.
- The unit pricing for the indirect potable reuse clearly indicates that this may be a viable option for the City to meet or supplement its future potable demands. Reclaimed water is a reliable source that is drought proof and each community has full control over. The largest obstacle in implementing such a program is public perception.

In conclusion, the most cost effective option to meet future demands is to develop an indirect potable reuse system.

9.8 Recommendations

Based on this evaluation, it is recommended that:

- Proceed with implementation of a reclaimed water system for indirect potable reuse to augment the City's raw water supply.
- To ease the financial burden of implementing the above, both Cities should continue to explore alternative financing approaches, including federal and state grant or loan programs, and participation from customers and/or developers.
- Both Cities should take advantage of every opportunity that presents itself, now and in the future, to purchase or otherwise obtain additional Rio Grande Water Rights. This includes aggressively pursuing water rights that may become available elsewhere within the Region M planning area.

It should be noted that the cost analysis performed was based on the projected demands presented in Chapter 5. Experience with other established reclaimed water systems suggests that once facilities are in place, demand for reclaimed water often exceeds projected values. Although the "if we build it, they will come" strategy does not come without risk, most reclaimed water systems must, to some extent, rely on uncommitted future demands to justify initial implementation.

It is reasonable to expect that the cost to acquire additional water rights will only increase and become more difficult to secure. Furthermore, it is likely that all available agricultural water rights will be converted to municipal rights before the Year 2060. Once Rio Grande water rights are obtained, these rights may be leased for approximately 20% of the purchase price.

Figures 9.1 and 9.2 shows a plan that utilizes the various sources of raw water to meet future demand projections. The water sources include: (1) purchase of additional water rights, (2) groundwater, and (3) raw water augmentation. The graph indicates that Pharr and San Juan will exceed their current allotment of water rights by 2015 and 2017, respectively.

FIGURE 9.1
City of Pharr Raw Water Supply Plan
City of Pharr and San Juan Water Reuse Priority and Implementation Plan

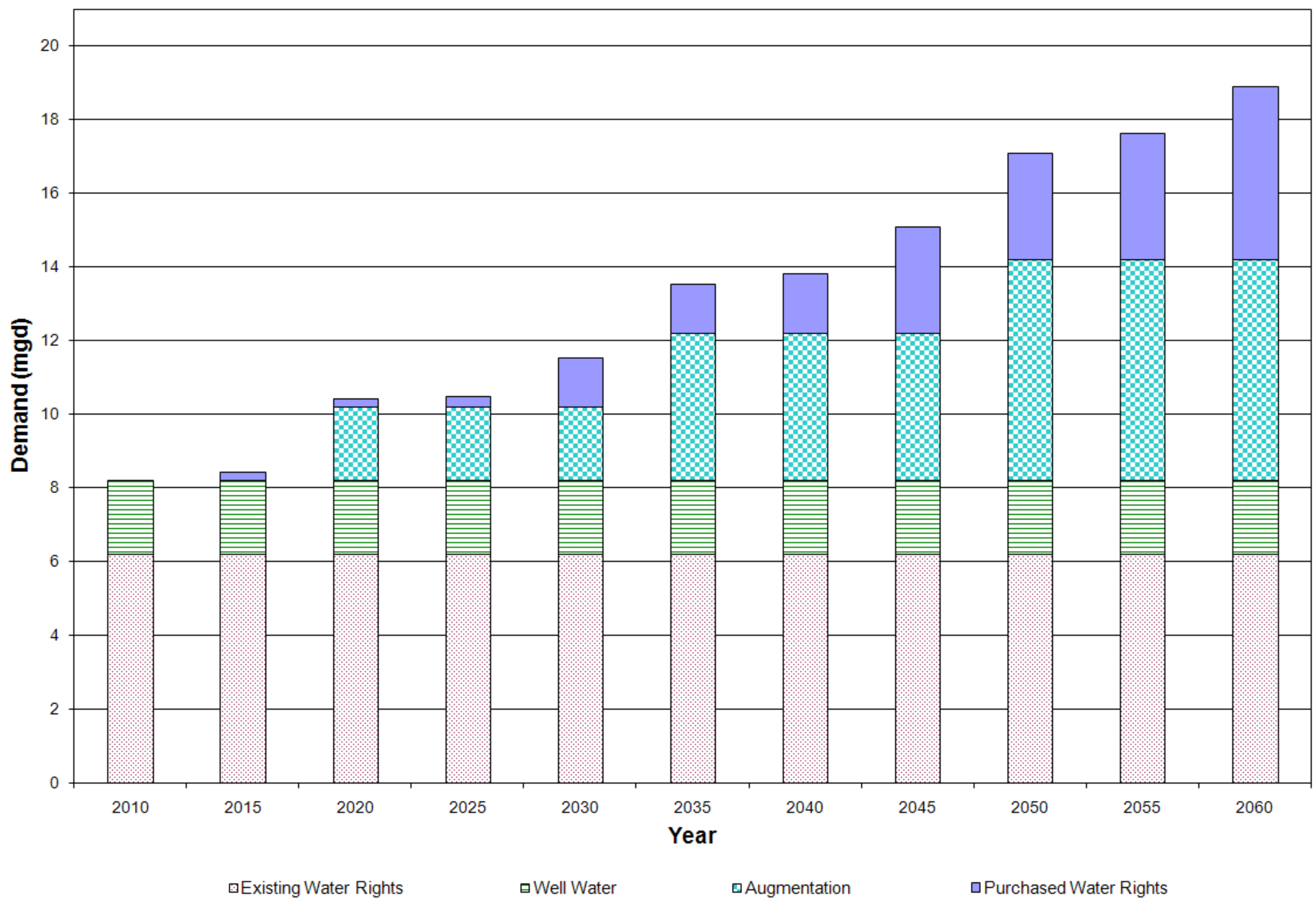
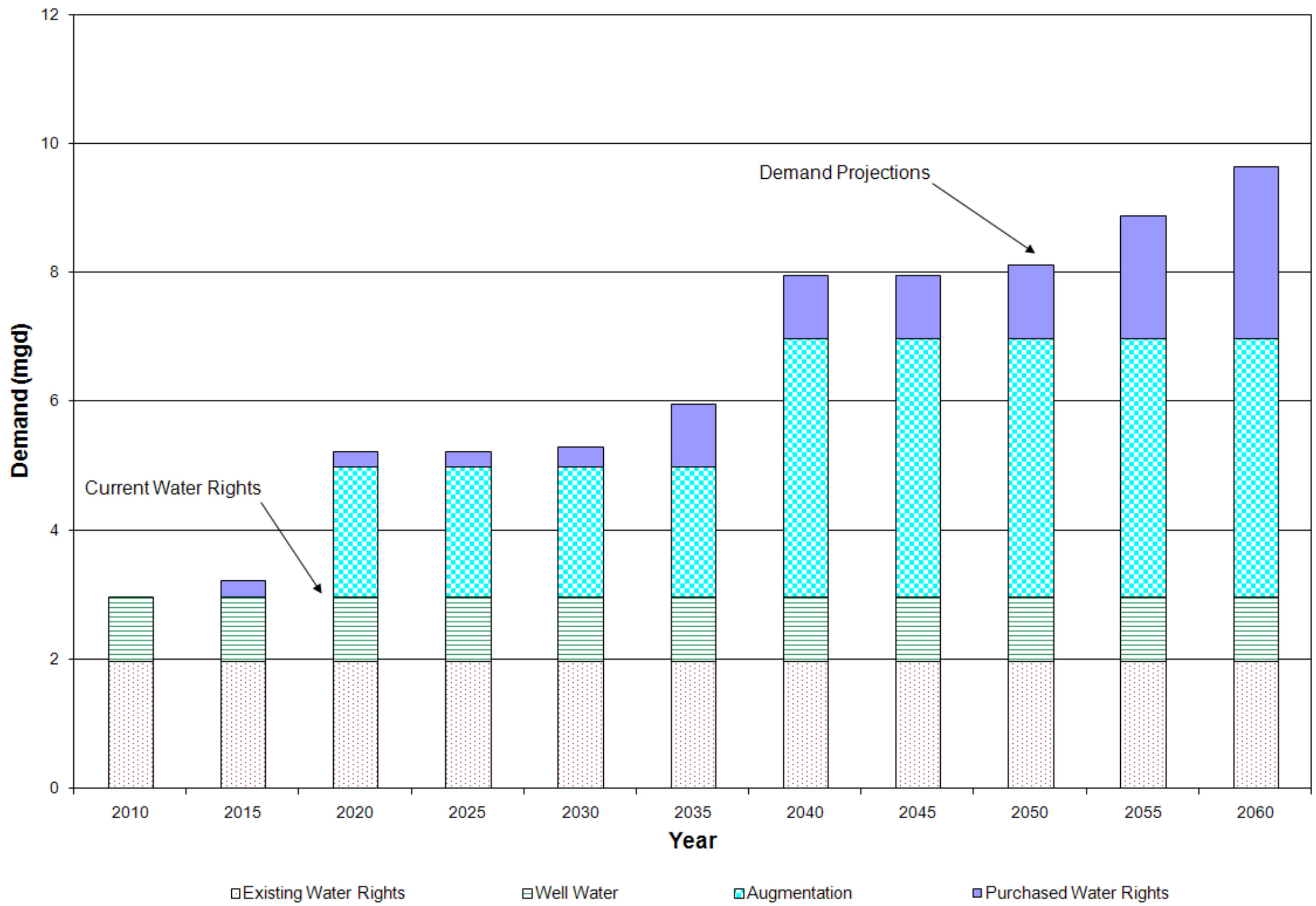


FIGURE 9.2
City of San Juan Raw Water Supply Plan
City of Pharr and San Juan Water Reuse Priority and Implementation Plan



SECTION 10.0

Public Information Data

10.1 Introduction

This section summarizes, based on published case studies, several water reuse programs that implement and maintain a public outreach program. Typically these programs do not experience the time delays and financial setbacks that are common for projects that ignore or do not maintain the outreach programs. The section begins with a discussion of public relations issues and examples of public outreach programs and their roles in reclaimed water projects. The role that a public outreach program plays in the success or failure of a water reclamation project is also addressed. The second part of this section provides a summary of the meetings held with the public information committee (PIC) for reclaimed water and the public meetings held in conjunction with this project. Finally, an approach to working with the public to implement the reclaimed water implementation plan is discussed.

10.2 Public Relations Issues Associated with Reclaimed Water Projects

Because the principal source of reclaimed water is wastewater, there are often challenges that must be overcome with respect to public perception. Most of the time these challenges manifest as concerns that the water is still contaminated with pathogens and therefore is unsafe for public exposure. However, even with proper education, people still have an instinctual aversion to using that which they think is “gross”. Fundamentally, this is the most difficult and most critical hurtle that reuse projects have to overcome. Public reluctance at incurring additional costs associated with dual distribution systems, treatment plants, etc. is also a problem, but often only because the public good gained from employing reuse water is not properly communicated to the community.

10.3 Examples of Public Outreach Programs in Other Communities

The following sections summarize public outreach programs that have been developed in other communities throughout the United States.

10.3.1 Projects that Benefited from a Public Outreach Program

The following water reuse projects benefited from a public outreach program. While the components of the public outreach programs varied from project to project, it is apparent that early implementation of a public outreach program typically resulted in timely public acceptance.

10.3.1.1 El Paso Water Utilities, Texas

Since its water resources are limited to aquifers and the Rio Grande, El Paso Water Utilities (EPWU) made the decision in 1963 to begin delivering reclaimed water to the community. EPWU has successfully completed multiple water reuse projects including the NW Wastewater Reclamation Facilities project, Haskell R. Street Reclaimed Water project, and the Bustamante Wastewater Plant to the Riverside International Industrial Center project. Because EPWU already had a strong water conservation program in place prior to initiating these reuse projects, public response was favorable when reuse projects were proposed.

The EPWU water conservation program includes brochures and pamphlets, online resources, financial incentives in the form of lower water rates for reclaimed water users, workshops, and direct access for the public to EPWU senior staff to ask questions or discuss concerns. In addition, the EPWU maintains a good relationship with the media by continually updating and educating them on new water reuse developments. As a result, media coverage and public response to proposed water reuse projects has been favorable.

10.3.1.2 Irvine Ranch Water District, California

The Irvine Ranch Water District (IRWD) was formed in 1961 to provide water and irrigation to a rapidly growing community. Two years after its inception, the IRWD made the decision to begin collecting and treating wastewater as well as producing reclaimed water. By 1967, this reclaimed water was being supplied to agricultural users to irrigate crops. As part of its aggressive water conservation program, the IRWD has since broadened its use of reclaimed water. Reclaimed water is now used on crops, golf courses, parks, school grounds, greenbelts, street medians, and freeway landscaping. Furthermore, it is supplied to local high-rise office buildings and individual homeowners for flushing toilets and is scheduled to be supplied to office towers and other buildings for similar use. These highly successful, innovative projects have placed this community among the nation’s water reuse leaders. Much of this success is a result of an aggressive public outreach program that is part of the IRWD’s water conservation program. This outreach program includes: 1) a residential tour program, 2) an in-school education program, and 3) newsletters and brochures.

The residential tour program is free and provides area residents an opportunity to learn more about the district facilities and water supply issues. A member of IRWD’s board of directors as well as the senior staff begin the tour with a presentation and question and answer session on the district’s history, water sources, conservation information, and other similar topics. Participants are supplied with packets that include district information and free conservation devices like low-flow shower heads and faucet aerators. Following this presentation, participants are taken on walking and driving tours of the Michelson Water Reclamation Plant (MWRP) and IRWD points of interest (i.e., reservoirs, reuse sites, wells, etc). The tour is concluded with a lunch at the Duck Club, an historic building adjacent to the MWRP during which additional water conservation techniques are discussed and a survey rating the tour’s educational effectiveness is provided. Based on the positive responses documented by this survey, the residential tour program has been an effective method to educate the public on water conservation and water reuse.

An in-school education program was created to educate students on the importance of water to Southern California's arid region. It was developed not only to correlate with, but also supplement, the school district's social science curriculum by offering free classroom presentations, videos, workbooks, tours, and special projects. Students are taught a variety of topics including water pollution prevention, water conservation, and point versus nonpoint source pollution. Teachers receive "leave behind" materials (i.e., booklets, posters, and stickers) as well as an evaluation sheet, the results of which assist the IRWD in refining the program so it will maintain pace with current academic trends. Many students also participate in the IRWD's residential tour program each year. IRWD staff members are also involved in the program by not only serving as guest speakers in the students' classrooms but also as science fair judges. The winning students get their projects displayed at district headquarters, are recognized at a board of directors meeting, and a financial award is given to the student's school district for the purchase of science materials.

In order to keep teachers abreast of new programs, presentations, and materials, the IRWD publishes newsletters and brochures twice annually. These materials provide educational program highlights, announcements of student award winners, and other information such as how to book a speaking engagement. Finally, the IRWD provides teachers educational mini-grants each year that supplement school budgets and allow teachers to provide water or other environmental education programs that might not otherwise be possible.

10.3.1.3 Orange County, California

The Irvine Company, located in Monterrey, Orange County, California, has been irrigating produce with reclaimed water for over 20 years; however, this method was not advertised to the public. In order to determine if there was a need or desire to label the produce to indicate the source of irrigation, a series of interviews was conducted with brokers, receivers, and wholesale and non-wholesale buyers.

The results of these interviews indicated that labeling was not recommended unless it would add some value to the product. Nevertheless, the growers remained concerned about how the public would perceive the source of the irrigation water. Therefore, three approaches were developed to help control public perception: 1) operate the treatment plant beyond regulatory requirements, 2) conduct an education program, and 3) plan for real or perceived problems.

The public education program included an active school education component with multiple classroom demonstrations. Booths were set up at county fairs and other local events and speakers were available to civic or service groups. Furthermore, tours of the water reclamation plant were conducted and education materials were included as part of bi-monthly billing materials. Finally, a crisis communication manual was prepared to deal with possible scenarios and educate growers on how to deal with the press. While growers remain concerned about the possibility of negative public perception, they are confident they have the tools in place to deal with it if needed.

10.3.1.4 Phoenix, Arizona

The 91st Avenue Wastewater Treatment Plant (WWTP) located near Phoenix, Arizona, utilizes reclaimed water for agricultural irrigation and industrial purposes. The reclaimed water supply is the greatest during the winter months due to the influx of winter visitors, while the supply is lowest during the summer months as a result of higher demand. Because this WWTP is located in a desert environment where water is such a valuable resource, the Sub regional Operating Group (SROG), which owns the WWTP, began researching methods to capture the unused portions of reclaimed water present during the winter months.

Groundwater recharge was proposed as an efficient method to store the excess supply for later recovery during periods of higher demands. This proposal became known as the Agua Fria Linear Recharge Project (Agua Fria Project). This project specifically involved transporting reclaimed water from either the 91st Avenue WWTP or a series of constructed wetlands into the Agua Fria River. The reclaimed water would supplement the renewable water supply, improve the habitat along the river, and provide recreational and educational opportunities to the community.

Stakeholder coordination and public information was the first phase of a four-phased plan that was developed to create stakeholder consensus, address technical issues, and secure all necessary permits. During this first phase, stakeholders were identified along with issues of concern. Meetings were then conducted with several stakeholder groups while others were interviewed via telephone. A project newsletter was distributed to the public within a one-mile radius of the proposed project, and then two public meetings were conducted to gather public input. The input was compiled and organized into common themes and several technical committees were assigned to address these concerns.

This public involvement program proved to be very successful. The efforts conducted as part of this program led to the creation of one document that addressed the public's concerns and provided recommendations and guidelines that will be invaluable as the next phase of the Agua Fria Project begins.

10.3.1.5 Pinellas County, Florida

Pinellas County Utilities (PCU) recognized a public educational opportunity after it renovated its South Cross Bayou Water Reclamation Facility. To help students and residents better understand water reclamation, the importance of clean water, how people can help manage their limited water resources, and the various careers in water and wastewater treatment, the PCU created a hands-on educational program.

This program included supplemental educational materials for teachers to use in the classroom. It also included a hands-on tour of the South Cross Bayou site in which tour participants are able to conduct their own water quality testing and compare it to results reported from a professional laboratory. Finally, video presentations before and after the tour highlight various aspects of the water reclamation process.

10.3.1.6 Scottsdale, Arizona

Scottsdale, Arizona proposed and successfully implemented a water reclamation project known as the "Water Campus." The "Water Campus" is a water reclamation plant that discharges approximately 20 million gallons of reclaimed water per day. This water is then utilized as irrigation water at several local golf courses. In an effort to conserve the water during periods of low demand, it is treated to drinking water standards, and then fed back into the aquifer. Due to the potential for negative public perception of recharging the aquifer with reclaimed water, the City implemented a three-step process. First, a technical advisory committee was formed at the onset of the proposed project that included local professors and other members of the community. Efforts were made to educate these members about the importance of reclaimed water and how it related to the proposed project. Once educated, the members of the technical committee became strong allies for the project. Second, several neighborhood meetings were held to educate the community as well as give them a chance to ask questions about the proposed project. Finally, an open house was conducted at the plant with invitations to local residents as well as the media. The open house was heavily attended and many residents left with positive views of the proposed project. Furthermore, these positive views were then broadcast to the community at large during interviews with the local media. The cumulative results of these efforts worked to educate the community and create a positive perception of the proposed project.

10.3.1.7 St. Petersburg, Florida

St. Petersburg, Florida, began supplying reclaimed water to be used for residential irrigation in 1977. Nearly 20 years later, the popularity of the program had increased, so the program was expanded to include additional customers. Incentives such as lower water rates were offered and neighborhood participation rates were lowered to encourage additional hookups.

In addition to these incentives, the City conducted a public outreach program. The public outreach program consisted of speaking engagements, educational materials such as books, CD-ROMs, and videos permanently on display at the local library, and the creation of two Xeriscape demonstration sites. Furthermore, the City has sponsored various educational programs, contests, and forums to educate the public on how to conserve and protect the valuable water resources.

10.3.1.8 Yelm, Washington

In 2001, the City of Yelm, Washington, began producing reclaimed water. This water is used for irrigation at schools and churches, for automobile wash water, and supply for fire hydrants. The reclaimed water is produced at the City's award-winning water reclamation facility that is composed of an eight-acre memorial park, a fishing pond, and a constructed wetlands system. These facilities have been very popular to the public who frequent the facility to fish, view wildlife, and even hold weddings.

The City has an active program to promote its reclaimed water use. As a part of this program, the City sponsored a contest to see which student could create the most imaginative water reuse mascot. This contest was taken a step further by local teachers who created a skit with the winning mascot ("Mike the Pipe") along with other characters ("Water Sprite," "Little Bug," and "Sledge") to teach what the different options are with water that is disposed down a drain.

10.3.2 Projects that Suffered Due to Poor Public Outreach

The following are examples of water reuse projects that were negatively impacted due to a poor public outreach program. In both cases, the proposed project was technically sound; however, project delays were realized due to either the lack of or failure to maintain a strong public outreach program.

10.3.2.1 Cape Coral, Florida

The City of Cape Coral, Florida is a rapidly growing community with a fluctuating winter population. Due to water supply concerns, along with the need to dispose of wastewater effluent, the City developed the Water Independence in Cape Coral (WICC) project. This project involved the installation of a dual water system that would deliver potable and reclaimed water in parallel pipelines to the community. The project was created without any public outreach activities. Consequently, when the public did become aware of the project, their negative reaction resulted in delaying the project for six and a half years. Had a public outreach program been formed early in the planning stage, it could have addressed the public's concerns prior to finalizing the program.

The project was a major success once it was finally constructed, by conserving more than four billion gallons of potable water in the project's first eight years. Soon, however, residents began excessive use of the reclaimed water, and it became necessary to apply restrictions on reclaimed water use. Having learned its lesson, the City implemented a new education campaign to encourage responsible reclaimed water use. "Cape Coral Alligator" was created to remind users of proper watering times and other water conservation practices. Furthermore, a hotline was also formed that residents could call to confirm watering schedules. As a result of the now successful reclaimed water programs, the City is prepared to be able to supply water for its anticipated future growth.

10.3.2.2 City of San Diego, California

The City of San Diego has very limited local water supply sources; therefore, it is forced to import the majority of its water supply from outside sources. In an effort to supplement the limited local water supplies, the City proposed the "Water Repurification Project" in which treated reclaimed water would be piped into and blended with surface water reservoirs thus increasing the available water supply.

Due to the nature of the proposed project, the City of San Diego recognized that public acceptance was critical to the project's success. Consequently, the City initiated public involvement efforts as soon as technical studies began. Telephone surveys, focus groups, and stakeholder interviews were conducted to identify local supporters for the use of repurified water, and other education efforts were targeted towards the local media. City and San Diego Water Authority (the Authority) staff conducted a community outreach program using print and visual materials. Tours of the pilot plant were provided and policymakers and their staffs were briefed on the proposed project. While these initial efforts resulted in early public approval, numerous factors emerged as the project progressed that changed the public perception.

Shortly after moving from the concept to the design phase, the City changed the project team from the Water Repurification project team to the Wastewater Department. This change may have sent a mixed message to the public and caused them to view the project as a wastewater disposal rather than as a water supply solution. As the project neared final approval, key election dates were ignored and final approval of the project by the City Council was scheduled concurrently with several competitive elections.

Consequently, final approval was delayed until after these competitive elections. Misinformation generated by various political candidates running for office was not promptly addressed by members of the proposed project and resulted in the misinformation being perceived as the truth. Early education efforts and relationships with the media were not maintained and resulted in negative media coverage. Finally, early efforts to identify all interested stakeholders overlooked a group of residents that lived outside the City's jurisdiction. As a result, these residents, who had not received any mailings with accurate information, began to aggressively oppose the project at various public meetings. As a result of the collapse of the public information program and failure to include several key stakeholders, the San Diego project was defeated and delayed several years.

10.4 Reclaimed Water Priority and Implementation Plan Public Meetings

The Cities of Pharr and San Juan have conducted three public meetings related to the Recycled Water Implementation Plan. The first public meeting was held early in the study and provided information about the project team and the scope of work to be performed. The second meeting was held following development of the initial project alternatives and provided information about proposed service areas and preliminary project costs. The third public meeting was held following submission of the draft report and presented a summary of the final recommended alternatives, feasibility evaluation and implementation plan. A brief description of the topics discussed at each of these meetings and the public response is presented below.

10.4.1 Public Meeting No. 1- November 15, 2010

This meeting provided an overview of the study goals and objectives and summarized the specific project tasks. Background information related to reclaimed water was also presented. A copy of the PowerPoint Presentation, Meeting Minutes, and Sign-in-Sheet is included in **Appendix G**.

10.4.2 Public Meeting No. 2- March 7, 2011

At this meeting, preliminary project alternatives for each service area were presented. The approach to identifying potential customers and defining the service areas was discussed. Again, attendees were very supportive of the proposed alternatives. During the presentation it was mentioned that indirect potable reuse is being considered to augment the City of Pharr's Raw Water supply. The City of San Juan also expressed an interest in implementing an indirect potable reuse system as water may not be available to meet projected growth. As such, this option will be considered for the City of San Juan as well. A copy of the PowerPoint Presentation, Meeting Minutes, and Sign-in-Sheet is included in **Appendix G.**

10.4.3 Public Meeting No. 3- October 12, 2011

At this meeting, an overview of the study goals and objectives was presented, together with a review of each of the recommended alternatives. Opinions of probable cost were summarized. Again, discussion following the presentation was supportive of the projects.

10.5 Public Information Committee

In order to facilitate communications with community leaders about the proposed reclaimed water program, a public information committee (PIC) will be established. A summary of suggested meeting topics for the committee is provided below.

10.5.1 PIC Meeting No. 1- July 6, 2011

At this meeting, general background information related to reclaimed water will be presented, together with an overview of the project scope. The agenda should include a review of reclaimed water definitions, national, regional and local perspectives on the use of reclaimed water, regulatory issues and financing of reclaimed water projects. The role of the PIC should also be discussed. A copy of agenda and sign-in sheet is included in **Appendix H**.

10.5.2 PIC Meeting No. 2- September 6, 2011

The focus of this meeting will be on a discussion of policies and procedures for reclaimed water programs. A review of policies and procedures for other reclaimed water programs in Texas should be presented, followed by a discussion of considerations associated with developing policies and procedures for the City program. A copy of agenda and sign-in sheet is included in **Appendix H**.

10.5.3 PIC Meeting No. 3- October 11, 2011

At this meeting, funding and pricing strategies for reclaimed water systems should be discussed. Factors impacting the marketability of reclaimed water should also be considered, together with approaches to financing of reclaimed water systems. A review of reclaimed water rates in other communities and potential strategies for developing a reclaimed water rate for the City should be discussed.

In addition to these focused meetings, the PIC was invited to attend each of the public meetings described above. As the City moves forward with implementation of the reclaimed water program, it is recommended that meetings with the PIC continue. A copy of agenda and sign-in sheet is included in **Appendix H.**

10.6 Proposed Public Information Program

Since well-designed public outreach programs have been demonstrated to contribute to the success of reclaimed water projects, an important component of the City's implementation plan will be the development of an effective public outreach program. Such a program would identify key stakeholder groups and use a phased approach to informing these groups, soliciting input and gaining trust and support.

Potential components of a public information program include:

- Identification of and partnership with allies
    - ✓ Identification of a "public champion"
- Engagement of stakeholder groups
    - ✓ Identification of target stakeholders
    - ✓ Stakeholder workshops

- Development of a broad-based awareness campaign
    - ✓ Identification of key messages
    - ✓ Production of collateral materials and tools
- Development of media relations program
    - ✓ Media packets
    - ✓ Briefings

Target stakeholders in the initial phases of the reclaimed water program will likely include industries, park facilities, and school districts. The City has already had initial meetings with many of the key stakeholders identified as potential customers. Future expansion of the reclaimed water program will most likely depend on generating interest with additional stakeholders for reclaimed water uses. Public involvement with existing stakeholders and revised outreach materials will need to be developed as appropriate to bring additional stakeholders on board.

10.6.1 Public Announcements and Responses

To ensure that reclaimed water projects are not misrepresented in the public domain, press releases are suggested as a means of disseminating the project parameters accurately and the goals of the project.

Upon release of project announcements of a reclaimed water project in the press, the public and City leaders may have questions or be asked questions about the project. City staff and leaders will need to be aware of and have been briefed on the project to respond knowledgeably to public inquiries.

There are many approaches available for public outreach programs. Ultimately, the most appropriate approach for the Public and Customer Awareness Program will be developed based on the projects being implemented and the City's preferences for interaction with the public, and the identity of the stakeholders.

10.7 Public Information Committee

Five (5) community's leaders were selected to be on the PIC. The volunteer members included the following:

- Mr. Chris Vela
- Mr. Joe Anaya Jr.
- Mr. Heriberto "Eddie" De Leon
- Mr. David Garza
- Mr. Adan Farias

Refer to **Appendix H** for minutes from the three (3) meetings conducted.

This page intentionally left blank

Appendices removed.

Contact publicinfo@twdb.state.tx.us to request these items.