San Marcos Direct Water Reuse Expansion Feasibility Study

Study Participants:

THE CITY OF SAN MARCOS

TEXAS STATE UNIVERSITY

Final Report

TWDB Contract No. 1248321448

Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231

December 2013

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Funding for this project was provided by the City of San Marcos, Texas State University, and the Texas Water Development Board.

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Direct Water Reuse Expansion Feasibility Study

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1 Executive Summary

This report is prepared in coordination with City of San Marcos (city) and Texas State University (TxSt or the university). The report presents an engineering evaluation of the feasibility of expanding the city's reclaimed water system to serve additional users, including TxSt.

The report has been prepared by the city's consultant, RPS in fulfillment of the requirements of a Regional Planning Grant provided by the Texas Water Development Board (TWDB). TWDB participates in regional water and wastewater planning efforts by providing partial funding of studies of the feasibility of developing alternative water supplies.

The Direct Water Reuse Expansion Feasibility Study describes the project area, key water management issues and needs within the project area, identifies opportunities for expanded uses of reclaimed water in the project area, develops and analyzes alternatives for delivering reclaimed water to meet industrial, commercial, and institutional water demands, presents an economic and financial analysis of the project, summarizes the legal and institutional elements of the project, and provides an overview of a plan for implementing an expansion of the city's reclaimed water system. As shown in Figure 1-1, the study area encompasses the city limits, including the TxSt campus.

1.1 Existing Reclaimed Water System

The existing reclaimed water system consists of a reclaimed water pump station located at the San Marcos Wastewater Treatment Plant (WWTP) and an 18-inch pipeline that extends approximately 8.5 miles from the WWTP to the existing industrial reclaimed water users located south of the city. Existing users include a power generating plant and a cement manufacturing plant. A contract for reclaimed water service has also been approved for the proposed golf course at the Paso Robles development.

1.2 Reclaimed Water Supply and Demand

The university operates four thermal plants located on the campus make up the remainder of the potential industrial reclaimed water demand. Extending service to the university thermal plants creates an opportunity to serve additional uses of the city and university. Both entities have extensive parks and athletic fields within a broad corridor along the San Marcos River that can be served by the reclaimed water pipeline that would be built to serve the thermal plant demands. Extensions of service to include the city's soccer fields and Gary baseball fields are also considered in this study.

Planning for expansion of the reclaimed water system began by identifying potential users along the existing reclaimed water pipeline and along the route of a proposed pipeline to serve the university's thermal plants. Additional extensions to serve the city's soccer complex and Gary ball fields were planned in order to reduce potable water demands in those areas.

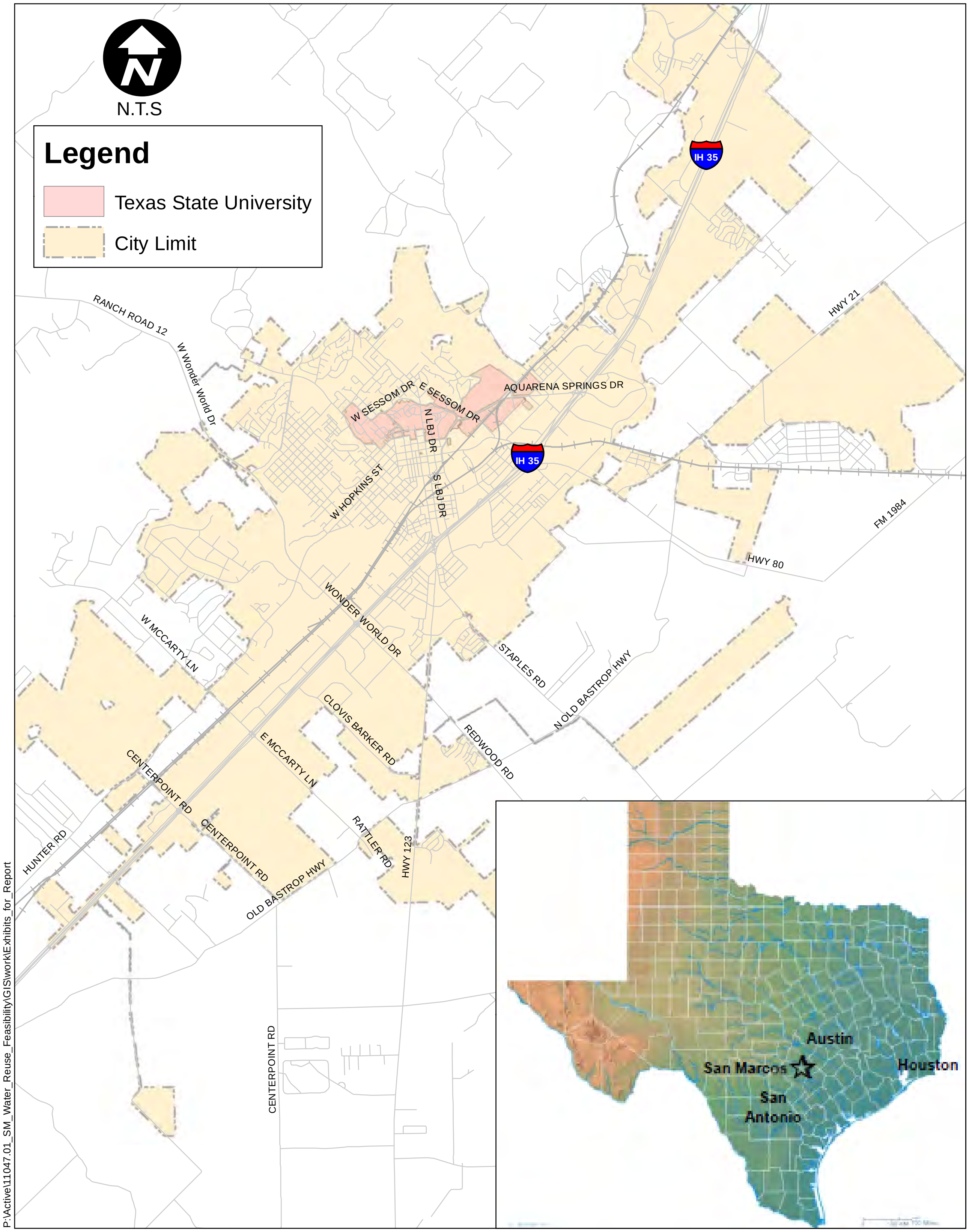

Figure 1-1. Study area.

The water demands of potential reclaimed water users were developed using one of three methodologies: metered potable water consumption; irrigation demand based on landscape coefficients; and demand specified under existing contracts for reclaimed water service. The total of 2,123 AF of reclaimed water demands identified through this study is detailed in Table 1-1.

Table 1-1. Projected annual reclaimed water demand.

Use (AF)	2015	2017	2020	2032	Total
Industrial	1,616	--	--	--	1,616
City Irrigation	--	221	19	120	360
University Irrigation	--	20	--	--	20
School Irrigation	--	--	49	3	52
Commercial Irrigation	--	--	26	49	75
Total	1,616	241	94	172	2,123

The San Marcos Wastewater Treatment Plant (WWTP) produces effluent that meets the state criteria for the highest quality of reclaimed water. As Type 1 reclaimed water, no additional costs for treatment are required in order to make reclaimed water available for irrigation of public parks. The WWTP flow is sufficient to meet the average demand for reclaimed water. However, just as the peak demand for reclaimed water can be expected to occur during the summer months, the coincidental minimum day flow for the WWTP was found to occur between the second summer session and fall semester at the university. Alternatives for supplementing the supply of reclaimed water to meet peak demands were developed and evaluated. The recommended peak demand supply alternative is construction of a 105 MG seasonal storage facility on the 97-acre city-owned tract located adjacent to the WWTP. This facility will provide approximately 30 days of storage capacity to meet peak summer demand for reclaimed water.

1.3 Reclaimed Water Project Benefits

Expansion of the reclaimed water system is consistent with the city's 2013 Comprehensive Plan goal of establishing proactive policies that encourage recycling and resource and energy efficiency. The proposed system expansion is a step toward meeting the defined objective of Goal 3 of the Environment & Resource Protection section of the Comprehensive Plan by making reclaimed water available in specific activity nodes. As detailed in Section 5.3, there are a number of potential benefits that can be attributed to the expansion of the reclaimed water system. While many are indirect benefits that are difficult to quantify in terms of cost, savings, or economic value, there are significant potential benefits in:

- further diversification of water supply sources,
- environmental benefits as a result of reduced withdrawals from the Edwards Aquifer and the San Marcos River, and
- improved sustainability of public parks.

Some of the key benefits of an expanded reclaimed water system include:

Reduced potable water demand

Reducing potable water demand benefits the city and the university by reducing the future demand on water supply sources. Approximately 224 AF of potable water now used by potential reclaimed water users for landscape irrigation could be offset using reclaimed water. These current uses include city and university facilities, as well as schools and commercial irrigation. In addition to providing an offset to potable water consumption for irrigation, converting thermal plant makeup water from water supplied by the university's Jackson Well to reclaimed water would reduce potable water demand by an additional 388 AF.

Environmental enhancement

The university has committed to reduce withdrawals from the San Marcos River as spring flow at the San Marcos Springs declines. Making reclaimed water available to the university would reduce demand for San Marco River water and benefit the areas of critical habitat by allowing increased river flows through the areas of critical habitat. Reclaimed water could also be used to support the riparian and aquatic habitat along the San Marcos River by providing water for irrigation of vegetative buffers in city parks along the river identified in the USACE Section 206 Aquatic Ecosystem Restoration Project.

Park sustainability

The city's parks along the San Marcos River are the centerpiece of the city's recreational tourist economy. Much of the city's parks are maintained without supplemental irrigation. The prospect of developing reclaimed water for irrigation of city parks highlights a significant paradox in the economics of operating and maintaining city parks.

Ensuring that parks are developed and maintained at levels of service that meet the needs and expectations of current and future residents presents a significant dilemma for any city. In its simplest form, the city must choose between operating parks without irrigation, irrigating with potable water, or irrigating parks with reclaimed water.

Leaving parks without irrigation appears to be the lowest cost alternative, but that option does not address the loss of some uses during drought periods and a limited ability to restore overused areas or to boost community appeal. The alternative of irrigating parks using potable water will increase the level of service and costs during normal rainfall years, but will essentially become the no-irrigation alternative during drought periods when outdoor water use is restricted. This alternative also increases the city's overall demand for new water supplies that are developed at higher costs. Supplemental irrigation of parks, picnic areas, playgrounds, and athletic fields, can contribute to developing additional capacity for accommodating the increased and heavier uses associated with more visitors and activities.

1.4 Reclaimed Water Costs

Expansion of the reclaimed water system to meet all of the demands summarized in Table 1-1 was developed in a phased approach in which the system would be expanded as the projected demands are developed. Development of each phase would add reclaimed water service to one or more service areas. The four service areas are:

- ***South Service Area*** **–** an area generally between IH 35 and Old Bastrop Highway between the WWTP and the power plant.
- ***TxSt/Downtown Service Area*** **–** along CM Allen Parkway and the San Marcos River between the WWTP and University Drive.
- ***Gary Service Area*** **–** an extension to the existing Gary Ball Fields and the future baseball complex.
- ***North Service Area*** **–** an area that includes the city's soccer complex and Blanco Vista.

The phases of system development are summarized in Table 1-2 below.

Table 1-2. Reclaimed water system expansion.

Phase	Year	Service Area(s)	Potential Users Added	Features
1	2015	TxSt/Downtown	TxSt thermal plants	Construct a 16-in. transmission main to the TxSt thermal plants. Service to a concrete products plant and cement batch plant is initiated.
2	2017	TxSt/Downtown	City parks & facilities; TxSt athletic fields.	Install two high service pumps at the reclaimed water pump station to serve city and university irrigation demands. Construction of a seasonal storage pond to meet peak demands.
3	2020	South; Gary	Schools, commercial users & Gary ball fields	Add a third high service pump and construct an 8-in. pipeline to Gary Ball Fields. Initiate service to schools and commercial users in the South Service Area.
4	2032	North	Soccer complex, BV HOA, future baseball complex	Add a fourth high service pump and extend an 8-in. pipeline to the city's soccer complex and Blanco Vista.

A summary of the reclaimed water demands and project costs is presented in Table 1-3.

Table 1-3. Summary of project costs.

Year	Annual Demand (MG)	Capital Cost	Unit Cost ($/AF)	Unit Cost ($/kgal)
2015	526.73	$ 3,128,400	$ 212.94	$ 0.65
2017	78.55	6,555,000	546.25	1.68
2020	30.53	4,647,600	772.15	2.37
2032	56.05	7,737,800	1,083.16	3.32
Total	691.86	$22,068,800	$1,083.16	$ 3.32

Since the primary value of reclaimed water lies in the postponement and minimization of costs associated with expanding supply, particularly the costs of importing water from the Carrizo-Wilcox Aquifer, the price of reclaimed water should be compared to the cost of expanding capacity instead of the current average cost of existing water supplies. In this case, the marginal cost of water will be the cost of adding water from the HCPUA at approximately $1,245 per AF or $3.88 per thousand gallons.

1.5 Project Financing

There are a number of financing strategies available for water reuse projects that include federal and regional grants, state loans, and local revenue bonds. The U.S. Department of the Interior Bureau of Reclamation (Reclamation), through its highly competitive Title XVI program, can fund up to 25 percent of the capital costs of reuse projects. Regional funding opportunities include Conservation Grants from the Edwards Aquifer Authority.

State financing opportunities are available through the TWDB. Most common are low interest loans through the Clean Water State Revolving Fund (CWSRF) and the Drinking Water State Revolving Fund (DWSRF), but applicants may be eligible for some level of loan forgiveness. To receive loan forgiveness, applicants must be included in the Intended Use Plan (IUP) as an eligible Green Project Reserve (GPR) project and be invited to apply for the subsidy. The GPR can be used for planning, design, and/or construction activities that advance one or more of the objectives in the categories of Green Infrastructure, Water Efficiency, Energy Efficiency, and Environmentally Innovative.

A new financing mechanism will become available to TWDB in 2015 as a result of actions of the 83rd Legislature. Three bills were passed as part of a broad package to provide funding for projects in the State Water Plan. The bills proposed an amendment to the state constitution that would create the State Water Implementation Fund for Texas (SWIFT), appropriate $2 billion from the economic stabilization fund to the SWIFT, and direct TWDB on how the SWIFT may be used.

The SWIFT legislation references funding projects on the 2011 regional water plan list, but the draft 2016 lists will be available about the same time as the SWIFT funds become available. That may indicate that the 2011 water plans would not have to be revised in order to get a project into consideration, but would need to be included in the draft 2016 regional water plan.

Approved by voters on November 5, 2013 as Proposition 6, the SWIFT will become available about the time the draft 2016 list of regional projects is published. The regional water planning group (RWPG) stakeholder committee will submit project prioritization criteria to the TWDB by Dec. 1, 2013. The TWDB rules for SWIFT should be adopted by March 2015. The draft 2016 regional water plans are due May 1, 2015. The subsidy for the SWIFT will be established over the next 18 months. The subsidy is capped so that entities, such as local governments, will have to pay at least half of the interest rate for TWDB's cost of funds.

As part of a comprehensive water supply plan, financing plans for water reuse should consider cost sharing as part of the water, wastewater, and reclaimed water rate structures. Considerations in the pricing of reclaimed water include defining both the overall goals and objectives of developing a reclaimed water system and a desired level of cost sharing with the water and wastewater operations.

1.6 Project Implementation

Implementation involves a logical, step-by-step approach, beginning with a consensus on the need for the project and the framework in which the project would be developed. The initial steps toward implementation should include:

- Securing inclusion of the reclaimed water expansion project in the Region L Regional Water Plan and the State Water Plan.
- Disseminating public information regarding the purposes of reclaimed water and the project costs.
- Securing commitments for reclaimed water from potential users.
- Developing a project financing plan.
- Incorporating the project into the city's CIP.

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2 Introduction

The City of San Marcos (city) developed a reclaimed water system in 1999 to provide cooling water to a power generation plant located southeast of the city. In subsequent years, the city has added as reclaimed water customers a cement manufacturing plant and a proposed golf course. The university's need for new thermal plants resulting from continued campus growth comes at a time when the university, the city, and others who rely on the Edwards Aquifer are focused on diversifying water supplies. This diversification is, in part, driven by the Edwards Aquifer Recovery Implementation Plan (EARIP).

The city and university have commissioned RPS to perform a study of the feasibility of expanding the existing reclaimed water system to serve industrial and irrigation needs of the city, university, and private sector users. This feasibility study has identified and categorized existing and potential users and developed a proposed plan for expanding the existing reclaimed water system.

2.1 Background

The city has actively pursued the development of water conservation and water supply strategies for more than thirty years. The city's efforts have not only been driven by the recurring drought cycles of the region, but also part of the city's cooperation in regional efforts to preserve the endangered species habitat of the San Marcos River by reducing demands on the Edwards Aquifer. In 1989, the city contracted with the Guadalupe-Blanco River Authority (GBRA) to supply 5,000 acre-feet (AF) of surface water from Canyon Lake and increased that supply to 10,000 AF in 2009. During the next decade, the city, with cooperation by GBRA, developed a regional surface water treatment plant that has shifted the bulk of the city's water demand from the Edwards Aquifer to surface water. By upgrading the WWTP process from secondary to tertiary treatment, the city also began producing wastewater effluent that meets the state criteria for Type 1 reclaimed water.

As these major capital investments were being completed, the developer of a gas-fired power plant approached the city seeking a reliable supply of cooling water. The power plant was built south of the city and is supplied with both reclaimed water from the city's WWTP and raw water from the raw water pipeline that transports the city's surface water supply from the Guadalupe River to the San Marcos Surface Water Treatment Plant.

Since service to the first reclaimed water customer began in 2000, the city has approved two additional reclaimed water contracts. One user is a cement manufacturer that has committed to reducing reliance on Edwards Aquifer wells for water used for manufacturing and dust control and the other is a proposed golf course for a new residential development.

As part of the regional effort to reduce reliance on the Edwards Aquifer, the university has also undertaken efforts to evaluate alternative water sources. Water sources for the university include the city water system that supplies much of the eastern campus, a university-owned Edwards Aquifer well that serves the western campus, and water rights to Spring Lake and the San Marcos River. Converting the source of makeup water for the four thermal plants to reclaimed water would provide a significant reduction in the use of water from both the Edwards Aquifer and the San Marcos River.

2.2 Purpose of the Study

Discussions of the feasibility of providing reclaimed water to the university thermal plants began in 2010. The city and the university, in partnership with the TWDB, initiated a feasibility study for an expansion of the existing reclaimed water system in 2011. The concept for the expanded system includes reclaimed water service to: existing industrial users, university thermal plants, city and university parks and athletic fields, and commercial and school district users.

The purpose of this study is to evaluate the feasibility of expanding the city's existing reclaimed water system for various public and private sector uses within the city and its utility service area during a twenty year planning period (2015-2035). The project scope includes tasks that provide a review of available data, identify potential reclaimed water users, develop conceptual distribution system plans, evaluate costs, benefits, and environmental considerations, and to identify necessary steps for implementation. The Direct Water Reuse Expansion Feasibility Study (Study) includes the projected water demands for irrigation and potable water replacement and a recommended plan for a system that will meet the projected demands using reclaimed water.

The initial challenges of an expanded system are balancing the increase in reclaimed water demand with supply and defining the potential costs for planning the expansion. The feasibility study provides an evaluation of wastewater volume, current and potential reclaimed water demands, and defines the most appropriate service areas for expansion of the city's reclaimed water system along with planning costs for extending service to each service area.

2.3 Participants

The City of San Marcos, as the study sponsor, engaged the participation of Texas State University in conducting the Study. The Study was made possible through funding by participants and by the Texas Water Development Board (TWDB) Regional Water and Wastewater Planning Grant Program.

2.4 Study Area

The study area includes the city limits and the Texas State University campus. Within the study area, the existing reclaimed water system extends from the power plant located approximately 8.5 miles southwest to the San Marcos WWTP. The 2012 population of the city is 50,001 and the enrollment of the university is 34,225 as of the fall 2012 semester. Figure 2-1 provides an overview of the study area and existing reclaimed water system.

The topography of the study area consists of gently rolling plains east of the Balcones Escarpment and rocky hills to the west. Elevations change from approximately 560 feet above mean sea level at San Marcos River near the WWTP to 760 feet at the university's West Campus Thermal Plant. The study area is located along the eastern boundary of the Edwards Aquifer Recharge Zone (EARZ) that runs southwest to northeast through the city. Much of the study area is located in the Transition Zone, an area defined by the Edwards Aquifer Authority (EAA) for the purpose of regulating underground petroleum storage tanks. The climate in study area is characterized by mild winters and hot, dry summers. The average maximum temperatures of

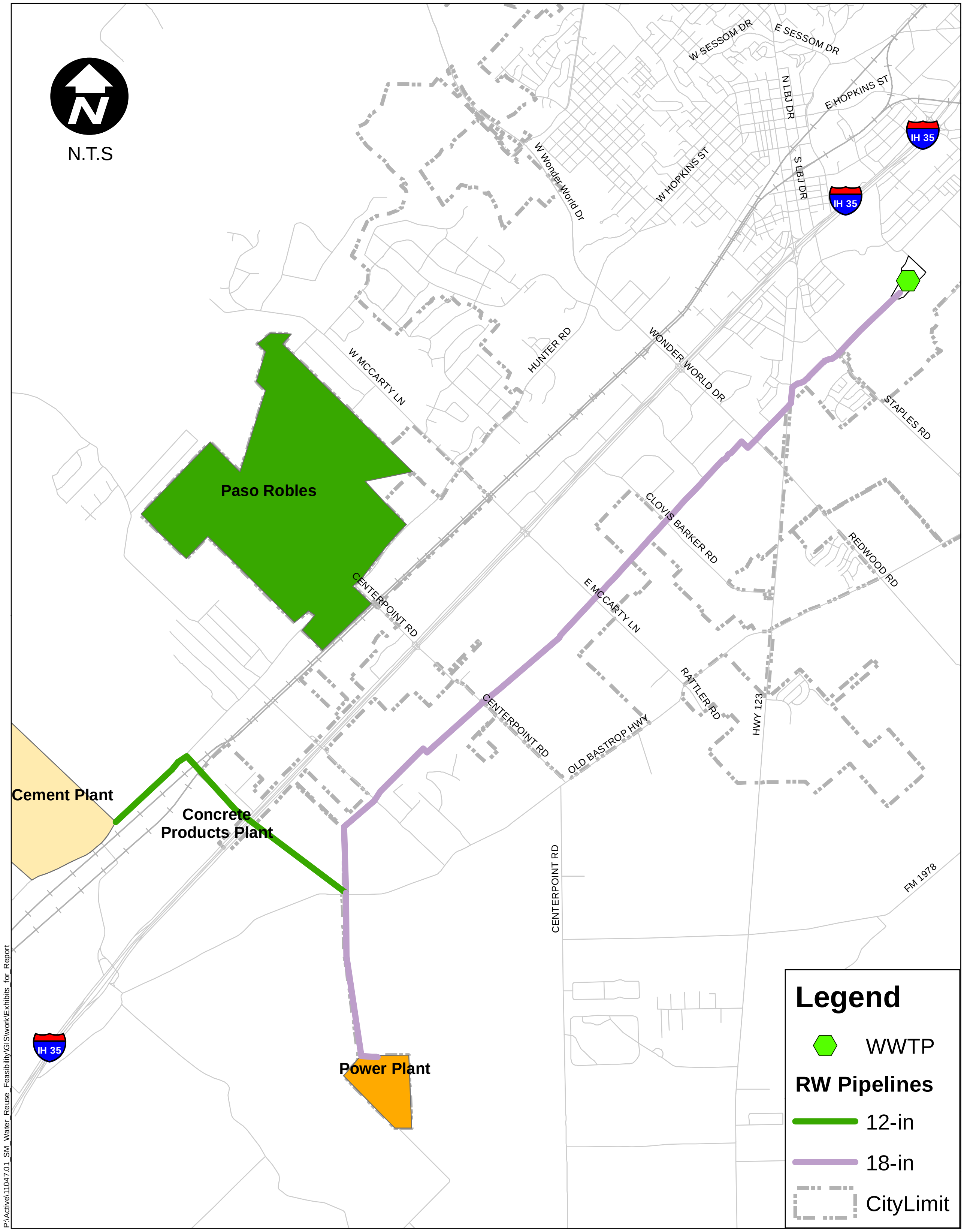

Figure 2-1. Study area and existing reclaimed water system.

over 95° F occur in August while the average minimum temperature of 35° F occurs in January. Historically, the wettest month of the year has been May with an average rainfall of 3.76 inches. With an average annual rainfall of just over 31 inches, extended drought cycles have prompted utilities in the region to implement comprehensive water conservation programs.

The city presently receives water from the Edwards Aquifer and the Canyon Lake, but also is participating in the development of the Carrizo-Wilcox Aquifer in eastern Caldwell and Gonzales Counties. The university receives water from a separate Edwards Aquifer well, and is also a retail customer of the city's water utility.

In conducting Study, the following features of the study area were considered:

- The city and university are committed to the goals of the Edwards Aquifer Recovery Implementation Plan (EARIP) Habitat Conservation Plan (HCP) to improve springflow at the San Marcos Springs by reducing withdrawals from the aquifer.
- The commitments of the city and university to the goals of the HCP include undertaking activities to improve watershed water quality.
- The university has committed to a graduated reduction in diversions of its municipal water rights based on the rate of springlfow from the San Marcos Springs.
- Existing and future infrastructure will be required for the conveyance and storage of reclaimed water.
- City and university parks and city athletic fields, as well as commercial customers could benefit from a relatively drought-proof water supply source for irrigation.

2.5 Planning Process

2.5.1 Overview

This study addresses delivering reclaimed water to customers of the city's water utility and to the university for industrial and irrigation needs. The planning process gave participants and the public opportunities to understand and contribute to the overall direction of the study.

2.5.2 Public Involvement

Three public meetings were conducted to solicit public input regarding the study with notices of the meetings posted in accordance with public meeting notice requirements and on the city’s web site. The first meeting was a conducted as an open public meeting on July 23, 2012. The second public meeting was conducted as part of the city's regular Parks and Recreation Board meeting on January 22, 2013. The final public meeting was conducted as part of the regular agenda for the City Council on October 2, 2013. Documentation of public involvement is presented in Appendix E.

The draft final report was made available for public review and comment between September 22 and October 2, 2013 with a notice posted in the local newspaper. Copies of the draft report were also provided for review by the following agencies:

- Texas Parks and Wildlife Department
- Edwards Aquifer Authority
- U.S. Fish and Wildlife Service
- Texas Commission on Environmental Quality

Review comments received from the public and from TWDB are presented in Appendix F with responses to those comments.

2.6 Document Organization

This report is organized into 11 sections:

- ***Executive Summary*** provides a summary of the key findings of the feasibility study.
- ***Section 1*** provides an introduction and background information for water reuse in San Marcos, as well as a description of the study area.
- ***Section 2 - Problems and Needs*** identifies the key water resource management issues that caused the city and university to evaluate the feasibility of expanding the existing reclaimed water system, including projected water demands and supplies.
- ***Section 3 - Water Reuse Opportunities*** describes the source and potential uses of reclaimed water in the study area.
- ***Section 4 – Description of Alternatives*** summarizes the objectives that alternatives are designed to meet and the project costs.
- ***Section 5 - Economic and Financial Capability Analysis*** provides an economic comparison of alternatives that could meet the projected reclaimed water demands.
- ***Section 6 - Recommended Alternative*** provides a review of the needs, demands, supplies, costs, benefits, and tradeoffs of the alternatives and presents the recommended alternative.
- ***Section 7 - Environmental Considerations*** provides information regarding potential environmental impacts and benefits related to the project.
- ***Section 8 - Legal and Institutional Requirements*** analyzes existing regulatory requirements and institutional issues that may affect implementation of the recommended alternative.
- ***Section 9 - Implementation Strategy*** outlines an approach to developing the recommended project alternative and describes potential research needs for the project.
- ***Section 10 - References*** contains a list of references used in the preparation of the study.

2.7 Abbreviations, Acronyms and Conversions

AF, ac-ft ……………Acre-Feet (1 acre-foot = 325,851 gallons)
AWWA……….……. American Water Works Association
BOD_5………………. Biochemical Oxygen Demand
$CBOD_5$……….…….Carbonaceous Biochemical Oxygen Demand
CFU…………………Colony Forming Units
CIP ……………...…Capital Improvements Plan
City…………………City of San Marcos
EAA…………...…….Edwards Aquifer Authority
EARZ……………… Edwards Aquifer Recharge Zone
ET………………….. Evapotranspiration
FEMA……….………Federal Emergency Management Agency
GBRA……….………Guadalupe-Blanco River Authority
gpm………….………Gallons per Minute
HCPUA……….…… Hays – Caldwell Public Utility Agency
HP ………….………Horsepower
IH……………….……. Interstate Highway
in …………….……. Inches
kgal ……….………. Thousand Gallons
kwh………...……….. Kilowatt Hours
LF………………….. Linear Feet
mgd…………….……. Million Gallons per Day
mg/l ……………….. Milligrams per Liter
ml …………….……..Milliliter
NPDES…………….. National Pollutant Discharge Elimination System
NRCS………….…… Natural Resources Conservation Service
NTU………….…….. Nephelometric Turbidity Units
NWI…………….…… National Wetlands Inventory
O&M………………..Operations and Maintenance
POTW……...……….. Publicly Owned Treatment Works
Region L…..…………South Central Texas Regional Water Planning Group
RWPF……….………Reclaimed Water Production Facility
TAC …………….…..Texas Administrative Code
TCEQ……….……… Texas Commission on Environmental Quality
TPDES ………….…. Texas Pollutant Discharge Elimination System
TPWD………...….. Texas Parks & Wildlife Department
TWCA………….….. Texas Water Conservation Association
TWDB………….….. Texas Water Development Board
TSS ……………….. Total Suspended Solids
TxDOT…………….. Texas Department of Transportation
TxSt/University………Texas State University
USACE…………….. U.S. Army Corps of Engineers
USFWS……...…… U.S. Fish and Wildlife Service
UV…………………..Ultraviolet (disinfection)
WWTP……….…….. Wastewater Treatment Plant

2.8 Background Reports

Several existing reports and studies were reviewed to develop a general background of information. The following documents provide an historical basis for developing the feasibility of expanding the City of San Marcos reclaimed water system.

- Engineering Feasibility Study Reclaimed Water Reservoir Site, Alan Plummer Associates, Inc. (APAI), June 2002.
- Reclaimed Water Technical Memorandum, APAI, September 2003.
- Reclaimed Water Distribution System Evaluation, APAI, April 2004.
- City of San Marcos Water Supply Master Plan, Turner Collie & Braden, Inc., December 2004.
- Texas State University Campus Water System Study, Final Engineering Report (Section 9.0 Reclaimed Water System Analysis), Bury Partners, May 2012.
- Texas State University Utilities Review, Affiliated Engineers, April 2011.

The scope and recommendations of each of these reports are summarized below.

Engineering Feasibility Study Reclaimed Water Reservoir Site

This 2002 report evaluated the feasibility of developing a 97 acre tract adjacent to the San Marcos WWTP as a reclaimed water reservoir. The report included an assessment of engineering costs and feasibility of construction on the site, as well as a review of potential environmental constraints.

The report concluded that the environmental constraints were wetlands along the San Marcos River and a potential prehistoric site on the western boundary of the site. The report also concluded that the only engineering constraints associated with developing the site as a reclaimed water reservoir was the overland flow across the tract between the Blanco River and San Marcos River and a 30-inch gas pipeline that bisects the proposed reservoir site. The 2002 report presented opinions of probable construction costs of $4.2 million for a 120 million gallon reservoir and $5.5 million for a 225 million gallon reservoir.

Reclaimed Water Technical Memorandum

The memorandum addressed the disinfection requirements for a potential expansion of the reclaimed water system. The report presented four alternatives for disinfection:

1. Installation of UV disinfection in the reclaimed water discharge header: It was noted that turning the UV lamps off when the reclaimed water pumps are not in operation and then turning the lamps on when pumping starts could present a significant operational issue. Chlorination was recommended to inhibit bacterial regrowth in the transmission system.
2. Relocation of the reclaimed water pump station downstream of the existing plant UV disinfection system: This alternative was developed to reduce the chlorine demand of reclaimed water by changing the withdrawal point from the effluent filters to after the plant UV disinfection and reaeration.

3. Construction of a gravity line from the reaeration basin to the existing reclaimed water pump station: As an alternative to relocation of the reclaimed water pump station, construction of a 48-in. diameter gravity pipeline from the reareation basin to the existing pump station would have the advantage of low capital and low operations and maintenance costs. However, the feasibility of this alternative depends on whether the minimum submergence requirements for the vertical turbine pumps could be maintained.
4. Relocation of the reclaimed water pump station to a seasonal storage reservoir: In this alternative, a gravity pipeline would transport reclaimed water from the reaeration basins to a seasonal storage reservoir, where a new reclaimed water pump station would then pump water from the reservoir into the transmission system. Additional filtration and disinfection are required for water that has been stored in an open environment.

Reclaimed Water Distribution System Evaluation

This draft report summarized the WWTP flow volume, the reclaimed water contract volume, and listed potential reclaimed water users. The supply and demand estimates were then used to develop three alternatives for expanding the reclaimed water system to extend service to city parks along the San Marcos River, San Marcos Independent School District athletic fields, university thermal plants and athletic fields, and to a proposed resort development in the vicinity of Post Road and Mimosa Circle that would include landscape and golf course irrigation.

A list of potential concerns associated with the expansion of the reclaimed water system was included in the report. Those potential concerns were:

1. Peak summer demands for reclaimed water exceeded the volume of wastewater effluent by 2.2 mgd based on the base power plant demand volume. Maximum demand from the power plant would leave no effluent for other users. The solution of a seasonal storage reservoir was suggested.
2. The fecal coliform monitoring point is located 13,000 LF from the reclaimed water pump station and the addition of a new transmission main approximately 3,400 LF from the pump station would require installation of additional fecal coliform monitoring points.
3. Depending on the proximity of the closest reclaimed water user to the pump station, the chlorine dosage needed to ensure Type I reclaimed water quality would have to be increased significantly.
4. It was observed that a separate pump station that draws water from the reaeration basin could serve as the fecal coliform monitoring point and significantly reduce the chlorine dosage required to maintain Type I water quality.
5. Construction of additional storage and a secondary pump station at the university could reduce the irrigation peak demand and overall pipeline diameter.

City of San Marcos Water Supply Master Plan

Several water supply strategies were evaluated as part of this report, including expanded direct nonpotable reuse, substituting reclaimed water for surface and groundwater demands, and indirect potable reuse.

Texas State University Campus Water System Study (Section 9.0 Reclaimed Water System Analysis)

A study of the TxSt campus water system included an evaluation of the potential demands and uses for reclaimed water. This evaluation estimated cooling tower make-up water to be 87 MG and 81 MG for fiscal years 2010 and 2011. The projected cooling tower make-up water volume was projected to increase by 16 MG to approximately 100 MG per year with the construction of an additional one million square feet of new buildings during the 2012-2017 Campus Master Plan period.

Texas State University Utilities Review

As part of the development of the TxSt Campus Master Plan for 2012-2017, a review of campus utilities was conducted and documented in this report. In the report, it was observed that potable water supplied to the campus from the Edwards Aquifer has a very high hardness and that the use of reclaimed water from the City could provide a source of make-up water for the campus thermal plants.

Texas State University Well and Aquifer Evaluation

According to this letter report, production from the TxSt Jackson Well was 304 MG in 2011 and projected to increase to 377 MG in 2020. The projected peak day demand is projected to be 1.66 MGD in 2015 and 1.86 MGD in 2020. TxSt is permitted by EAA to withdraw up to 2,000 AF from the Edwards Aquifer using the Jackson Well. Stage V conditions would reduce the maximum allowable production to 1,120 AF. TxSt production is presently below the Stage V limit and the projected 2020 demand would be approximately 1,156 AF.

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3 Problems and Needs

The City of San Marcos and Texas State University have undertaken this study of the feasibility of expanding the city's reclaimed water system as part of ongoing efforts to maintain water levels in the Edwards Aquifer and San Marcos River in order to preserve critical habitat, as well as to expand water reuse as an alternative water supply for industrial and municipal uses. This section describes the water management needs within the study area which have led the city and the university to evaluate increased use of reclaimed water.

3.1 Water Management Needs

The San Marcos area is a unique setting of environmental sensitivity and significant growth of city population and university enrollment. The Edwards Aquifer was the primary water supply source for the south central Texas region for many decades. Realizing that the region could not remain heavily dependent on the aquifer without adversely affecting the source of supply for the San Marcos and Comal Springs, utilities began to expand efforts to develop water management strategies to address local and regional water management needs. The water management needs of the study area can be summarized in five primary components:

- Develop reliable sources of water supply;
- Ensure that water supplies protect and promote public health;
- Develop water management strategies that enhance and restore the local environment;
- Minimize the costs of developing new water supplies by full utilization of local water sources; and
- Make water resource management an integral part of local economic development.

Expanding the reclaimed water system also addresses two secondary water management needs in that it generates revenue for the utility and provides water that satisfies the specific needs of users, such as public parks that would otherwise continue without supplemental landscape irrigation.

3.1.1 Water Quality

The Edwards Aquifer and San Marcos River are exceptional in terms of water quality and habitat for threatened and endangered species. The EARIP and HCP represent the efforts of the regional stakeholders to preserve the water quality and spring flow necessary to protect the endangered species found in the aquifer and river from harm during the most severe drought.

Efforts to protect the water quality of the San Marcos River include implementation of best management practices (BMPs) for stormwater management. BMPs that rely on maintaining vegetation can be compromised during periods of drought when landscape irrigation is curtailed.

3.2 Water Supplies and Demands

Completion of the construction of a surface water treatment plant and rehabilitation of the WWTP in 2000 signaled the city's transition from complete reliance on the Edwards Aquifer to a more diversified water management strategy. With those construction projects, the city moved from solely groundwater supply to mostly surface water for potable water and added reclaimed water to the city's inventory of water supplies.

3.2.1 Water supplies

The city and the university maintain a diverse inventory of water supplies. The city presently relies on the Edwards Aquifer and surface water to meet all demands of its water utility customers. The city also provides water utility service to a large portion of the university, primarily the eastern portions of the campus. The city is also a member of the Hays-Caldwell Public Utility Agency (HCPUA) - a consortium of water utilities that was formed to develop a water supply from the Carrizo-Wilcox Aquifer in Gonzales and eastern Caldwell Counties.

The city's current water supplies include an annual maximum of 5,433 AF from the Edwards Aquifer and the purchase of 10,000 AF of surface water from GBRA. The GBRA surface water supply is pumped from the Guadalupe River downstream of New Braunfels to the San Marcos Surface Water Treatment Plant located just south of the municipal airport. The surface water supply contract consists of a rate for delivery of each 1,000 gallons and an annual raw water fee per acre-foot on a 'take-or-pay' basis. An additional 4,000 AF will be added to the city's water supply in 2023 from the HCPUA, with an additional 8,000 AF of water from HCPUA in 2032.

The university operates an Edwards Aquifer well that has a permitted maximum withdrawal of 2,000 AF to supply the campus potable, industrial, and irrigation uses. The university also purchases approximately 62 AF of potable water from the city on a retail basis.

Both the city and university have implemented detailed and aggressive conservation programs in an effort to extend existing water supplies for continuing growth. Average per capital water consumption in San Marcos now averages 116 gpcd after implementation of a broad range of water conservation measures.

San Marcos River

The San Marcos River originates at San Marcos Springs, where approximately 200 springs emerge from the Edwards Aquifer to fill Spring Lake. The springs provide an environment for eight federally listed endangered or threatened species. The river is a constant 72^{o} F and is used year round for recreational activities.

Both the city and university hold water rights on the San Marcos River. Through certificate of adjudication (CA) number 18-3865D, the university has a range of uses that include municipal, irrigation, and industrial. The university's rights include consumptive use of up to 513 AF for municipal uses and 534 AF for industrial uses. The city is authorized under permit number 5092 to divert up to 150 AF for municipal uses (Table 3-1). Presently, the San Marcos River is not used as a source of potable water supply by either the city or the university. Both water from the university's Jackson Well and the 534 AF of industrial water rights have been used to provide makeup water for the university's thermal plants.

Table 3-1. San Marcos River water rights in the study area.

Water Right Number	Priority Date	Authorized Annual Diversion Rate (AF/Yr.)	Authorized Use	Maximum Diversion Rate (cfs)
CA# 18-3865D	09/04/1895	513	Municipal	2.22
		534	Industrial	1.33
		64,370	Hydroelectric	120.00
		80	Irrigation	1.33
		700	Artificial Waterfall	4.78
		100	Irrigation	1.33
P# 5092	09/02/1986	150	Municipal	1.10

A key provision of the HCP is a progressive reduction of the university's total surface diversion rate from the headwaters of the San Marcos River for consumptive use based on spring flow. The reduced diversion would occur just below Spring Lake Dam in order to enhance the flow through the areas of critical habitat in the San Marcos River. Under the HCP, the university committed to reduce the total rate of surface water diversion by an additional 2 cfs to a total of approximately 6.1 cfs when spring flow reaches 80 cfs. The university would reduce the rate of diversion by another 2 cfs when spring flow drops to 60 cfs and would suspend all diversions when spring flow drops to 45 cfs.

3.2.2 Water demands

The population of San Marcos has grown from 34,733 in the 2000 Census to over 50,000 in 2012. The city maintains population projections for both the water utility and wastewater utility service areas. Recognizing that the reclaimed water supply relies on the city's wastewater utility service area, the projected population for both the water and wastewater utility service areas through 2035 are presented in Table 3-2.

Table 3-2. Projected service area population.

	Water utility service area population	Wastewater utility service area population
2015	65,120	72,711
2020	71,117	79,407
2025	77,666	86,719
2030	84,818	94,705
2035	92,629	103,426

Driven by an estimated annual average population growth of approximately 3.9%, the annual water demand is projected to increase from 8,402 AF in 2012 to 15,650 AF in 2035. As shown in Figure 3-1, new and necessarily more expensive water sources have become part of the city's water supplies to keep pace with the increasing demand.

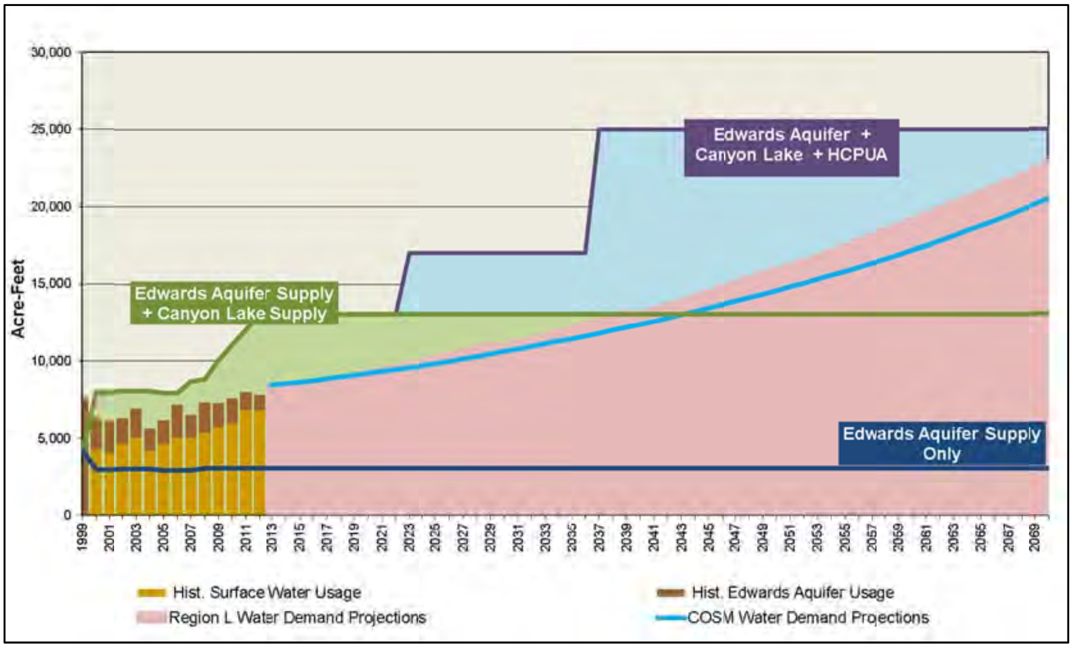

Figure 3-1. City of San Marcos water supply vs. demand.

Environmental demand

Environmental water demand can be viewed as the level in the Edwards Aquifer that is necessary to produce the Comal and San Marcos Springs flows need to maintain the aquatic habitat for the eight endangered species that rely on water from the aquifer. The Texas Legislature amended the enabling legislation of the Edwards Aquifer Authority (EAA) in 2007 to limit withdrawals from the aquifer to 572,000 AF per year subject to the adoption and enforcement of a Critical Period Management (CPM) plan. The CPM plan schedules reductions in the permitted withdrawals from the aquifer that range from 20% to 40% over five stages based on readings from the index well (J-17) and flow rates from the Comal and San Marcos Springs (Recon, 2011)

3.3 Supply Costs

The price of each source of water (Table 3-3) reflects the increasing costs of developing new and more distant sources of water. Water from the Edwards Aquifer, being both nearby and requiring only disinfection and pumping, is the lowest cost supply, while the projected HCPUA costs will be considerably higher. It should be noted that, except for the costs to deliver raw water to the San Marcos Water Treatment Plant, the water supply costs presented in Table 3-3 do not include the costs of storage, pumping, treatment, or delivery.

Table 3-3. Average water supply costs.

Year	Water Demand (AF)	Edwards Aquifer (CSM) (AF)	Edwards Aquifer (TxSt) (AF)	GBRA (AF)	HCPUA (AF)	Total Supply	Total Cost	Average Cost ($/AF)
2015	10,125	5,433	2,000	10,000	0	17,433	$ 2,438,072	$ 139.85
2020	12,474	5,433	2,000	10,000	0	17,433	$ 2,438,072	$ 139.85
2025	14,215	5,433	2,000	10,000	4,000	21,433	$ 7,418,072	$ 346.11
2030	16,245	5,433	2,000	10,000	4,000	21,433	$ 7,418,072	$ 346.11
2035	18,782	5,433	2,000	10,000	12,000	29,433	$ 17,378,072	$ 590.43

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4 Water Reclamation and Reuse Opportunities

While the rate of population growth in the South Central Texas region continues to lead the state and nation, utilities in the region are working to extend water supplies through conservation and the development of new supplies. Recognizing the value of diversified water resources, the City of San Marcos began their first water reuse project in 2000 following the expansion of the city's wastewater treatment plant and change from secondary to tertiary treatment. Extending an 18-inch diameter pipeline approximately 8.5 miles from the city wastewater treatment plant to a gas-fired power plant in 2000 made it possible for the city to serve additional customers. Contracts were executed for extending reclaimed water service to a cement plant in 2007 and to a proposed golf course in 2010.

Development of the Edwards Aquifer Recovery Implementation Plan (EARIP) and the Habitat Conservation Plan (HCP) have increased regional interests in reducing demand on the Edwards Aquifer as a way to preserve springflow for the San Marcos River. As part of a continuing commitment of Texas State University to preserve flow in the Upper San Marcos River, the university is evaluating reclaimed water as an alternative to water from its Edwards Aquifer well or water rights to the San Marcos River for makeup water for the university's four thermal plants.

In addition to the current and potential industrial uses for reclaimed water in San Marcos, the city's parks department has suggested that reclaimed water irrigation of the city's parklands along the San Marcos River could provide environmental and social benefits by reducing erosion potential along the river and improving the level of service of the local parks. This section discusses the potential for delivering reclaimed water within the study area.

4.1 Existing and Potential Reclaimed Water Users

The primary water demands in the study area that can be met using reclaimed water are industrial and irrigation uses. Three categories of reclaimed water users were identified for this study: 1) industrial users that have a need for process water or for dust control; 2) landscape irrigation for commercial properties; and 3) institutional customer irrigation. Institutional customers include city parks and city, school, and university athletic fields. A proposed private golf course and a homeowners association located near the city’s soccer complex were also included as institutional customers.

For the purposes of the study, potential commercial users are primarily limited to those properties that are located in close proximity to the existing or proposed reclaimed water distribution system and have significant historical irrigation demands. The city has contracts to deliver reclaimed water to a power plant, a cement manufacturer, and a proposed golf course. All of the contracted users are located south of the city and in close proximity to the existing reclaimed water distribution system. Potential industrial users include a concrete products manufacturer, a concrete batch plant, and the university’s thermal plants.

Both the city and the university have a number of parks and other facilities that are not included as potential reclaimed water users. Parks and athletic fields included as potential reclaimed water users in the study are those that are close to the existing pipeline or to the pipeline intended to serve the university thermal plants, or are heavily used and have a significant irrigation demand, such as the city's soccer and baseball complexes.

4.1.1 Reclaimed Water Demand Projections

The potential demands of reclaimed water uses were developed based on available data using one of three methodologies.

Method A – Demand Based on Water Use Data

Metered consumption data was available for water utility accounts that included some of the parks, university facilities east of the San Marcos River, school district athletic fields, HOA irrigation meters, industrial, and commercial customers. Data included monthly metered volumes for the period of 2006 – 2011 and advanced metering infrastructure (AMI) data for the period of May 1, 2012 through August 31, 2012. Peak month demands for irrigation accounts were identified from the peak irrigation period of May through September. AMI data also provided peak day and peak hour information.

The university's thermal plant average annual demand was based on the historical metered consumption for three of the four thermal plants provided by the university, along with the projected annual demand provided by the university for the new South Thermal Plant. The projected annual demand was increased to account for increases in cycles of concentration due to higher conductivity and ammonia in reclaimed water.

Method B – Irrigation Demand Based on Landscape Coefficient Data

Method B was used for potential users where metered consumption data are not available. These users included park areas that are presently not irrigated or are not fully irrigated, and where the level of irrigation has been limited. Method B is based on historical evapotranspiration rate data for the Austin station maintained by the Texas A&M Agrilife Extension's Texas ET Network. The ET Network average ET_0 is computed using climatic data over a period of 70 years. Precipitation data was obtained from the Texas Water Development Board (TWDB) Precipitation and Lake Evaporation Data for Texas. Single runoff and irrigation efficiency factors were assumed for all sites.

Turf coefficients (Tc) and quality factors (Qf) used are those available through the Texas ET Network that assume turfgrass with no stress conditions. The following equation was used to determine the unit irrigation demand for Method B:

$[(ET_0 \times Tc \times Qf) - (P-R)] \div e_i$

Where:

ET_0	= Monthly evapotranspiration, from Texas ET Network (inches)
Tc	= Turf coefficient (unitless)
Qf	= Quality factor (unitless)
P	= Average monthly precipitation, from TWDB (inches)
R	= Runoff, 25% of precipitation (inches)
e_i	= Irrigation efficiency, (assumed 75%)

The irrigation demand was calculated using the area of each parcel to be irrigated as provided by the city Parks Department.

Method C – Water Demand Based on Existing Reclaimed Water Contracts

The average and peak demands contained in existing reclaimed water contracts were also used. While the city has three existing reclaimed water use contracts (power plant, cement manufacturer, and proposed golf course), only the power generating plant has a history of actual demand. The supply pipeline to the cement manufacturing plant was completed in 2012 and construction of the proposed golf course has not begun. All three users have contracts that specify peak and average demand volumes for reclaimed water.

Based on the proximity of each potential user to the existing distribution system or to the proposed route to serve the university thermal plants, a list of parks, athletic fields, schools, and commercial users was developed. Extensions of the distribution system to serve the city's soccer fields and baseball fields were developed to add those locations to the list of potential reclaimed water users. The average annual demand and maximum day demand are presented in Table 4-1.

Table 4-1. Reclaimed water demand.

Reclaimed water use	Average Annual Demand (MG)	Maximum Day Demand (gpd)
Industrial		
Power plant	66	2,600,000
Cement plant	197	700,000
Concrete products plant	19	87,943
Concrete batch plant	3	19,453
TxSt Thermal Plants	170	754,383
Subtotal	455	4,161,779
Irrigation		
City Parks & Facilities	118	1,590,052
TxSt	7	113,956
Schools	17	263,052
Commercial Properties	8	58,309
HOA	16	254,171
Golf Course	72	1,200,000
Subtotal	237	3,479,540
Total	**692**	**7,641,319**

4.1.2 University Thermal Plant Makeup Water

Makeup water for the university's thermal plants is presently supplied by both the Jackson Well and industrial use water rights to the San Marcos River. Consumption records and projected makeup water demand for the new South Chill Plant indicate that the four thermal plants require approximately 170 MG annually. The thermal plant seasonal demands reflect the periods of interior space cooling during the summer terms of the university, with a slight drop in demand between the second summer session and the beginning of the fall term (Figure 4-1).

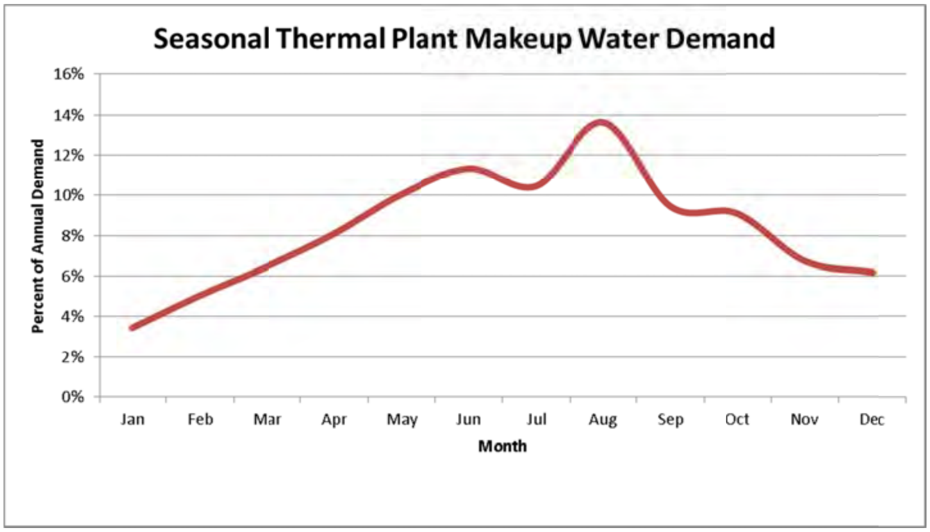

Figure 4-1. Seasonal thermal plant makeup water demand.

TxSt has the flexibility to change from potable water to raw water for cooling makeup water by switching from water produced by the Jackson well to its industrial use water rights in the San Marcos River. Water quality is the primary consideration in evaluating the potential reclaimed water demand for makeup water for the TxSt thermal plants. The cycles of concentration of the makeup water may increase depending on water quality parameters that affect chemical scaling and corrosion. Water quality parameters such as pH, total alkalinity, calcium, and total dissolved solids, as well as ammonia and nitrogen are monitored in the operation of the cooling plants. Chemical analyses of Edwards Aquifer water and reclaimed water (Table 4-2) reveal that reclaimed water is similar to that supplied by the university's Jackson Well, but can have higher conductivity and nitrogen than water from the Edwards Aquifer.

Table 4-2. Reclaimed water chemical analysis.

Parameter	TxSt Jackson Well	Reclaimed Water
Conductivity (µmhos/cm)	661	930
Total Hardness (mg/l)	316	270
pH	7.2	7.6
Total Alkalinity (mg/l)	254	174
Nitrogen, NH_3 (mg/l)	<0.4	0.1

Operation of the TxSt thermal plants using reclaimed water will require regular testing and data collection to verify system operational performance. While an increase in the corrosion or scaling potential can be managed with the application of water treatment chemicals, it is anticipated that a change to reclaimed water will also increase demand by increasing the cycles of concentration.

4.2 Reclaimed Water Source

The source of reclaimed water in San Marcos is the city's WWTP. The plant is a tertiary treatment process designed to treat 9 MGD and presently discharges an annual volume of approximately 4,800 AF. The WWTP effluent passes through rapid sand filters and UV disinfection before being reaerated and discharged to the San Marcos River. Reclaimed water is drawn from downstream of the filters prior to the UV/reaeration basins, chlorinated, and pumped to the existing users through an 18-in. pipeline. Effluent quality is consistently within the discharge permit parameters shown in Table 4-3.

Table 4-3. San Marcos WWTP discharge parameters.

Parameter	Limit
Flow, mgd	9.0
BOD, mg/l	5.0
TSS, mg/l	5.0
Ammonia, mg/l	2.0
Phosphorous, mg/l	1.0
Dissolved Oxygen, mg/l	6.0
Fecal coliform, CFU/100 ml	126/394

4.2.1 San Marcos WWTP Flow Volume

Influent flow data for the San Marcos WWTP for the years 2006 – 2011was reviewed to define hourly, daily, and seasonal variations that may affect the availability of reclaimed water. During this six year period, the per capita flow ranged from 80 gallons per capita per day (gpcd) to 123 gpcd for a six year average of 98 gpcd. Comparing the 2006 per capita value of 80 gpcd during a year in which the precipitation totaled 32.7 inches, with the drought years of 2008 and 2011, when the per capita values were 86 and 90 respectively, indicates a possible inconsistency in the data for 2006. The flow volume for the year 2007 was abnormally high due to above average rainfall. Based on the flow data for the years 2008 – 2011 and the population projections discussed in Section 4.1, an average annual effluent flow of 96.42 gpcd was used in estimating the annual volume of reclaimed water available during the planning period.

The average monthly WWTP flow rate is presented in Figure 4-2. While the review of the daily flow data for the years 2008 – 2011 revealed that the low flows are not confined to the summer months, the lowest monthly flow during the summer months is of particular interest in that it coincides with the peak irrigation demand period. Average summer month flows during 2011 ranged from a high of 4.26 mgd in September to a low of 3.94 mgd during July. Similarly, minimum day flows during the same period were 3.90 mgd in September and 3.69 mgd in July.

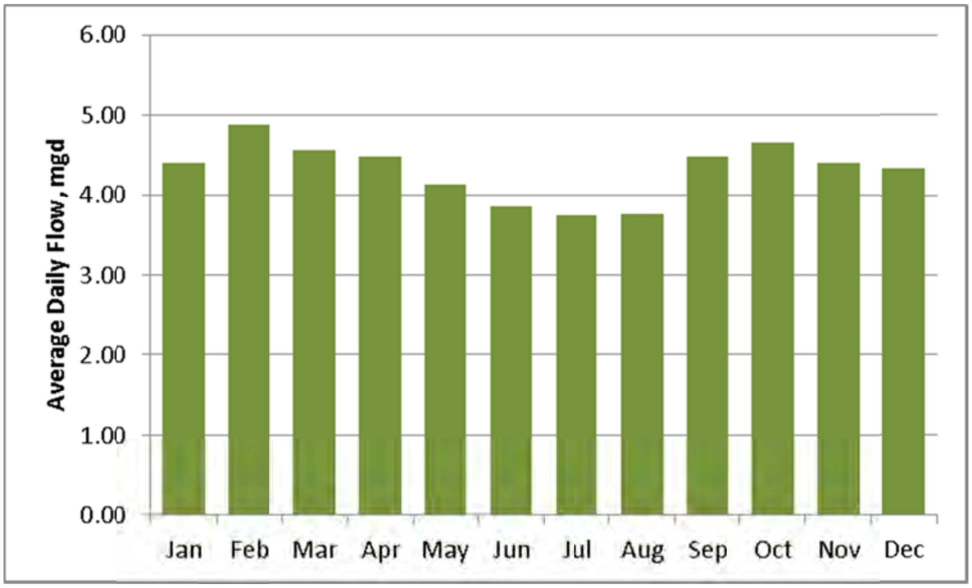

Figure 4-2. Average monthly effluent flow (2008 - 2011), mgd.

Using the projected wastewater utility service area population (Table 3-2) and resulting annual WWTP flow volume, the projected average day flow volume was calculated for the period of 2015 - 2035 (Table 4-4). The review of available WWTP flow data indicates that flow

Table 4-4. Projected WWTP average day flow (mgd).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	4.2	5.3	4.2	4.8	4.3	4.3	3.9	4.0	4.3	4.6	3.8	3.8
2020	4.6	5.8	4.5	5.2	4.7	4.7	4.3	4.4	4.7	5.1	4.1	4.2
2025	5.0	6.3	5.0	5.7	5.2	5.1	4.6	4.8	5.1	5.5	4.5	4.6
2030	5.4	6.9	5.4	6.2	5.6	5.6	5.1	5.3	5.6	6.0	4.9	5.0
2035	5.9	7.6	5.9	6.8	6.2	6.1	5.5	5.7	6.1	6.6	5.4	5.5

during the month of July averages 7.4% of the total annual effluent volume. The minimum July flow for the period of 2008 - 2011 accounted for approximately 2.6% of the flow for the month.

4.3 Existing Reclaimed Water System

In the existing reclaimed water system, effluent is withdrawn following filtration and before UV disinfection. Since reclaimed water is diverted before UV disinfection and residual disinfection is necessary for distribution, chlorine is injected into the reclaimed water line. The city conducts routine monitoring for disinfection effectiveness and residual downstream from the WWTP at Clovis Barker Road to allow adequate contact time within the pipeline. However, with a connection to the existing distribution system at Staples Road to serve university thermal plants, the current system of chlorine injection will not provide adequate disinfection contact time. A 2003 review of disinfection options (APAI, 2003) recommended construction of a gravity line from the reaeration basin to the reclaimed water pump station. This relatively minor modification could be accomplished as part of the Phase 2 project construction.

4.4 Evaluation and Sizing Criteria

A hydraulic model was developed for the existing reclaimed water system and the planned expansions through the year 2032. Sizing the required facilities for the maximum demands for projected uses through 2032 ensured existing and initial facilities were adequate to serve initial and projected future demands. Hydraulic analyses were conducted to identify pipeline sizes, storage, and pumping facilities necessary to meet projected reclaimed water demands through 2032 while meeting established design goals.

Specific design goals were established for the reclaimed water system hydraulic model. The goals included:

- Maximum Pressure: 110 psi
- Minimum Pressure (measured at main): 65 psi
- Design velocity range: 2 - 5 fps
- Minimum main diameter: 2-in.
- Pumps sized for peak hour demands.
- One standby pump.
- Minimum pump efficiency of 75%.
- Industrial users will provide storage for the user's maximum day demand.
- Establish optimum phasing of infrastructure expansions to meet projected demands.

4.4.1 Conceptual Design

Development of a conceptual design is necessary to develop realistic project cost estimates. Once the listing of potential reuse customers has been finalized, as well as their demand, pressure, and storage requirements determined, a conceptual design including treatment upgrades, storage and pumping structures, and transmission system layout can be developed as follows.

- Low head transfer pumps to convey treated effluent from the wastewater treatment plant to seasonal storage.
- Seasonal storage volume based on effluent production and projected demand.
- High service pump station requirements to meet projected demand and pressure requirements.
- Pipeline routing based on customer location. A hydraulic model was developed to size piping and pumping systems.

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5 Description of Alternatives

This section describes the planning process used to develop the conceptual supply and transmission alternatives for each service area. The delineation of potential service areas for the extension of reclaimed water service focused on the immediate and readily identifiable opportunities for industrial uses (including university thermal plants), city, school, and university irrigation demands in close proximity to the reclaimed water distribution service to industrial users, and major demands in two outlying areas.

Alternatives for expanding the San Marcos reclaimed water system were evaluated on the basis of meeting the objectives of providing service to meet the users' water demands while reducing current and future potable water demand, and providing positive social and environmental benefits. An analysis of potential reclaimed water users was performed within the city and the university campus to determine options for expanding the existing reclaimed water distribution system. The goals of the analysis were to provide an economically sound distribution system to maximize utilization of the available reclaimed water supply while allowing for system flexibility for future demand, reduction in potable water demand, and enhancement of city and university facilities. The options considered represent a phased approach in an attempt to maximize the reduction in potable water demand and expansion of the reclaimed water system. Five phases of potential system expansion for the reclaimed water system were developed. The options were compared to a "no-action" option to provide a point of reference point for maintaining the existing system without any expansion.

The broad characteristics that would be used to define potential service areas and reclaimed water users were defined in the Study. These characteristics included:

- existing, identified, and potential reclaimed water uses in the study area;
- proximity to the existing reclaimed water distribution system and to an extension of the system to serve the university thermal plants; and extensions to serve areas of significant demand in limited areas; and
- supply alternatives to meet peak reclaimed water demands during summer minimum WWTP flows.

Two water sources were considered during the planning process: treated effluent from the San Marcos WWTP and use of potable water to meet peak demands that cannot be met using only reclaimed water. Construction of seasonal storage for reclaimed water was also considered. Based on the initial evaluation, a preferred alternative was selected and used as the basis for the recommended project alternative.

Social benefits were generally defined as enhancements to the aesthetic appeal of public parks and facilities (city, university, public schools, and homeowners association), as well as commercial facilities that have a significant presence in the community (hospital and shopping centers). Environmental benefits as objectives for project alternatives included reducing demands on the Edwards Aquifer and Upper San Marcos River, as well as establishing and maintaining a vegetative buffer along the San Marcos River within public parks.

5.1 Service Area Definition

As previously noted, prospective reclaimed water users were evaluated on the basis of potential reclaimed water demand and proximity to a reclaimed water conveyance system to serve existing users and the university thermal plants. Four service areas were defined by existing and potential extensions of the reclaimed water conveyance system to areas of significant use with limited need for service lateral extensions. The service areas, shown in Figure 5-1, are:

1. South Service Area
2. TxSt/Downtown Service Area
3. Gary Service Area
4. North Service Area

The service areas are described in the following sections.

5.1.1 South Service Area

The South Service Area includes the area generally along South IH 35 between the San Marcos River and the existing power plant delivery point. The reclaimed water conveyance system consists of an existing 18-inch diameter main from the WWTP to the power plant with an existing 12-inch diameter extension to the cement plant and a planned extension to the proposed Paso Robles golf course.

In addition to the power plant and cement plant, a contract to supply reclaimed water to the proposed Paso Robles golf course was completed in 2010. Potential users in the South Service Area include a concrete products plant and a concrete batch plant. Potential irrigation customers in the South Service Area include the local hospital, shopping centers, and public schools.

5.1.2 TxSt/Downtown Service Area

This service area includes both the thermal plants and irrigation uses on the Texas State University campus, as well as the irrigation demands for the city's parks and facilities located along the San Marcos River corridor, downtown, and along Hopkins St. Service to the area begins with construction of a 16-inch diameter pipeline from the existing transmission main to a delivery point for the university's thermal plants at N. LBJ St. and University Drive. City and university irrigation demands are concentrated along the river corridor and along Hopkins St. and Aquarena Springs Dr.

5.1.3 Gary Service Area

The Gary Service Area includes two major potential reclaimed water users. The Gary Ball Fields currently use potable water for irrigation and are located adjacent to the Gary Job Corps Center (GJCC) property. A baseball complex is proposed to be built on property adjacent to the GJCC and the city's surface water treatment plant sometime within the next 20 years would also be part of the Gary Service Area. Reclaimed water service to this area would involve construction of almost five miles of an 8-inch diameter pipeline.

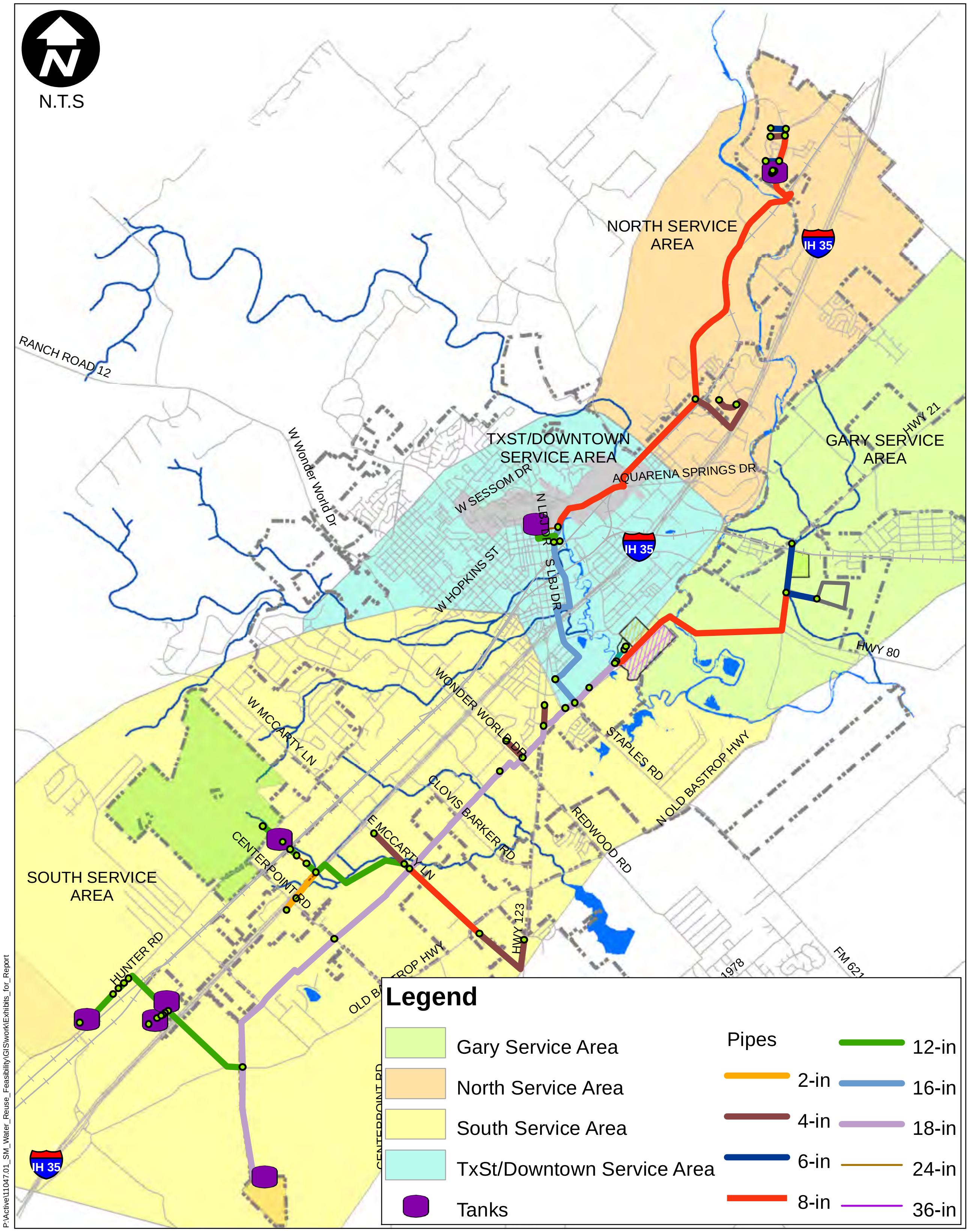

Figure 5-1. Reclaimed water service areas.

5.1.4 North Service Area

An extension of approximately seven miles of an 8-inch pipeline to the city's soccer complex would create the North Service Area. This service area also includes service to the Blanco Vista HOA, Blanco Vista Elementary School, and Alameda Park in the River Ridge subdivision.

5.2 Phased Demand Increase

The addition of reclaimed water service to new users is through four projected phases of system expansion. Each phased expansion of the reclaimed water system will extend reclaimed water service to one of the service areas and will address additional demands within one or more service areas. The projected year, areas served, and potential users added in each phase are presented in Table 5-1. It should be noted that the phasing of construction will be driven by the development of the various demands.

Table 5-1. System expansion phases.

Phase	Year	Service Area(s)	Potential Users Added	Features
1	2015	TxSt/Downtown	TxSt Thermal Plants	Construct a 16-in. transmission main to the TxSt thermal plants. Service to a concrete products plant and cement batch plant is initiated.
2	2017	TxSt/Downtown	City Parks & Facilities; TxSt athletic fields.	Install two high service pumps at the reclaimed water pump station to serve city and university irrigation demands. Construction of seasonal storage to meet peak demands.
3	2020	South; Gary	Schools, Commercial & Gary Ball Fields	Add a third high service pump and construct an 8-in. pipeline to Gary Ball Fields. Initiate service to schools and commercial users in the South Service Area.
4	2032	North	Soccer Complex, BV HOA, Baseball Complex	Add a fourth high service pump and extend an 8-in. pipeline to the city's soccer complex and Blanco Vista.

Figures 5-2 through 5-5 provide an overview of phases of expansion of the reclaimed water system.

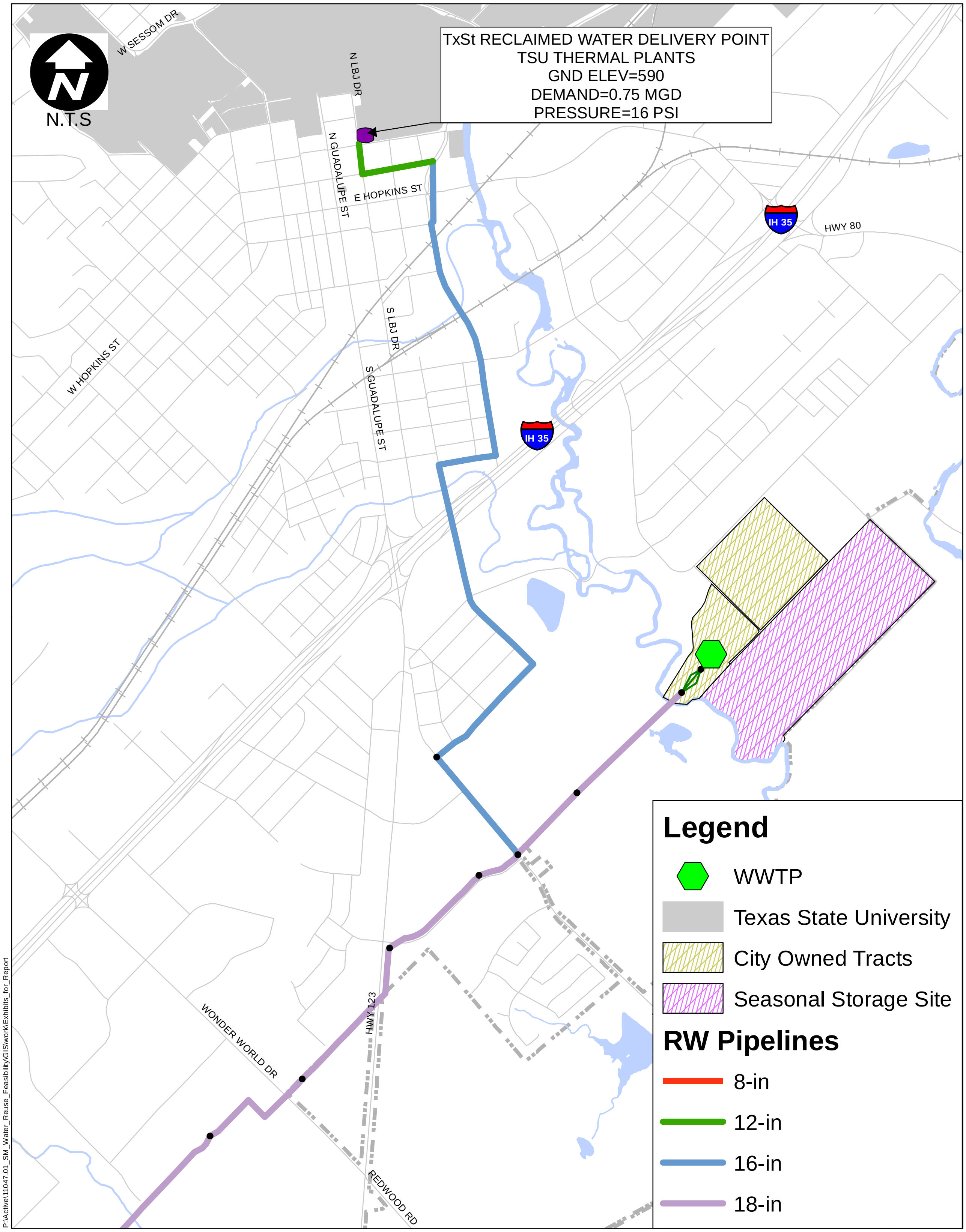

Figure 5-2. Phase 1 service expansion

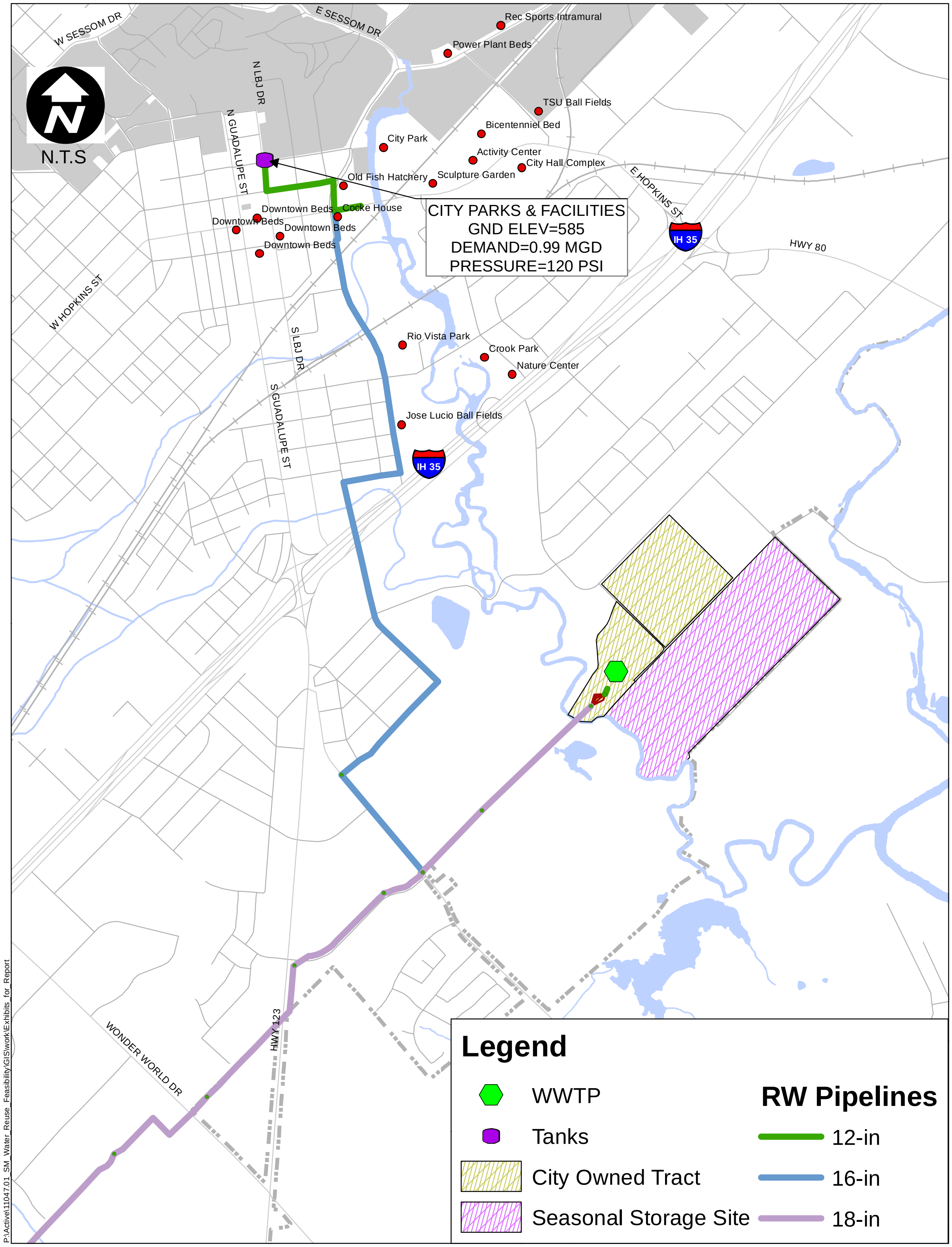

Figure 5-3. Phase 2 service expansion.

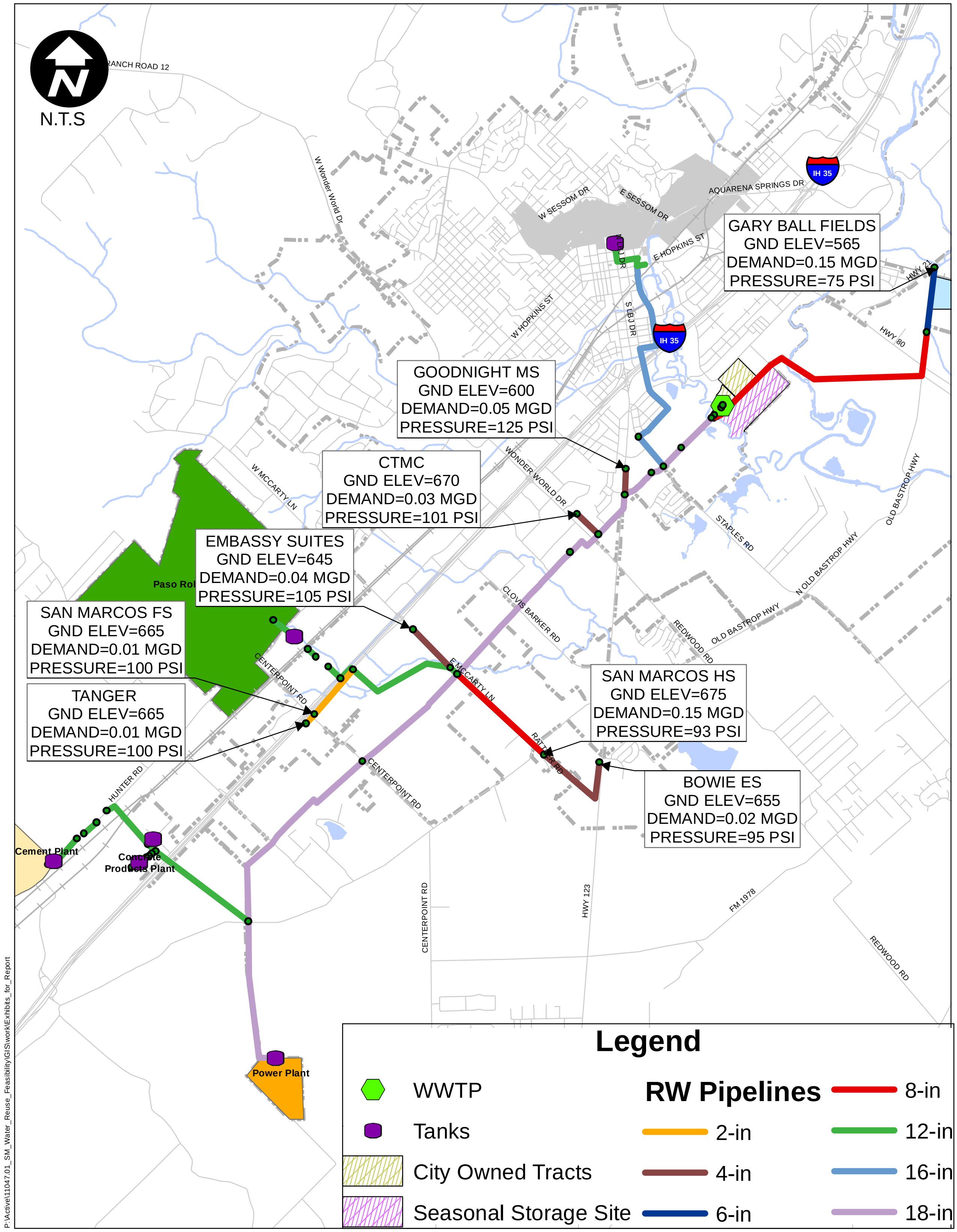

Figure 5-4. Phase 3 service expansion.

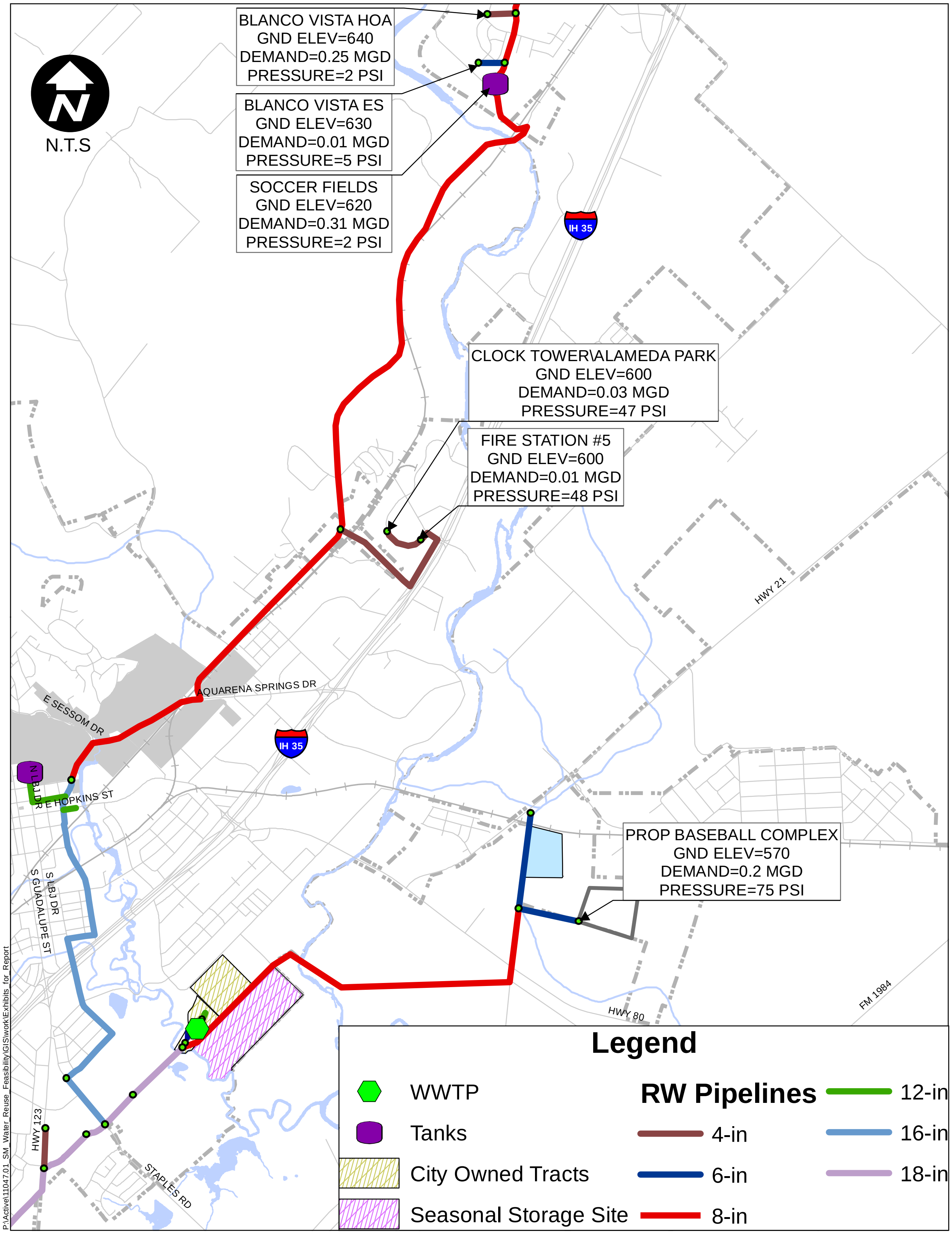

Figure 5-5. Phase 4 service area expansion.

5.3 Formulation of Project Alternatives

A review of WWTP discharge data for the years 2006 – 2011 defined trends in daily, monthly, and annual WWTP flows. This review indicated that the maximum daily demand (MDD) for the existing user contracts exceed the average daily WWTP flow during much of the year. However, as the power plant relies on reclaimed water as only an emergency alternative to raw water supplied by GBRA, the maximum demand has not yet exceeded the WWTP discharge volume. As summarized in Table 5-2, a comparison of the MDD for each phase with the minimum summer day and average day WWTP flow indicated that a supplemental source of supply would be required to meet all demands.

Table 5-2. Peak demand supply requirement.

Year	Max. Reclaimed Water Demand (MGD)	Summer Min. Daily Flow (MGD)	Supplemental Supply Required (MGD)
2013	4.61	3.03	1.57
2015	5.36	3.14	2.22
2017	5.86	3.25	2.61
2020	6.10	3.43	2.66
2035	6.51	4.47	2.04

A comparison of the WWTP flow records and projected reclaimed water demands indicate that the average day reclaimed water demands for all users can be met with the average summer daily flow of the WWTP (Figure 5-6).

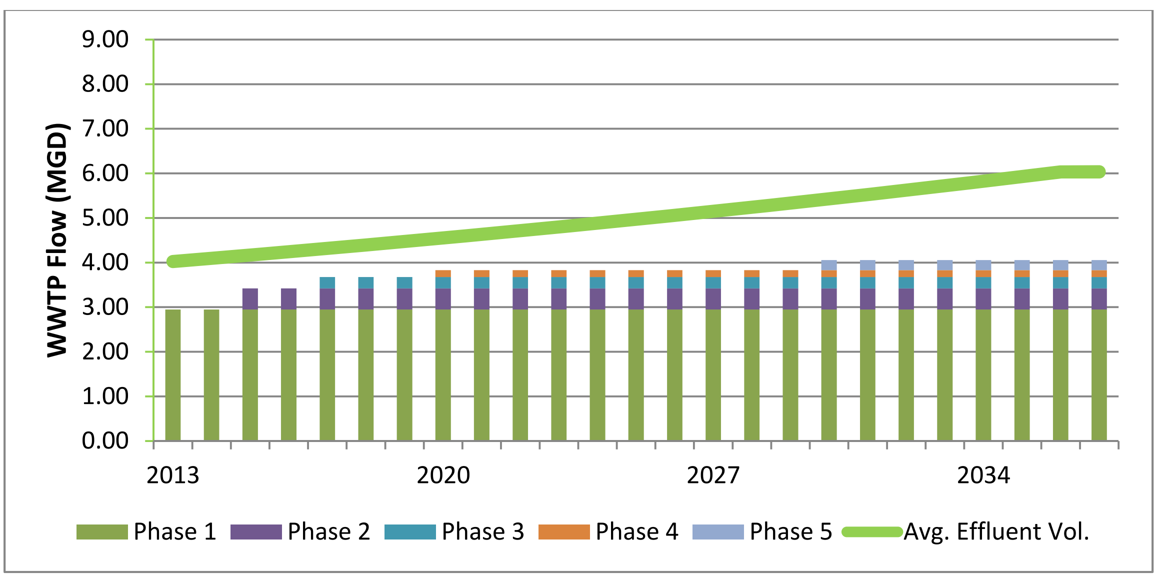

Figure 5-6. Average day reclaimed water demand.

However, the maximum day demands of all potential reclaimed water users would exceed both the minimum day and average day WWTP flows (Figure 5-7).

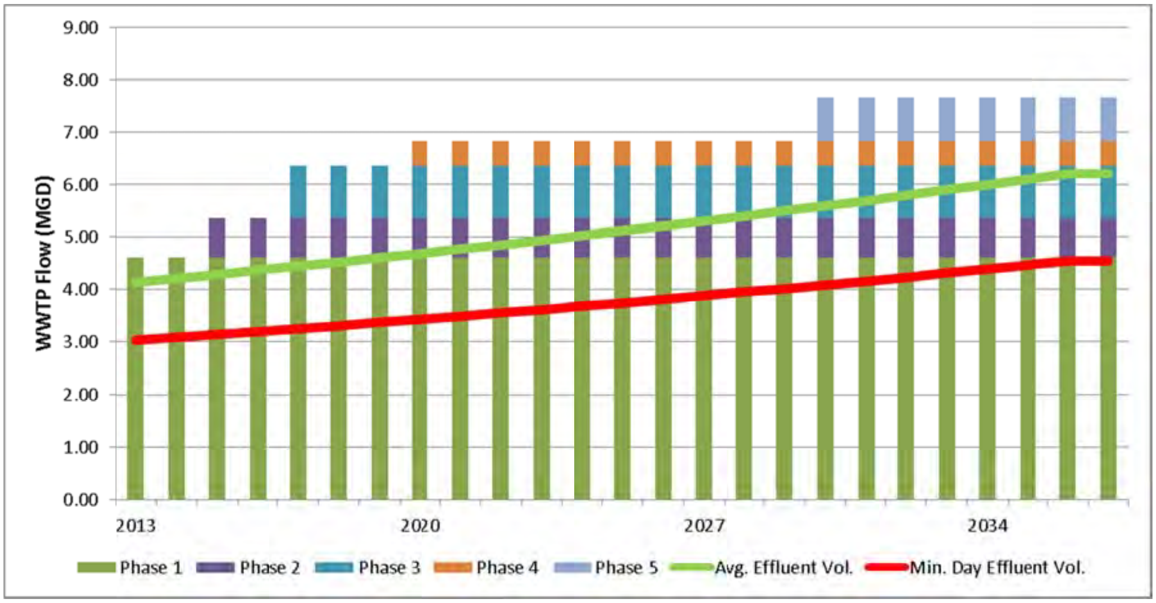

Figure 5-7. Maximum day reclaimed water demand.

5.4 Peak Demand Supply Alternatives

Four alternatives were considered for meeting the projected maximum day reclaimed water demands. The following sections describe three alternatives for meeting the peak demands of the reclaimed water users. The conveyance system in the service areas described in Section 5.1 are common to each of the peak demand supply alternatives.

5.4.1 Alternative 1 - Seasonal Storage

A 2002 study evaluated the feasibility and costs of construction for a 120 MG or a 225 MG seasonal storage pond on a 97 acre city-owned tract adjacent to the WWTP to meet the projected 30 day peak demand. The 2002 study included constructed wetland for water quality polishing to provide the necessary removal of sediment and algae from reclaimed water prior to distribution.

This alternative would provide an overall reduction in demand on the current and future water supplies by reducing demand on the Edwards Aquifer, water rights from the San Marcos River and on the proposed Carrizo-Wilcox supply while meeting the projected maximum day reclaimed water demand. Based on the projected maximum day reclaimed water demands for the users identified in this study, it was determined that a 105 MG seasonal storage pond would be appropriate.

System requirements

Seasonal storage involves earthwork to construct the storage pond and yard piping. The costs presented in Appendix B.6 also provide for fountains and constructed wetlands to preserve the water quality of the stored water.

Effect on existing water supplies

With the combined city and university potable supply sources being approximately 76.8% surface water from Canyon Lake and 23.2% groundwater from the Edwards Aquifer, Alternative 1 could provide 1,504AF of reclaimed water as an offset to the Edwards Aquifer and Canyon Lake water supplies. As a potable water offset, this would reduce the need to withdraw 1,155 AF from Canyon Lake and 349 AF from the Edwards Aquifer. For the projected water demand that is not presently receiving potable water, an additional 372 AF from the HCPUA would be offset by using reclaimed water. As a potable offset, Alternative 1 extends the city's Canyon Lake supply and both the city and university's Edwards Aquifer supply and increases the availability of the HCPUA supply for the service area.

5.4.2 Alternative 2 - Raw Water Supply Supplement

The city purchases stored water from GBRA that is treated at the city's Surface Water Treatment Plant. Under the terms of the 'take or pay' contract, the city bears the cost of the full contract volume of stored water whether used or not. Using this alternative, a portion of the city's stored water purchased from the GBRA would be used to meet the peak demands of the reclaimed water users until the minimum daily flow of the WWTP is sufficient to meet all demands. To avoid interconnection of the raw and reclaimed water systems, raw water would be delivered to a ground storage tank located near the power plant and then pumped to the reclaimed water pipeline. Meeting the maximum-day demand in this fashion has a significant drawback in that the raw water delivery infrastructure would be used infrequently.

System requirements

Alternative 2 includes a ground storage tank and pump station to receive raw water to be pumped to the reclaimed water system during peak demand periods. The facilities and costs associated with this alternative are presented in Appendix B.7.

Effect on existing water supplies

Alternative 2 will provide a reduction in demand on current and future water supplies by minimizing demand on the Edwards Aquifer and on the proposed Carrizo-Wilcox supply while meeting the projected maximum day reclaimed water demand. The reclaimed water peak demands can be met using the Canyon Lake supply within the city's existing stored water contract. As the service area population increases and water supplies are converted to wastewater flow, the supply of reclaimed water will increase, offsetting the use of raw water for meeting peak demands.

While most peak demands could be met using reclaimed water supplemented with raw water, the overall reliability of the raw water supply should be carefully considered as it relates to the demands of the power plant. The power plant operates during periods of peak electrical demand when flow to the WWTP can be at its lowest. The power plant maintains a primary supply of cooling water using the same GBRA raw water pipeline that supplies the city's water treatment plant. The reclaimed water supply contract provides an emergency supply alternative for the power plant that has been used during interruptions in the operation of the raw water pipeline.

The proposed infrastructure to use the raw water pipeline as a peak demand supply alternative would support most user demands, but the combination of the 1.25 MG ground storage tank and the 2.2 MG storage capacity at the power plant would limit the ability of the power plant to remain in operation during a prolonged interruption of the raw water supply. The value of the raw water supply would require further analysis using an assessment of risk to the power plant and raw water supply developed in conjunction with seasonal storage or supplement using water rights in the San Marcos River.

5.4.3 Alternative 3 - Water Rights Supplement

The university's water rights at Spring Lake and Sewell Park total 1,207 AF for municipal, irrigation, and industrial uses. The right to 513 AF (167 MG) for municipal use has not been exercised and no diversion point has been established (HCP, 2012, p. 5-34). As part of the Habitat Conservation Plan for the EARIP, the university has committed to reducing the total rate of surface water diversion of municipal water rights at the headwaters of the San Marcos River (HCP, 2012, p. 5-33). By establishing the point of diversion for the university's municipal water rights at the WWTP, the supply of water to the critical habitat would be further enhanced and it could be demonstrated that the reduced diversions committed to in the HCP could be avoided without adversely affecting the San Marcos River critical habitat.

By locating a diversion point at the WWTP, municipal water rights owned by the university could be incorporated into the reclaimed water system and used to offset peak demands in the reclaimed water system. The need for supplemental supply during periods of maximum demand and minimum WWTP flow ranges from 1.57 MGD (2013) to 3.40 MGD (2020). However, the current maximum diversion rate of 1,000 gpm would limit the supplemental supply to 1.44 MGD if only the municipal water rights were diverted to an intake at the WWTP. Diversion of the university's industrial water rights to the WWTP at the current diversion rate of 600 gpm would provide an additional 0.864 MGD. This supplement of 2.3 MGD would be sufficient to meet the projected peak demand occurring during periods of minimum WWTP flows through the year 2016. Storage would be required as part of this alternative due to the limited diversion rate of 600 gpm. A 35 MG seasonal storage pond located on the adjacent 97 acre tract would be sufficient to meet the maximum day reclaimed water demands.

This alternative includes certain assumptions:

- An agreement could be developed that would permit the use of the university's municipal water rights.
- The diversion point for the municipal water rights would be established at the WWTP.
- The university's agreement under the HCP to limit municipal water rights diversions would not apply to diversions downstream of the critical habitat.

System requirements

It should be noted that this alternative alone would not meet the entire projected maximum day reclaimed water demand, but could be used to reduce the scope of Alternative 1 or Alternative 2. For Alternative 2, for example, supplementing the reclaimed water supply using both the university's industrial and municipal water rights during peak demand periods would reduce the capacity of the seasonal storage pond from 105 MG to 35 MG. The infrastructure requirements for the 35 MG seasonal storage pond are detailed in Appendix B.8 and the raw water intake on the San Marcos River is detailed in in Appendix B.9.

Effect on existing water supplies

Alternative 3 will benefit the city and the university by making full use of the university's existing municipal water right without reduction while still preserving springflows through the critical habitat area of the San Marcos River. This alternative would also reduce the university's reliance on water from the Edwards Aquifer by supplying the makeup water demand for the thermal plants with reclaimed water instead of water from the Jackson Well.

5.4.4 Alternative 4 - No Action Alternative

The "no action alternative" assumes no expansion of the reclaimed water system with only a continuation of service under existing contracts. With "no action," the TxSt thermal plants would continue to rely on the Edwards Aquifer or the San Marcos River for a supply of makeup water. The city's parks would continue with no irrigation except using potable water for limited areas needed to preserve structural foundations and vegetative barriers along the river would not be irrigated during drought periods. Other irrigated locations, including the university's athletic fields, would continue to rely on the Edwards Aquifer, Canyon Lake, and the proposed Carrizo-Wilcox supplies.

Industrial users

Without an expansion of the reclaimed water system, supply for industrial use would be limited during peak demand periods. Current contracts for reclaimed water provide a commitment to the power plant, but supply other users only on the basis of available supply. Other than the power plant, current and potential industrial users have access to potable water supplies to meet peak demands during periods of limited supply. Of the total 1,616 AF of projected average annual demand for industrial users, 204 AF is attributable to the power plant's contract for reclaimed water as an alternative water supply. Another 220 AF in average annual demand for the proposed Paso Robles golf course is under contract, but there is to date no construction of the facility. The remaining 1,192 AF is industrial demand that is met using water supplied by the Edwards Aquifer, Canyon Lake, or San Marcos River. Since the infrastructure for supplying the average and peak demands is already in place, capital costs associated with the No-Action alternative would be the opportunity costs associated with system expansion for future potable water customers.

The result of the evaluation process was that two alternatives were carried forward for further feasibility analysis:

- Alternative 1 - Seasonal Storage
- Alternative 3 - Water Rights Supplement

Alternative 2 - Raw Water Supplement was not evaluated further as the reliance on raw water from the GBRA raw water pipeline to meet the projected maximum day reclaimed water demand would not provide a reliable alternative supply to the power plant in the event of a service interruption of that pipeline occurring during peak reclaimed water demand periods.

5.5 Development of Project Costs

Preliminary opinions of probable project costs were developed using cost data provided by equipment suppliers and recent project bid tabulations for utility construction. Current 2013 year costs are used for all phases of construction. Sizes of pumps and distribution piping were developed through a computer model of the proposed system using H2OMap Water® software.

5.5.1 Opinions of Probable Project Costs

The assumptions used in developing the probable project costs for expansion of the reclaimed water system begin with assumed year for each phase of development. However, the timing of construction, and components of the system will likely be modified and refined as the system is being built over the approximately 20-year planning period. Factors that can impact the design and timing of expansion of the actual reclaimed water system include actual utilization of the reclaimed system, identification of additional potential users, removal of identified potential users, changes in projected demands, effects of possible climate and regulatory changes, and city and university budgeting.

Capital costs are based on 2012 and 2013 construction prices, with no attempt to predict future price levels. The probable costs include allowances of 30 percent for contingencies and 15 percent for engineering and survey costs. The costs include an allowance for land and right-of-way acquisition when appropriate, but assume all other construction will take place on city property or within existing rights-of-way. All of the cost opinions are subject to refinement during final design and build-out of the system. As exact routes are determined for individual pipelines, the cost projections can be adjusted to reflect actual conditions.

Operation and Maintenance costs (O&M) are comprised of the following items:

- Purchased power (pumping costs): The majority of purchased power will be used to pump the reclaimed water. Average flow pumping is used to determine the power consumption. The costs are based on an average of $0.10 per kilowatt-hour.
- Disinfection: Disinfection costs include the addition of chlorine for the average annual volume of reclaimed water.
- Maintenance of the pumping and distribution systems: The average annual maintenance expense is estimated as 1.5% of the construction costs.

Details of the opinions of probable project costs are included in Appendix B.

6 Economic Analysis

The purpose of the economic analysis it to evaluate the cost-effectiveness of an expansion of the reclaimed water system and to identify any net economic benefits to the City of San Marcos and Texas State University. The economic analysis includes a life cycle cost analysis of the project that calculates the annual costs of implementing the project over the thirty year period of analysis using a four percent (4%) discount rate with the addition of operations and maintenance (O&M) costs.

6.1 Life Cycle Cost Analysis

This section presents the life cycle cost analysis for Alternatives 1 and 3. It also evaluates the economic benefits of Alternatives 1 and 3 versus the no action alternative. Alternative 2 is not considered as it does not provide a reliable standby water source for the power plant

6.1.1 Reclaimed Water Conveyance System

Table 6-1 summarizes the opinions of probable project costs for the reclaimed water conveyance system. These costs do not include reclaimed water storage or development of peak demand supply alternatives.

Table 6-1. Conveyance system opinion of probable project costs.

Project Year	Phase	Capital Costs
2015	1	$ 3,128,400
2017	2	239,500
2020	3	4,647,600
2032	4	7,737,800
Total		$15,753,300

6.1.2 Peak Demand Supply Alternatives

In addition to the costs associated with the phased expansion of the reclaimed water conveyance system, costs for the alternatives for meeting the peak system demand described in Section 5.4 were also developed. The seasonal storage project involves construction of a 105 MG reservoir at the WWTP. The Raw Water Connect project includes a ground storage tank and pumps to supplement the reclaimed water system with raw water from the GBRA pipeline during peak demand periods that occur during low flows at the WWTP. The San Marcos River (SMR) intake includes construction of a 35 MG seasonal storage reservoir and an intake structure on the river at the WWTP. The opinion of probable costs for the three peak demand supply alternatives is shown in Table 6-2.

Table 6-2. Peak demand supply alternatives.

Project	Capital Costs
Alternative 1 - Seasonal Storage	$ 6,315,500
Alternative 3 - Water Rights Supplement*	$ 2,929,900
* includes 35 MG seasonal storage	

6.1.3 Project Alternatives

As shown in Table 6-3, incorporating the projected costs for conveyance system expansion into the opinions of probable project costs for each of the peak demand supply alternatives provides a complete project cost for comparison. As the no-action alternative, there are no project costs for meeting all of the projected demands using potable water. Those costs would be realized as part of the potable water utility cost of service.

Table 6-3. Project alternative costs.

Project	Capital Costs
Alternative 1 - Seasonal Storage	$ 22,068,800
Alternative 3 - Water Rights Supplement	$ 18,683,200

Annual operations and maintenance (O&M) costs for the conveyance system and the peak demand supply alternatives are included in Appendix C. Table 6-4 summarizes the total, annual, and unit costs of Alternatives 1 and 3 to supplement the projected summer minimum day supply of reclaimed water to meet a projected average annual demand of 691.86 MG. Bond issues would take place in four increments as construction of each phase takes place. Phase 1 and Phase 2 of the planned conveyance system expansion would be combined into a single project. Life cycle costs are calculated over a 30-year period of analysis using a 4 percent discount rate.

Table 6-4. Life cycle cost analysis.

	Alternative 1	Alternative 3
Total Capital Costs	$ 22,068,800	$ 18,683,200
Annual Debt Service Costs	1,604,791	1,358,598
Annual O&M Costs	344,586	295,178
Total Annual Costs	$ 1,949,377	$ 1,653,776
Supply (MG)	691.86	691.86
Unit Cost ($/MG)	$918	$779
Unit Cost ($/kgal)	$2.82	$2.39

6.2 Reclaimed Water Cost Comparison

This analysis compares the costs of three reclaimed water project alternatives with the costs of supplying water from existing water supplies. The primary value of reclaimed water lies in the ability to postpone and minimize costs associated with expansion of supply, particularly, in the case of San Marcos, the costs of importing water from the Carrizo-Wilcox Aquifer. For this reason, the price of reclaimed water should be compared to the marginal cost of expanding capacity instead of the current average cost of existing water supplies. In this case, the marginal cost of water will be the cost of adding water from the HCPUA at approximately $1,245 per AF.

Table 6-5 presents a comparison of the projected cost of water from the Carrizo-Wilcox Aquifer as the marginal cost of the city's water supply with each of the three reclaimed water alternatives.

Table 6-5. Reclaimed water cost comparison.

Project	Capital Costs	Unit Cost ($/AF)	Unit Cost ($/kgal)
Alternative 1 - Seasonal Storage	$ 22,068,800	$ 918	$ 2.82
Alternative 3 - Water Rights Supplement	18,683,200	779	2.39
Alternative 4 - No Action	--	1,245	3.82

6.3 Economic Analysis

The water supply benefits of expanding the reclaimed water system would be realized through the provision of water for industrial use and for landscape irrigation, thereby reducing demand on existing and future water supplies. Expanding the reclaimed water system will also provide environmental benefits by enhancing the critical habitat of the Edwards Aquifer and San Marcos River by reducing withdrawals and providing a drought resistant water supply for irrigation of vegetative barriers along the river.

Water supply benefits are measured by comparing the project costs shown in Table 6-5 above with the costs of a feasible non-reuse project that would provide similar water supplies to the potential reclaimed water users. If the costs of the reclaimed water system expansion are less than the non-reuse water supply, the project would be considered to be cost-effective and provide a net economic water supply benefit to the region. The use of alternative costs to calculate water supply benefits is an accepted method for evaluating federally developed water supplies.

The economic analysis estimates benefits of expanding the reclaimed water system relative to future conditions without such a project. It is expected that the project would yield direct benefits to sustaining San Marcos River flows needed for maintaining critical aquatic habitat, as well as additional benefits to municipal water supplies.

6.3.1 Overview of Economic Benefits

There are a number of benefits related to the use of reclaimed water which may accrue to different entities and stakeholders in the community that can be either difficult to quantify or may only be described qualitatively. These benefits accrue directly and indirectly to the city, the university, the environment, and to the region. In many cases, since these benefits extend across political boundaries they are also difficult to quantify in financial terms (Raucher, 2006).

In addition to a projected lower cost water supply, there are a number of potential financial and non-financial benefits that must be considered in evaluating the feasibility of expanding the reclaimed water system. These benefits include revenue from the sale of reclaimed water, potable water supply benefits, avoided cost of disposal capacity upgrades, avoided costs of water supply facility upgrades, and supply reliability. The potential water supply benefits are discussed in the following sections.

6.3.2 Water Supply Benefits

Expansion of the reclaimed water system is expected to provide an annual average of 2,123 AF of water for industrial and irrigation customers. The distribution of average annual reclaimed water demand by user type is shown in Table 6-6.

Table 6-6.   Average annual reclaimed water demand (AF).

Use (AF)	2015	2017	2020	2032	Total
Industrial	1,616	--	--	--	1,616
City Irrigation	--	221	19	120	360
University Irrigation	--	20	--	--	20
School Irrigation	--	--	49	3	52
Commercial Irrigation	--	--	26	49	75
Total	1,616	241	94	172	2,123

As previously discussed, the 'no-action' alternative is to meet the projected demands without expanding the reclaimed water system.

Water supply reliability

Water supply reliability is a significant issue for the region as water supplies that are susceptible to drought make up a significant portion of the water supply in the region. Increased reclaimed water use could enhance the overall reliability of water supply and provide a valuable resource during recurring drought conditions that will support the environmental goals of the region as well as the local economy. The benefit of reliability has not been quantified for this project.

Reduced potable water demand

The potential reclaimed water uses identified in this study include an annual average of approximately 224 AF of potable water used for landscape irrigation that could be replaced with reclaimed water. These current uses include city and university facilities, as well as schools and commercial irrigation. In addition to providing an offset to potable water consumption for irrigation, converting thermal plant makeup water from water supplied by the university’s Jackson Well to reclaimed water would reduce potable water demand by an additional 388 AF.

Water demand in the City of San Marcos' service area is expected to increase by an average of approximately 378 AF per year between 2013 and 2035. Reclaimed water service within the city's service area could minimize the use of higher quality water supplies, particularly the more expensive HCPUA supply, leaving the higher quality supplies for the potable water demands of a growing community.

Realization of the financial benefit associated with conserving potable water comes when new residential or business development is supported by the potable water supply that is made available by substituting reclaimed water for uses that would otherwise require water from the potable water sources of supply.

Avoided cost of future water supply

Presently, the city and university have water supplies available to meet projected demands. However, as growth continues, water supplies will continue to become more expensive. In addition to the Carrizo-Wilcox Aquifer supply, other utilities in the region are exploring even more costly water supply options (e.g. brackish water desalination and purchase of distant groundwater rights). This benefit could be quantified by evaluating the future water supply projects that may be needed to meet demand. An estimated value of this benefit has not been quantified to date.

6.3.3 Environmental Benefits

Environmental enhancement

The Habitat Conservation Plan (Recon, 2012) has identified minimizing withdrawals from the Edwards Aquifer and the San Marcos River as essential to the survival of the endangered species that rely on both the aquifer and the river. Sustaining San Marcos Spring flows depends on the efforts of users to identify alternative sources of water supply. Significant levels of reclaimed water use may reduce withdrawals from both the aquifer and from the San Marcos River.

Expansion of the reclaimed water system can reduce the demand for river water needed for the university's thermal plant makeup water. Making reclaimed water available to the university would reduce demand for San Marcos River water and benefit the areas of critical habitat by allowing increased river flows through the areas of critical habitat.

TxSt has committed to reduce withdrawals from the San Marcos River as spring flow at the San Marcos Springs declines. Making reclaimed water available to the university will reduce demand for San Marco River water and benefit the areas of critical habitat by allowing increased river flows through the areas of critical habitat. Reclaimed water could also be used to support the riparian and aquatic habitat along the San Marcos River by providing water for irrigation of vegetative buffers in city parks along the river identified in the USACE Section 206 Aquatic Ecosystem Restoration Project. An estimated value of environmental restoration has not been quantified to date.

Storm water quality improvement

In the Section 206 Biological Assessment, establishment of riparian corridor plantings is recommended to provide filtration of surface runoff and to minimize erosion (USACE, 2013). Maintenance of turf grasses, shrubs and trees in city and university parks provide a vegetative buffer along the San Marcos River that filters storm water runoff to improve water quality. Maintaining vegetation in areas adjacent to the river reduces both the sediment load and contaminants in urban runoff.

6.3.4 Social Benefits

The city's parks along the San Marcos River are the centerpiece of the city's recreational tourist economy. Much of the city's parks are maintained without supplemental irrigation. The prospect of developing reclaimed water for irrigation of city parks highlights a significant paradox in the economics of operating and maintaining city parks.

Ensuring that parks are developed and maintained at levels of service that meet the needs and expectations of current and future residents presents a significant dilemma for any city. In its simplest form, the city must choose between operating parks without irrigation, irrigating with potable water, or irrigating parks with reclaimed water.

Leaving parks without irrigation appears to be the lowest cost alternative, but that option does not address the loss of some uses during drought periods and a limited ability to restore overused areas or to boost community appeal. The alternative of irrigating parks using potable water will increase the level of service and costs during normal rainfall years, but will essentially become the no-irrigation alternative during drought periods when outdoor water use is restricted. This alternative also increases the city's overall demand for new water supplies that are developed at higher costs.

Improved community aesthetics

Both city and university parks and athletic fields incorporate a variety of plants and grasses to provide shade, visual enjoyment and playing surfaces. Supplemental irrigation of parks, picnic areas, playgrounds, and athletic fields, can provide an improved capacity for accommodating the increased and heavier uses associated with more visitors and activities.

Support for community values associated with recreation

Summer recreational programs provide opportunities for a healthy lifestyle. The drought-proof nature of reclaimed water provides a source of water for ensuring plant maintenance and for providing increased recreational opportunities that enhance the local quality of life, particularly during the summer months when activities peak and potable water conservation measures are in effect.

6.3.5 Other Project Benefits

Tournament revenue

The city's Parks and Recreation Department annually hosts up to four youth soccer tournaments at the San Marcos Soccer Complex. The complex has turf fields that are irrigated using potable water. The city is scheduled to host four tournaments during 2013 and estimates the total economic impact to be $631,100, exclusive of hotel revenues. The annual number of tournaments is assumed to remain constant unless the quality of the facilities cannot be maintained, as would be the case with a loss of irrigation due to Stage V restrictions. The city is presently evaluating artificial turf as an alternative to potable or reclaimed water irrigation.

Long-term sustainability of parks

Developing parks is a significant investment by the current generation to ensure that the city's parks meet the needs of the present without compromising the ability of future generations to meet their own needs. Preserving vegetation in the parks provides both an inviting developed environment for people and a means of preventing damage due to erosion of surfaces worn by increasing use.

Support and diversification of the local economy

San Marcos is fortunate to have a diverse local economy that includes higher education, retail shopping, manufacturing, and tourism. There are clear and strong links between all four segments of the economy, as seen with university students and visitors who come to shop at the city's outlet malls and also take advantage of river recreation. A study of the economic impact of the university (LeSage, 2007) concluded that students and visitors to TxSt have an annual impact of $516.5 million on the Texas economy and a $56.5 million impact in Hays County.

The study does not attempt to determine what impact the university's location at the headwaters of the San Marcos River might have on attracting students or visitors, but few would disagree that the San Marcos River and adjacent city and university parks are an integral part of the local and regional economy. These areas are the centerpiece of both the tourist economy as well as a key point of attraction for potential TxSt students and faculty. The level of maintenance of parks during the summer months has a positive effect on the local economy by attracting tourists to the area.

Reclaimed water cost recovery benefit

Reclaimed water is a valuable commodity that can be sold to recover much of the costs of a project to expand the reclaimed water system. Like any commodity, market conditions will govern the sale of reclaimed water. For existing customers, rates for reclaimed water are established under existing contracts. The city's potable water rate is approximately $2,158 per AF. It is assumed that a similar water rate would apply for irrigation and industrial uses. This benefit is realized by serving new customers. The rate at which reclaimed water could be sold depends on a number of economic factors. Additional discussion and consideration of policy objectives are needed to identify appropriate rates.

Regionalization benefit

The financial benefit of regionalization is difficult to quantify, but expansion of the reclaimed water system would allow for cost-sharing opportunities and economy of scale benefits for the city and university.

6.4 Methodology

A present value analysis was performed to determine the relative expense of expanding the reclaimed water system as a water supply alternative compared to a baseline alternative of continued potable water use for industrial use and landscape irrigation. An alternative is preferred in a present value analysis when its present value is lower in absolute terms relative to other alternatives. The analysis forecasts the costs of each alternative over a 30-year period with a discount rate of 4%. The analysis horizon of 30 years has been selected because it captures each of the phased expansions of the reclaimed water system and the retirement of three of the four anticipated debt issuances (2015, 2017, and 2032), as well as 60% of the projected life of the project.

6.4.1 Calculating the Annual Costs of the Baseline Alternative

The baseline alternative is defined as the cost of meeting the projected reclaimed water demands with water from the potable water sources during each year of the analysis horizon to meet the maximum day and annual average demands of reclaimed water users. The baseline scenario includes the average cost of supply and the costs of potable water treatment, conveyance, storage, and distribution.

As a water supply source, the cost of reclaimed water can be considered as part of the overall average cost of water supply as presented in Table 3-3. For the purposes of the present value analysis, the average costs of water are assumed to be uniform for each year and increased only with the cost of an additional source of supply. The costs of debt service, potable water treatment, and conveyance are included to complete the annual costs of the baseline non-reuse alternative

6.4.2 Calculating the Annual Costs of the Reuse Alternatives

The annual costs of the reuse alternatives include the costs of other water supply sources, debt service costs, power costs, treatment, and operations and maintenance.

Costs of other water supply sources

Since the reuse alternatives would be used in conjunction with the existing and planned water supplies, the existing water supply sources are considered as part of the cost structure, though the quantity required to meet required demand would be reduced as a result of the availability of this alternative. These existing water sources include the city and university's Edwards Aquifer permitted volumes, the Canyon Lake stored volume contract supply through GBRA, and the HCPUA. As discussed in Section 6.4.1, the average costs of water are assumed to be uniform for each year and increased only with the cost of an additional source of supply.

Debt Service Costs

Bond issues are projected in the years 2015, 2017, 2020, and 2032 to fund the capital components of each phase of the reuse alternatives.

Recurring Annual Costs

The cost of power, operations and maintenance, and treatment are provided in Appendix C.

6.5 Summary and Conclusions

The proposed project could be developed in four phases:

- Phase 1: extension of reclaimed water conveyance to the TxSt delivery point.
- Phase 2: installation of a high service pump to meet city and TxSt irrigation demands; construction of seasonal storage for peak demands.
- Phase 3: addition of additional users in the South Service Area and extension of service to the Gary Ball Fields.
- Phase 4: extension of service to the North Service Area, including the city's soccer fields.

Costs for the four phases are summarized in Table 6-7.

Table 6-7. Project cost summary.

Phase	Year	Annual Demand (MG)	Capital Cost	Unit Cost ($/AF)	Unit Cost ($/kgal)
1	2015	526.73	$ 3,128,400	$ 212.94	$ 0.65
2	2017	78.55	6,555,000	546.25	1.68
3	2020	30.53	4,647,600	772.15	2.37
4	2032	56.05	7,737,800	1,083.16	3.32
	Total	691.86	$22,068,800	$1,083.16	$ 3.32

The present value analysis provides the costs for two alternatives for expanding the reclaimed water system to serve industrial and irrigation uses and, using the same methodology, compares those costs to the present value of using current water supply sources. Comparing the results of the present value analysis for each of the reuse alternatives show that expanding the reclaimed water system using either alternative is more cost-effective than the non-reuse alternative of using potable water.

The detail of the present value analysis is presented in Appendix D. Comparing the results of the present value analysis for each alternative, the reuse alternatives are more cost-effective than the non-reuse alternative, that is Alternative 3 - Water Rights Supplement is more cost effective than Alternative 1 - Seasonal Storage.

$$PV_{\mathrm{ReuseAlternative1}} = \$167,773,811 < PV_{Baseline} = \$755,550,369$$

$$PV_{ReuseAlternative3} = \$163{,}662{,}212 < PV_{Baseline} = \$755{,}550{,}369$$

In summary, if the projected annual costs of each alternative over thirty years were compared and "brought back to the current year" through discounting, expansion of the reclaimed water system to serve industrial and irrigation demands would be preferable to continued and expanded use of the potable water supply.

7 Recommended Alternative

The previously described analysis indicates that expansion of the reclaimed water system will be cost effective in providing water supplies to meet many of the city and university industrial and irrigation water demands. Of the two viable alternatives for peak demand supply, Alternative 3 - Water Rights Supplement was found to have a lower capital cost as a result of building a 35 MG seasonal storage pond and river intake pump station instead of a 105 MG seasonal storage pond included in Alternative 1 - Seasonal Storage. Both peak demand supply alternatives will reduce water demands on the Edwards Aquifer and the Canyon Lake supplies, and both will allow higher volumes of spring flow to remain in the San Marcos River through the critical habitat areas.

Even though Alternative 3 is the lowest cost alternative, implementation of the alternative will require completion of an interlocal agreement between the city and the university to establish a diversion point for the university's industrial and municipal water rights at the WWTP that could be used to meet the peak demands of the reclaimed water system. Such an agreement will require a full review and vetting by both city and university management, as well as review by state and federal agencies in the context of the EARIP Habitat Conservation Plan (HCP).

Besides a lower overall cost of reclaimed water, Alternative 3 presents certain other advantages in the university's water supply planning, such as further enhancement of the aquatic environment by allowing the university's entire municipal and industrial water rights to remain in the San Marcos River through the critical habitat area. But recognizing there are no changes to the conveyance system as a result of either alternative, the initial phases of construction of the expanded system are not controlled by a choice between Alternative 1 and Alternative 3.

Proceeding with Alternative 1, for example, would afford the city with the fastest path to project implementation by allowing construction of the seasonal storage pond to be phased with an initial capacity of 35 MG. This would allow more time for the issues of water rights and diversion to be resolved concurrent with commencement of reclaimed water deliveries to the university thermal plants and potentially the city's parks.

Recognizing the advantages of allowing development of the project to proceed, Alternative 1 is the recommended alternative in recognition of the additional time required to address the institutional issues related to the proposed use of university water rights. A change to the project to use San Marcos River water to meet the peak system demand could be made and the construction phasing modified to implement the peak demand supply alternative during the project design phase.

Construction of the seasonal storage facility (Alternative 1) could be phased between 2015 and 2017, included as part of Phase 1, or included as part of Phase 2 (2017) with the addition of high service pumps to serve city and university irrigation demands.

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8 Environmental Considerations

This section provides an overview of potential environmental considerations that may be addressed as part of the identified alternative for expansion of the San Marcos reclaimed water system. The review does not include a detailed survey or detailed investigation of environmental features or of cultural resources. A more detailed investigation would be conducted at the time actual facility locations are determined and final design is initiated. The primary environmental features within the study area include the floodplain of the San Marcos River and its tributaries and the Edwards Aquifer Recharge Zone.

8.1 Potential Environmental Effects

Potential environmental effects of the project would be anticipated to occur primarily during construction. Construction activities such as trench construction would cause limited and temporary impacts. The activities would vary with the project components, with construction related to expansion of existing facilities having the least expected impact (*e.g.* pump station expansions at the WWTP). The sections below provide a brief discussion of the nature of construction and operational impacts of the project.

8.1.1 Project Construction

The potential impacts of project construction will be consistent with those of other utility construction project and will require the use of construction related Best Management Practices (BMPs) to manage potential impacts to local hydrology and water quality, biological resources, air quality, noise, and transportation. Pipeline extensions will follow the established procedures of delineating potential wetland areas and developing a project design that will avoid those areas by location or by alternative construction methods, such as trenchless construction.

8.1.2 Project Operation

Project operation includes the distribution and use of reclaimed and nonpotable water for industrial and irrigation uses. The production, distribution, and use of reclaimed water would be consistent with the existing state regulations regarding the provision and use of reclaimed water. The quality of reclaimed water supplied by the project will meet the quality parameters for Type I reclaimed water under 30 TAC 210. In accordance with state regulations, reclaimed water users will be prohibited from allowing reclaimed water to pond or to runoff during use. The use of reclaimed water for irrigation will provide improved vegetative buffers in recreational areas by enhancing and maintaining vegetation even during periods of dry weather. Industrial use of reclaimed water will reduce groundwater withdrawals by providing an alternative to the use of water from the Edwards Aquifer.

8.2 Endangered or Threatened Species

The Texas Parks and Wildlife Department (TPWD) Rare, Threatened, and Endangered Species database contains county level information about the habitat of species of special concern in the State of Texas. A review of the TPWD database for Hays County reveals that the habitats for several federally listed threatened and endangered species in Hays County are found in the San Marcos River and in subterranean features of the Edwards Formation.

During the project design phase, a survey of areas affected by the proposed project will be conducted to determine if habitats for any listed species exist within the project construction area and, if any are identified, for the project to be designed to avoid impacting those areas during construction. An onsite assessment of potential habitat for listed species would be conducted as part of the design process. Once completed and in service, the use of reclaimed water for irrigation of developed property and for industrial uses will be operated in accordance with state and federal regulations. State regulations (30 TAC 210) prohibit the release of reclaimed water, including irrigation practices that lead to reclaimed water runoff.

8.2.1 Edwards Aquifer

The Edwards Aquifer extends 180 miles from Brackettville in Kinney County to just north of San Marcos. The aquifer is the primary source of drinking water for over 2 million people in south central Texas and serves the domestic, agricultural, industrial, and recreational needs of the region. The Edwards Aquifer is also the source of the San Marcos springs, one of only two major springs remaining in Texas, and feed the flow of the San Marcos River. The decline in water levels the Edwards Aquifer due to increased groundwater use can affect spring flow of the San Marcos Springs and flow in the San Marcos River.

The transition zone of the Edwards Aquifer is described as a thin strip of land south and southeast of the recharge zone from San Antonio to Austin where limestone that overlies the Edwards formation is faulted and fractured and where caves and sinkholes are fairly common. The boundary between the recharge and transition zones transects the San Marcos area just outside of the study area. The transition zone was established to regulate petroleum storage tanks. Since the proposed project will be located entirely outside of the Edwards Aquifer recharge zone and will be designed and operated to meet all regulations that apply to the transition zone, the proposed project will not create a potential for significantly impacting the Edwards Aquifer (Figure 8-1). With the proposed use of reclaimed water for irrigation being limited to the transition zone of the Edwards Aquifer, the use of reclaimed water in San Marcos will not affect endangered or threatened species habitats of the Edwards Aquifer.

Expansion of the use of reclaimed water would reduce reliance on the Edwards Aquifer during drought periods. This would contribute to maintenance of springflow of the San Marcos Springs and protection of endangered species in the San Marcos River.

8.2.2 San Marcos River

The City of San Marcos and Texas State University are situated at the head waters of the San Marcos River which flows from San Marcos Springs. The San Marcos River provides habitat for four species listed by the USFWS as endangered. At the headwaters of the San Marcos River are a series of springs in Spring Lake located between Aquarena Springs Dr. and Ed JL Green Dr. in San Marcos. Habitats for Texas wild rice, the fountain darter, San Marcos salamander, and San Marcos gambusia depend on constant natural spring flow. The San Marcos Recovery plan for

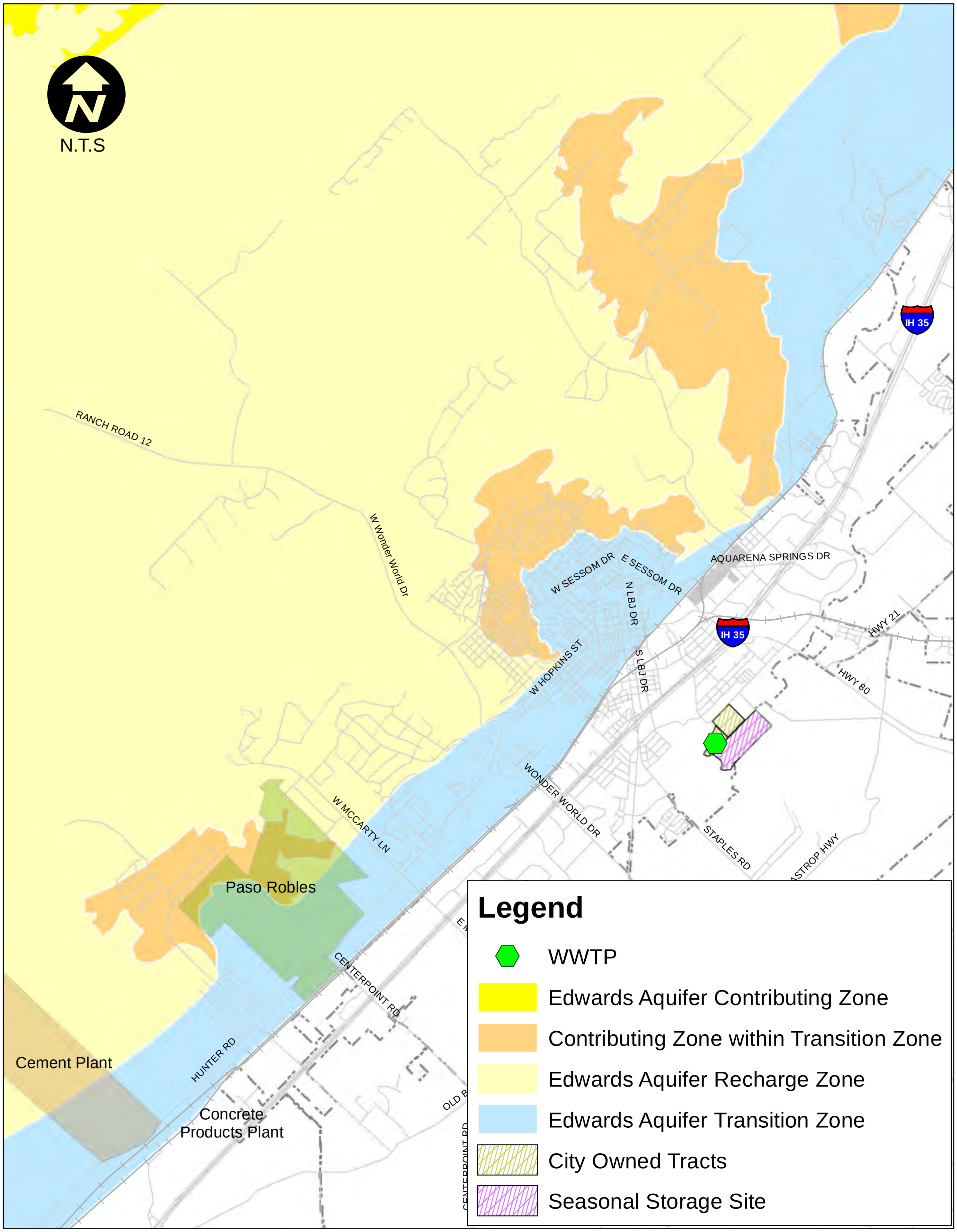

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Figure 8-1. Edwards Aquifer recharge zone.

San Marcos River Endangered and Threatened Species (USFWS, 1984) identified reduced flow from the San Marcos Springs, habitat modification and loss from human actions that affect the river, and the introduction of exotic species as the primary threats to the San Marcos River ecosystem. The areas of the San Marcos Springs and San Marcos River that are designated as critical habitat for threatened and endangered species is presented in Figure 8-2. Recommended recovery actions included managing the Edwards Aquifer to ensure continuation of the San Marcos Springs flow. Reduced diversions from the San Marcos River resulting from expanded use of reclaimed water will increase instream flows in the upper San Marcos River in the areas of critical habitat

8.2.3 Edwards Aquifer Habitat Conservation Plan

Eight species that are federally-listed as threatened or endangered depend directly on water in the Edwards Aquifer or on the water discharged from the San Marcos and Comal springs. The Edwards Aquifer Authority (EAA) was created by the Texas Legislature as a result of a 1991 lawsuit to enforce the Federal Endangered Species Act. The EAA was created to regulate pumping from the aquifer, implement critical period management restrictions, and pursue measures to ensure that springflows of the San Marcos and Comal springs are maintained to protect endangered and threatened species.

In 2006, the US Fish and Wildlife Service (USFWS) implemented the Edwards Aquifer Recovery Implementation Program (EARIP), a collaborative process focused on developing a workable plan to contribute to the recovery of federally-listed species dependent on the aquifer. The following year, the Texas Legislature directed the EAA and certain other water agencies to participate in the EARIP and to prepare a USFWS approved plan for managing the aquifer to preserve the listed species at Comal and San Marcos springs. As directed by the Legislature, the Habitat Conservation Plan (HCP) includes recommendations regarding withdrawal adjustments during critical periods that ensure protection of the federally-listed species associated with the aquifer.

Protection and supporting measures of the HCP that may be supported by expanded use of reclaimed water include:

- Management of Recreation in Key Areas and Designation of Permanent Access Points/Bank Stabilization: To minimize the impacts of recreation, permanent access points will be combined with bank stabilization at various locations. These locations will provide entry and exit access to the river for canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. In these areas, the bank is eroding generally due to clearing of riparian vegetation and specifically due to intense recreational use. The City of San Marcos will stabilize banks in eroded areas, to include City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and Cheatham Street Underpass. Permanent access will be located at dog beach, Lion’s Club Tube Rental, Bicentennial Park, Rio Vista Park, the Nature Center, and potentially other areas. As observed in the HCP, the increasing population of San Marcos and the region will result in an increase in the number of park visitors making irrigation of park vegetation in the parks that host the stabilized access points an important part of recreation management.

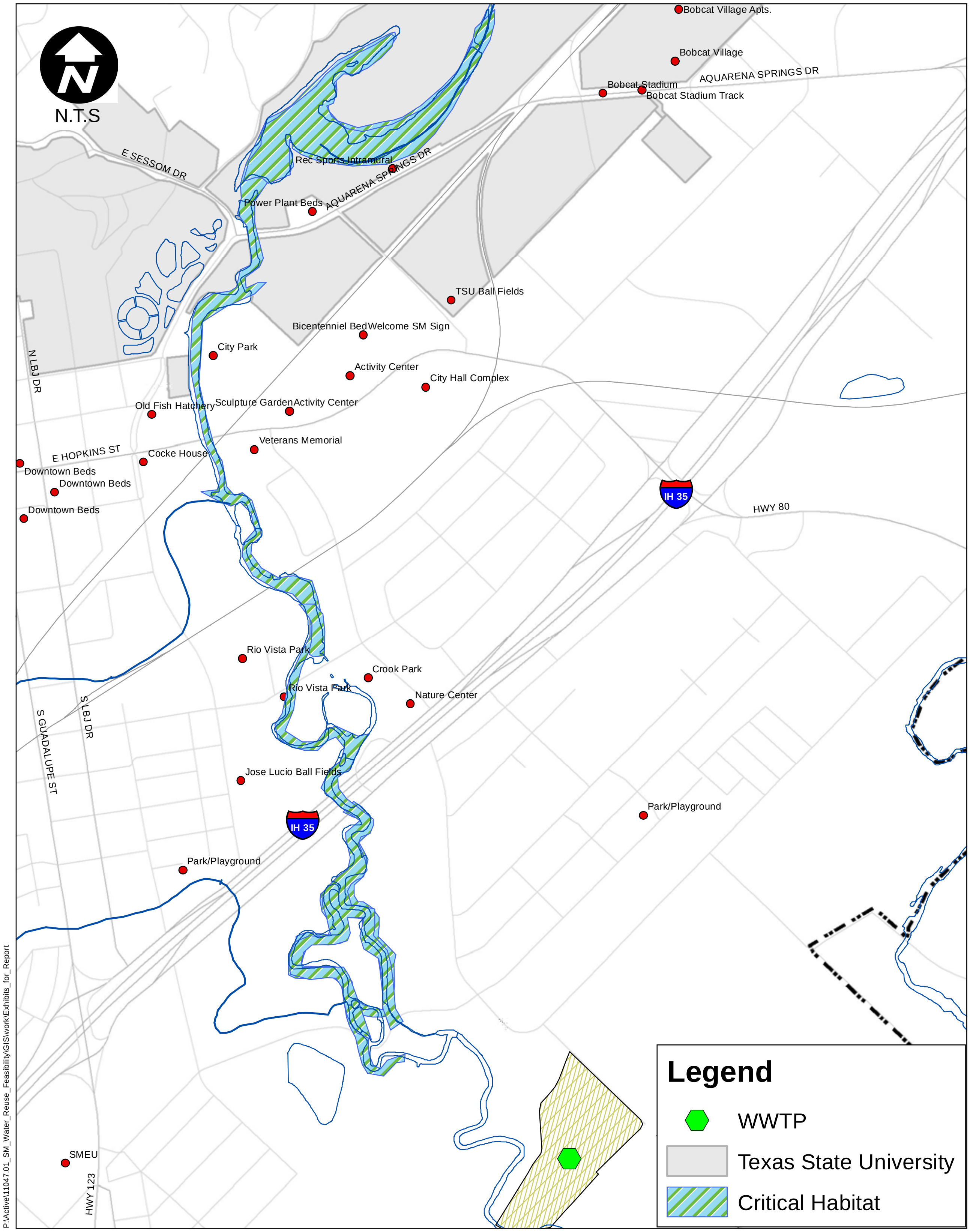

Figure 8-2. Critical habitat areas.

- Minimizing Impacts of Contaminated Runoff: reduce bank erosion, and subsequently the amount of sediment that enters the river.
- Regional Municipal Water Conservation Program (RMWC): The RMWC was developed to promote conservation of the Edwards Aquifer with a program goal of conserving 20,000 acre-feet of permitted or exempt aquifer withdrawals. The plan offers water conservation incentives to utilities in exchange for half of all conserved water to remain in the aquifer for fifteen years. Of the 20,000 AF target of conserved water under the RMWC, 10,000 AF will help sustain aquifer levels in support of continued springflow. The city and TxSt are two of the program participants that have committed to reduce aquifer withdrawals beginning in 2013. As comparable levels of the water are conserved through the program, the participating entities will regain access to the dedicated water. The RMWC program municipal use activities with such community specific efforts, such as low-flow toilet replacement programs and leak detection.

8.3 Wetlands

Wetlands are defined for regulatory purposes under the Clean Water Act as [EPA Regulations listed at 40 CFR 230.3(t)] as:

"…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

A preliminary review of the USFWS National Wetlands Inventory (NWI) revealed that neither digital nor scanned wetlands mapping is available for the study area. Identification of wetland areas along creeks and near the San Marcos River would require a detailed delineation of wetland areas in the project area during the final design of a reclaimed water system. To conform with the terms of Sec. 404 of the Federal Clean Water Act (CWA), utility crossings must comply with the terms of Nationwide Permit 12 (NWP-12) relating to activities required for the construction, maintenance, and repair of utility lines and associated facilities in waters of the United States. The design of the project will ensure that waters of the U.S. and wetland areas are avoided both during construction and operation of the proposed project.

8.4 Floodplain

The location and extent of floodplains (Figure 8-3) were considered for the purposes of locating potential reclaimed water pumping and storage facilities. The base flood elevations (BFE) and flood insurance rate maps (FIRM) provided by Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program would be used during project design to locate reclaimed water pumps and storage above the BFE or outside the regulatory floodplain.

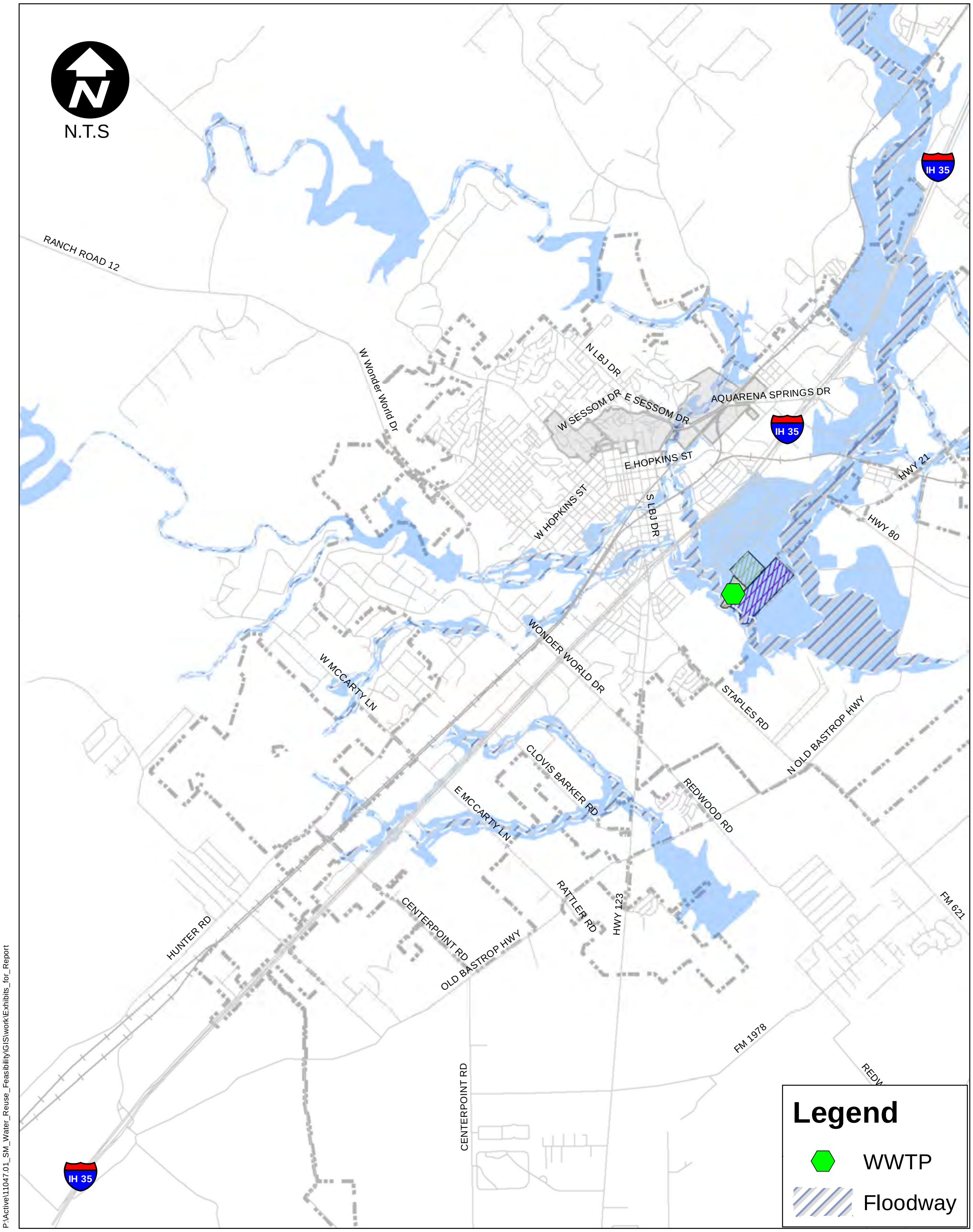

Figure 8-3. Floodplain areas.

8.5 Archeological and Cultural Resources

Construction of the project must adhere to various state and federal regulations intended to ensure that historic and prehistoric resources are identified along the project route or will be identified through a reconnaissance. Since construction of the proposed project would take place in existing and future public rights-of-way and on developed property, it is unlikely that the project will have a significant impact on a site, structure, or object that is listed in or eligible for listing in the National Registry of Historic Places, affects a historic or cultural resource or traditional and sacred sites, or the loss or destruction of a significant scientific, cultural, or historic resources. While the proposed project should not impact historic properties or prehistoric sites, the city will, during the design phase, coordinate the project design with the State Historic Preservation Officer or secure the services of a qualified archeologist to ensure that the requirements of the Archeological and Historic Preservation Act of 1974; National Historic Preservation Act of 1966; and the Texas Antiquities Code are addressed prior to construction. Once completed and in service, the use of reclaimed water for irrigation of developed property and for cooling will not create a potential for significantly impacting cultural resources.

8.6 Public Health and Safety

Existing regulations regarding the use of reclaimed water are developed to ensure that the environment and the health and safety of the public are protected. Similarly, existing federal, state, and city construction safety and construction-phase storm water quality management requirements will ensure protection of the environment and public health and safety during the construction phase. Project construction will contribute to some increase in vehicular and truck traffic in the project area that may result in increased short-term air emissions and noise levels in and around the construction areas. Construction activities may involve the use of hazardous materials during construction; however the implementation of best management practices (BMPs) related to fueling, vehicle washing and the handling, use, and storage of chemicals will minimize risks to workers, the public, and the environment. Project implementation will incrementally increase the use of chemicals used for disinfection of reclaimed water. All treatment chemicals would be handled and stored in compliance with federal, state and local requirements.

8.7 Natural Resources

Natural resources are materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic benefit. The construction and operation of a reclaimed water system for irrigation of existing landscaped areas and industrial uses will not significantly impact the natural resources of the project area except for the potential to reduce demands on the Edwards Aquifer.

8.8 Potentially Significant Environmental Effects

Potentially significant environmental effects related to construction are short term in nature and include potential impacts on soils, water resources, biological resources, traffic, aesthetics, and noise. It is anticipated that these environmental effects will be mitigated to a less than significant level through avoidance, minimization, and the use of BMPs.

Operational impacts that are potentially long-term relate to the continuing pumping, distribution, and use of reclaimed water within the service area. These impacts would include increased electrical consumption related to increased pumping, as well as increased chemical consumption to provide residual disinfection of reclaimed water.

8.9 Regional Water Supply and Water Quality

The use of stormwater BMPs during construction would minimize potential impacts to receiving waters. Typical BMPs include installing temporary sediment barriers such as silt fence or fiber rolls, and limiting the area for construction related traffic.

Increasing the use of reclaimed water in the study area would increase the reliability of supplies for industrial and municipal irrigation uses. The reduced demand on the Edwards Aquifer resulting from the increased use of reclaimed water has the potential of increasing spring flow by reducing withdrawals from the aquifer.

Irrigation of city parklands along the San Marcos River would also provide a vegetative buffer along the areas of critical habitat that will aid in reducing erosion and the transportation of sediment to the river. The reclaimed water produced by the San Marcos WWTP will meet the Type I reclaimed water quality standards in 30 TAC Chapter 210.

8.10 Public Involvement

As described in Section 2.5.2, the planning process included outreach meetings to provide information about the project and to invite public comment. As the project moves into design and construction, potential users will be engaged in refining the projected reclaimed water demands and in securing commitments to use reclaimed water. Additional public meetings will be conducted during the scoping phase of the project design.

8.11 Historic Properties

Most pipelines associated with the project would be located along existing streets in public rights-of-way. There are no buildings or structures that are anticipated to be directly or indirectly affected by construction of the project. No impacts to historical properties as a result of the project are anticipated. Historic districts of the city are shown in Figure 8-4. Historic districts..

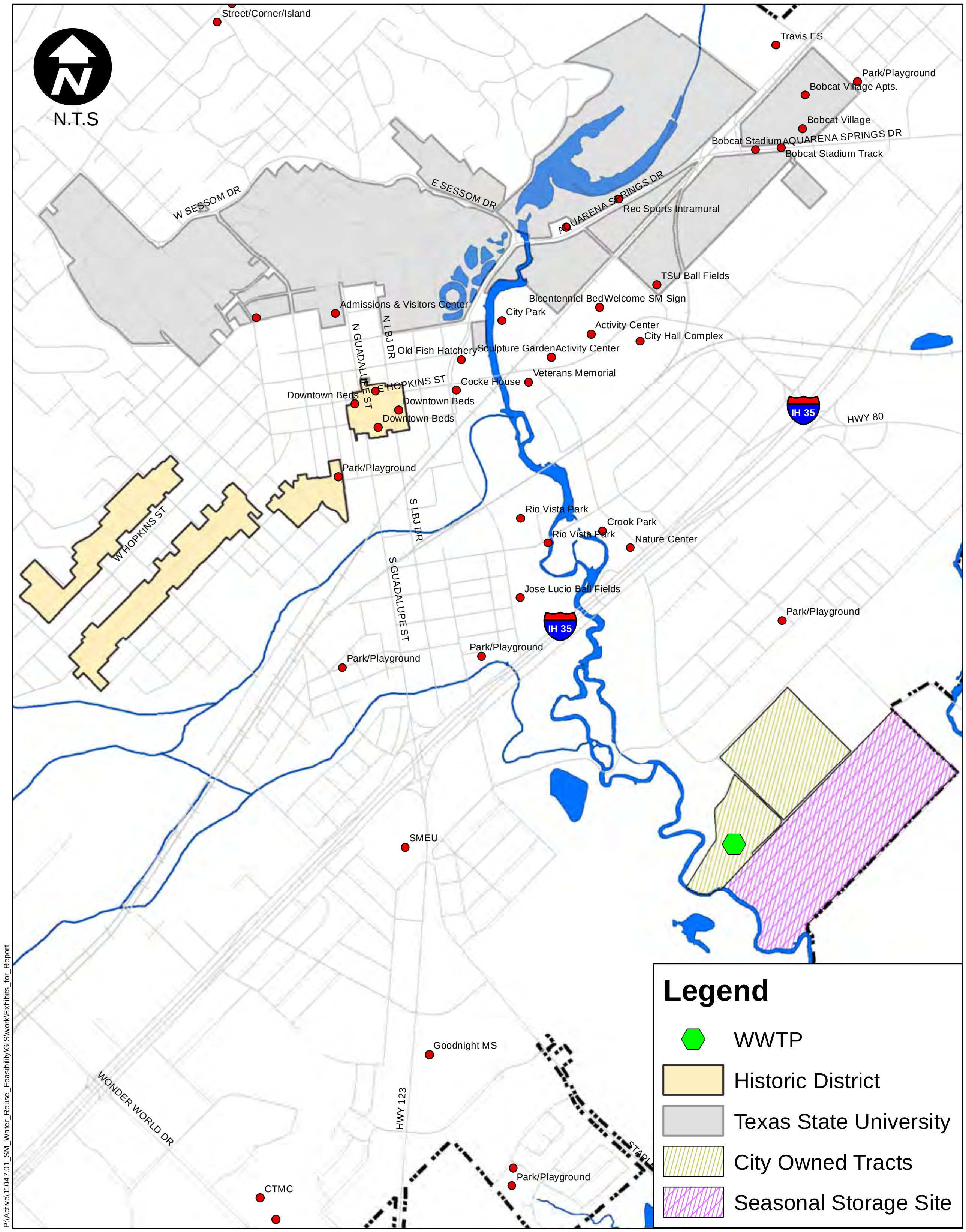

Figure 8-4. Historic districts.

9 Legal and Institutional Requirements

9.1 State Regulations

The regulations that govern the use of reclaimed water in Texas are found in Title 30 of the Texas Administrative Code (TAC), 30 TAC §210 (Chapter 210). The regulations provide for the quality criteria, design, and operational requirements for the beneficial use of reclaimed water. Use of reclaimed water requires notification and approval of the TCEQ under Chapter 210, with specific responsibilities assigned to the reclaimed water producer, the reclaimed water provider, and the reclaimed water user. The specific responsibilities of each party as designated by the Chapter 210 regulations are summarized in the following points.

The responsibilities of the reclaimed water producer include ensuring that the quality of the reclaimed water that leaves the treatment process meets the minimum quality prescribed by state regulations, and for sampling, analyzing, and reporting the quality of reclaimed water produced. The reclaimed water provider is responsible for the delivery of reclaimed water to the user that meets the minimum quality prescribed by state regulations, and for maintaining records of the volume and quality of reclaimed water delivered to the user. The reclaimed water provider must notify the TCEQ of proposed direct reuse and obtain written approval to provide reclaimed water. Minimum notification requirements include a detailed description of the intended use, a clear indication of the means for regulatory compliance, evidence of the provider's authority to terminate noncompliant reclaimed water use by contract or other binding agreement, an operation and maintenance plan, and a description of the reclaimed water quality. The reclaimed water user is responsible for the proper use of reclaimed water.

9.1.1 Record keeping

The reclaimed water provider is responsible for maintaining records associated with the delivery, use, and quality of reclaimed water. The reclaimed water provider must maintain records of notifications to TCEQ of reclaimed water projects, copies of contracts with each user, volumes of reclaimed water delivered, and analyses of reclaimed water quality. The reclaimed water provider must submit monthly reports to TCEQ that include the volume of reclaimed water conveyed to a user or provider and the quality of water delivered.

9.1.2 Reclaimed water quality standards

The quality parameters contained in 30 TAC §210.33 are summarized in Table 9-1.

Table 9-1. Texas reclaimed water quality standards.

	Type I (30-day average)	Type II (30-day average)
BOD5 or CBOD5	5 mg/l	20 mg/l
Turbidity	3 NTU	15 mg/l
Fecal Coliform	20 CFU/100 ml*	200 CFU/100 ml*
Fecal Coliform (not to exceed)	100 CFU/100 ml**	800 CFU/100 ml**
* geometric mean	** single grab sample	

The Chapter 210 rules regulate the quality, place and manner of use of effluent from wastewater treatment facilities to protect public health by minimizing risks of infection and disease transmission. Depending on the potential for human contact, Texas regulations provide for two types of reclaimed water.

Type I Reclaimed Water Use

Type I reclaimed water can be used where human contact with the reclaimed water is likely. The potential uses for Type I reclaimed water include (30 TAC §210.32):

- Residential irrigation, including landscape irrigation at individual homes.
- Urban uses, including irrigation of public parks, golf courses with unrestricted public access, school yards, or athletic fields.
- Use of reclaimed water for fire protection, either in internal sprinkler systems or external fire hydrants.
- Irrigation of food crops where the applied reclaimed water may have direct contact with the edible part of the crop, unless the food crop undergoes a pasteurization process.
- Irrigation of pastures for milking animals.
- Maintenance of impoundments or natural water bodies where recreational activities, such as wading or fishing, are anticipated even though the water body was not specifically designed for such a use.
- Toilet or urinal flush water.
- Other similar activities where there is the potential for unintentional human exposure.

Type II Reclaimed Water Use

Type II reclaimed water can be used where human contact with the reclaimed water is unlikely. The potential uses for Type II reclaimed water include (30 TAC §210.32):

- Irrigation of sod farms, silviculture, limited access highway rights of way, and other areas where human access is restricted or unlikely to occur. The restriction of access to areas under irrigation with reclaimed water could include the following:
- The irrigation site is considered to be remote.
- The irrigation site is bordered by walls or fences and access to the site is controlled by the owner/operator of the irrigation site.
- The irrigation site is not used by the public during the times when irrigation operations are in progress. Such sites may include golf courses, cemeteries, and landscaped areas surrounding commercial or industrial complexes. The "syringing" or "wetting" of greens and tees on golf courses shall be allowable under Type II so long as the "syringing" is done with hand-held hoses as opposed to automatic irrigation equipment. The public need not be excluded from areas where irrigation is not taking place. For example, irrigation of golf course fairways at night would not prohibit the use of clubhouse or other facilities located a sufficient distance from the irrigation.
- The irrigation site is restricted from public access by local ordinance or law with specific standards to achieve such a purpose.

- Irrigation of food crops where the reclaimed water is not likely to have direct contact with the edible part of the crop, or where the food crop undergoes pasteurization prior to distribution for consumption.
- Irrigation of animal feed crops other than pasture for milking animals.
- Maintenance of impoundments or natural water bodies where direct human contact is not likely.
- Soil compaction or dust control in construction areas where application procedures minimize aerosol drift to public areas.
- Cooling tower makeup water. Use for cooling towers which produce significant aerosols adjacent to public access areas may have special requirements.
- Irrigation or other non-potable uses of reclaimed water at a wastewater treatment facility.
- Type I reclaimed water may be utilized for any of the listed Type II uses.

9.1.3 Reclaimed water system operations

The Design Criteria for Wastewater System (30 TAC§217) and Use of Reclaimed Water (30 TAC §210) contain the regulations affecting the design and operation of reclaimed water systems in Texas. The design, construction and operation of a reclaimed water conveyance system is addressed through 30 TAC§217.51. The reclaimed water system design criteria (§217.69) requires signs and color coding of pipes and appurtenances to indicate the presence of non-potable water and requires a minimum separation distance of 4.0 feet from potable water pipes. Pipe for non-potable systems are required to have a minimum pressure rating of 150 psi.

The local regulations for reclaimed water systems should require purple pipe for all reclaimed water piping as an element of the city's cross-connection control program. Chapter 210 regulations require that hose bibs, faucets, and exposed piping (interior and outside) used for reclaimed water be painted purple and labeled as non-potable. When converting existing buried potable water piping (such as irrigation piping) to reclaimed water, it is not typically required to replace existing piping provided that all visible features, such as irrigation heads, and valve boxes, are changed to purple (Centeno, 2012).

Runoff of reclaimed water to waters of the state is to be prevented by the reclaimed water user (30 TAC §210.24), primarily by avoiding excessive irrigation and avoiding storage in ponds directly influenced by storm water runoff. Applying reclaimed water at the proper rate for the existing soil and atmospheric conditions is the principal means of avoiding runoff from irrigated sites. Maintenance of the irrigation system to correct sprinkler head and controller malfunctions is also an essential part of avoiding runoff from irrigated sites.

Reclaimed water is virtually indistinguishable from potable water by sight and scent, making cross connection control an essential part of the development or expansion of a reclaimed water system. Chapter 86, Article 9 of the San Marcos Code of Ordinances establishes the regulations for preventing contaminants and pollutants from entering the city's potable water system. This section of the city's ordinances ensures effective cross-connection control, inspection of backflow prevention devices, and conformance with TCEQ reclaimed water regulations.

9.2 Water Rights Considerations

As the population of the state and nation grows, wastewater effluent makes up an increasing percentage of the water in streams and rivers. Some estimates suggest that as much as sixty percent of the water that is distributed through a municipal water system for use as potable water is returned to Texas' streams and rivers as wastewater effluent (TWCA, 2004). These return flows can become part of the water to be appropriated from the watercourse or otherwise considered to be an important part of maintaining the aquatic environment. To appreciate the relationship between water reuse and water rights requires a review of some certain aspects of water law in Texas. It is important to note that once water is returned to a watercourse, it is considered waters of the state and subject to appropriation by the state.

The regulatory definition of reuse (30 TAC §297.1) is the authorized use for one or more beneficial purposes that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake, or other body of state-owned water. Reuse projects are defined in terms of either indirect or direct reuse. Direct reuse is known as "flange-to-flange" reuse in that treated effluent is drawn from the plant before it is discharged to a watercourse. Indirect reuse is when treated effluent is captured downstream from the point at which it was discharged to a watercourse. The diversion and indirect reuse of return flows utilizing from surface water sources is considered to be a new appropriation of state water. The indirect reuse of return flows that are the product of groundwater has not been considered to be a new appropriation.

The fundamental difference between direct and indirect water reuse in Texas is that direct reuse does not involve retrieving effluent from a stream or waterway, and thus avoids a new state surface water permitting process. Indirect reuse, on the other hand, does involve a permitting process that may consider the potential negative impacts on downstream water rights holders whose water rights may be based on an assumed reliability or continuation of return flows. Direct reuse, however, involves diversion of effluent for beneficial reuse without being released to a stream or waterway. The Texas Water Code provides the basis for utilities to reuse water without additional water rights permitting until that water is discharged from the wastewater treatment plants:

> *Except as specifically provided otherwise in the water right, water appropriated under a permit, certified filing, or certificate of adjudication may, prior to its release into a watercourse or stream, be beneficially used and reused by the holder of a permit, certified filing, or certificate of adjudication for the purposes and locations of use provided in the permit, certified filing, or certificate of adjudication. Once water has been diverted under a permit, certified filing, or certificate of adjudication and then returned to a watercourse or stream, however, it is considered surplus water and therefore subject to reservation for instream uses or beneficial inflows or to appropriation by others unless expressly provided otherwise in the permit, certified filing, or certificate of adjudication.* [Texas Water Code 30 §11.046(c)]

But if the underlying water right contains limitations on the return of unused water, the reuse of water, either by direct or indirect reuse, can be limited (30 TAC§297.45(a)).

Presently, a number of issues related to the direct reuse of treated effluent are currently unresolved, not the least of which is how return flow volumes should be analyzed in the context of protecting existing downstream water rights. Unlike indirect reuse authorizations, direct reuse has historically been unaffected by the issue of downstream water rights.

9.3 Return Flows and Environmental Flows

Return flows are the portion of diverted waters of the state that are not consumed and are returned to a watercourse. Historically, the regulation of return flows has been limited to water quality standards established by the state. But since the passage of Senate Bill 1, the role of return flows in the aquatic environment of a watershed has become a consideration in the indirect reuse permitting process. Presently, since no surface water permitting process is required for direct reuse projects, environmental flows are not a regulatory consideration in defining direct reuse projects. However, the passage of Senate Bill 3 has established processes for each river basin in Texas to develop environmental flow standards specifying flow requirements to maintain a sound ecological environment at various locations within the river basins, as well as estuarine flow requirements for Texas' coastal estuarine systems. Such standards have been developed and adopted for the Sabine, Neches, Trinity, San Jacinto, Colorado, Lavaca, Guadalupe, and San Antonio river basins, and are in the process of being developed elsewhere.

The development of such environmental flow standards has largely been based on statistical analyses of historic hydrologic data in the component watersheds comprising these river basins. Depending upon the watershed and the process employed by the stakeholders and their scientific experts, the historic period of streamflow analyzed may be from conditions in the early 1900's through recent hydrologic streamflow conditions. It is important to recognize that these historic flows include varying levels of historic return flows. As such, the specified environmental flow criteria within the standard may include an implicit assumption of some level of return flows. Consequently, the adopted environmental flow criteria may potentially impact the availability and reliability of indirect reuse water in a particular watershed.

In March 2013, a U.S. District Court judge issued an opinion that the State's management of water rights in the Guadalupe Basin has adversely affected the critical habitat of whooping cranes in the Aransas National Wildlife Refuge on the Texas Gulf Coast (The Aransas Project v. Shaw, 2013). The ruling enjoined TCEQ from issuing new water permits in the Guadalupe River Basin until the State can assure the Court that permits will not violate the Endangered Species Act by "taking" whooping cranes. The court also ordered the TCEQ to seek a Habitat Conservation Plan (HCP) that could result in an incidental take permit. While the Court ruling is subject to appeal, current state and federal regulations affecting environmental flows in the San Marcos River remain in effect and do not affect the development or expansion of direct reuse projects.

9.4 Interlocal Agreements

Under Chapter 791 of the Texas Government Code, local governments are authorized to contract with agencies of the state for a broad range of governmental functions and services. An interlocal agreement (ILA) can include a broad range of administrative and governmental functions and services in which the participating agencies share an interest. As presented in Section 7, development of a diversion point at the WWTP for university water rights presents the advantages of a lower cost of reclaimed water while meeting the maximum day demands of all users and would allow the maximum volume of water to remain in the San Marcos River through the areas of critical habitat during all sprinflow regimes. An ILA would provide the framework for the cooperative agreement between the city and university.

10 Implementation Strategy

A plan to expand the reclaimed water system in the City of San Marcos would focus on optimizing the reclaimed water pipeline alignments to efficiently serve industrial, commercial, and public reclaimed water demands. The implementation strategy summarizes the various actions and a proposed schedule to develop a program for design, construction, and operation of an expanded reclaimed water system.

Development of an expanded reclaimed water system will involve identifying viable alternatives for capital funding, implementation of appropriate policies and procedures and adoption or modification of existing ordinances. Expansion of reclaimed water service will require application of the management, operation, and maintenance procedures and processes presently in use in the city's water and wastewater utilities.

10.1 Financial Status of the City

This section summarizes the city's financial capability for undertaking a project that will expand the reclaimed water system. A more thorough analysis of the financial capacity of the city would be developed before the city prepares applications for grants or low interest loans.

The city's economy remained relatively stable during the recession that began in 2008. According to the city's 2012 Comprehensive Annual Financial Report (CAFR), tourism, retail and construction activities continue to show signs of growth with the local community benefitting from a stable, diversified economic base that includes a major university, a regional retail center, and tourist destination.

Low mortgage interest rates and new residential developments in San Marcos added more than $131 million (4.8%) in new valuations to the property tax roll in 2012 with $80 million of that total being new construction. The city maintains a targeted economic development effort that focuses on industry segments that complement the existing business mix.

The city's underlying credit rating was confirmed by Standard & Poor’s in October 2012. The city’s bond rating for revenue bonds for its water and sewer utility operations is A1 by Moody's Investor Services and AA- by Standard & Poor's. The city's water and wastewater utility has gross revenues of approximately $28.1 million in FY 2012, with M&O expenses of $15.3 million. Revenue bond coverage for FY 2012 was 1.28 percent.

10.2 Implementation Schedule

Project implementation should proceed in a logical, step-by-step approach, beginning with a public and political consensus on the need for the project and the framework in which the project would be developed. The initial steps toward implementation should include:

1. Secure inclusion of the reclaimed water expansion project in the Region L Regional Water Plan and the State Water Plan.

2. Conduct a review of establishing a diversion point for TxSt water rights at the WWTP. The review should include TCEQ, USFWS, and EAA in addition to TxSt and the City of San Marcos.
3. Initiate meetings through youth sports leagues, HOAs, and civic associations to disseminate information regarding the purposes of reclaimed water and the project costs.
4. Negotiate commitments for reclaimed water with potential users.
5. Incorporate the project into the city's CIP.
6. Seek funding opportunities and partnership with regional entities.
7. Public outreach should continue throughout the implementation process with the following key elements:
   a. Involve the public throughout the project implementation with opportunities for comment. Managing expectations becomes more than answering whether the project is on budget and on schedule, it is also important to provide a clear reminder that the primary purpose of the project is to expand the city's water supply.
   b. Address public concerns that arise with complete candor using all available scientific and regulatory information.

10.2.1 Project Implementation

The following summarizes the schedule for implementing the reclaimed water system expansion project:

2013

1. Conduct a review of the feasibility study with the City Council.
2. Disseminate public information and conduct public meetings on the findings of the feasibility study.
3. Outline additions and revisions to the code of ordinances and utility policies and procedures.
4. Negotiate commitments for reclaimed water use with public and private sector users.
5. Begin development of a project funding plan, including debt issuance schedule and application for state or federal grants and/or loans.
6. Initiate a request to amend the Region L Regional Water Plan and State Water Plan to include the reclaimed water system expansion as a recommended water management strategy for the City of San Marcos.

2014

1. Incorporate the reclaimed water system project and park irrigation systems into the CIP.
2. Disseminate public information regarding project schedule and funding.
3. Develop amendments to city ordinances, policies and procedures for reclaimed water use.
4. Complete project funding plan. Establish schedule for debt issuance and applications for state or federal grants and/or loans.
5. Complete negotiations for reclaimed water user commitments.
6. Complete the design of the Phase 1 extension to Texas State University.

7. Obtain TxDOT and railroad permits for pipeline crossings.
8. Complete environmental and cultural resources assessments.
9. Design Phase 1 facilities.
10. Obtain authorizations required under 30 TAC §210.

2015

1. Begin construction of Phase 1 facilities.
2. Develop funding plans for park irrigation systems.

2016

1. Design park irrigation systems for Phase 2.

2017

1. Begin installation of park irrigation systems to receive reclaimed water.
2. Install Phase 2 high service pump.

2019

1. Obtain TxDOT and railroad permits for pipeline crossings for Phase 3.
2. Complete environmental and cultural resources assessments.
3. Complete design of Phase 3 extension to Gary Ball Fields.

2020

1. Begin construction of Phase 3.

2030

1. Begin design of Phase 4 extension to the San Marcos soccer complex.
2. Obtain TxDOT and railroad permits for pipeline crossings for Phase 4.
3. Complete environmental and cultural resources assessments.

2031

1. Begin construction of Phase 4.

10.3 Project Funding Alternatives

This section presents a summary of potential funding opportunities for expansion of the reclaimed water system and a discussion of the administrative issues to be addressed as part of implementation planning. Implementation of the reclaimed water utility can occur in phases to take advantage of the full capacity of the existing system. The actual scope and timing of each phase will depend on development of user facilities and the availability of funding for construction of the necessary infrastructure.

The terms "financial" and "economic" analysis are often used interchangeably when discussing project implementation. However, the terms describe very different aspects of project implementation in that a project can be economically viable, but due to lack of funds, financially infeasible. Economic analysis refers to the evaluation on a societal level of costs and benefits of a project. When benefits equal or exceed costs for a project, the project is deemed economically viable. To be financially viable, a project must have the funds necessary for implementation including construction, operation and maintenance (O&M), and recurring costs.

This summary of funding opportunities is intended to address the financial viability of a reclaimed water system by identifying and describing funding sources that can assist in funding the implementation of the project. It should be noted that timing is a significant factor when seeking multiple funding sources. Funding sources may not have available funds or the application dates may occur before a project has the necessary information available to submit an application.

This section summarizes the major funding sources with potential for application in implementing recycled water projects. The local, state, and federal government funding mechanisms for reclaimed water projects are summarized below.

Project funding mechanisms for capital projects typically involve:

- Cash (collected as user fees or general revenue)
- Bonds and Certificates of Obligation
- State Revolving Fund (Loans)
- Grants

These types of funding mechanisms are also applicable to reclaimed water projects. A brief description of these types of funding mechanisms is provided below.

Cash: Cash includes revenues from operations and ad valorem taxes plus interest income minus operating expenses and debt service charges. The sources of revenues could include utility service charges and property taxes.

Bonds and Certificates of Obligation: There are two types of bonds available to support reclaimed water projects. Revenue bonds are those funded by the service fees and charges paid by the city's utility customers. General obligation bonds that are guaranteed by the property taxing authority of the city are another common debt instrument. Under Chapter 271 of the Local Government Code, cities are authorized to issue certificates of obligation (CO) that are guaranteed by the taxing authority of the city.

Loans: Loans are available from a variety of sources including the state Clean Water Revolving Fund (CWSRF) and the Water Infrastructure Fund (WIF). SRF loans are administered by the Texas Water Development Board and are intended to fund a variety of projects. SRF programs can offer low interest loans, as well as refinancing of existing debt under certain conditions.

Grants: Grants are typically money from governmental agencies for specific projects and require no repayment.

Potential State Funding Mechanisms

The following sections describe specific state programs that may be available for implementing a reclaimed water system.

Texas Water Development Board (TWDB)

Clean Water State Revolving Fund and Drinking Water State Revolving Fund

Both the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) provide loans at below-market interest rates for planning, designing, and constructing wastewater and water utility infrastructure, including water reuse projects.

Prospective loan applicants submit project information to TWDB that describes their existing facilities, facility needs, the nature of the project being considered, and project cost estimates. This information is used to rate each proposed project and place prospective projects in priority order on the project priority list in the Intended Use Plans. Fundable projects lists for the CWSRF and DRWSRF are established, and available funds are distributed in accordance with the funding order specified in the Intended Use Plans. All applicants on the fundable projects lists are notified and invited to submit complete applications within three months of the date of the invitation letter. Applicants are encouraged to schedule a pre-application conference that will guide them through the CWSRF and DRWSR application processes. The fundable projects lists are revised as projects decline or funding becomes available. Invitations are then sent to the next eligible applicant on the lists.

The CWSRF offers fixed rate loans at subsidized interest rates with a maximum loan repayment period of 30 years from the completion of project construction. A cost-recovery loan origination fee of 1.85% is imposed to cover administrative costs of operating the Fund. Applicants have the option to finance the origination fee in their loan. The DWSRF offers similar loan arrangements, but with a maximum repayment period of 20 years and a 2.25% loan origination fee.

The TWDB offers subsidies to applicants in the form of loan forgiveness (similar to grants) on a limited basis. In order to receive loan forgiveness, applicants must be included in the Intended Use Plan (IUP) as an eligible Green Project Reserve (GPR) project and be invited to apply for the subsidy. The GPR is intended to fund projects that:

- utilize green or soft-path practices to complement and augment hard or gray infrastructure,
- adopt practices that reduce the environmental footprint of water and wastewater treatment, collection, and distribution,
- help utilities adapt to climate change,
- promote innovative approaches to water management problems

The GPR can be used for planning, design, and/or construction activities that advance one or more of the objectives in the categories of Green Infrastructure, Water Efficiency, Energy Efficiency, and Environmentally Innovative. Water reuse is among the projects considered as categorically qualified for GPR funding. Categorically qualified projects must demonstrate at savings in energy, an increase in water efficiency, or utilize green stormwater practices that demonstrate new or innovative approaches to sustainable water management.

Water Infrastructure Fund (WIF)

Projects must be specifically recommended water management strategies in the most recent TWDB approved regional water plan or approved State Water Plan. A semi-annual priority rating process applies. Loans for planning, design, and construction can be funded through the WIF. All loans through the WIF are offered at a subsidized interest rate that was most recently 100 basis points below the TWDB cost of funds. Repayment periods are a maximum of 20 years. Presently, the WIF has no available funds until appropriations are received from the Legislature

Water Development Fund II (DFund)

The DFund can be used for planning, acquisition and construction of water related infrastructure, including water supply, wastewater treatment, stormwater and nonpoint source pollution control, flood control, reservoir construction, storage acquisition, and agricultural water conservation projects, and municipal solid waste facilities. This is essentially a pure state loan program that does not receive Federal subsidies, and is the more streamlined of the agency programs. The interest rate on a Texas Water Development Fund loan varies depending on market conditions, with bonds sold by TWDB as needed to fund eligible projects. Currently, the lending rate scales are set 0.40 percent above the TWDB's borrowing cost.

State Water Implementation Fund for Texas (SWIFT)

The SWIFT is part of a broad package of legislation from the 83rd Legislature developed to provide state funding for projects in the State Water Plan. Approved by voters on November 5, 2013 as an amendment to the Texas Constitution, initial funding of the SWIFT is by way of $2 billion from the economic stabilization fund.

The legislation references funding projects on the 2011 regional water plan list, but the draft 2016 lists will be available about the same time the SWIFT funds become available. Adoption of the TWDB rules for SWIFT is expected by March 2015. The subsidy for the SWIFT will be established over the next 18 months. The subsidy is capped so that entities, such as local governments, will have to pay at least half of the interest rate for TWDB's cost of funds.

The regional water planning group (RWPG) stakeholder committee is scheduled to submit project prioritization criteria to the TWDB by December 1, 2013. Loan rates are yet to be determined, but could be similar to the WIF, that is 1 percent below the TWDB costs of funds.

Edwards Aquifer Authority (EAA)

Conservation Grants

The Authority's Groundwater Conservation Grant Program, introduced in 2009, is an annual program to improve water use efficiency across the region. Through this program, municipal Edwards Aquifer permit holders can apply to the Authority for grant funding to cover up to half the projected costs of qualified conservation programs and Best Management Practices (BMPs) that result in savings of Edwards groundwater. Funding has been limited to about $300,000 per year.

U.S. Bureau of Reclamation (Reclamation)

Reclamation Wastewater and Groundwater Study and Facilities (Title XVI)

Reclamation provides funding for both the planning and construction of water recycling projects. Planning funds may be made available for either appraisal or feasibility level study efforts.

Currently, Reclamation funds for water recycling and reuse are appropriated under the authority of the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992 (Title XVI of Public Law 102-575 as amended). Reclamation funding for Title XVI is subject to the availability of congressionally appropriated funds. Generally, Title XVI authorizes the Federal government to fund up to 25 percent of the capital cost of authorized water recycling projects, up to a maximum of $20 million per project.

Federal construction funds are provided only for projects specifically authorized by Congress pursuant to the various sections of Title XVI. Reclamation makes funding recommendations on construction of authorized projects in the President's annual budget request to Congress. Projects not yet authorized for construction require specific congressional authorization before Congress can appropriate funds through the Title XVI program.

Before Congress will authorize a project that meets the definition in Title XVI, the following prerequisites must be met:

- A feasibility report that complies with the provision of Title XVI must be completed by Reclamation or the non-Federal project sponsor.
- The Secretary of Interior has determined that the non-Federal project sponsor is financially capable of funding its share of the project costs.
- Project compliance with the National Environmental Policy Act and other environmental laws.
- The Secretary of Interior has approved a cost-sharing agreement with the non- Federal project sponsor that commits the non-Federal project sponsor to funding its proportionate share of the project construction costs on an annual basis.

Reclamation does not make recommendations to Congress on Title XVI project authorizations. Project sponsors must work with their local Congressional delegation to receive project authorization. When and if a project is authorized, project sponsors will be eligible to receive competitive grants under the WaterSMART program, contingent upon appropriations. Project sponsors should coordinate with their local Reclamation office to find out about the status of program funding.

Depending on the number of funding requests, a delay of several years may be expected due to the Congressional pace and schedule. Continuation of funding from one fiscal year to the next may also be an issue as it is at the discretion of Congress. Also, due to limited budgets, not all projects may receive a full 25 percent federal participation. In accordance with Title XVI and other federal laws, priority will be given by Reclamation to projects that:

- reduce, postpone, or eliminate development of new or expanded water supplies;
- reduce or eliminate the use of existing diversions from natural watercourses;
- reduce the demand on existing federal water supply facilities;
- improve surface or groundwater quality, or the quality of effluent discharges, except where the purpose is to meet surface discharge requirements;

- help fulfill Reclamation’s legal and contractual water supply obligations;
- serve the federal environmental interests in restoring and enhancing habitats and providing water for federally threatened and endangered species;
- promote and apply a regional or watershed perspective;
- serve a small, rural, or economically disadvantaged community; and
- provide significant economic benefits.

10.4 Project Implementation Considerations

This section discusses some of the additional administrative actions involved in expanding the reclaimed water system.

10.4.1 Chapter 210 Reclaimed Water Use Notification

Chapter 210 regulations (30 TAC §210) assign specific responsibilities to the reclaimed water producer, the reclaimed water provider, and the reclaimed water user. The specific responsibilities of each party as designated by the Chapter 210 regulations are summarized in the following points.

- The responsibilities of the city as the reclaimed water producer include ensuring that the quality of the reclaimed water that leaves the treatment process meets the minimum quality prescribed by state regulations, and for sampling, analyzing, and reporting the quality of reclaimed water produced.
- As the reclaimed water provider, the city is also responsible for the delivery of reclaimed water to the user that meets the minimum quality prescribed by state regulations and for maintaining records of the volume and quality of reclaimed water delivered to the user.
- Each reclaimed water user is responsible for the proper use of reclaimed water.

10.4.2 Policies and Procedures

The current reclaimed water policies are codified in the city’s code of ordinances. The policies and procedures provide guidance for the installation, operation and maintenance of both city-owned facilities and customer facilities. The following list includes several additional policies and procedures to consider as part of the project implementation.

- Reclaimed water system design specifications;
- Site inspection authority;
- Enforcement policies;
- Cost recovery policies and pricing structure;
- Reclaimed water system standard operating procedures;
- System record keeping and reporting procedures;
- Emergency procedures plan; and

- Park irrigation standard operating procedures.

Certain aspects of a reclaimed water utility may necessitate modification of existing ordinances or adoption of new ordinances. These may include:

- Consider a reclaimed water contract structure where payment by the user is unconditional on whether the contract volume is actually used. This type of contract would aid in managing peak to average demand capacity of the system.
- Include reclaimed water services in the city's rate and fee ordinance; and
- Changes to Chapter 86, Article 9 of the San Marcos Code of Ordinances to include:
  - Minimum separation distances between reclaimed and potable water lines or wastewater mains; and
  - Establish design requirements to provide the necessary appurtenances for draining reclaimed water storage tanks to the city's wastewater collection system.

10.5 Preliminary Project Funding Plan

Funding for the design and construction of the expansion of the reclaimed water system can be phased over a period of years using city issued debt or can be financed using a combination of federal grants, state loans, and city issued debt. A plan proposed for the project assumes that the city would be successful in securing Title XVI grant funding in an amount of 25% of the total project cost and that the remaining 75% of the project cost could be funded through the SWIFT administered by the TWDB, provided the constitutional amendment is approved by voters and the Region L Regional Water Plan and State Water Plan include expansion of the reclaimed water system as a recommended water management strategy for the City of San Marcos.

Certain assumptions were used in the development of the preliminary funding plan. These include:

- Peak demand supply will be met using seasonal storage.
- Seasonal storage will be built in 2017
- Construction of the expanded reclaimed water system will be in 4 phases.
- Full reclaimed water demand is realized at each phase.
- SWIFT interest rates at 2.85% for a period of 20 years.

The preliminary funding plan is shown in Table 10-1.

Table 10-1. Preliminary funding plan.

Year	Annual Demand (MG)	Capital Cost	Title XVI Grant Funding	SWIFT Financing	Annual Debt Service	Annual O&M Costs	Unit Cost ($/AF)	Unit Cost ($/kgal)
2015	526.73	$ 3,128,400	$ 782,100	$ 2,346,300	$ 154,045	$ 124,557	$ 172.35	$ 0.53
2017	78.55	6,555,000	1,638,750	4,916,250	476,817	334,772	436.92	1.34
2020	30.53	4,647,600	1,161,900	3,485,700	705,668	500,411	618.11	1.90
2032	56.05	7,737,800	1,934,450	5,803,350	1,086,683	750,264	865.17	2.66
Total	691.86	$22,068,800	$5,517,200	$16,551,600	$1,086,683	$ 750,264	$ 865.17	$ 2.66

As a comparison to the phased approach, Table 10-2 illustrates the effect of the system expansion designed, funded and constructed as a single project.

Table 10-2. Alternative funding plan.

Year	**Annual Demand (MG)**	**Capital Cost**	**Title XVI Grant Funding**	**SWIFT Financing**	**Annual Debt Service**	**Annual O&M Costs**	**Unit Cost ($/AF)**	**Unit Cost ($/kgal)**
2015	526.73	$22,068,800	$ 5,517,200	$16,551,600	$1,086,683	$ 124,557	$749.31	$ 2.30
2017	78.55	-	-	-	1,086,683	334,772	765.24	2.35
2020	30.53	-	-	-	1,086,683	500,411	813.38	2.50
2032	56.05	-	-	-	1,086,683	750,264	865.17	2.66

Willingness to pay

Formal actions on the part of the City of San Marcos to proceed with design and construction of the reclaimed water system expansion begin with the inclusion of the project in the city's Capital Improvements Plan. Once included in the CIP, a schedule for project design and funding would be developed. The city's construction of the existing reclaimed water system and subsequent extensions of service to major industrial customers, along with the local funding of the feasibility study are indicative of the city's continuing support for developing reclaimed water as a water supply strategy.

10.6 Reclaimed Water Pricing

A “cost of service” methodology is the typical standard for setting utility rates where utility rates include the full system operation and maintenance costs, as well as recovery of the capital costs. Rates are charged to different customer classes on the basis of how their use of the service drives system costs. However, there are certain aspects of developing reclaimed water rates that makes the process different from that of typical utility rate designs. Utilities that provide reclaimed water utility service typically do so as part of a broader public purpose of minimizing demands on limited or higher cost potable supplies, as part of the utility's wastewater treatment and disposal operation, and to enhance the aesthetic appeal of the community by encouraging landscape irrigation.

The rate-making process for reclaimed water is also different from potable water in that potable water is a readily available substitute for reclaimed water. With a choice of equal commodities, the logical consumer response is for a consumer to use that which has the lowest price (Casey, 2006).

As a supplement to potable water, reclaimed water can provide a drought-resistant water source that can benefit future water utility customers by reducing water demand attributable to irrigation. This has the effect of extending the city’s potable water supplies. Future customers could be expected to share in the cost of developing a reclaimed water system as part of the overall cost of securing water sources for the future potable water demand.

10.7 Research Needs

Expansion of the San Marcos reclaimed water system will not require additional research in order to implement the project. The proposed project is developed to rely on proven technologies for the treatment, pumping, and transmission of reclaimed water.

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12 Appendices

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Appendix A
Reclaimed Water Demand

Facility	No.	Street	Average Annual Demand (gal.)	Avg. Day Demand (gpd)	Avg. Month Vol. (gal.)	Peak Month Vol. (gal.)	Peak Day Demand (gpd)
City Facilities							
Activity Center / Library	501	E HOPKINS ST	1,052,244	2,765	150,321	184,700	17,016
Baseball Complex (proposed)		HWY 80	13,962,990	56,992	1,994,713	5,067,976	198,649
Bicentennial Bed	628	HOPKINS ST	133,606	545	19,087	47,184	1,901
Bicentennial Park	209	CM ALLEN PKWY	595,038	546	85,005	215,974	3,357
Children's Park	205	CM ALLEN PKWY	2,077,245	8,479	296,749	753,952	29,553
City Hall	630	E HOPKINS ST	1,033,252	2,505	147,607	269,700	31,085
City Park	170	CHARLES AUSTIN DR	5,765,641	8,518	823,663	2,092,684	34,058
Clock Tower/Alameda Park	500	CARLSON CIRCLE	2,231,214	9,107	318,745	809,837	31,743
Cocke House/Veramendi Plaza	400	E HOPKINS ST	1,927,608	5,416	275,373	423,200	46,398
Crook Park	420	RIVERSIDE DR	2,763,240	11,279	394,749	1,002,940	39,312
Downtown Beds	114	N. LBJ	257,584	591	36,798	44,028	2,058
Downtown Beds	118	E. SAN ANTONIO ST	279,163	271	39,880	32,165	944
Downtown Beds	127	E HOPKINS ST	340,220	1,090	48,603	107,500	3,800
Downtown Beds	137	N. GUADALUPE	329,394	846	47,056	115,633	2,949
Fire Station No. 5	100	CARLSON CIRCLE	1,408,308	5,337	201,187	304,764	18,601
Gary Ball Fields	2600	HWY 21	4,883,471	35,771	697,639	1,047,418	121,718
Gary Ball Fields	2600	HWY 21	1,201,123	8,798	171,589	156,080	29,914
Jose Lucio Ball Fields/Ramon Lucio Park	601	601 S CM ALLEN PKWY	8,753,721	35,729	1,250,532	3,177,231	124,538
Nature Center (incl. with Crook Park)	430	RIVERSIDE DR	86,988	232	12,427	22,510	809
Old Fish Hatchery/San Marcos Plaza	202	N CM ALLEN PKWY	2,835,561	11,574	405,080	1,029,189	40,341
Power Plant Beds	709	AQUARENA SPRGS. DR.	345,223	981	49,318	369,300	3,420
Rio Vista Park	205	CM ALLEN PKWY	648,154	1,838	92,593	204,200	6,407
Rio Vista Park	205	CM ALLEN PKWY	491,833	1,800	70,262	119,248	6,275
Sculpture Garden	501	E HOPKINS ST	490,891	1,721	70,127	106,714	5,998
Soccer Fields	4440	OLD STAGECOACH RD	9,925,680	63,929	1,417,954	24,980,020	106,940
Swift Memorial Park	200	MONTERREY ST.	160,395	655	22,914	58,217	2,282
Veterans Memorial	450	E HOPKINS ST	126,210	712	18,030	47,584	1,525
Veterans Park	320	MARIPOSA ST.	1,765,781	7,207	252,254	640,904	25,121
Welcome Sign	600	E HOPKINS ST	100,733	380	14,390	43,100	634
Subtotal			*73,061,414*	*314,548*	*10,437,345*	*46,046,924*	*1,038,200*
TSU Facilities							
TSU Ball Fields	225	CHARLES AUSTIN DR	3,299,972	6,287	471,425	1,197,750	41,463
Bobcat Stadium Track	1200	AQUARENA SPRINGS DR	1,181,718	3,238	168,817	428,914	25,540
Intramural Fields	821	AQUARENA SPRINGS DR	1,315,629	5,627	187,947	477,518	28,424
Intramural Fields	821	AQUARENA SPRINGS DR	765,792	4,369	109,399	277,950	18,529
Co-Gen Chill Plant			104,411,156	280,675	8,700,930	15,612,324	490,579
East Chill Plant			24,069,880	66,741	2,068,967	4,917,720	110,760
West Campus Chill Plant			16,811,330	62,638	1,941,783	3,072,240	63,814
South Chill Plant			24,328,220	65,398	1,448,108	3,044,580	89,230
Subtotal			*176,183,697*	*494,973*	*15,097,374*	*29,028,996*	*868,339*
School Facilities							
Blanco Vista ES	2951	BLANCO VISTA BLVD	1,030,644	4,207	147,235	374,080	18,824
Bowie ES	4020	MONTERREY OAK ST	1,018,714	4,773	145,531	380,512	27,934
Goodnight MS	1301	HWY 123	1,413,639	5,878	201,948	561,000	36,352
Goodnight MS	1301	HWY 123	1,089,307	8,147	155,615	400,100	22,679
San Marcos HS	2601	RATTLER RD	12,439,578	56,494	1,777,083	2,648,600	157,263
Subtotal			*16,991,882*	*79,499*	*2,427,412*	*4,364,292*	*263,052*
Commercial - Industrial Facilities							
CTMC	1301	WONDER WORLD DR	807,580	3,296	115,369	293,118	16,626
CTMC	1301	WONDER WORLD DR	1,161,558	4,741	165,937	421,597	14,567
Embassy Suites	1001	E MCCARTY LN	587,885	2,400	83,984	213,378	14,399
Power Plant[1]	1601	FRANCES HARRIS LN	66,320,541	2,000,000	9,474,363	834,226	2,600,000
Concrete Products Plant	5700	S IH 35	18,636,373	40,060	2,662,339	1,622,182	87,943
Ready Mix	3830	S IH 35	3,150,654	10,874	450,093	337,103	19,453
Shopping Center 1	3943	S IH 35	2,427,275	9,907	346,754	880,998	15,928

Appendix A
Reclaimed Water Demand

Facility		No.	Street	Average Annual Demand (gal.)	Avg. Day Demand (gpd)	Avg. Month Vol. (gal.)	Peak Month Vol. (gal.)	Peak Day Demand (gpd)
Shopping Center 2		4015	S IH 35	3,500,378	14,287	500,054	1,270,489	13,415
TXI[2]		7781	FM 1102	197,400,000	700,000	28,200,000	21,700,000	700,000
	Subtotal			*293,992,244*	*2,785,566*	*41,998,892*	*27,573,091*	*3,482,332*
HOA Facilities								
Blanco Vista HOA		4040	TRAIL RIDGE PASS	1,184,135	4,833	169,162	429,791	37,292
Blanco Vista HOA		2711	BLANCO VISTA BLVD	4,609,413	18,814	658,488	1,673,023	51,667
Blanco Vista HOA		2997	BLANCO VISTA BLVD	1,734,358	7,079	247,765	629,499	30,928
Blanco Vista HOA		405	EASTON DR	3,926,952	16,028	560,993	1,425,318	69,640
Blanco Vista HOA		3151	BLANCO VISTA BLVD	2,602,042	10,621	371,720	944,431	41,174
Blanco Vista HOA		3155	BLANCO VISTA BLVD	1,840,664	7,513	262,952	668,083	23,470
Paso Robles[2]				71,604,419	196,176	10,229,203	12,522,067	1,200,000
	Subtotal			*87,501,982*	*261,065*	*12,500,283*	*18,292,212*	*1,454,171*
	TOTAL			**647,731,219**	**3,935,651**	**82,461,306**	**125,305,515**	**7,106,093**

[1] Existing RW User

[2] RW Contract

Appendix B.1
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: Phase 1
Project Year: 2015
Detailed Description: Construction of 16-in. diameter pipeline from the existing reclaimed water pipeline to the TxSt delivery point at Moon and University.
Project Purpose: Extend reclaimed water service to Texas State University thermal plants.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	16-inch C900 Pipe	12,400	LF	$ 105.00	$ 1,302,000
2	8-inch C900 Pipe	400	LF	90.00	36,000
3	6-inch Flow Control Valve	1	EA	8,600.00	8,600
4	8-inch Flow Control Valve	1	EA	15,000.00	15,000
5	12-inch Flow Control Valve	1	EA	30,000.00	30,000
6	16-inch Gate Valve	1	EA	3,300.00	3,300
7	Combination Air Release/Vacuum Relief Valve	3	EA	2,000.00	6,000
8	TxDOT ROW Crossing (bore & encase)	540	LF	460.50	248,670
9	Railroad ROW Crossing (bore & encase)	500	LF	460.50	230,250
10	Creek/River Crossing (bore & encase)	200	LF	460.50	92,100
11	Disinfection Sampling Port	1	EA	3,000.00	3,000
12	Meter Vault	1	EA	40,000.00	40,000
13	SCADA	1	LS	50,000.00	50,000

SUBTOTAL		$ 2,064,920
CONTINGENCY	30%	619,476
LAND/ROW		
ENGR/SURVEY	15%	402,659
PERMITTING	2%	41,298
PROJECT TOTAL		$ 3,128,400

Appendix B.2
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: Phase 2
Project Year: 2017

Detailed Description: Addition of high service pump required for city and university irrigation uses.

Project Purpose: Increase pumping and supplemental supply capacity to extend reclaimed water service to city and university parks and athletic fields for irrigation.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	200 HP Pump and Motor	2	LS	$ 80,106.00	$ 160,212

SUBTOTAL		$ 160,212
CONTINGENCY	30%	48,064
LAND/ROW		
ENGR/SURVEY	15%	31,241
PERMITTING		-
PROJECT TOTAL		$ 239,500

Appendix B.3
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: Phase 3
Project Year: 2020
Detailed Description: Construct 24,000 LF extension of reclaimed water pipeline from the San Marcos WWTP to the Gary Ball Fields; additional high service pumping capacity.

Project Purpose: Extend reclaimed water pipeline to Gary Ball Fields.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	8-inch C900 Pipe	24,200	LF	$ 90.00	$ 2,178,000
2	4-inch C900 Pipe	9,800	LF	63.90	626,220
3	8-inch Gate Valve	1	EA	1,544.80	1,545
4	6-inch Gate Valve	1	EA	1,165.00	1,165
5	4-inch Gate Valve	4	EA	1,134.60	4,538
6	Combination Air Release/Vacuum Relief Valve	6	EA	2,000.00	12,000
7	Disinfection Sampling Port	1	EA	3,000.00	3,000
8	200 HP Pump and Motor	1	LS	80,106.00	80,106
9	Creek/River Crossing (bore & encase)	250	LF	460.50	115,125
10	TxDOT ROW Crossing (bore & encase)	100	LF	460.50	46,050

SUBTOTAL		$ 3,067,749
CONTINGENCY	30%	920,325
LAND/ROW		
ENGR/SURVEY	15%	598,211
PERMITTING	2%	61,355
PROJECT TOTAL		$ 4,647,600

Appendix B.4
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: Phase 4
Project Year: 2032

Detailed Description: Construct approximately 44,000 LF of reclaimed water pipeline and add 3rd. high service pump at WWTP.

Project Purpose: Extend reclaimed water pipeline to the city's soccer complex and to the Blanco Vista HOA.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	8-inch C900 Pipe	43,940	LF	$ 90.00	$ 3,954,600
2	6-inch C900 Pipe	4,910	LF	88.00	432,080
3	4-inch PVC C900	6,300	LF	63.90	402,570
4	6-inch Flow Control Valve	1	EA	8,600.00	8,600
5	8-inch Gate Valve	1	EA	1,544.80	1,545
6	6-inch Gate Valve	3	EA	1,165.00	3,495
7	4-inch Gate Valve	2	EA	1,134.60	2,269
8	Combination Air Release/Vacuum Relief Valve	6	EA	2,000.00	12,000
9	Disinfection Sampling Port	1	EA	3,000.00	3,000
10	Creek/River Crossing (bore & encase)	150	LF	460.50	69,075
11	Railroad ROW Crossing (bore & encase)	200	LF	460.50	92,100
12	TxDOT ROW Crossing (bore & encase)	100	LF	460.50	46,050
13	200 HP Pump and Motor	1	LS	80,106.00	80,106

SUBTOTAL		$ 5,107,490
CONTINGENCY	30%	1,532,247
LAND/ROW		
ENGR/SURVEY	15%	995,961
PERMITTING	2%	102,150
PROJECT TOTAL		$ 7,737,800

Appendix B.5
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: Reclaimed Water System Expansion
Project Year: 2015 - 2032

Detailed Description: Total project cost for reclaimed water conveyance system extension.

Project Purpose:

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	16-inch C900 Pipe	12,400	LF	$ 105.00	$ 1,302,000
2	8-inch C900 Pipe	68,540	LF	90.00	6,168,600
3	6-inch C900 Pipe	4,910	LF	88.00	432,080
4	4-inch C900 Pipe	16,100	LF	63.90	1,028,790
5	6-inch Flow Control Valve	2	EA	8,600.00	17,200
6	8-inch Flow Control Valve	1	EA	15,000.00	15,000
7	12-inch Flow Control Valve	1	EA	30,000.00	30,000
8	4-inch Gate Valve	6	EA	1,134.60	6,808
9	6-inch Gate Valve	4	EA	1,165.00	4,660
10	8-inch Gate Valve	2	EA	1,544.80	3,090
11	16-inch Gate Valve	1	EA	3,300.00	3,300
12	Combination Air Release/Vacuum Relief Valve	15	EA	2,000.00	30,000
13	200 HP Pump and Motor	4	EA	80,106.00	320,424
14	TxDOT ROW Crossing (bore & encase)	740	LF	460.50	340,770
15	Railroad ROW Crossing (bore & encase)	700	LF	460.50	322,350
16	Creek/River Crossing (bore & encase)	600	LF	460.50	276,300
17	Disinfection Sampling Port	3	EA	3,000.00	9,000
18	Meter Vault	1	EA	40,000.00	40,000
19	SCADA	1	LS	50,000.00	50,000

SUBTOTAL		$ 10,400,371
CONTINGENCY	30%	3,120,111
LAND/ROW		
ENGR/SURVEY	15%	2,028,072
PERMITTING		204,803
PROJECT TOTAL		$ 15,753,400

Appendix B.6
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: 105 MG Pond at WWTP
Project Year: 2013

Detailed Description: Seasonal storage for reclaimed water.

Project Purpose: Peak demand supply alternative.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Excavation	520,000	CY	$ 5.82	$ 3,026,400
2	Embankment	30,000	CY	10.40	312,000
3	Scarify and Recompact Bottom	156,000	SY	2.80	437,166
4	Channel Excavation	11,000	CY	7.35	80,850
5	Yard Piping	1	LS	60,000.00	60,000
6	Fountains	3	EA	14,011.72	42,035
7	Constructed Wetland	1	LS	210,175.82	210,176

SUBTOTAL		$ 4,168,627
CONTINGENCY	30%	1,250,588
LAND/ROW		
ENGR/SURVEY	15%	812,882
PERMITTING	2%	83,373
PROJECT TOTAL		$ 6,315,500

Appendix B.7
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

RPS

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: Raw water supply.
Project Year: 2013
Detailed Description: 18-in. connection to raw water pipeline with discharge to 1.25 MG GST. Replace existing RW pumps at WWTP with 2200 GPM pumps and 1000 GPM pumps for raw water.

Project Purpose: Peak demand supply alternative.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	18" DIP	2,250	LF	$ 190.00	$ 427,500
2	18" Gate Valve	1	EA	13,000.00	13,000
3	125 HP Pump & Motor	2	LS	34,282.00	68,564
4	200 HP Pump & Motor	2	LS	80,106.00	160,212
5	Ground Storge Tank	1.25	MG	1.00	1,250,000
6	18" Gate Valve	1	EA	13,000.00	13,000
7	Electrical Wiring, Panel & Controls	1	LS	175,000.00	175,000
8	Structural Slab	300	SF	75.00	22,500
9	Masonry Building	1	LS	45,000.00	45,000
10	Chain Link Fence	350	LF	10.00	3,500
11	SCADA	1	LS	50,000.00	50,000

SUBTOTAL		$ 2,228,276
CONTINGENCY	30%	$668,483
LAND/ROW		$261,360
ENGR/SURVEY	15%	$434,514
PERMITTING	2%	$44,566
PROJECT TOTAL		$ 3,637,200

Appendix B.8
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost — *July 19, 2013*

Project Name: 35 MG Seasonal Storage
Project Year: 2015

Detailed Description: Seasonal storage for reclaimed water.

Project Purpose: Peak demand supply alternative.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Excavation	175,000	CY	$ 5.82	$ 1,018,500
2	Embankment	20,000	CY	10.40	208,000
3	Scarify and Recompact Bottom	55,000	SY	2.80	154,129
4	Channel Excavation	11,000	CY	7.35	80,850
5	Yard Piping	1	LS	60,000.00	60,000

SUBTOTAL		$ 1,521,479
CONTINGENCY	30%	456,444
LAND/ROW		
ENGR/SURVEY	15%	296,688
PERMITTING	2%	30,430
PROJECT TOTAL		$ 2,305,000

Appendix B.9
City of San Marcos
Direct Water Reuse Feasibility Study
Capital Project

Opinion of Probable Construction Cost *July 19, 2013*

Project Name: San Marcos River Intake
Project Year: 2013

Detailed Description: Intake structure for diversion of TxSt municipal and industrial water rights to the San Marcos River.

Project Purpose: Peak demand supply alternative.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	75 HP Vertical Turbine Pump	2	EA	$ 25,181.00	$ 50,362
2	12" PVC C900	300	LF	145.00	43,500
3	12" Gate Valve	2	EA	2,700.00	5,400
4	12" Swing Check Valve	2	EA	4,800.00	9,600
5	2" Air Release Valve	2	EA	500.00	1,000
6	15" DI Pipe	350	LF	155.00	54,250
7	Structural Slab	200	SF	75.00	15,000
8	Earthwork/Excavation/Fill	35	CY	10.40	364
9	Electrical Wiring, Panel & Controls	1	LS	175,000.00	175,000
10	River Intake Structure	1	LS	8,000.00	8,000
11	SCADA	1	LS	50,000.00	50,000
	SUBTOTAL				$ 412,476
	CONTINGENCY	30%			123,743
	LAND/ROW				
	ENGR/SURVEY	15%			80,433
	PERMITTING	2%			8,250
	PROJECT TOTAL				$ 624,900

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Appendix C
O&M Cost Detail

Phase 1 (2013)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Demand	8,286,609	11,568,605	27,825,412	32,485,957	37,024,555	48,629,139	57,794,143	58,822,824	33,767,184	21,884,855	11,069,980	7,952,722	357,111,987
Daily Demand	267,310	413,164	897,594	1,082,865	1,194,340	1,620,971	1,864,327	1,897,510	1,125,573	705,963	368,999	256,539	978,389
Time of Pumping (hrs)	2.2	3.4	7.5	9.0	10.0	13.5	15.5	15.8	9.4	5.9	3.1	2.1	2,975.9
kwh	412.10	636.96	1383.79	1669.42	1841.27	2499.00	2874.17	2925.33	1735.26	1088.36	568.87	395.50	550,547.6
Power Cost/Day	$ 41.21	$ 63.70	$ 138.38	$ 166.94	$ 184.13	$ 249.90	$ 287.42	$ 292.53	$ 173.53	$ 108.84	$ 56.89	$ 39.55	
Monthly Power Cost	$ 1,277.52	$ 1,974.58	$ 4,289.75	$ 5,008.25	$ 5,707.95	$ 7,496.99	$ 8,909.93	$ 9,068.52	$ 5,205.77	$ 3,373.92	$ 1,706.62	$ 1,226.04	$ 55,245.85
Disinfection Costs	$ 194.74	$ 271.86	$ 653.90	$ 763.42	$ 870.08	$ 1,142.78	$ 1,358.16	$ 1,382.34	$ 793.53	$ 514.29	$ 260.14	$ 186.89	$ 8,392.13

Phase 2 (2015)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Demand	14,123,423	20,123,415	38,806,989	46,218,733	54,085,055	67,835,514	75,546,349	81,955,833	49,782,628	37,314,466	22,500,157	18,440,010	526,732,573
Daily Demand	455,594	718,693	1,251,838	1,540,624	1,744,679	2,261,184	2,436,979	2,643,737	1,659,421	1,203,692	750,005	594,839	1,443,103
Time of Pumping (hrs)	3.8	6.0	10.4	12.8	14.5	18.8	20.3	22.0	13.8	10.0	6.3	5.0	4,389.4
kwh	702.37	1107.99	1929.92	2375.13	2689.71	3485.99	3757.01	4075.76	2558.27	1855.69	1156.26	917.04	812,046.0
Power Cost/Day	$ 70.24	$ 110.80	$ 192.99	$ 237.51	$ 268.97	$ 348.60	$ 375.70	$ 407.58	$ 255.83	$ 185.57	$ 115.63	$ 91.70	
Monthly Power Cost	$ 2,177.36	$ 3,102.36	$ 5,982.74	$ 7,125.39	$ 8,338.11	$10,457.98	$11,646.73	$12,634.86	$ 7,674.82	$ 5,752.65	$ 3,468.77	$ 2,842.83	$ 81,204.60
Disinfection Costs	$ 331.90	$ 472.90	$ 911.96	$ 1,086.14	$ 1,271.00	$ 1,594.13	$ 1,775.34	$ 1,925.96	$ 1,169.89	$ 876.89	$ 528.75	$ 433.34	$ 12,378.22

Phase 3 (2017)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Demand	15,745,279	22,348,355	45,173,516	53,555,143	62,297,369	78,960,464	89,304,729	95,423,323	57,224,207	41,603,238	24,286,026	19,482,244	605,277,877
Daily Demand	507,912	798,156	1,457,210	1,785,171	2,009,593	2,632,015	2,880,798	3,078,172	1,907,474	1,342,040	809,534	628,459	1,658,296
Time of Pumping (hrs)	3.8	6.0	11.0	13.5	15.2	19.9	21.8	23.3	14.5	10.2	6.1	4.8	4,585.4
kwh	569.48	894.90	1633.84	2001.56	2253.18	2951.05	3229.99	3451.28	2138.68	1504.71	907.66	704.64	678,644.9
Power Cost/Day	$ 56.95	$ 89.49	$ 163.38	$ 200.16	$ 225.32	$ 295.10	$ 323.00	$ 345.13	$ 213.87	$ 150.47	$ 90.77	$ 70.46	
Monthly Power Cost	$ 1,765.38	$ 2,505.72	$ 5,064.91	$ 6,004.67	$ 6,984.86	$ 8,853.14	$10,012.95	$10,698.98	$ 6,416.05	$ 4,664.61	$ 2,722.98	$ 2,184.37	$ 67,878.62
Disinfection Costs	$ 370.01	$ 525.19	$ 1,061.58	$ 1,258.55	$ 1,463.99	$ 1,855.57	$ 2,098.66	$ 2,242.45	$ 1,344.77	$ 977.68	$ 570.72	$ 457.83	$ 14,226.99

Phase 4 (2020)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Demand	16,375,693	23,211,774	47,644,133	56,402,137	65,484,270	83,277,652	94,643,856	100,649,565	60,112,013	43,267,554	24,979,057	19,886,697	635,808,386
Daily Demand	528,248	828,992	1,536,908	1,880,071	2,112,396	2,775,922	3,053,028	3,246,760	2,003,734	1,395,728	832,635	641,506	1,741,941
Time of Pumping (hrs)	2.0	3.1	5.8	7.1	8.0	10.5	11.6	12.3	7.6	5.3	3.2	2.4	2,408.4
kwh	592.28	929.48	1723.20	2107.96	2368.44	3112.40	3423.09	3640.31	2246.61	1564.91	933.56	719.26	712,876.1
Power Cost/Day	$ 59.23	$ 92.95	$ 172.32	$ 210.80	$ 236.84	$ 311.24	$ 342.31	$ 364.03	$ 224.66	$ 156.49	$ 93.36	$ 71.93	
Monthly Power Cost	$ 1,836.06	$ 2,602.53	$ 5,341.92	$ 6,323.88	$ 7,342.18	$ 9,337.19	$10,611.58	$11,284.95	$ 6,739.83	$ 4,851.21	$ 2,800.68	$ 2,229.72	$ 71,301.74
Disinfection Costs	$ 384.83	$ 545.48	$ 1,119.64	$ 1,325.45	$ 1,538.88	$ 1,957.02	$ 2,224.13	$ 2,365.26	$ 1,412.63	$ 1,016.79	$ 587.01	$ 467.34	$ 14,944.46

Phase 5 (2032)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Demand	17,533,016	24,796,850	52,179,728	61,628,690	71,334,828	91,203,209	104,445,502	110,243,977	65,413,489	46,322,931	26,251,333	20,629,197	691,856,735
Daily Demand	565,581	885,602	1,683,217	2,054,290	2,301,123	3,040,107	3,369,210	3,556,257	2,180,450	1,494,288	875,044	665,458	1,895,498
Time of Pumping (hrs)	1.4	2.2	4.3	5.2	5.8	7.7	8.5	9.0	5.5	3.8	2.2	1.7	1,747.1
kwh	634.14	992.95	1887.24	2303.29	2580.05	3408.60	3777.60	3987.32	2444.75	1675.41	981.11	746.12	775,718.2
Power Cost/Day	$ 63.41	$ 99.29	$ 188.72	$ 230.33	$ 258.00	$ 340.86	$ 377.76	$ 398.73	$ 244.47	$ 167.54	$ 98.11	$ 74.61	
Monthly Power Cost	$ 1,965.82	$ 2,780.25	$ 5,850.45	$ 6,909.88	$ 7,998.15	$10,225.81	$11,710.56	$12,360.69	$ 7,334.24	$ 5,193.78	$ 2,943.33	$ 2,312.97	$ 77,585.94
Disinfection Costs	$ 412.03	$ 582.73	$ 1,226.22	$ 1,448.27	$ 1,676.37	$ 2,143.28	$ 2,454.47	$ 2,590.73	$ 1,537.22	$ 1,088.59	$ 616.91	$ 484.79	$ 16,261.59

SMR Intake	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Intake	0	0	0	0	0	0	71,424,000	0	0	0	0	0	71,424,000
Daily Intake							2,304,000						
Time of Pumping (hrs)							24.0						744.0
kwh							444.00						13,764.0
Power Cost/Day							$ 44.40						
Monthly Power Cost							$ 1,376.40						$ 1,376.40

Raw Water Transfer	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly Transfer	0	0	0	0	0	0	44,640,000	0	0	0	0	0	44,640,000
Daily Transfer							1,440,000						
Time of Pumping (hrs)							24.0						744.0
kwh							1332.00						41,292.0
Power Cost/Day							$ 133.20						
Monthly Power Cost							$ 4,129.20						$ 4,129.20
Disinfection Costs							$ 1,049.04						

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Alternative 1

Reuse Alternative

Year	Total Other Sources	Reuse Capital Costs	Reuse Debt Service	Reuse Power	Reuse O&M	Reuse Treatment	Total Annual Reuse Costs	Total Water Supply Cost
2015	($2,438,072)	($9,502,300)	($544,385)	($136,450)	($127,056)	($20,770)	($828,662)	($3,266,734)
2016	($2,438,072)		($544,385)	($136,450)	($127,056)	($20,770)	($828,662)	($3,266,734)
2017	($2,438,072)	($239,500)	($558,106)	$ (204,329)	($161,108)	($34,997)	($958,541)	($3,396,613)
2018	($2,438,072)		($558,106)	$ (204,329)	($161,108)	($34,997)	($958,541)	($3,396,613)
2019	($2,438,072)		($558,106)	$ (204,329)	($161,108)	($34,997)	($958,541)	($3,396,613)
2020	($2,438,072)	($3,540,300)	($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($3,765,750)
2021	($2,438,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($3,765,750)
2022	($2,438,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($3,765,750)
2023	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2024	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2025	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2026	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2027	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2028	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2029	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2030	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2031	($7,418,072)		($760,929)	$ (275,631)	($241,176)	($49,942)	($1,327,678)	($8,745,750)
2032	($17,378,072)	($5,760,200)	($1,090,930)	$ (353,217)	($397,857)	($66,203)	($1,908,207)	($19,286,279)
2033	($17,378,072)		($1,090,930)	$ (353,217)	($397,857)	($66,203)	($1,908,207)	($19,286,279)
2034	($17,378,072)		($1,090,930)	$ (353,217)	($397,857)	($66,203)	($1,908,207)	($19,286,279)
2035	($17,378,072)		($1,090,930)	$ (353,217)	($397,857)	($66,203)	($1,908,207)	($19,286,279)
2036	($17,378,072)		($546,545)	($353,217)	$ (397,857)	($66,203)	($1,363,822)	($18,741,894)
2037	($17,378,072)		($546,545)	($353,217)	$ (397,857)	($66,203)	($1,363,822)	($18,741,894)
2038	($17,378,072)		($532,824)	($353,217)	$ (397,857)	($66,203)	($1,350,101)	($18,728,173)
2039	($17,378,072)		($532,824)	($353,217)	$ (397,857)	($66,203)	($1,350,101)	($18,728,173)
2040	($17,378,072)		($532,824)	($353,217)	$ (397,857)	($66,203)	($1,350,101)	($18,728,173)
2041	($17,378,072)		($330,001)	($353,217)	$ (397,857)	($66,203)	($1,147,278)	($18,525,350)
2042	($17,378,072)		($330,001)	($353,217)	$ (397,857)	($66,203)	($1,147,278)	($18,525,350)
2043	($17,378,072)		($330,001)	($353,217)	$ (397,857)	($66,203)	($1,147,278)	($18,525,350)
2044	($17,378,072)		($330,001)	($353,217)	$ (397,857)	($66,203)	($1,147,278)	($18,525,350)
								($167,773,811)

Baseline (Potable) Alternative

Year	Total Non-Reuse Sources	Potable Water Treatment, Debt Service & Delivery Costs	Total Water Supply Cost
2015	($2,438,072)	($30,866,342)	($33,304,414)
2016	($2,438,072)	($30,866,342)	($33,304,414)
2017	($2,438,072)	($30,866,342)	($33,304,414)
2018	($2,438,072)	($30,866,342)	($33,304,414)
2019	($2,438,072)	($30,866,342)	($33,304,414)
2020	($2,438,072)	($30,866,342)	($33,304,414)
2021	($2,438,072)	($30,866,342)	($33,304,414)
2022	($2,438,072)	($30,866,342)	($33,304,414)
2023	($7,418,072)	($34,518,342)	($41,936,414)
2024	($7,418,072)	($34,518,342)	($41,936,414)
2025	($7,418,072)	($34,518,342)	($41,936,414)
2026	($7,418,072)	($34,518,342)	($41,936,414)
2027	($7,418,072)	($34,518,342)	($41,936,414)
2028	($7,418,072)	($34,518,342)	($41,936,414)
2029	($7,418,072)	($34,518,342)	($41,936,414)
2030	($7,418,072)	($34,518,342)	($41,936,414)
2031	($7,418,072)	($34,518,342)	($41,936,414)
2032	($17,378,072)	($41,822,342)	($59,200,414)
2033	($17,378,072)	($41,822,342)	($59,200,414)
2034	($17,378,072)	($41,822,342)	($59,200,414)
2035	($17,378,072)	($41,822,342)	($59,200,414)
2036	($17,378,072)	($41,822,342)	($59,200,414)
2037	($17,378,072)	($41,822,342)	($59,200,414)
2038	($17,378,072)	($41,822,342)	($59,200,414)
2039	($17,378,072)	($41,822,342)	($59,200,414)
2040	($17,378,072)	($41,822,342)	($59,200,414)
2041	($17,378,072)	($41,822,342)	($59,200,414)
2042	($17,378,072)	($41,822,342)	($59,200,414)
2043	($17,378,072)	($41,822,342)	($59,200,414)
2044	($17,378,072)	($41,822,342)	($59,200,414)
			($755,550,369)

Alternative 3

Reuse Alternative

Year	Total Non-Reuse Sources	Reuse Capital Costs	Reuse Debt Service	Reuse Power	Reuse O&M	Reuse Treatment	Total Annual Reuse Costs	Total Water Supply Cost
2015	($2,438,072)	($5,735,300)	($328,574)	($137,827)	($76,272)	($20,770)	($563,444)	($3,001,516)
2016	($2,438,072)		($328,574)	($137,827)	($76,272)	($20,770)	($563,444)	($3,001,516)
2017	($2,438,072)	($239,500)	($342,295)	($205,705)	($110,324)	($34,997)	($693,322)	($3,131,394)
2018	($2,438,072)		($342,295)	($205,705)	($110,324)	($34,997)	($693,322)	($3,131,394)
2019	($2,438,072)		($342,295)	($205,705)	($110,324)	($34,997)	($693,322)	($3,131,394)
2020	($2,438,072)	($3,540,300)	($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($3,500,532)
2021	($2,438,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($3,500,532)
2022	($2,438,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($3,500,532)
2023	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2024	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2025	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2026	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2027	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2028	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2029	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2030	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2031	($7,418,072)		($545,119)	($277,007)	($190,392)	($49,942)	($1,062,460)	($8,480,532)
2032	($17,378,072)	($5,760,200)	($875,119)	($354,593)	($304,501)	($66,203)	($1,600,417)	($18,978,489)
2033	($17,378,072)		($875,119)	($354,593)	($304,501)	($66,203)	($1,600,417)	($18,978,489)
2034	($17,378,072)		($875,119)	($354,593)	($304,501)	($66,203)	($1,600,417)	($18,978,489)
2035	($17,378,072)		($875,119)	($354,593)	($304,501)	($66,203)	($1,600,417)	($18,978,489)
2036	($17,378,072)		($532,824)	($354,593)	$ (304,501)	($66,203)	($1,258,122)	($18,636,194)
2037	($17,378,072)		($532,824)	($354,593)	$ (304,501)	($66,203)	($1,258,122)	($18,636,194)
2038	($17,378,072)		($532,824)	($354,593)	$ (304,501)	($66,203)	($1,258,122)	($18,636,194)
2039	($17,378,072)		($532,824)	($354,593)	$ (304,501)	($66,203)	($1,258,122)	($18,636,194)
2040	($17,378,072)		($532,824)	($354,593)	$ (304,501)	($66,203)	($1,258,122)	($18,636,194)
2041	($17,378,072)		($330,001)	($354,593)	$ (304,501)	($66,203)	($1,055,298)	($18,433,370)
2042	($17,378,072)		($330,001)	($354,593)	$ (304,501)	($66,203)	($1,055,298)	($18,433,370)
2043	($17,378,072)		($330,001)	($354,593)	$ (304,501)	($66,203)	($1,055,298)	($18,433,370)
2044	($17,378,072)		($330,001)	($354,593)	$ (304,501)	($66,203)	($1,055,298)	($18,433,370)
								($163,662,212)

Baseline (Potable) Alternative

Year	Total Non-Reuse Sources	Potable Water Treatment, Debt Service & Delivery Costs	Total Water Supply Cost
2015	($2,438,072)	($30,866,342)	($33,304,414)
2016	($2,438,072)	($30,866,342)	($33,304,414)
2017	($2,438,072)	($30,866,342)	($33,304,414)
2018	($2,438,072)	($30,866,342)	($33,304,414)
2019	($2,438,072)	($30,866,342)	($33,304,414)
2020	($2,438,072)	($30,866,342)	($33,304,414)
2021	($2,438,072)	($30,866,342)	($33,304,414)
2022	($2,438,072)	($30,866,342)	($33,304,414)
2023	($7,418,072)	($34,518,342)	($41,936,414)
2024	($7,418,072)	($34,518,342)	($41,936,414)
2025	($7,418,072)	($34,518,342)	($41,936,414)
2026	($7,418,072)	($34,518,342)	($41,936,414)
2027	($7,418,072)	($34,518,342)	($41,936,414)
2028	($7,418,072)	($34,518,342)	($41,936,414)
2029	($7,418,072)	($34,518,342)	($41,936,414)
2030	($7,418,072)	($34,518,342)	($41,936,414)
2031	($7,418,072)	($34,518,342)	($41,936,414)
2032	($17,378,072)	($41,822,342)	($59,200,414)
2033	($17,378,072)	($41,822,342)	($59,200,414)
2034	($17,378,072)	($41,822,342)	($59,200,414)
2035	($17,378,072)	($41,822,342)	($59,200,414)
2036	($17,378,072)	($41,822,342)	($59,200,414)
2037	($17,378,072)	($41,822,342)	($59,200,414)
2038	($17,378,072)	($41,822,342)	($59,200,414)
2039	($17,378,072)	($41,822,342)	($59,200,414)
2040	($17,378,072)	($41,822,342)	($59,200,414)
2041	($17,378,072)	($41,822,342)	($59,200,414)
2042	($17,378,072)	($41,822,342)	($59,200,414)
2043	($17,378,072)	($41,822,342)	($59,200,414)
2044	($17,378,072)	($41,822,342)	($59,200,414)
			($755,550,369)

Public Meeting Notice

The City of San Marcos Public Services Department will hold a public meeting to discuss and obtain public input on a Water Reuse Feasibility Study. The Study will evaluate the feasibility of expanding the existing water reuse system to provide reclaimed water to City facilities, Texas State University and other private sector customers.

The Meeting will be held on
Monday, July 23, 2012
at
6:00 PM
at
The San Marcos Activity Center
501 E. Hopkins
San Marcos, TX 78666

Meeting Agenda

1. Introductions and project overview
2. What is water reuse and history of water reuse in San Marcos
3. Texas Water Development Board Facility Planning Program
4. Study objectives and timeline
5. Reclaimed water quality
6. Questions and comments

The City of San Marcos does not discriminate on the basis of disability in the admission or access to its services, programs, or activities. Individuals who require auxiliary aids and services for this meeting should contact the City of San Marcos ADA Coordinator at 805-2645 (voice) or 393-8229 (TDD), or call Relay Texas at 7-1-1. Requests can also be sent by e-mail to cityhall@ci.san-marcos.tx.us.

Jamie Lee Pettijohn, City Clerk

Published July 18, 2012

NEWS

City to hold public meeting on water reuse

Monday, July 23 at the San Marcos Activity Center

Posted Date: 7/18/2012

City of San Marcos staff will hold a public meeting on Monday, July 23 at 6 p.m. at the San Marcos Activity Center, 501 E. Hopkins, to gather input for a water reuse study that will assess the feasibility of expanding the current reclaim water system.

Currently the City provides treated wastewater, also known as reclaimed water, to Hays Energy for power plant cooling. The City also has agreements to provide reclaimed water in the future to TXI Industries for process water and Paso Robles for golf course irrigation.

The study will investigate the feasibility of further expanding the reclaim water system to City properties for irrigation, and to Texas State University for irrigation and use in cooling towers. The study will also research other potential uses of reclaim water.

The majority of the City's treated wastewater is currently discharged into the San Marcos River. The City treatment process meets the highest quality standards required of Texas cities.

"The City's wastewater plant provides a tertiary level of treatment, resulting in an extremely clean and usable water resource." says Tom Taggart, Director of Public Services for the City of San Marcos. "We need to make the best use of our available water resources, and we believe it makes a lot of sense to use reclaimed water instead of potable water for appropriate uses. We also are very excited to be partnering with Texas State and the Texas Water Development Board to explore this opportunity. "

The study is being funded through a Texas Water Development Board grant, and a partnership between the City and Texas State University.

For more information please contact Jan Klein, City of San Marcos Conservation Coordinator, at jklein@sanmarcostx.gov or 512.393.8310.

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July 19, 2012

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Water reuse options will be studied (http://www.sanmarcosrecord.com/local/x333948867/Water-reuse-options-will-be-studied)

(http://www.sanmarcosrecord.com)

San Marcos — The city is gathering input for a water reuse study that will assess the feasibility of expanding the current reclaim water system.

City staff will hold a public meeting on Monday, July 23 at 6 p.m. at the San Marcos Activity Center, 501 E. Hopkins, to explore ideas.

The city currently provides treated wastewater, also known as reclaimed water, to Hays Energy for power plant cooling. The city also has agreements to provide reclaimed water in the future to TXI Industries for process water and Paso Robles for golf course irrigation.

The study will investigate the feasibility of further expanding the reclaimed water system to city properties for irrigation, and to Texas State University for irrigation and use in cooling towers. The study will also research other potential uses of reclaimed water.

The majority of the city's treated wastewater is currently discharged into the San Marcos River. The city treatment process meets the highest quality standards required of Texas cities, city officials said.

"The city's wastewater plant provides a tertiary level of treatment, resulting in an extremely clean and usable water resource." Tom Taggart, director of Public Services for the city of San Marcos, said. "We need to make the best use of our available water resources, and we believe it makes a lot of sense to use reclaimed water instead of potable water for appropriate uses. We also are very excited to be partnering with Texas State and the Texas Water Development Board to explore this opportunity. "

The study is being funded through a Texas Water Development Board grant and a partnership between the city and Texas State University.

For more information please contact Jan Klein, city of San Marcos conservation coordinator, at **jklein@sanmarcostx.gov (http://jklein@sanmarcostx.gov)** or 393-8310.

Sign in Sheet

City of San Marcos

Water Reuse Feasibility Study

July 23, 2012

NAME	ORGANIZATION	EMAIL
DAVID Meesey	TWDB	
Tom Taggart	CITY OF SAN MARCOS	
Juan Guerra	TxState Facilities	
JOHN FRIEDMAN	KLOTZ ASSOCIATES	john.friedman@klotz.com
RICARDO ZAMARRIPA	KLOTZ ASSOCIATES	RICARDO.ZAMARRIPA@KLOTZ.COM
Jeff Hutchinson		jthutch1950@gmail.com
Jan Klein		
Thomas D Hill	GBRA	thill@gbra.org
Dianne Wassenich	SMRF	
Edra Aji		

Sign in Sheet

City of San Marcos

Water Reuse Feasibility Study

July 23, 2012

NAME	ORGANIZATION	EMAIL
Linda Alexander	citizen	

Community Services
PARKS AND RECREATION DEPT.
PARKS BOARD

Grant Harris, Jr. Bldg
401 East Hopkins
San Marcos, Texas 78666
5:30 P.M.

Regular Meeting

Tuesday, January 22, 2013

I. Call to Order

II. Roll Call

III. Citizen Comment Period – (each individual will be limited to 3 minutes; no specific action may be taken on these items)

IV. Approval of the minutes from the December 11, 2012 meeting

V. **Public Hearing** – Reclaimed Water Usage – Stephen Jenkins, RPS Espey: Solicit public participation and input into the city's Direct Water Reuse Feasibility Study. This study is a cooperative effort of the City of San Marcos, Texas State University and the Texas Ware Development Board to evaluate the supply and additional uses of reclaimed water in San Marcos.

VI. **Discussion** – Planning Development Process – Matthew Lewis, Director of Development Services

VII. **Discussion and/or Recommendation** – Items for Upcoming Agenda: Members of the board may suggest items to be placed on future agendas. The board may reach a consensus regarding which items will be placed on future agendas, but may not discuss the substance of the item or take any action on the item at this meeting.

VIII. Question and Answers with Press and Public

IX. Adjournment

Posted on the 18th day of January, 2013, at 3:48pm

Notice of Assistance at the Public Meetings

The San Marcos Parks and Recreation Department is wheelchair accessible. The entry ramp is located on the right side of the building. Accessible parking spaces are also available in that area. Sign interpretative services for meetings must be made 48 hours in advance of the meeting. Call the Parks and Recreation Department at 512-393-8400 for any special arrangements needed.

PUBLIC NOTICE

The City Council of the City of San Marcos, Texas, will hold a public hearing in the Council Chambers at City Hall, 630 E. Hopkins, at **7:00 p.m.** on **Wednesday, October 2, 2013**, to receive comments for or against the **draft Direct Water Reuse Expansion Feasibility Study.**

The Study evaluates the feasibility of expanding the existing water reuse system to provide reclaimed water for Texas State University cooling towers, for irrigation at City and University properties, and for other private sector uses.

The draft report is available for review at the San Marcos Public Library located at 625 E. Hopkins. The report will be available for review until October 2, 2013. Written comments should be submitted to citizencomment@sanmarcostx.gov.

The City of San Marcos does not discriminate on the basis of disability in the admission or access to its services, programs or activities. Individuals who require auxiliary aids and services for this meeting should contact the City of San Marcos ADA Coordinator at 512-393-8000 (voice) or call Texas Relay Service (TRS) by dialing 7-1-1. Requests can also be faxed to 512-393-8074 or sent by email to ADArequest@sanmarcostx.gov.

Jamie Lee Pettijohn, City Clerk

SAN MARCOS
CITY COUNCIL AGENDA
CITY COUNCIL REGULAR MEETING
630 E. HOPKINS; CITY COUNCIL CHAMBERS
WEDNESDAY, OCTOBER 2, 2013
5:30 P.M.

1. Call To Order

2. Roll Call

3. Receive a Staff presentation and hold discussion regarding the Hunter Road Improvements project from Wonder World Drive to Bishop Street, and provide direction to Staff.

NOTE: *The City Council may adjourn into Executive Session to consider any item listed on this agenda if a matter is raised that is appropriate for Executive Session discussion. An announcement will be made of the basis for the Executive Session discussion. The City Council may also publicly discuss any item listed on the agenda for Executive Session.*

6:00PM

4. Invocation

5. Pledges Of Allegiance - United States And Texas

6. 30 Minute Citizen Comment Period

CONSENT AGENDA

THE FOLLOWING ORDINANCES, RESOLUTIONS AND OTHER ITEMS NUMBERED 7 - 15 MAY BE ACTED UPON BY ONE MOTION. NO SEPARATE DISCUSSION OR ACTION ON ANY OF THE ITEMS IS NECESSARY UNLESS DESIRED BY A COUNCIL MEMBER OR A CITIZEN, IN WHICH EVENT THE ITEM SHALL BE CONSIDERED IN ITS NORMAL SEQUENCE AFTER THE ITEMS NOT REQUIRING SEPARATE DISCUSSION HAVE BEEN ACTED UPON BY A SINGLE MOTION.

7. Consider approval of the September 13, 2013, Special Called Meeting Minutes and the September 17, 2013, Regular Meeting Minutes.

8. Consider approval of Ordinance 2013-56, on the second of two readings, designating a No Parking Tow-Away Zone at all times on both sides of Foxtail Run east of Hunter Road and amending the traffic register maintained under Section 82.067 of the San Marcos City Code to reflect such designation; and including procedural provisions.

9. Consider approval of Ordinance 2013-58, on the second of two readings, establishing a Comprehensive Plan Oversight Committee; establishing the duties of the committee; including

procedural provisions; and providing an effective date.

10. Consider approval of Resolution 2013-147R authorizing the City Manager or his designee to submit an application to the Edwards Aquifer Authority for a Conservation Grant in the amount of $200,000.00 to initiate engineering activities for expansion of the City's reclaimed water system; authorizing the City Manager or his designee to accept the grant, if awarded, and to execute all contracts and documents as necessary to implement the grant; and declaring an effective date.

11. Consider approval of Resolution 2013-148R, approving the purchase of electric materials from Techline, Inc. in connection with the Loop 82 Overpass Project in the estimated amount of $680,000.00 through the City's Material Acquisition Services Agreement with the Lower Colorado River Authority; authorizing the Purchasing Manager to execute the appropriate purchasing documents on behalf of the Cityand declaring an effective date.

12. Consider approval of Resolution 2013-149R approving a contract between the City and the Texas Department of State Health Services, Vital Statistics Unit, for the provision of on-line vital statistic computer services for the City; authorizing the City Manager or his designee to execute the agreement on behalf of the City; and declaring an effective date.

13. Consider approval of Resolution 2013-150R authorizing the City Manager to accept the award of a Emergency Management Performance Grant from the Texas Department of Public Safety Division of Emergency Management (TDEM) for fiscal year 2013 (FY13) in the amount of $27,290.60, and declaring an effective date.

14. Consider approval of Resolution 2013-151R, approving a lease with Martin Marietta Materials Southwest, Inc. leasing the City's right to withdraw 450 acre feet of water from the Edwards Aquifer in exchange for payment to the city of $145,800 in lease payments and payment of Edwards Aquifer Management Fees on the City's behalf in the sum of $37,800; and declaring an effective date.

15. Consider approval of Resolution 2013-152R, authorizing the City Manager to execute a fourth amended and restated contract for collection and disposal of solid waste and recyclable materials with Texas Disposal Systems, Inc. providing for a change in the size of the Base-Rate Garbage Cart from 96 to 65 Gallon capacity; and declaring an effective date.

PUBLIC HEARINGS

16. **7:00PM** Receive a Staff presentation and hold a Public Hearing to receive comments for or against the Water Reuse Expansion Feasibility Study, and provide direction to Staff.

NON-CONSENT AGENDA

17. Consider approval of Ordinance 2013-57, on the second of two readings, amending Chapter 34, Article 5, Division 2 of the San Marcos City Code by adding provisions to prohibit smoking in the enclosed areas of all public places and workplaces; providing exceptions; providing penalties; providing for severability; and providing an effective date.

18. Consider approval of Ordinance 2013-59, on the first of two readings, amending Chapter 66, Article 2 – Residential and Multifamily Collection and Disposal, Section 66.028 by adding a monthly service fee for Residential Solid Waste Service for a Large Trash Cart

consisting of a capacity of 96 gallons, and reducing the size of the Base-Rate Trash Cart from a 96 gallon to a 65 gallon cart; ratifying an increase in the Recycle Drop Off Center rate; including procedural provisions; and providing an effective date.

19. Consider approval of Ordinance 2013-60, on the first of two readings, establishing the San Marcos Commission on Children and Youth; setting forth the duties of the Commission; including procedural provisions; and providing an effective date.

20. Consider approval of Ordinance 2013-61, on the first of two readings, establishing the San Marcos Youth Commission; setting forth the duties of the Commission; including procedural provisions; and providing an effective date.

21. Consider approval of Resolution 2013-132R, approving a State Government Relations Representation Agreement between the City of San Marcos and Winstead, P.C. in a not to exceed amount of $99,000.00 for the two year term of the agreement; authorizing the City Manager or his designee to execute this agreement on behalf of the City and declaring an effective date.

22. Consider approval of Resolution 2013-133R, approving a Federal Governmental Relations Services Agreement between the City of San Marcos and Normandy Group, L.L.C. in a not to exceed amount of $192,000.00 for the two year term of the agreement; authorizing the City Manager or his designee to execute this agreement on behalf of the City and declaring an effective date.

23. Consider approval of Resolution 2013-153R expressing the City’s opposition to a proposed truck stop at the intersection of Yarrington Road and IH-35 access road in the City of Kyle; and requesting Kyle City Officials to deny any legislative recommendations and approvals in support of the truck stop; and declaring an effective date.

24. Consider approval of Resolution 2013-154R approving an Economic Development Incentive Agreement with Mensor Corporation pursuant to Section 1.4.4.1 of the Land Development Code (“LDC”) that grants a waiver of the requirement under Section 7.4.2.3 of the LDC to install sidewalks on both sides of a lot with double street frontage as part of the expansion of the manufacturing facility at 201 Barnes Drive; authorizing the City Manager to execute said agreement on behalf of the City; and declaring an effective date.

25. Consider an appeal filed by Brian Harper d/b/a BRSP, LLC, regarding the Planning and Zoning Commission's decision approving a 6 month Conditional Use Permit to allow on-premise consumption of alcoholic beverages, with conditions, at 202 East San Antonio Street, San Marcos, TX 78666.

26. Consider an appeal filed by HDH, LLC regarding the Planning and Zoning Commission's decision to deny the Conditional Use Permit application to allow on-premise consumption of alcoholic beverages at 205 West Hopkins Street, San Marcos, TX 78666.

27. Discuss and consider appointments to the Comprehensive Plan Oversight Committee, and provide direction to Staff.

28. Receive a Staff update and hold discussion regarding the Fall 2013 Preferred Scenario Amendment applications received and procedures for consideration, and provide direction to Staff.

29. Receive an update from the Conditional Use Permit Subcommittee and hold discussion regarding the process, and provide direction to Staff.

30. Hold discussion regarding Grande Communications' recent digitizing of the City's cable channel, and provide direction to Staff.

31. Question and Answer Session with Press and Public. *This is an opportunity for the Press and Public to ask questions related to items on this agenda.*

32. Adjournment.

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I certify that the attached notice and agenda of items to be considered by the City Council was removed by me from the City Hall bulletin board on the ______________________________ day of ______________________________

____ Title: ____

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Review Comments and Responses on the Draft Final Report

1. **Edwards Aquifer Authority (EAA) staff applauds City efforts to find innovative methods to reduce the use of Edwards Aquifer water. However, EAA staff continue to recommend that reuse water not be applied on the Edwards Aquifer Recharge Zone or in a location where runoff from the application of reuse water, or leaking reuse water infrastructure, can enter critical habitats for listed aquatic species. While the Type 1 reuse water available from the City's waste water treatment plant exceeds Type 1 criteria, trace concentrations of pharmaceuticals and personal care products are inherent in reuse water and degrade ambient water quality, the effects of which are unknown. Therefore, EAA staff would encourage the City to pursue the application of reuse water in areas not located on the recharge zone, and that are not located near critical habitats. The Gary Service Area and most of the North and South Service Areas would meet this criteria.**

   (A) None of the potential reclaimed water irrigation uses included in the feasibility study are located on the Edwards Aquifer Recharge Zone.

   Pharmaceutical and personal care products (PPCPs) have probably been present in water and the environment for as long as humans have been using them. PPCPs can be introduced into the environment through more ways than wastewater treatment, including the discharge of OSSF systems located on the Recharge Zone. Ongoing studies into the effects and fate of PPCPs have yet to define a single compound as a reliable indicator due in part to the vast number of medical and personal care products. Similarly, the various processes used in wastewater treatment provide a range of removal efficiencies for different compounds. There is limited scientific information regarding PPCPs due to low pollutant concentration levels, detection limitations, statistical error, complexity of the pollutants, limitations in treatment technologies, and lack of long-term epidemiological data.

   A study of the City of San Marcos' wastewater treatment plant effluent (Foster, 2007) revealed that the San Marcos wastewater treatment plant removed up to 92% of those compounds most frequently detected in the city's wastewater influent. While the fate of trace contaminants after the effluent has been filtered and applied to soil and plants is not yet known, there has been a significant amount of research into the fate of urban contaminants in stormwater. Research has shown that exposure of urban stormwater runoff to soil, plants, and sunlight is an effective method of contaminant reduction.

   Based on the current body of knowledge regarding dose-response relationships of various organisms to low level concentrations of trace contaminants, it may be several years before any water quality standards regarding PPCPs are promulgated. At the same time that the scientific study of the potential effects of low-level exposure to PPCPs in humans and aquatic species is increasing, the EPA and other organizations are evaluating approaches for regulating PPCPs. The use of reclaimed water for irrigation *creates an additional field of study as it is recognized that the interaction of plants and soil can improve water quality. Regulatory agencies, the public, and lawmakers will have to weigh relative risks against real and perceived costs, increasing water demands, and in many cases, diminishing quality and quantity of raw water supplies relative to the costs of controlling the use or treatment for many types of trace contaminants.*

2. **On page 6, Section 1.5 Project Financing, since re-use projects are eligible for funding from the Drinking Water State Revolving Fund, please include a description of this program. This comment also applies to page 79.**

   (A) Pages 6 and 79 have been revised to include a description of the DWSRF.

3. **On page 6, Section 1.5 Project Financing, please discuss the passage of Proposition 6 which summarizes the use of $2 billion for implementation of the State Water Plan. Please note that the subsidy for the State Water Implementation Fund for Texas (SWIFT) has not been established. That subsidy is capped so that the entity must pay at least half of the interest rate for the TWDB's cost of funds. The subsidy will be established over the next 18 months. This comment also applies to page 80.**

   (A) Pages 6 and 80 have been revised to update the discussion of the SWIFT.

4. **On page 35, Figure 5-1, please provide a description in the legend defining the various lines and other items.**

   (A) Figure 5-1 has been revised to include pipe sizes and other features in the legend.