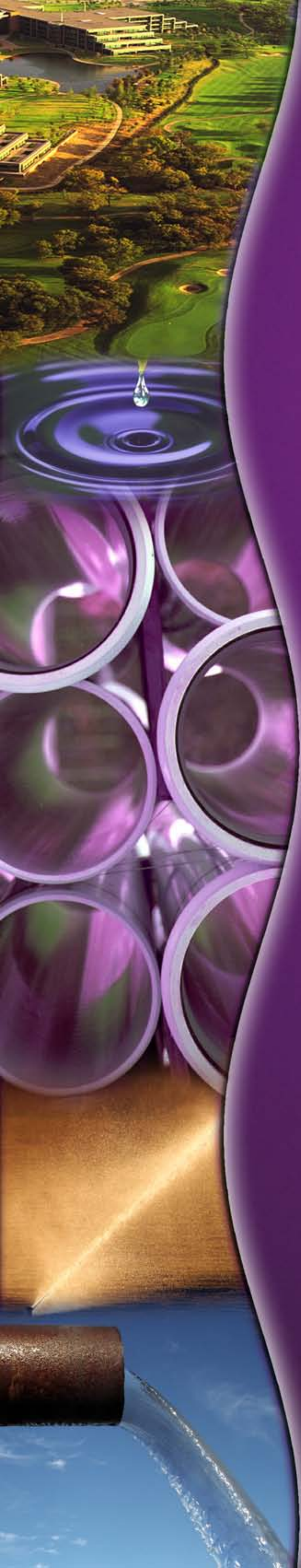

FINAL REPORT

FORT WORTH

Reclaimed Water Priority and Implementation Plan

May 2007

Submitted by:

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS • DESIGNERS • SCIENTISTS

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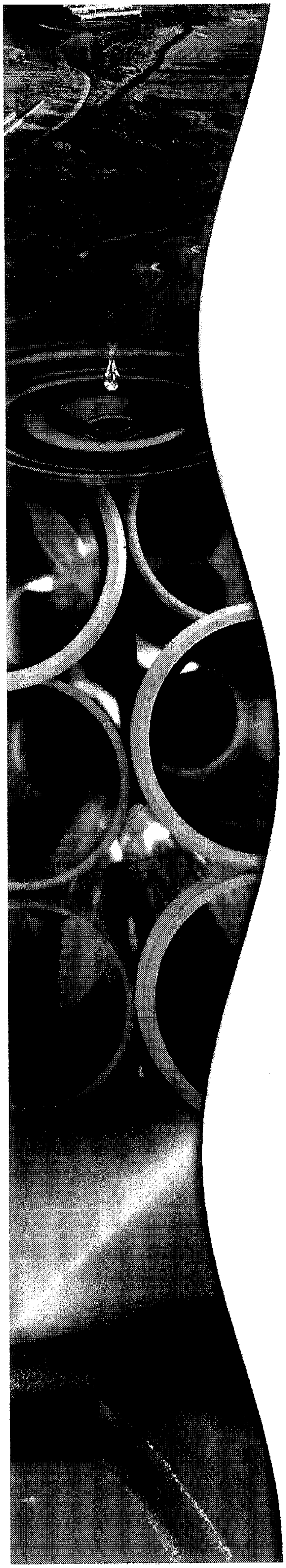

FINAL REPORT

FORT WORTH

Reclaimed Water Priority and Implementation Plan

STATE OF TEXAS
ELLEN T. MCDONALD
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PROFESSIONAL ENGINEER

Ellen T. McDonald
5/24/07

May 2007

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CITY OF FORT WORTH

RECLAIMED WATER PRIORITY AND IMPLEMENTATION PLAN

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ES.1 The Need for Reclaimed Water in Fort Worth

The City of Fort Worth and surrounding areas are projected to experience significant growth in population over the next several decades. In order to help meet its future water supply needs, the City is pursuing opportunities that include conservation and the use of highly treated wastewater effluent to reduce demands for potable water.

The regional water supply planning process, originally mandated by the 75th Texas Legislature in Senate Bill 1, has identified a number of future water management strategies for the City of Fort Worth and Tarrant Regional Water District (TRWD), who currently provides the City with raw water. In addition to conservation and reuse, future water management strategies for TRWD in the 2006 Region C Water Plan include construction of the Marvin Nichols Reservoir in the Sulfur River Basin, importing water from Toledo Bend Reservoir and importing water from Oklahoma.

Through Senate Bill 1 and subsequent legislation, the Texas Legislature has placed a strong emphasis on the efficient use of water resources. As a result of Senate Bill 1, the Texas Water Code now requires that an applicant for a water right involving an interbasin transfer of raw water develop and implement a water conservation plan that will result in the "highest practicable levels of water conservation and efficiency achievable...[1]" Since three of the planned future water supplies for TRWD (and, hence Fort Worth) involve interbasin transfers, it will be necessary to demonstrate that this requirement has been met prior to approval and implementation of these projects.

Water reuse has been identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature under Senate Bill 1094[2]. Therefore, in addition to other water conservation efforts, development of a water reuse program will provide for efficient use of the City's water resources and will assist TRWD in securing necessary future water supplies to meet anticipated growth within the City of Fort Worth and surrounding areas.

Although previous studies related to water reuse have identified some potentially viable alternatives for the City, these studies have not developed a detailed, comprehensive plan that evaluates and prioritizes alternatives for the City and its service area. The purpose of this study is to provide the City with a plan that can be used to guide implementation of a direct reuse program to support future water supply requirements for the City. In addition, during development of this plan, the City has worked closely with its wholesale customers, TRWD, Trinity River Authority (TRA) and other surrounding cities to identify potential approaches to its reuse program that could include regional support and cooperation among these entities.

This study includes the evaluation of alternatives for direct non-potable reuse. No indirect reuse is considered here. However, it should be noted that TRWD has been issued a water right permit to

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[1] Texas Water Code, Subtitle B, Chapter 11, §11.085

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

implement a major indirect reuse project that diverts return flows from the Trinity River to a constructed wetland and ultimately into Richland Chambers and Cedar Creek Reservoirs[3]. Implementation of a direct reuse program for the City of Fort Worth is intended to complement these ongoing reuse efforts by TRWD.

ES.2 Projected Population Growth and Water Supply Needs

According to population projections from the 2005 Fort Worth Water Master Plan Update, the City's population is expected to exceed 1,000,000 by the year 2025. As a result of this population growth, and growth of customer cities within the City's water service area, average day water demands are expected to increase to 332 MGD (371,840 acre-feet/year) and maximum day demands are expected to increase to nearly 700 MGD (780,640 acre-feet/year). This growth will result in the need for development of additional water supplies by Tarrant Regional Water District (TRWD), and additional water treatment and distribution facilities by the City. Substitution of reclaimed water for potable water usage will help to defer the need for additional raw water supplies and potable water treatment and distribution facilities.

ES.3 Potential Reclaimed Water Users and Service Areas

An analysis of potential reclaimed water users was performed based on information from several sources. A list of top water users, with metered water usage, was provided by the City, from which potential customers were identified. To supplement these data, the City surveyed several potential reclaimed water users and then met with these potential customers to discuss potential reclaimed water quantity and quality requirements. Demands within the Mary's Creek Basin for the anticipated Walsh, Brown and Murrin Ranch developments were taken from a recent study conducted by Alan Plummer Associates, Inc. (APAI) for the City.[4] The City of Fort Worth Parks and Community Services Department also provided projected demands for all of its facilities that could use reclaimed water. In addition, several surrounding cities and wholesale customers have indicated an interest in receiving reclaimed water from the City and were included in the study. These entities were contacted in order to determine potential reclaimed water demands.

The potential customers were evaluated based on location and ranking to identify areas of high reclaimed water use. Emphasis was placed on locating large customers and clusters of smaller customers. Individual projects to serve the potential customers were then conceptualized and grouped together to form reclaimed water service areas. The following five reclaimed water service areas were identified, and are generally shown on Figure ES-1:

1. Central System
2. Eastern System
3. Northern System

[3] Amendment to Certificate of Adjudication, 08-5035C (Richland Chambers Reservoir) and 08-4976C (Cedar Creek Reservoir), Texas Commission on Environmental Quality, granted February 8, 2005.

[4] Draft Feasibility Study – Mary's Creek Water Recycling Center. Alan Plummer Associates, Inc. June 2004

4. Southern System

5. Western System

Within each of these service areas, the potential reclaimed water customers and demands were identified, and are included in Tables ES-1 through ES-5.

ES.4 Treated Wastewater Availability

Currently, the Village Creek Wastewater Treatment Plant (VCWWTP) discharges approximately 110 MGD of treated effluent on an annual average basis. A small portion of this flow (~400,000 gpd) is used to provide irrigation water for the Waterchase Golf Course, currently the City's only existing reclaimed water customer. The remainder of the effluent is available for supply to additional reclaimed water projects and provides more than enough water to meet projected direct non-potable reclaimed water demands for the City. However, the location of the VCWWTP on the far eastern side of the City makes it difficult to serve all areas of the City economically from this source.

As a part of this study, the City has had several meetings with Trinity River Authority (TRA) to discuss the potential of purchasing reclaimed water from the TRA Denton Creek Regional Wastewater System (DCRWS) to serve potential reclaimed water customers in the northern part of the City. TRA has indicated that it is very interested in partnering with the City in this way. The DCRWS currently discharges approximately 3 MGD of treated effluent on an annual average basis. This flow is projected to increase to nearly 12 MGD by 2013, and is adequate to serve the projected reclaimed water demands in the Northern service area.

Reclaimed water can also be provided from small satellite wastewater treatment facilities, called water recycling centers (WRCs). A WRC is a strategically located wastewater treatment plant that intercepts wastewater flows from a specific area of the collection system, treats the water to standards appropriate for specific reclaimed water applications and then delivers the effluent to users within its geographical proximity. As is summarized below, alternatives with WRCs were considered in all service areas except the Eastern Service Area.

ES.5 Suitability of VCWWTP and DCRWS Effluent for Reclaimed Water Projects

There are two types of nonpotable reuse practiced in Texas – Type I for which there is a high probability of contact with the public and which, therefore, requires more stringent water quality, and Type II for which public access is controlled and thus does not require the stringent water quality of Type I. An example of Type I reuse would be irrigation of a school's landscaping or athletic fields. An example of Type II reuse would be irrigation of a golf course. Water quality from VCWWTP consistently meets Type I quality standards. As a part of this project, the City obtained formal authorization from the TCEQ to provide reclaimed water for both Type I and Type II uses.

Data provided by TRA for DCRWS did not include measurements for turbidity, which is one of the regulated Type I parameters. These data did indicate that the DCRWS effluent does consistently meet the Type I requirements for CBOD, and with some operational adjustments and/or chlorine disinfection could meet the Type I requirements for fecal coliform. The City is currently discussing water quality issues with TRA in order to insure that Type I quality water could be available from this treatment facility.

Figure ES-1
City of Fort Worth
Reclaimed Water Service Areas

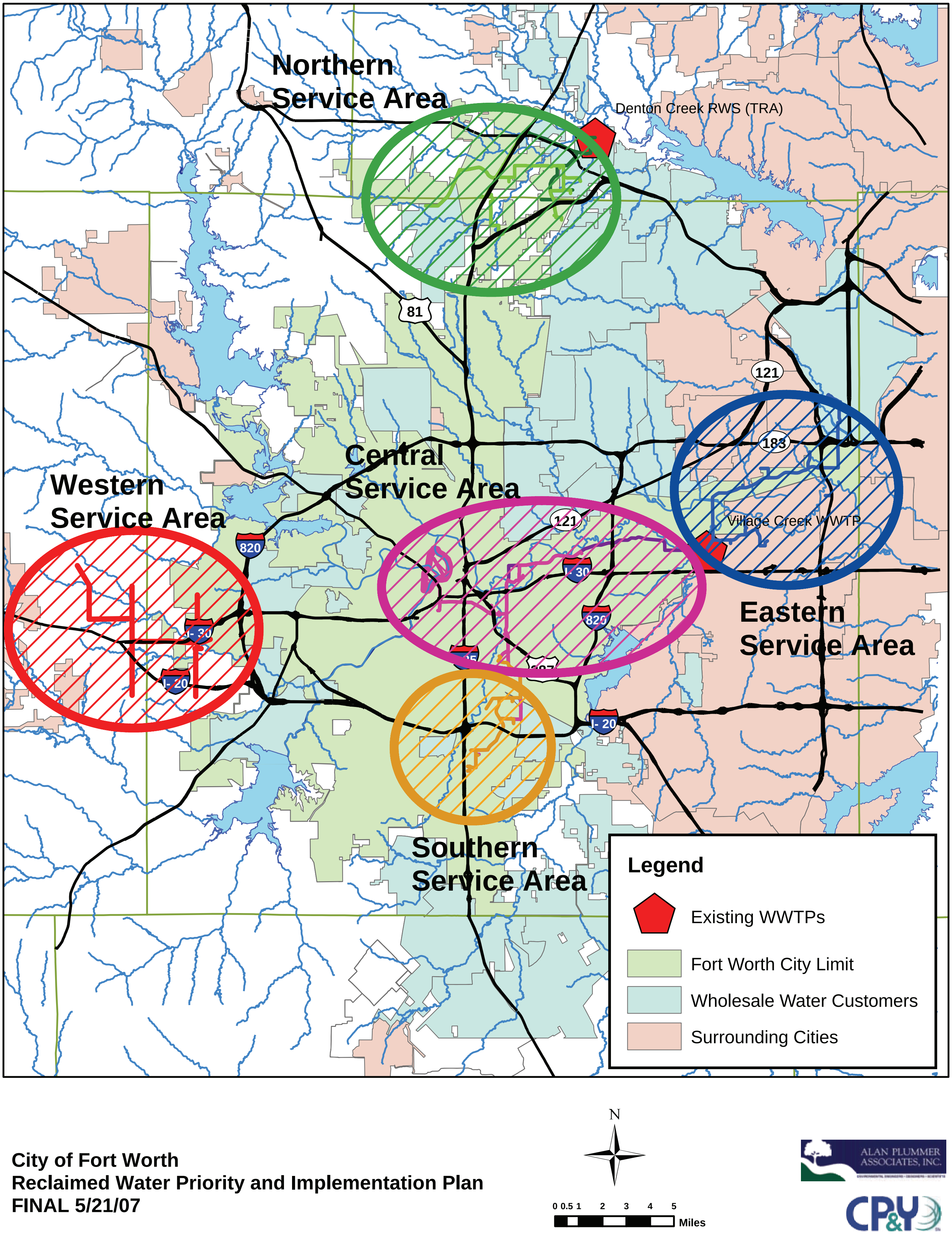


Table ES-1: Central System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand (MGD)	System Capacity (MGD)
Cobb Park[1]	0.17	3.96
Gateway Park	0.05	1.21
Harris Methodist Hospital	0.05	0.05
Meadowbrook GC	0.06	1.73
Sycamore Creek GC	0.03	0.74
Sycamore Park	0.04	0.86
Trinity River Vision Project[2]	0.76	7.50
Woodhaven GC	0.09	1.16
Total	**1.25**	**17.20**

(1) Cobb Park is also included in the Southern System Service Area
(2) The water demands for the Trinity River Vision Project include evaporative make-up water only, and could be expanded in the future to include irrigation water demand, once that data is available from the developers.

Table ES-2: Eastern System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand (MGD)	System Capacity (MGD)
American Airlines	0.03	0.52
City of Arlington		
JW Dunlop Sports Center	*0.01*	*0.10*
River Legacy Park	*0.04*	*0.40*
Chester Ditto Golf Course	*0.17*	*0.50*
City of Euless		
Texas Star Golf Course	*0.52*	*3.33*
Texas Star	*0.21*	*2.00*
Softball World	*0.02*	*0.50*
D/FW International Airport	1.53	6.06
Riverside GC	0.24	1.28
Total	**2.77**	**14.69**

Table ES-3: Northern System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand (MGD)	System Capacity (MGD)
Alliance Center East Assoc.	0.36	0.95
Alliance Center West Assoc.	1.12	2.96
Alliance Gateway Phase I Assoc.	0.24	0.62
Alliance Gateway Phase II Assoc.	0.44	1.17
Alliance Gateway Phase III Assoc.	0.56	1.48
Alliance Lonestar Association	0.43	1.13
Circle T Ranch / Westlake	0.96	2.53
Frac Water (Gas Drilling)	0.05	0.05
Texas Motor Speedway	0.03	0.07
Total	**4.19**	**10.97**

Table ES-4: Southern System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand (MGD)	System Capacity (MGD)
Alcon Laboratories	0.38	3.00
Ball Metal Container	0.01	0.01
Cobb Park(1)	0.17	3.96
Glen Garden GC	0.09	0.46
Miller Brewing Co.	0.19	0.25
Mrs. Bairds Bakeries	0.10	0.10
Rolling Hills Soccer	0.15	3.65
Tarrant County College	0.01	0.31
Total	**1.09**	**11.73**

(1) Cobb Park is also included in the Central System Service Area

Table ES-5: Western System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand(1) (MGD)	System Capacity(2) (MGD)
Blue Haze Elementary	0.01	0.15
East of Walsh Ranch	0.16	3.92
Leonard Golf Links	0.05	1.15
Lost Creek GC	0.18	0.93
New Commercial	0.14	2.25
New Golf Course	0.74	3.89
New Park	0.20	4.72
New Public Facility	0.04	0.86
New Residential	2.07	32.84
New School	0.13	3.06
Tannahill Intermediate	0.01	0.29
West of Walsh Ranch	0.06	1.52
Total	**3.79**	**10.00**

(1) Annual average water demands as reported in the June 2004 Draft Feasibility Study for the Mary's Creek Water Recycling Center
(2) Intermediate storage tanks and booster pump stations are included in the Western System Service Area to meet system pressure requirements and reduce overall system capacity requirements.

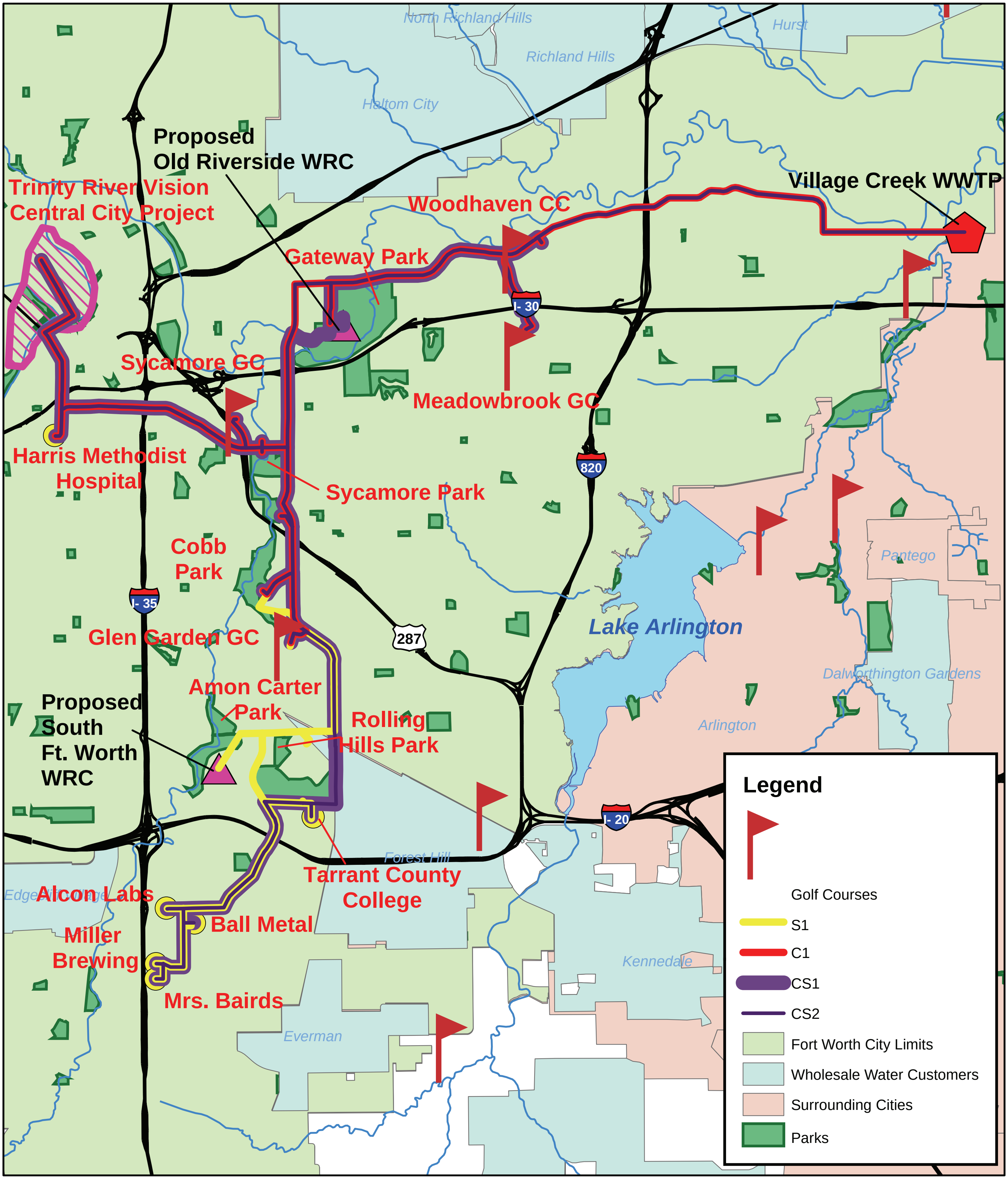
ES.6 Screening-Level Evaluation of Service Area Conceptual Projects

An initial, screening-level evaluation of conceptual treatment and conveyance projects for each service area was performed. The purpose of this screening-level evaluation was to determine whether each service area could be served more economically from a WRC or an existing WWTP. However, since the Eastern System is located close to VCWWTP, no alternative with a WRC was considered for this service area. Similarly, since the Western System is located so far away from an existing WWTP, no alternative using an existing WWTP was considered for this service area. A description of each alternative is provided below and a summary of the opinion of probable costs for each alternative is provided following the descriptions. All costs are based on a capital recovery period of 20 years and an annual interest rate of 5.5%. For the screening evaluation, all costs for constructing and operating the WRCs are included in order to compare the WRC alternatives with the alternatives that receive water from an existing WWTP. The screening level costs do not included financial credit for benefits.

ES.6.1 Central System Alternative 1 (C1)

Alternative C1 serves the Central System customers only, from the VCWWTP, as shown on Figure ES-2.

Figure ES-2
Central/Southern Alternatives



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ES.6.2 Southern System Alternative 1 (S1)

Alternative S1 serves the Southern System customers only, from a proposed WRC located near Amon Carter Park, east of IH-35 and north of IH-20, as shown in Figure ES-2.

ES.6.3 Central/Southern System Alternative 1 (CS1)

Alternative CS1 includes a proposed WRC at the site of the abandoned City of Fort Worth Riverside WWTP. Treated effluent from the WRC would serve all customers within the Central and Southern service areas, as shown on Figure ES-2.

ES.6.4 Central/Southern System Alternative 2 (CS2)

Alternative CS2 uses treated effluent from VCWWTP to serve all customers within the Central and Southern service areas, as shown on Figure ES-2.

ES.6.5 Eastern System Alternative 1 (E1)

Alternative E1 uses treated effluent from VCWWTP to serve customers in the Cities of Arlington, Euless and Grand Prairie, as well as the Centreport and D/FW areas (see Figure ES-3).

ES.6.6 Northern System Alternative 1 (N1)

Alternative N1 serves the Northern System customers from a WRC located east of IH-35, as shown in Figure ES-4.

ES.6.7 Northern System Alternative 2 (N2)

Alternative N2 serves the Northern System customers from the TRA Denton Creek Regional Wastewater System (DCRWS), as shown in Figure ES-4.

ES.6.8 Western System Alternative 1 (W1)

Alternative W1 serves the proposed developments within the Mary's Creek Basins from a WRC located between IH-20 and IH-30, as shown in Figure ES-5. As will be discussed in a later section, due to timing of flow availability in this area, it is anticipated that initially raw water from a TRWD raw water line will be used to provide nonpotable water service to this area. It should also be noted that initially, Alternative W1 included service to Z Boaz Park, Z Boaz Golf Course and Hawks Creek Golf Course. Service to these areas increased the unit cost of service significantly and, therefore, was eliminated from the alternative. However, these customers could be considered for service in the future.

ES.6.9 Summary of Screening-Level Evaluation

Table ES-6 presents a summary of the opinions of probable cost for all alternatives considered in the screening-level evaluation to identify the preferred alternative in each service area. Alternatives N2 and E1 provide reclaimed water at the lowest unit cost, primarily due to the proximity of these service areas to existing wastewater treatment facilities.

Figure ES-3
Eastern System Alternative

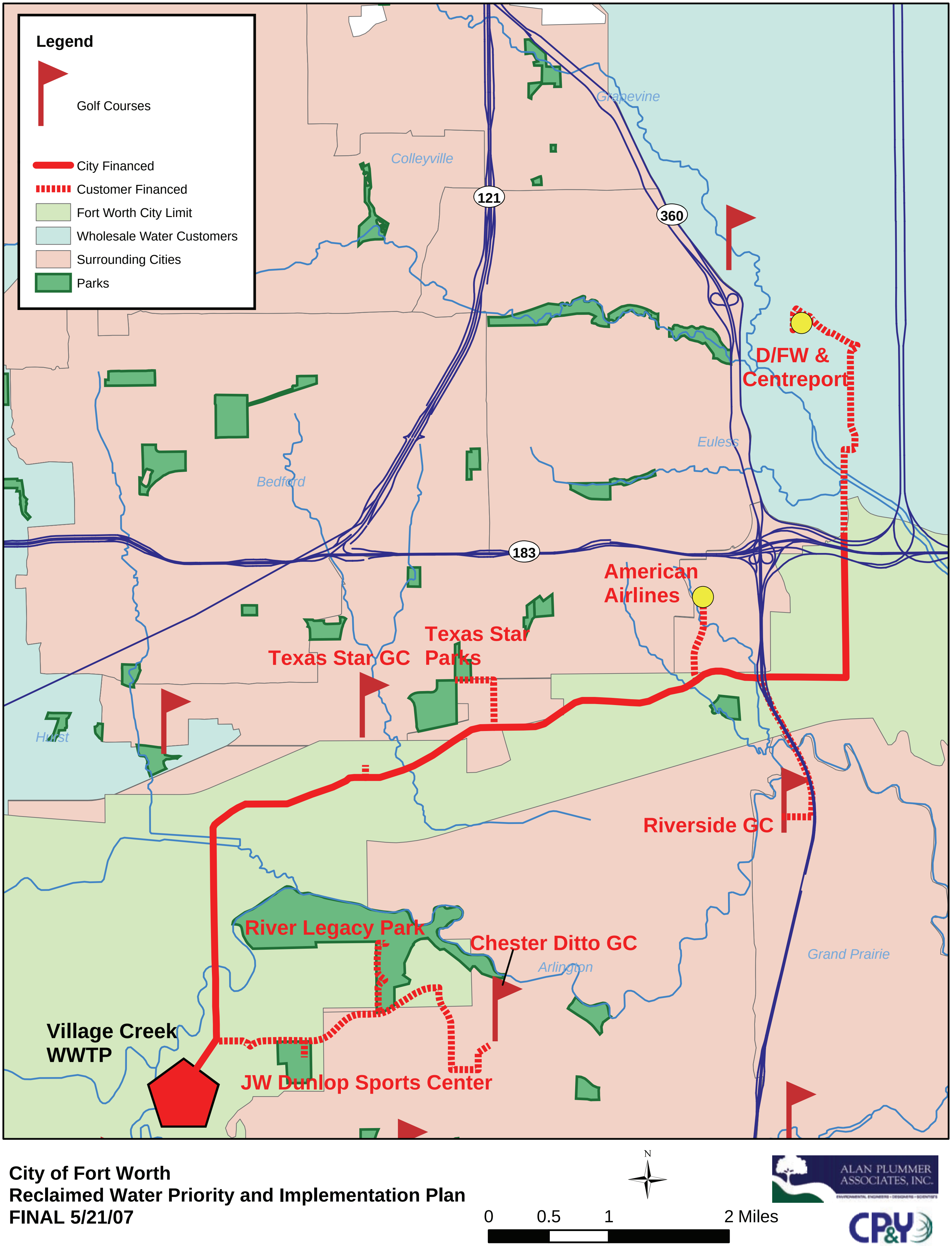

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Figure ES-4
Northern System Alternatives

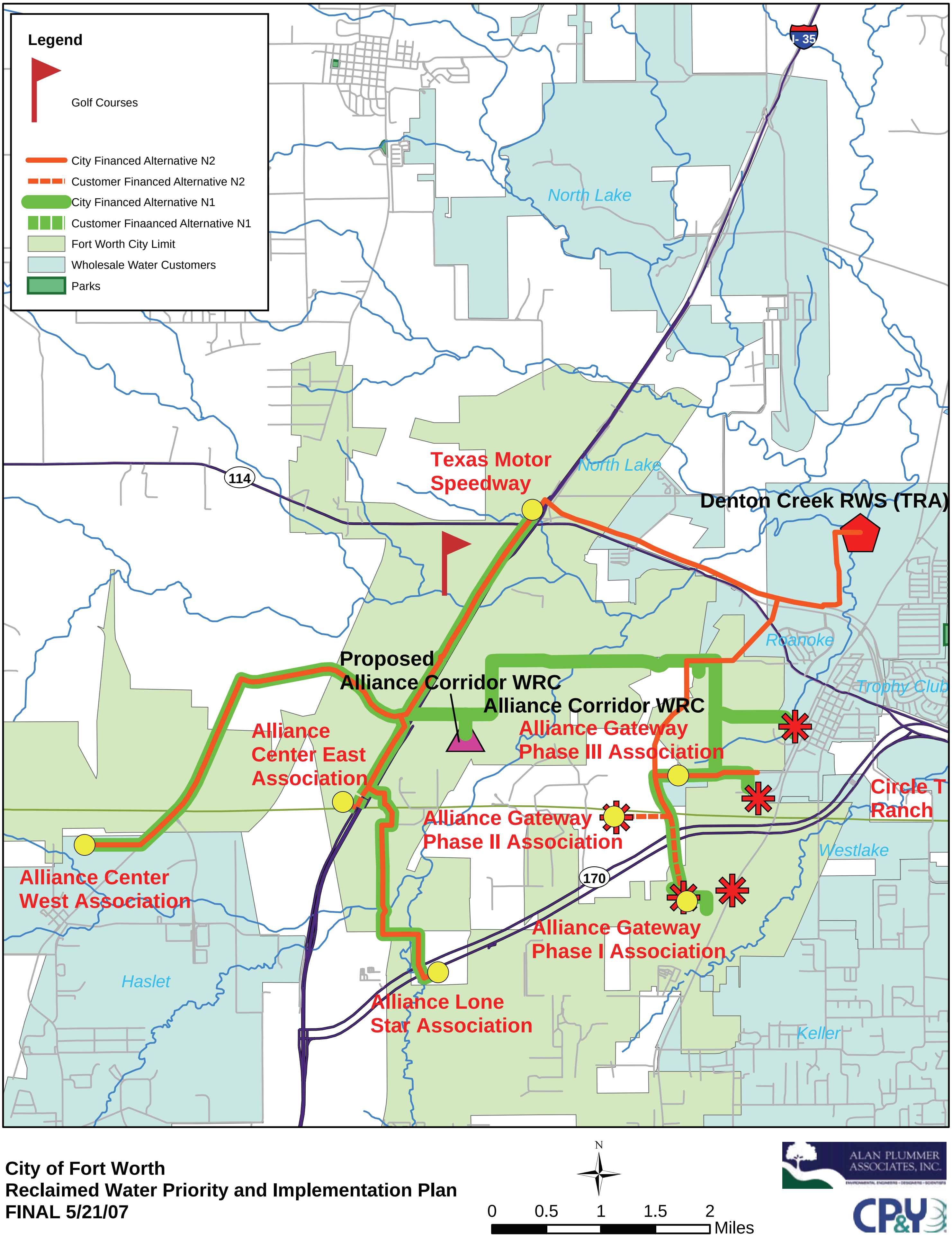

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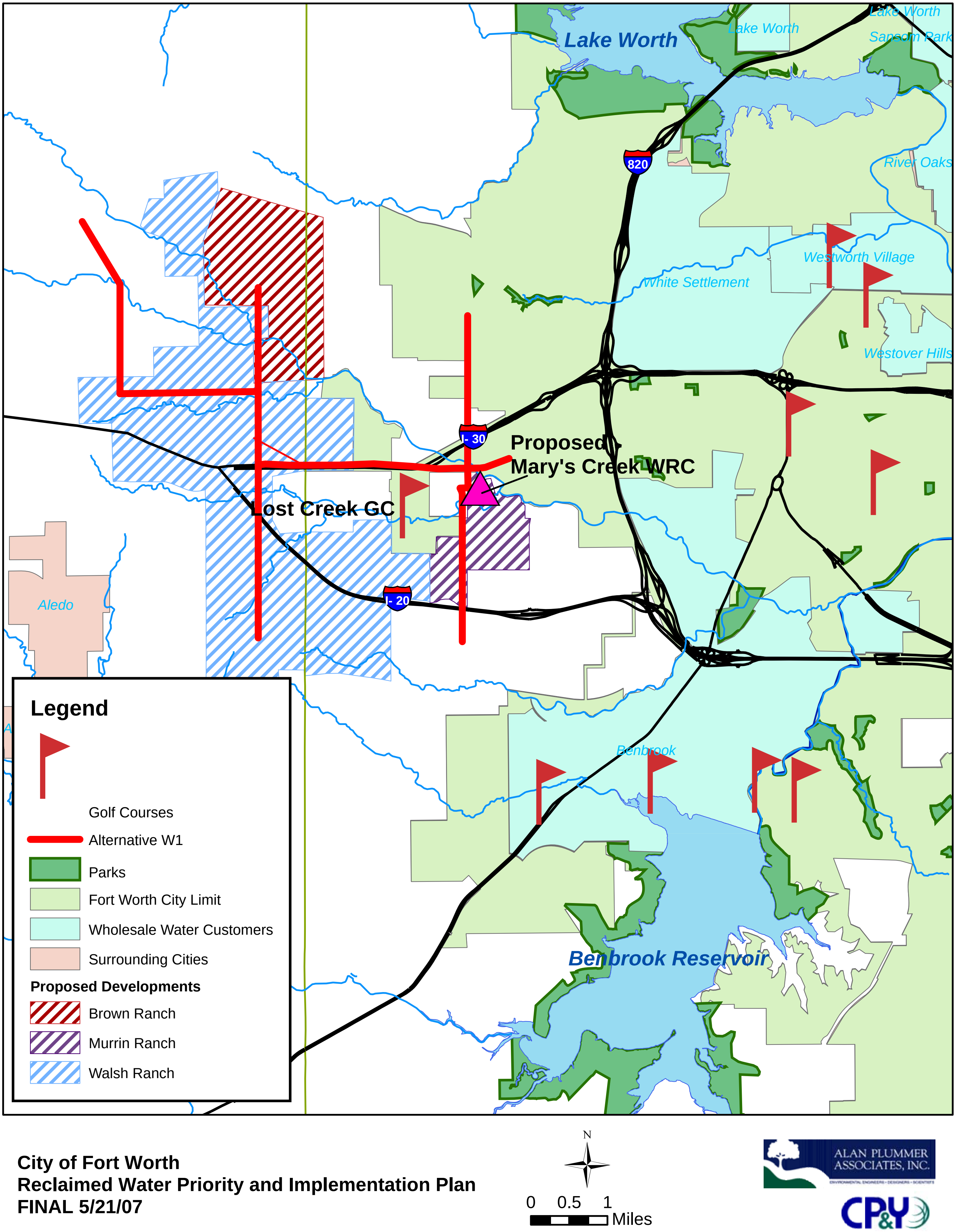
Figure ES-5
Western Alternative



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ALAN PLUMMER ASSOCIATES, INC.

Table ES-6: Summary of Costs for All Service Areas (without benefits)

Alt.	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service	O&M	Energy	Purchase Cost	Overall Unit Cost
	MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
C1	1.25	17.21	$32.70	$2,736,000	$316,000	$60,000	N/A	$3.22
S1	1.10	11.74	$21.75	$1,820,000	$176,000	$221,000	N/A	$2.87
CS1	2.18	19.47	$56.93	$4,764,000	$398,000	$439,000	N/A	$3.45
CS2	2.18	14.47	$40.75	$3,410,000	$412,000	$135,000	N/A	$2.40
E1	2.77	14.69	$15.52	$1,298,000	$215,000	$95,000	N/A	$0.82
N1	4.19	11.07	$54.45	$4,556,000	$304,000	$679,000	N/A	$1.84
N2	4.19	11.07	$17.09	$1,430,000	$188,000	$103,000	$0.25	$0.81
W1	3.79	18.12	$72.79	$6,091,000	$455,000	$772,000	N/A	$3.03

[1] Net Present Value of capital cost after accounting for interest during construction.

Based on the screening-level evaluation the preferred alternatives for each service area are as follows:

Central/Southern Service Areas: Alternative CS2

Eastern Service Area: Alternative E1

Northern Service Area: Alternative N2

Western Service Area: Alternative W1

ES.7 Preferred Alternative Phasing

A detailed evaluation of the preferred alternatives identified above was performed in order to identify project phasing and perform the subsequent feasibility study. Figures ES-6 through ES-9 show the identified project phases for each preferred alternative.

ES.8 Project Feasibility Evaluation

The feasibility evaluation includes an assessment of probable construction and operation and maintenance costs for each project and the system as a whole, an evaluation of potential benefits of the reclaimed water system, a review of potential financing strategies and funding opportunities, and development of a recommended initial rate structure for the City of Fort Worth reclaimed water system. In addition, it includes a discussion of administrative, regulatory and public relations issues that may impact project feasibility.

Figure ES-6
Central/Southern Alternative (Alt. CS2) Phasing

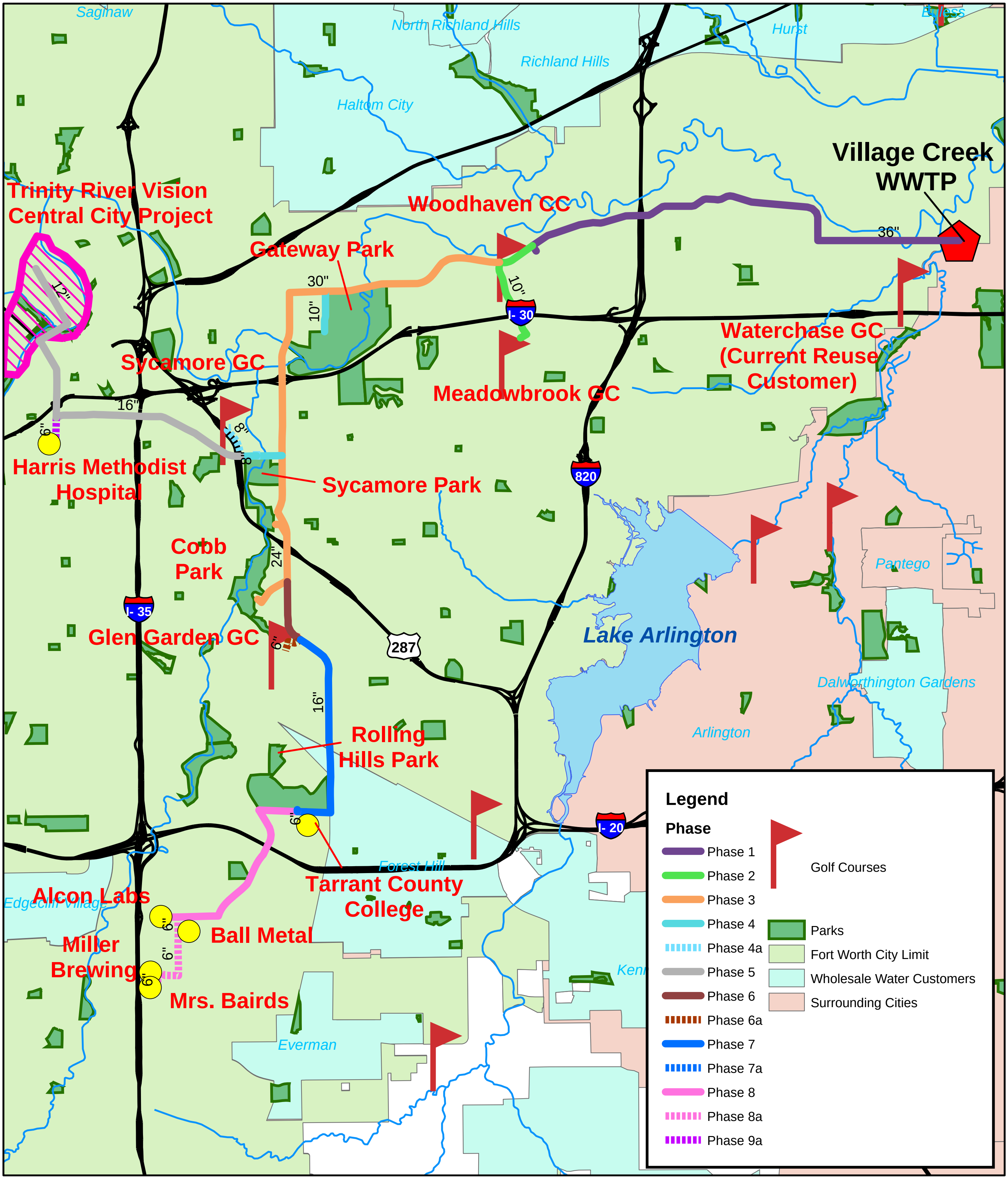

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Figure ES-7
Eastern Alternative Phasing

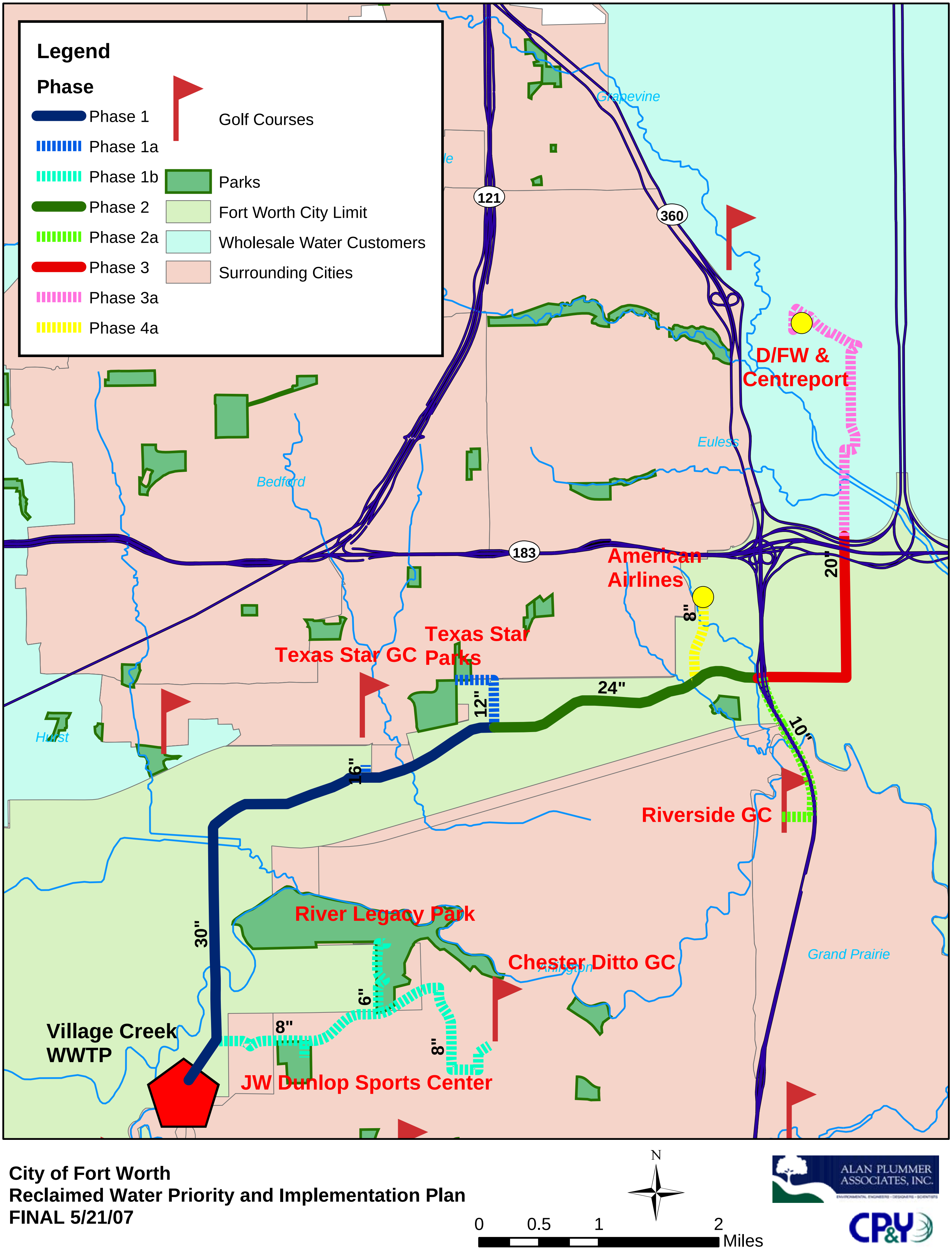

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Figure ES-8
Northern System Alternative Phasing

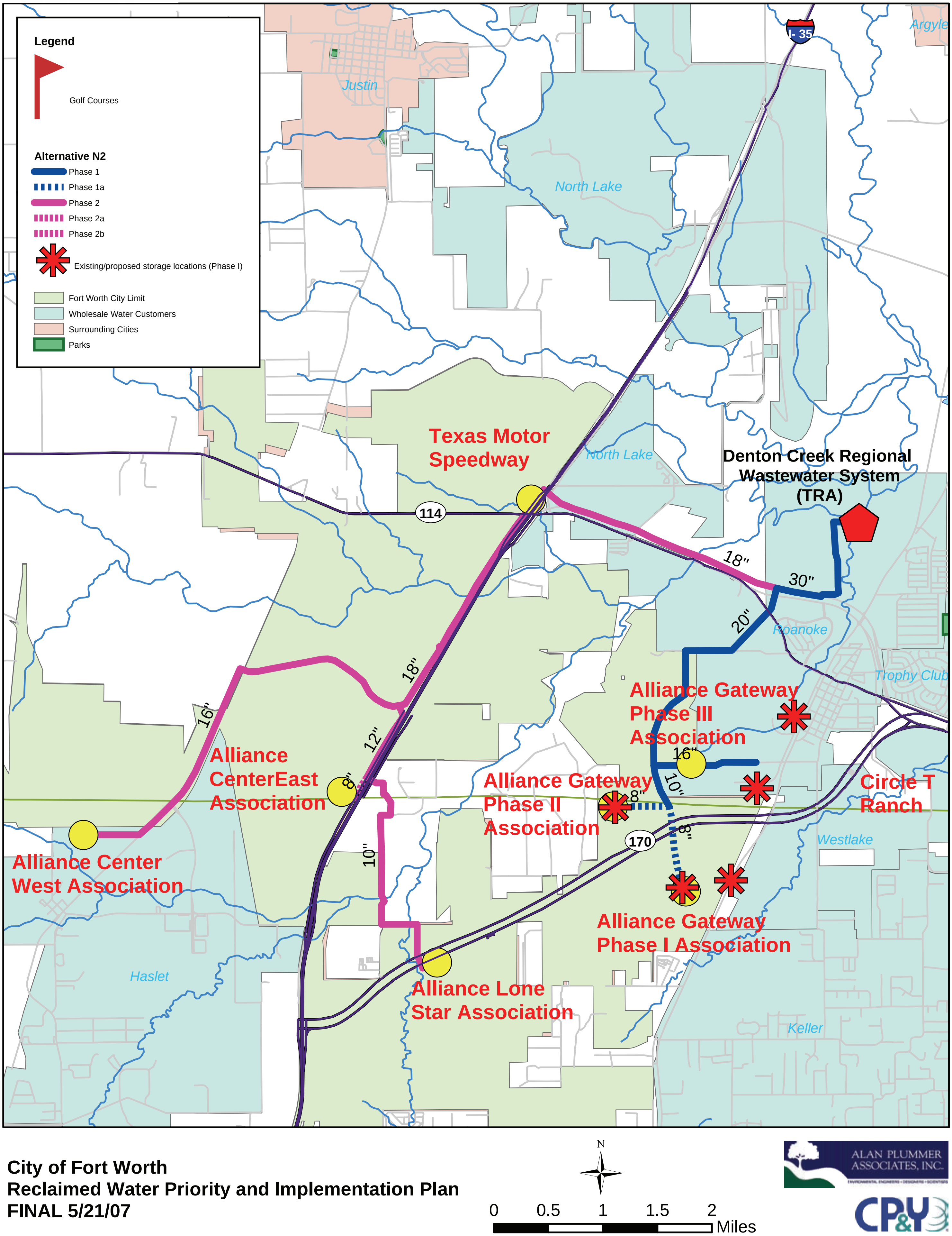

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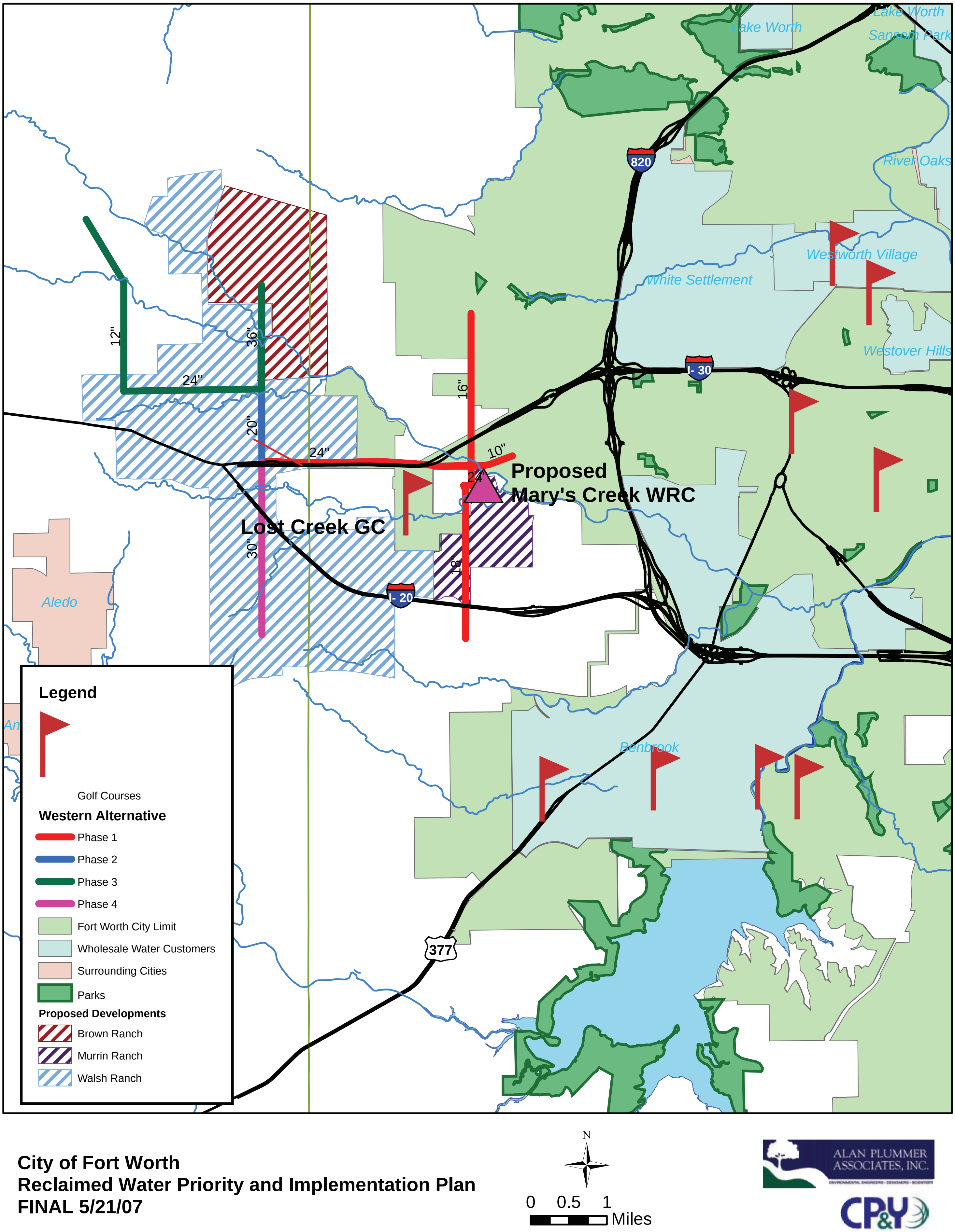
Figure ES-9
Western System Alternative Phasing



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ES.8.1 Benefits of Reclaimed Water Projects

A number of benefits associated with reclaimed water projects were evaluated and are presented in Chapter 7. These include, reduction of potable water demand, reduction in nutrient and BOD loadings to receiving streams, deferral of water and wastewater treatment plant expansions, deferral of collection system improvements, reduction in raw water requirements and deferral of reservoir construction. Three of the key benefits, reduction of potable water demand, deferral of water treatment plan expansions and raw water cost avoidance are summarized below.

<u>Reduction of potable water demand</u>

Reduction of potable water demand is an important component of the City's water conservation program and is critical to acquiring permits for future water supplies. Based on an evaluation of future demands with implementation of the preferred reclaimed water alternatives, potable water usage is projected to be reduced by about 8.8 gpcd, which is approximately a 4.4% decrease in the current per capita usage rate.

<u>Deferral of water treatment plant expansions</u>

In the 2005 Water Master Plan, a number of water treatment plant expansions and new facilities were identified. An evaluation of the potential reduction in peak demands resulting from implementation of the reclaimed water projects indicated that the overall required treatment capacity could be reduced by almost 70 MGD by the year 2025. This deferral of facilities was estimated to have a value of approximately $9.7 million (in 2006 dollars).

<u>Raw water cost avoidance</u>

A direct benefit to the City resulting reclaimed water usage is reduced raw water usage. Currently the City pays TRWD $0.65/1000 gallons for raw water. Any raw water usage that is offset by reclaimed water usage by the City or its wholesale water customers can be attributed as a direct benefit of the reclaimed water system.

ES.8.2 Net Cost of Reclaimed Water

As discussed in the previous section, a number of benefits can be attributed to the development of reclaimed water systems. Many of these benefits do not have a direct monetary value and are difficult to quantify in terms of a cost savings to the City. However, as referenced above, deferral of WTP facility expansions and avoidance of raw water costs were two benefits that were directly quantifiable and can be credited to the cost of the reclaimed water system. Table ES-7 provides a summary of the net opinion of probable cost with these benefits credited. With benefits, the system-wide cost of the reclaimed water is estimated to be approximately $0.73/1000 gallons based on full utilization of the projected demands.

ES.8.3 Financing Strategies and Funding Opportunities

Several financing strategies are available for reclaimed water projects. These include federal or state grants, federal or state loans, and rate/fee restructuring. Capital costs can be funded through federal or state grants or loans. Some limited federal financing is available through the U.S. Department of Agriculture (USDA) and U.S. Bureau of Reclamation (USBR).

Table ES-7: Summary of Costs, Recommended Alternatives, Including Benefits

Alt.	Service Area	Annual Avg. Demand	Peak System Demand	Identified Capital Benefits[1]	Capital Cost[2]		
		MGD	MGD	$MM	$MM		
E1	Eastern	2.77	14.69	$2.08	$13.44		
N2	Northern	4.19	11.07	$3.14	$13.94		
W1	Western	3.79	18.12	$2.84	$37.10		
CS2	Central/ Southern	2.179	14.47	$1.63	$39.12		
Total, All Projects		12.93	58.35	$9.70	$103.61		
Alt.	**Service Area**	**Debt Service[3]**	**O&M**	**Energy**	**Purchase Cost[4]**	**Operational Benefits[5]**	**Overall Unit Cost[6]**
		$/yr	$/yr	$/yr	$/1000G	$/1000G	$/1000G
E1	Eastern	$1,125,000	$215,000	$95,000	N/A	$0.37	$0.39
N2	Northern	$1,167,000	$188,000	$103,000	$0.25	$0.65	$0.10
W1	Western	$3,105,000	$455,000	$772,000	N/A	$0.65	$1.13
CS2	Central/ Southern	$3,273,000	$412,000	$135,000	N/A	$0.65	$1.68
Total, All Projects		$8,670,000	$1,270,000	$1,105,000	$0.08	$0.59	$0.73

[1]Includes credit for deferral of WTP expansions (see Section 7.3.4)- benefit distributed based on annual average demand of each project.
[2] Net Present Value of capital cost after accounting for interest during construction.
[3]Assumes a capital recovery period of 20 years and an annual interest rate of 5.5%.
[4]Purchase cost applies to water purchased from TRA's DCRWS for the Northern System.
[5]Includes credit for purchase of raw water. On Eastern system, only water used by wholesale customers is credited.
[6]Assumes 50-year project life.

State financing programs are available through the Texas Water Development Board (TWDB) and include the Clean Water or Drinking Water State Revolving Funds and State Participation Funding. The Clean Water State Revolving Fund is typically used to finance reuse and wastewater projects. The State Participation Funding program enables the TWDB to assume a temporary ownership interest in regional projects when the local sponsors are unable to assume debt for the optimally sized facility. While this program has typically been used for water system construction, the TWDB has indicated that it can also be applied to reuse projects if excess capacity is provided in the reuse facilities to meet anticipated future demands. The goal of this program is to allow for the "right sizing" of projects in consideration of future growth.

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

ES.8.4 Preliminary Reclaimed Water Rates for the City of Fort Worth

Several meetings were held with City staff to discuss approaches to establishing a rate for users of reclaimed water. During these meetings, the following guidelines were established:

- The reclaimed water rate should be low enough to be marketable and to attract new customers to the system;

- The reclaimed water rate should not be lower than the going cost of raw water (currently \$0.65/1000 gallons) and should not be higher than the going rate for potable water (currently \$2.37 - \$4.01 per 1000 gallons depending on class and tier);

- The reclaimed water rate should be based on a cost-of-service evaluation of the entire reclaimed water system as a whole;

- City of Fort Worth retail and wholesale water customers (hereafter referred to as “in-system” customers) should pay a lower rate for reclaimed water than other “out-of-system” customers.

- Sales contracts with reclaimed water users should be formulated in a way that allows for modification of the rates annually, based on updates to the cost-of-service evaluation.

In order to determine the basis and range of rates being used in Texas and nationally, a review of reclaimed water rates was carried out. In Texas, reclaimed water rates for those cities that have relatively large established reclaimed water programs range between \$0.86 and \$1.20 per thousand gallons.

Based on the guidelines presented above, and the review of water rates, the City staff recommended a preliminary initial reclaimed water rate of \$0.75/1000 gallons for in-system customers. Based on a similar structure for water rates, staff also recommended that out-of-system rates be increased by 25% to a rate of 1.25 x \$0.75 = \$0.94/1000 gallons. This rate has not yet been approved by the City and, as discussed above, would be subject to modification based on future cost-of-service evaluations.

ES.8.5 Projected Payback Periods for Reclaimed Water Projects

As a part of the feasibility evaluation, projected payback periods for each of the reclaimed water projects were evaluated. The payback period was defined as the time elapsed between the initial capital investment in the project and the break-even point, i.e. when the total cumulative revenue from the project is equal to the total cumulative expenditures (including debt service and operation and maintenance costs). It should be noted that the estimated payback period is very sensitive to financing assumptions, such as interest rate and inflation. For this evaluation, the following assumptions were made:

- Capital Recovery Period = 20 years for City financing and 34 years for state participation financing

- Project Life = 50 years

- Annual interest rate = 5.5%

- Annual inflation rate = 4.0%

- Investment return rate = 5.0%

- Initial (2006) commodity charge for raw water = $0.65 per 1000 gallons

- Initial (2006) commodity charges for reclaimed water = $0.75 per 1000 gallons (in-system) and $0.94 per 1000 gallons (out-of-system)

In addition, it was assumed that the commodity charges for both raw water and reclaimed water increased at the annual inflation rate. For simplicity, all operation and maintenance costs (including energy) were also inflated at this rate.

Two financing options were evaluated. The first used a loan with equal annual debt service payments, based on the assumptions outlined above. The second assumed that the City would obtain state participation funding for 50% of each project from the TWDB.

Figure ES-10 summarizes the payback period for each service area and all projects as a whole, based on the evaluation of the two financing options. Figure ES-10 indicates that the projects for the Northern System Service Area and Eastern System Service Area have relatively short payback periods as compared to the projects in the Western and Central/Southern Service Areas. In general, the payback period does not vary greatly between the two financing options. However, the analysis confirmed that for all projects as a whole, the accumulated debt is significantly less with state participation financing.

As discussed above, reclaimed water projects provide a number of benefits, many of which are difficult to quantify in terms of a direct financial benefit. Based on the financial evaluation of the individual projects and the reclaimed water system as a whole (including all 4 recommended projects), the following conclusions can be made:

- The Northern and Eastern System projects are the most cost-effective and provide the greatest near-term benefits. These projects will serve customers that have expressed a serious interest in receiving reclaimed water as soon as facilities can be constructed.

- The Central/Southern and Western System projects require more initial cost support than the Northern and Eastern System projects.

- The Central/Southern System project is the most expensive on a unit cost basis. However, there is some potential to supply additional demands in this service area, for example within the proposed Central City Project, and to additional smaller irrigation customers along the route. The proposed facilities provide some additional capacity, particularly if users can be encouraged to provide on-site storage.

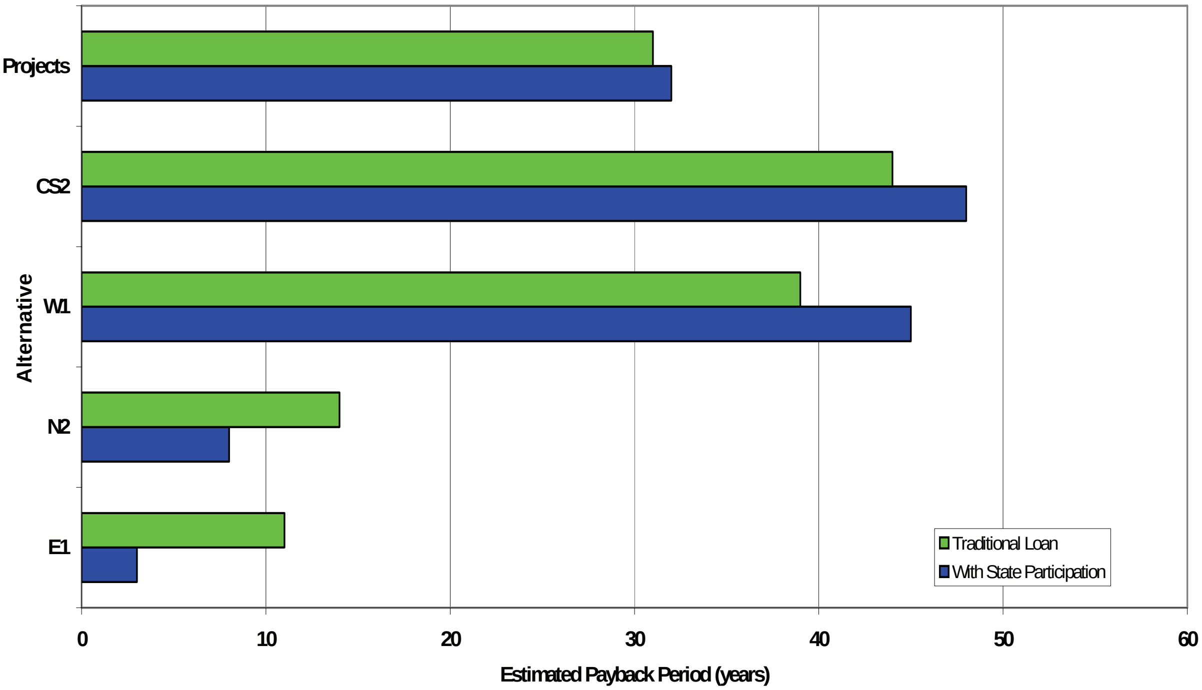

Figure ES-10: Summary of Payback Period for Reclaimed Water Projects

When evaluated as a system, the reclaimed water projects provide significant benefit to the City in terms of reduction in per capita potable water usage, achieving water conservation goals, and deferral of water and wastewater system facility expansions. Implementation of the reclaimed water system will demonstrate the City's commitment to efficient use of its water resources. This commitment is critical to the success of acquiring new water supply sources necessary to support future growth within the City of Fort Worth and in other communities within TRWD's service area.

Based on the feasibility evaluation, it is recommended that the City proceed with implementation of the reclaimed water system, including all four projects. The City should continue to explore alternative financing approaches, including federal or state grant or loan programs, and participation from customers and/or developers.

ES.9 Public Information Plan

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

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

ES.9.1 Proposed Public Information Program

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

Target stakeholders in the initial phases of the recycled water program will likely include industries, park facilities, and golf courses. Future expansion of the recycled water program will most likely depend on generating interest with additional stakeholders for reclaimed water uses. Public involvement with existing stakeholders and revised outreach materials will need to be developed as appropriate to bring additional stakeholders on board.

ES.10 Reclaimed Water Implementation Plan

The primary objectives of this project are to provide recommendations and evaluate the feasibility of reclaimed water projects for the City of Fort Worth and to develop an implementation plan for the viable reclaimed water projects. Advancement of Fort Worth's Reclaimed Water Program will involve the development of a number of policies and procedures and establishment or modification of ordinances supporting the program. The development of the program will also build upon the experience of the Waterchase Golf Course reclaimed water project, which has been in operation since 1999. Additionally, an organizational structure will need to be established to provide the leadership, marketing, and operations infrastructure necessary for a successful program.

The various actions for further developing the City of Fort Worth Reclaimed Water Program and pursuing the implementation of recommended reclaimed water projects are summarized in Table ES-8. A summary of the proposed project phasing timeline is provided in Figure ES-11 and a detailed timeline is presented in Figure ES-12.

ES.10.1 Administrative Actions

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

<u>Reclaimed Water Program Organization</u>

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

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Table ES-8: Reclaimed Water Implementation Steps

FISCAL YEAR 2006-2007
• Perform Administrative Actions • Initiate actions to establish reclaimed water program organizational structure. • Develop and adopt policies and procedures. • Update City ordinances (i.e. rates, financial provisions). • Develop and adopt reclaimed water standard contract. • Pursue state/federal funding opportunities • Negotiate and finalize agreement with TRA for DCRWS reclaimed water. • Identify any specific water quality requirements for potential customers. If necessary, perform testing for additional parameters at WWTP. • Initiate Public and Water Customer Reclaimed Water Awareness Program. • Initiate reclaimed water marketing and sales activities. • Perform routing delineation and surveying for Northern System, Phase 1 pipeline and pump station. • Perform environmental permitting for Northern System, Phase 1 pipeline and pump station.
FISCAL YEAR 2007-2008
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin and complete right-of-way acquisition and design for Northern System, Phase 1 pipeline and pump station. • Perform routing delineation and surveying for the Western System, Phase 1 pipeline and pump station. • Perform environmental permitting for the Western System, Phase 1 pipeline and pump station.
FISCAL YEAR 2008-2009
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Perform routing delineation and surveying for Eastern System, Phase 1 pipeline and pump station. • Perform environmental permitting for Eastern System, Phase 1 pipeline and pump station. • Begin construction of Northern System, Phase 1 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Western System, Phase 1 pipeline and pump station.
FISCAL YEAR 2009-2010
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin and complete right-of-way acquisition and design for Eastern System, Phase 1 pipeline and pump station. • Complete construction of Northern System, Phase 1 pipeline and pump station. • Perform routing delineation and surveying for Northern System, Phase 2 pipeline. • Perform environmental permitting for Northern System, Phase 2 pipeline. • Begin construction of Western System, Phase 1 pipeline and pump station. • Perform routing delineation and surveying for Western System, Phase 2 pipeline and pump station. • Perform environmental permitting for Western System, Phase 2 pipeline and pump station.
FISCAL YEAR 2010-2011
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin construction of Eastern System, Phase 1 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Northern System, Phase 2 pipeline. • Complete construction for Western System, Phase 1 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Western System, Phase 2 pipeline. • Perform routing delineation and surveying for Western System, Phase 3 pipeline and pump station. • Perform environmental permitting for Western System, Phase 3 pipeline and pump station.

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Table ES-8: Reclaimed Water Implementation Steps (cont'd)

FISCAL YEAR 2011-2012
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Complete construction of Eastern System Phase 1 pipeline and pump station. • Perform routing delineation and surveying for Eastern System Phase 2 and 3 pipelines. • Perform environmental permitting for Eastern System Phase 2 and 3 pipelines. • Begin construction of Northern System, Phase 2 pipeline. • Begin construction for Western System, Phase 2 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Western System, Phase 3 pipeline and pump station. • Perform routing delineation and surveying for Western System, Phase 4 pipeline. • Perform environmental permitting for Western System, Phase 4 pipeline.
FISCAL YEAR 2012-2013
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin and complete right-of-way acquisition and design for Eastern System Phase 2 pipeline. • Begin and complete right-of-way acquisition and design for Eastern System Phase 3 pipeline. • Complete construction of Northern System, Phase 2 pipeline. • Complete construction of Western System, Phase 2 pipeline and pump station. • Begin construction of Western System, Phase 3 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Western System, Phase 4 pipeline. • Perform routing delineation and surveying for Central System, Phase 1 pipeline and pump station. • Perform environmental permitting for Central System, Phase 1 pipeline and pump station.
FISCAL YEAR 2013-2014
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue Reclaimed water marketing and sales activities. • Begin and complete construction of Eastern System, Phase 2 pipeline. • Begin and complete construction of Eastern System, Phase 3 pipeline. • Complete construction of Western System, Phase 3 pipeline and pump station. • Begin construction of Western System, Phase 4 pipeline. • Begin preliminary studies for Western System, Phase 7 WRC. • Begin and complete right-of-way acquisition and design for Central System, Phase 1 pipeline and pump station. • Perform routing delineation and surveying for Central System, Phase 2, 3 and 4 pipelines. • Perform environmental permitting for Central System, Phase 2, 3 and 4 pipelines.
FISCAL YEAR 2014-2015
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Complete construction of Western System, Phase 4 pipeline. • Complete preliminary studies for Western System, Phase 5 WRC. • Begin design of Western System, Phase 5 WRC. • Begin construction of Central System, Phase 1 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Central System, Phase 2, 3 and 4 pipelines.
FISCAL YEAR 2015-2016
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Complete design of Western System, Phase 5 WRC. • Complete construction of Central System, Phase 1 pipeline and pump station. • Begin and complete construction of Central System, Phase 2 pipeline. • Begin construction of Central System, Phase 3 pipeline. • Begin and complete construction of Central System, Phase 4 pipeline. • Perform routing delineation and surveying for Central System, Phase 5 and 6 pipelines. • Perform environmental permitting for Central System, Phase 5 and 6 pipelines.

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Table ES-8: Reclaimed Water Implementation Steps (cont'd)

FISCAL YEAR 2016-2017
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin construction of Western System, Phase 5 WRC. • Complete construction of Central System, Phase 3 pipeline. • Begin and complete right-of-way acquisition and design for Central System, Phase 5 pipeline. • Begin and complete right-of-way acquisition and design for Central System, Phase 6 pipeline. • Perform routing delineation and surveying for Central System, Phase 7 pipeline and pump station. • Perform environmental permitting for Central System, Phase 7 pipeline and pump station.
FISCAL YEAR 2017-2018
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Complete construction of Western System, Phase 5 WRC. • Begin construction of Central System, Phase 5 pipeline. • Begin and complete construction of Central System, Phase 6 pipeline. • Begin and complete right-of-way acquisition and design for Central System, Phase 7 pipeline and pump station. • Perform routing delineation and surveying for Central System, Phase 8 pipeline. • Perform environmental permitting for Central System, Phase 8 pipeline.
FISCAL YEAR 2018-2019
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin and complete preliminary studies for Western System, Phase 6 WRC expansion. • Complete construction of Central System, Phase 5 pipeline. • Begin construction of Central System, Phase 7 pipeline and pump station. • Begin and complete right-of-way acquisition and design for Central System, Phase 8 pipeline.
FISCAL YEAR 2019-2020
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin and complete design of Western System, Phase 6 WRC expansion. • Complete construction of Central System, Phase 7 pipeline and pump station. • Begin construction of Central System, Phase 8 pipeline.
FISCAL YEAR 2020-2021
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Begin construction for Western System, Phase 6 WRC expansion. • Complete construction of Central System, Phase 8 pipeline.
FISCAL YEAR 2021-2022
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary. • Continue Public and Water Customer Reclaimed Water Awareness Program. • Continue reclaimed water marketing and sales activities. • Complete construction for Western System, Phase 6 WRC expansion.

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Figure ES-11: Reclaimed Water Implementation Plan Phasing

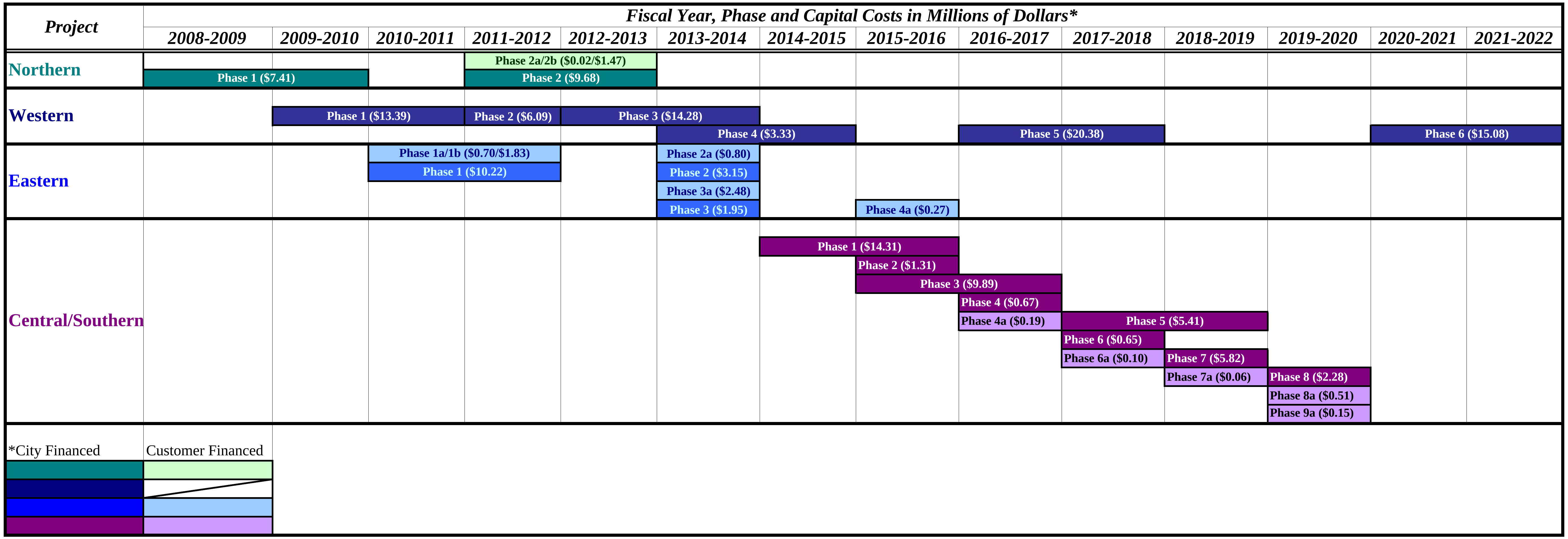

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Figure ES-12: Reclaimed Water Implementation Plan Detailed Timeline

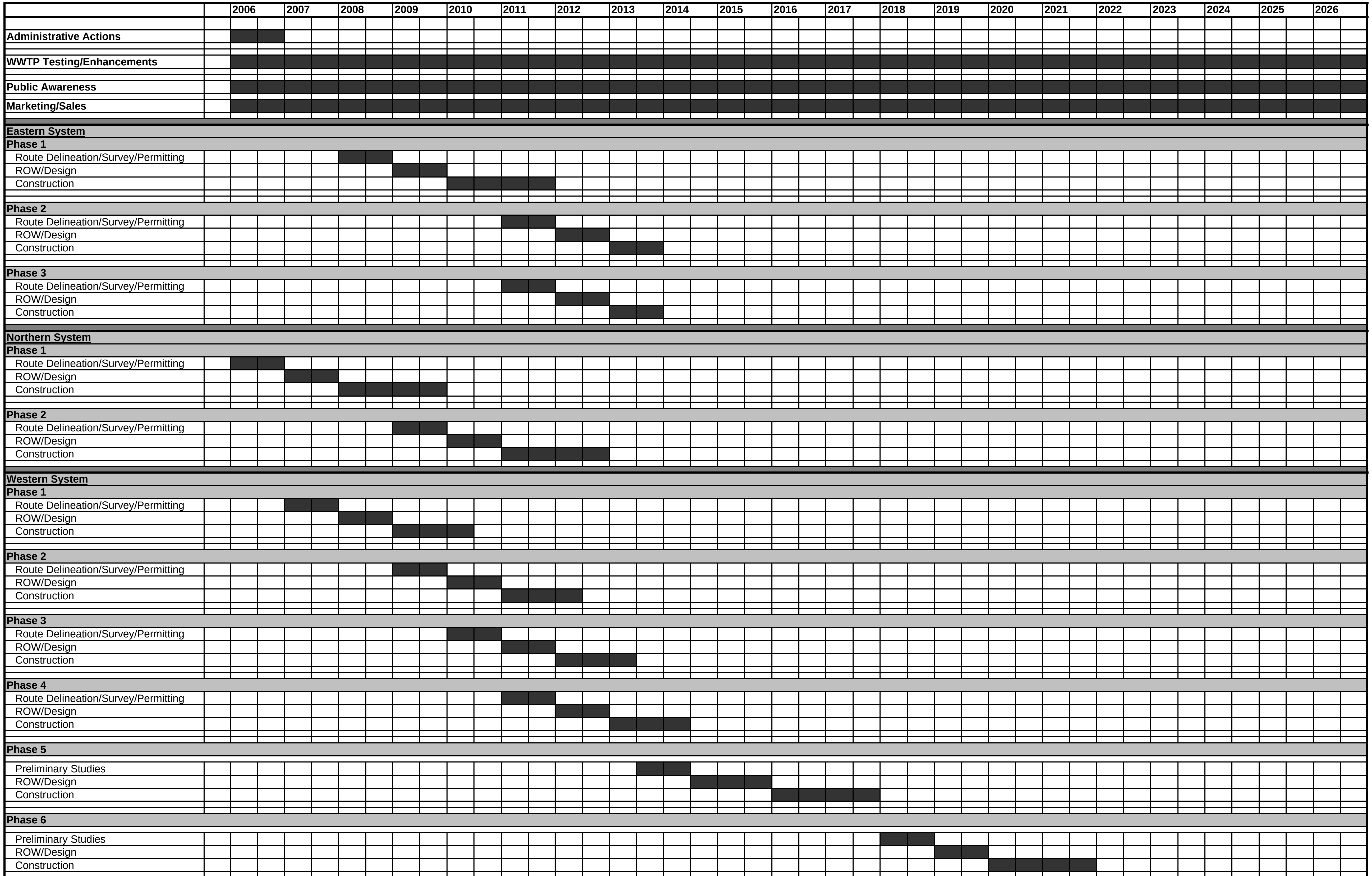

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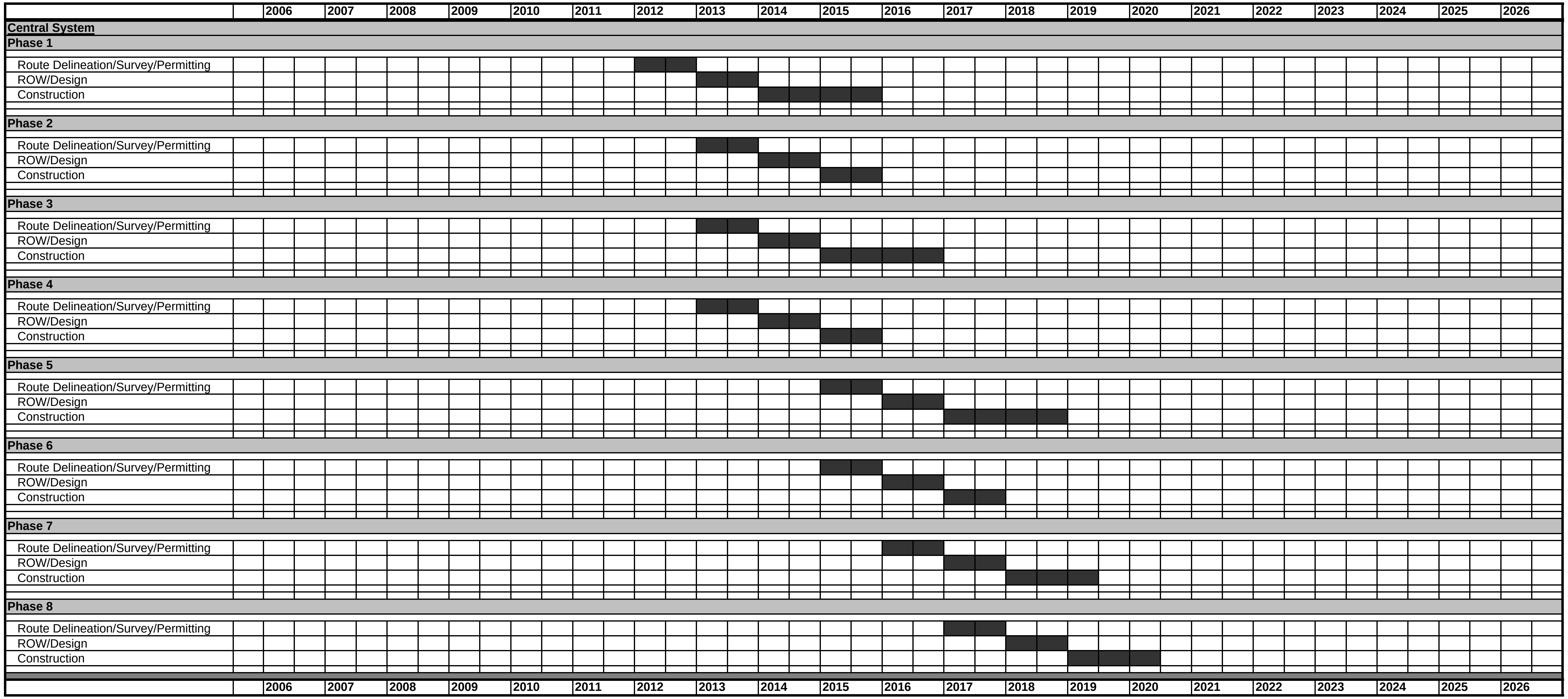
Figure ES-12: Reclaimed Water Implementation Plan Detailed Timeline



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Policies and Procedures

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

Update City Ordinances to Include Reclaimed Water Provisions

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

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

Reclaimed Water Customer Contract

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

ES.10.2 Other Actions

Waterchase Golf Course Reclaimed Water Project Experience

The City has been providing reclaimed water to the Waterchase Golf Course since 1999. The City can use this project as a development tool and building block for future reclaimed water projects. Much has been learned during the development and implementation of this project, and many of the assumptions and policies can be reviewed and refined based on this experience and provide beneficial knowledge for future operations and maintenance practices.

Wastewater Treatment Plant Testing Program

Based on a review of historical effluent data at Village Creek WWTP (VCWWTP) and TRA's Denton Creek Regional Wastewater System (DCRWS), both plants have demonstrated the ability to meet the quality requirements for both Type I and Type II reclaimed water applications (see Chapter 5). In Type I applications, there is likely public contact in areas irrigated with reclaimed water. In Type II projects, public contact is controlled. However, as flows from these plants increase, and approach their rated design capacities, careful observations should be made of the CBOD and turbidity levels. Any trends of increased concentrations should be addressed, possibly with optimization of operations or additional treatment capacity. Under the current flow and loading conditions, the effluent from either plant could be used for Type I or Type II reclaimed water projects.

Chapter 210 Reclaimed Use Notification

At the commencement of the study, the City held a reclaimed water authorization for Type II reclaimed water service to the Waterchase Golf Course. As a part of this study, the City submitted a general reclaimed water notification to the TCEQ to cover both Type I and Type II uses of reclaimed water throughout a much larger service area. The notification identified a number of potential uses for the reclaimed water. Official authorization for this notification was received from the TCEQ on August 28, 2006. A copy of the reuse authorization is included as Appendix M.

Public Information/Public Awareness Campaign

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

ES.10.3 Reclaimed Water Workgroup Goals and Accomplishments

A reclaimed water workgroup was established in order to begin the process of developing the appropriate administrative framework to support the reclaimed water program. The workgroup held 9 meetings between October 31, 2006 and March 8, 2007. The primary goals of the workgroup were as follows:

1. Identify and develop a general description of administrative documents necessary for the reclaimed water program;

2. Development of draft administrative documents identified in item 1, above. Draft documents developed by the workgroup include:

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

    b. A standard service agreement for reclaimed water users;

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

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

Copies of the draft reclaimed water ordinance and standard service agreements are included in Appendices N and O, respectively. It should be noted that in addition to the projects recommended in this report, the City is planning the construction of a truck depot at its Village Creek WWTP. Reclaimed water will be available at this depot to permitted haulers for transport to user sites. The ordinance and service agreement documents incorporate special provisions to address this reclaimed water hauling program.

The rate structure adopted by the workgroup is the same as the structure discussed in Section ES.8.4. These rates include an in-system volume charge of $0.75/1000 gallons and an out-of-system volume charge of $0.94/1000 gallons. In addition it was decided that the same general fee structure used for the potable water system would be used for the reclaimed water system. The reclaimed water rates will be incorporated into the City's existing ordinance for water and wastewater rates.

The ordinance and service agreement documents, together with the rate structure are scheduled to be taken to the City Council for approval in April 2007. Adoption of these documents by the City Council will provide the necessary foundation to begin contracting with users once facilities have been constructed.

ES.11 Summary- Recommended Reclaimed Water Projects

This study has identified four direct, nonpotable reclaimed water projects that can be implemented to serve the City of Fort Worth and surrounding communities. The feasibility evaluation has indicated that these projects are viable and provide a number of benefits to the City, its wholesale customers, its raw water provider (Tarrant Regional Water District), and surrounding communities participating in the reclaimed water program. In addition, a partnership with Trinity River Authority to use treated effluent from the Denton Creek Regional Wastewater System for the Northern service area will help TRA to defer upgrades necessary to comply with more stringent TPDES permitting requirements.

As a part of this project, the City has taken significant steps toward the implementation of its reclaimed water program. Development of the ordinance and service agreement documents, together with modifications to existing policy and procedure documents to incorporate specific provisions of the reclaimed water program are well underway.

The recommendation to implement the four proposed reclaimed water projects is based on the likelihood of customer interest and feasibility of the projects. Potential customers in both the Northern and Eastern service areas have expressed a serious interest in purchasing reclaimed water as soon as it is available. In addition, the developer of the Walsh Ranch area in the Western service area has indicated willingness to install dual distribution systems for that area. The City needs to pursue further discussions with these potential customers to finalize their commitment to reclaimed water use. Other potential customers identified in this report should also be contacted directly to confirm their interest, needs and expectations.

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CHAPTER 1: INTRODUCTION

1.1 Background

The City of Fort Worth and surrounding areas are projected to experience significant growth in population over the next several decades. In order to help meet its future water supply needs, the City is pursuing opportunities that include conservation and the use of highly treated wastewater effluent to reduce demands for potable water.

The regional water supply planning process, originally mandated by the 75th Texas Legislature in Senate Bill 1, has identified a number of future water management strategies for the City of Fort Worth and Tarrant Regional Water District (TRWD), who currently provides the City with raw water. In addition to conservation and reuse, future water management strategies for TRWD in the 2006 Region C Water Plan include construction of the Marvin Nichols Reservoir in the Sulfur River Basin, importing water from Toledo Bend Reservoir and importing water from Oklahoma.

Through Senate Bill 1 and subsequent legislation, the Texas Legislature has placed a strong emphasis on the efficient use of water resources. As a result of Senate Bill 1, the Texas Water Code now requires that an applicant for a water right involving an interbasin transfer of raw water develop and implement a water conservation plan that will result in the "highest practicable levels of water conservation and efficiency achievable...[5]" Since three of the planned future water supplies for TRWD (and, hence Fort Worth) involve interbasin transfers, it will be necessary to demonstrate that this requirement has been met prior to approval and implementation of these projects.

Water reuse has been identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature under Senate Bill 1094[6]. Therefore, in addition to other water conservation efforts, development of a water reuse program will provide for efficient use of the City's water resources and will assist TRWD in securing necessary future water supplies to meet anticipated growth within the City of Fort Worth and surrounding areas.

Although previous studies related to water reuse have identified some potentially viable alternatives for the City, these studies have not developed a detailed, comprehensive plan that evaluates and prioritizes alternatives for the City and its service area. The purpose of this study is to provide the City with a plan that can be used to guide implementation of a direct reuse program to support future water supply requirements for the City. In addition, during development of this plan, the City has worked closely with its wholesale customers, TRWD, Trinity River Authority (TRA) and other surrounding cities to identify potential approaches to its reuse program that could include regional support and cooperation among these entities.

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[5] Texas Water Code, Subtitle B, Chapter 11, §11.085

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

This study includes the evaluation of alternatives for direct non-potable reuse. No indirect reuse is considered here. However, it should be noted that TRWD has been issued a water right permit to implement a major indirect reuse project that diverts return flows from the Trinity River to a constructed wetland and ultimately into Richland Chambers and Cedar Creek Reservoirs[7]. Implementation of a direct reuse program for the City of Fort Worth is intended to complement these ongoing reuse efforts by TRWD.

1.2 Project Scope

The goals of this study were to develop a priority and implementation plan identifying appropriate uses for highly treated effluent from the City of Fort Worth Village Creek wastewater treatment plant (VCWWTP) and/or potential water recycling centers (WRCs or satellite WWTPs) at other locations within the City. The study includes the development of conceptual plans and an evaluation of costs and benefits for providing reclaimed water to several identified service areas within Fort Worth and surrounding communities.

The project scope included the following tasks, intended to provide a review of available information associated with the project, identify potential reclaimed water service areas, develop conceptual treatment and conveyance plans, evaluate costs, benefits and feasibility and identify necessary steps for implementation:

- Review previous City of Fort Worth reports or studies related to reclaimed water;
- Review population, water demand and wastewater flow projections;
- Evaluate quality of Village Creek WWTP effluent relative to potential reclaimed water quality requirements;
- Identify top water users within the City and develop a list of potential reclaimed water customers;
- Identify potential reclaimed water uses and options;
- Identify service areas, demands, and potential locations for reclaimed water projects;
- Conceptualize potential projects and develop a list of alternatives;
- Perform cost, benefit and feasibility analysis for the list of alternatives and identify the most viable projects;
- Support the City in establishing a Public Information Committee and recommended steps for development of a public information plan;
- Identify administrative or regulatory actions necessary to support a reclaimed water program;
- Develop a reclaimed water implementation plan that includes recommended projects, implementation steps and an implementation schedule.

[7] Amendment to Certificate of Adjudication, 08-5035C (Richland Chambers Reservoir) and 08-4976C (Cedar Creek Reservoir), Texas Commission on Environmental Quality, granted February 8, 2005.

The project objectives were achieved by reviewing previous studies; meeting with City staff, potential customers, TRWD and TRA; evaluating potential current and future reclaimed water needs and service areas; and assessing costs and benefits associated with each project. The potential projects were then analyzed based on engineering and economic feasibility to define the recommended reclaimed water options and develop an implementation plan.

In addition to the objectives defined above, a reuse workgroup was established in order to begin the process of developing policies and procedures and associated documentation for the City's reclaimed water program. The workgroup met on nine occasions and developed a set of draft documents that are scheduled to go to the City Council for approval in April 2007. Details of these efforts are discussed in Chapter 9.

1.3 Organization

This report is generally organized by the major tasks in the scope of work for the study. An executive summary precedes the main body of the report. Following the current introductory chapter, the remaining chapters of the report address the topics listed below:

- Review of previous reports and studies associated with water reuse, and relevant water and wastewater system characteristics;
- Population projections, water supply and demand, and treated wastewater availability;
- A review of potential reclaimed water users and their demands;
- Reclaimed water quality considerations;
- Identification of reclaimed water service areas, screening-level evaluation of potential alternatives and selection of preferred alternatives for further evaluation;
- Feasibility evaluation of the preferred alternatives, including evaluation of benefits and preliminary opinion of probable costs;
- A review of potential financing strategies and sources of funding;
- A summary of important public relations issues and a proposed public information plan;
- A summary of the proposed implementation steps and schedule for the reclaimed water system.

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CHAPTER 2: REVIEW OF PREVIOUS CITY OF FORT WORTH REUSE PROGRAM EVALUATIONS AND RECOMMENDATIONS

2.1 Introduction

Utilizing reclaimed water to supplement potable water supplies has been evaluated by the City of Fort Worth periodically over the past decade or more. The following documents record the history of reclaimed water studies for the City of Fort Worth service area and form the foundation for the Reclaimed Water Plan (RWP).

- Technical Memorandum Number 12: Effluent Reuse Alternative Identification and Feasibility Analysis, Freese & Nichols, Inc., November 1996.
- 1998 Wastewater Collection System Master Plan 2000-2020, Freese and Nichols, Inc., et al, September 1998.
- 1999 Fort Worth Wastewater Facilities Master Plan 2000-2020, Freese and Nichols, Inc., August 1999.
- Village Creek Sewershed Feasibility Study, Alan Plummer Assoc., Inc, December 2001.
- Wastewater Conveyance and Treatment Evaluation Study, Alan Plummer Associates, Inc., September 2003.
- Draft 2004 Comprehensive Plan, Lockwood, Andrews, and Newmann, 2004.
- Draft Mary's Creek Water Recycling Center Feasibility Study, Alan Plummer Assoc., Inc, June 2004.
- Fort Worth Water Master Plan, Freese and Nichols, Inc., May 2005.

The scope and findings of each of these studies are briefly described below.

2.2 Technical Memorandum No. 12: Effluent Reuse Alternative Identification and Feasibility Analysis

Technical Memorandum No. 12 (TM12) provided an analysis of potential water demands in the Fort Worth area, located areas where water reuse potential was high, and defined potential reclaimed water projects for the City of Fort Worth. The study used an evaluation matrix to assess the feasibility of selected potential projects. Evaluation parameters included public acceptance, economic considerations, technical considerations, regulatory factors, legal and institutional considerations, environmental impacts and public health considerations.

TM 12 identified several reclaimed water use options, including agricultural, urban, commercial, and industrial reuse systems, greywater systems, water supply augmentation projects, and water factory reclamation. Based on the results of a previous study (Technical Memorandum No. 8), which identified large water users and potential reuse customers, reuse service areas were delineated and prioritized based on several factors. These included:

- distance from the Village Creek WWTP;

- reuse potential;
- potential receptiveness of reclaimed water users to the use of reclaimed water; and
- current source of water for the potential reclaimed water users.

Several general service areas were identified by geographic location and included East Central Tarrant, East Tarrant, West Fort Worth, South Fort Worth, Northwest Tarrant, Northeast Tarrant, Southeast Tarrant, and Southwest Tarrant. The East Tarrant service area and the East Central service area were identified as having significant potential due to their proximity to Village Creek WWTP, the number of greenbelt areas and industrial water users, and other factors.

2.2.1 Projects Evaluated

The reuse projects for which feasibility analyses were conducted included two potential water supply augmentation projects in Fort Worth (Lake Benbrook & Lake Worth) and two general reuse projects in the East Tarrant and East Central Tarrant service areas.

The Lake Benbrook water supply augmentation project included the construction of a satellite wastewater plant and transmission line to intercept, treat and pump 10 MGD of wastewater from the City of Fort Worth's collection system in west Fort Worth to Lake Benbrook. The Lake Worth water supply augmentation project proposed intercepting and treating 20 MGD of wastewater flow and pumping it to Lake Worth. The estimated effective cost for the Lake Benbrook project was $0.76 per 1000 gallons (1996 dollars) while that of the Lake Worth project was $0.55 per 1000 gallons. These estimated costs included capital, operations and maintenance costs, as well as a credit for reduced flows to Village Creek WWTP.

The East Tarrant reuse project involved pumping water from the Village Creek WWTP to a number of potential reclaimed water customers east of the WWTP and was recommended for implementation in two phases. Phase I included the construction of a pump station and pipeline for transmission of treated effluent to areas near River Trails Land and Cattle, Bell Helicopter Textron, Euless Golf Course, and Euless Athletic Complex. Phase II included the extension of this reuse line to areas near Rolling Hills Golf Course, Riverside Golf Course, Bell Helicopter Textron Machinery Center and Great Southwest Golf Club in Grand Prairie. The estimated average project costs were nearly $2.00 per 1000 gallons of reclaimed water used. These costs included capital costs and O&M costs. They did not include any credits for potential benefits.

The East Central Tarrant reuse projects included two proposed alternatives. The most cost effective alternative involved pumping effluent from the Village Creek WWTP to restricted and unrestricted access greenbelt sites as well as a power plant for cooling water. The reclaimed water transmission line would extend through areas near Sharon Rose Hill Cemetery and the Texas Utilities Handley Power Plant as well as neighboring golf courses and parks. The estimated project cost for this alternative was $0.90 per 1000 gallons. It was envisioned that most of the water in this alternative would be substituted for raw water at the TXU Handley Plant.

2.2.2 Recommendations and Insights Related to Current Study

The primary conclusions of TM12 were:

- Economical direct use of reclaimed water depends on sufficient demand within an area close enough to the wastewater treatment plant to allow for inexpensive conveyance;

- Direct reuse was not economical at the time of the study;

- Water supply augmentation appeared to be more cost-effective than non-potable reuse due to the larger volumes of water involved. The study recommended that the City explore water supply augmentation alternatives through coordination with TRWD (formerly Tarrant County Water Control and Improvement District No. 1).

Since TM12 was completed, the City has explored the potential for implementing water supply augmentation projects using reclaimed water. This alternative has not yet been determined to be feasible.

Although direct reuse was not found to be cost effective, several factors influencing this conclusion are worth mentioning here. First, it is generally recognized that implementation of a direct reuse program has a number of benefits, some of which can be quantified and credited to the cost of the reuse system. These benefits may include deferral of potable water treatment facilities or deferral of expenditures for future raw water supplies. Direct reuse programs in other cities have been shown to be feasible if the costs are shared among all customers that receive a benefit from the system. Secondly, due to the increasing scarcity of new water supplies, the cost of raw and potable water is projected to increase significantly in the next several decades. If direct reuse programs are treated and evaluated as a new water supply, they often can be shown to be cost effective in comparison to other alternatives.

2.3 1998 Wastewater Collection System Master Plan 2000-2020

The 1998 Wastewater Collection System Master Plan provided an update to the 1989 wastewater system master plan developed by Camp, Dresser and McKee (CDM) in response to increased growth in Tarrant County. A hydraulic modeling effort capable of evaluating the sewer system at current and projected flows was the primary scope of the 1998 master plan; the results of the modeling effort demonstrated that the system could function only under dry weather conditions, and at 2020 flows, the Big Fossil, Marine Creek, and Village Creek basins would experience significantly more system overflows in a number of locations. As a consequence of these results, six alternative solutions were proposed and two were identified as the preferred options: 1) to engage in capacity corrections for the entire collection system in Fort Worth, 2) to construct a satellite plant that would augment the treatment capacity of Village Creek Wastewater Treatment Plant (VCWWTP).

2.3.1 Projects Evaluated

The vast majority of the Wastewater Collection System Master Plan described the development of the model and its input parameters. The model was used to assess Fort Worth's collection system under both a dry weather and wet weather condition for 2000 and 2020 flows. In addition, several alternatives were examined as potential solutions to the issues surrounding the capacity of Fort Worth's collection system during wet-weather events.

2.3.1.1 Alternatives for Wet-Weather Flow Events

The capacity corrections mentioned in Section 2.3 were broken further into specific solutions. The first was to incorporate wet-weather overflow facilities into the collection system which would discharge peak flows directly to a river or creek. Wet-weather storage facilities adjacent to the current piping system were also considered as was real time control in which flow could be diverted from under- to overloaded portions of the system. Piping replacements were also included in the proposed options, and finally, a satellite treatment facility was also discussed. This last option presented the only reference to water reuse in the master plan, as the discharge from a satellite plant could be used for water supply augmentation.

2.3.2 Recommendations and Insights Related to Current Study

Recommendations were far-reaching, involving capital improvement plans for the collection system. There were few mentions of the reclaimed water potential that a satellite plant would provide; no quantities for production or demand were presented.

2.4 1999 Fort Worth Wastewater Facilities Master Plan 2000-2020

The 1999 Facilities Master Plan evaluated the City of Fort Worth's wastewater collection and treatment facilities relative to changing demands and future projected growth. Projections regarding population, waste load allocation, base wastewater flows, etc. were used to predict the anticipated wastewater flows for the year 2020; an average daily wastewater flow and a peak 2-hour wastewater flow for this planning year was estimated at 164 MGD and 511 MGD, respectively. The current facilities, specifically the Village Creek Wastewater Treatment Plant (VCWWTP), were analyzed for capacity, and found to be limited in their ability to treat these anticipated flows; therefore, several alternatives for increasing capacity were considered using a matrix of cost, technical feasibility, public and government acceptance, and environmental soundness.

2.4.1 Projects Evaluated

Village Creek WWTP was previously rated for an annual average flow of 144 MGD; however, an uprating study conducted by Alan Plummer Associates, Inc demonstrated that without significant alterations, the plant could treat a nominal flow of 166 MGD which approximates the projected 2020 average daily flow. Projected wet-weather flows for 2020, however, exceeded the treatment capacity at the plant, which necessitated an evaluation and suggestions for how to mitigate this issue.

2.4.1.1 Alternatives

Alternative 1 suggested the continued routing of all flow to VCWWTP and upgrading both the plant and collection system. The advantages to this option were that construction and improvements could all occur at one location and that all flow would be treated, rather than diverting some wet-weather flow directly to rivers and streams. One disadvantage cited was the extensive sewer line replacement necessary to convey additional flow.

Alternative 2 would involve the interception of wet-weather flow, which would be discharged directly to receiving waters. The flow would have to be treated to primary standards, but government regulatory agencies reluctantly issue case-by-case permits for these types of minimal treatment facilities. Some improvements to the pipeline and to VCWWTP would still be needed. Because of the difficulties surrounding permitting, siting and constructing a plant designed for primary treatment would be a challenge, and O&M costs would increase with the addition of a new facility.

Alternative 3 considered the construction of above-ground wet-weather storage tanks for retention of peak flows during rain events. The stored flow would be routed to VCWWTP for subsequent treatment after the event subsided. VCWWTP would have to be upgraded to accommodate peak flows of 440 MGD, and 34 tanks would have to be constructed. This would increase O&M costs, and siting the tanks may be difficult.

Alternative 4 is similar to Alternative 3, but would include a real-time control system that would enable the diversion of flow from overloaded areas of the collection system to underutilized portions. Tanks would be installed, in addition to a system of force mains and inter basin valving connections, which would be controlled by a Supervisory Control and Data Acquisition (SCADA) system. Although few VCWWTP improvements would be required, the installation of interbasin connections and force mains would be difficult and O&M costs would increase.

Alternatives 5A and 5B recommend the construction of a 30-40 MGD satellite plant upstream of VCWWTP. The difference in the two alternatives is the location; 5A sites the plant on Village Creek south of Lake Arlington while 5B locates the facility on the Trinity River three miles upstream of VCWWTP. Full treatment of all flows would be achieved and future growth could be accommodated at this facility without the need for VCWWTP upgrades. Permitting and siting the facility may prove problematic, and O&M costs would increase.

Alternative 6 recommends a comprehensive sewer line replacement of pipes that are more than 50 years old. This would reduce infiltration, but would still require an upgrade of VCWWTP.

2.4.1.2 Evaluation Matrix

The above alternatives were evaluated using a matrix consisting of the following criteria;

- Technical Considerations, including feasibility and compatibility with both existing infrastructure and future improvements
- Performance Considerations, including the correction of system deficiencies and the level of protection each alternative affords
- Legal Considerations
- Public Health and Safety
- Public Support
- Social Impact/Environmental Justice

- Environmental Considerations
- Scheduling
- Benefit/Cost Analysis

Based on the results, Alternatives 1 and 5 were chosen as the most preferred of the six. A combination of these two alternatives was the final solution; collection system improvements and construction of a satellite plant would be undertaken. Improvements to VCWWTP are also necessary but they are not as extensive as those required without the inclusion of a new treatment facility.

2.4.2 Recommendations and Insights Related to Current Study

There were no direct implications for water reclamation mentioned in the Facilities Plan. Other documents summarized in this chapter have suggested, however, that the new wastewater treatment facility could be used to provide reclaimed water for water supply augmentation and could possibly serve as a source of direct reuse water for non-potable purposes.

2.5 Village Creek Sewershed Feasibility Study

The Village Creek Sewershed Feasibility Study addressed the recommendations and identified needs of several previously completed reports, including the City’s Wastewater Collection System Master Plan and Facilities Plan, while incorporating other planning issues that related to recently passed legislation. While the Facilities Plan recommended the construction of a Fossil Creek Satellite WWTP (FCSWWTP), it also acknowledged the need for a Village Creek Satellite WWTP (VCSWWTP) as a source of reuse water; subsequent water planning developments emphasized the need to examine the VCSWWTP further. The primary objective of the Sewershed Study therefore was to investigate the feasibility of constructing a satellite wastewater treatment plant to satisfy the needs of Fort Worth’s projected growth and provide a source of reuse water to alleviate the demands this growth will place on the potable water supply. The scope of this study included an evaluation of opportunities for water supply augmentation, interceptor construction savings potential, a treatment plant concept, economic evaluation and path-forward actions. Direct non-potable reuse possibilities were mentioned but not examined in any great detail. For the purpose of this report, the scope items will be discussed only as they apply to the water reuse project.

2.5.1 Projects Evaluated

Two water supply augmentation projects were examined in addition to a brief description of a possible direct nonpotable reuse project.

2.5.1.1 Alternatives for Reuse

The first water supply augmentation project examined the current and projected needs of Lake Arlington customers; currently, Lake Arlington cannot supply the existing water treatment plant demands and augments supply with water from the Cedar Creek and Richland-Chambers reservoirs. After a discussion of projected increases in water usage, the Feasibility Study stated that up to 25

MGD of reuse augmentation could be supplied, which is approximately 22% of the projected 2020 demands for Lake Arlington.

Another augmentation supply project proved infeasible; transportation of reuse water from the Village Creek Sewershed to Lake Benbrook was found to be cost prohibitive. In addition, there were water quality concerns associated with adding large quantities of reclaimed water to Lake Benbrook.

Direct non-potable use was mentioned, however, the potential users and their demands had been summarized more thoroughly in previous reports. Various golf courses, parks, and industrial landscaping were all cited as potential users in addition to TXU, which would employ reuse water in cooling towers, provided the water could be treated to a high enough quality.

2.5.2 Recommendations and Insights Related to Current Study

The recommendations put forth by the Sewershed Study were divided into sequential, dependent categories that began with the planning and public information gathering phases and ended with the construction of a satellite wastewater treatment plant. Reuse was given a prominent position in a number of these categories; the siting of the future plant was to be considered relative to the proximity of reuse customers, and discussions with TRWD regarding the potential quantities of reuse and economic benefits thereof were also included.

2.6 Wastewater Conveyance and Treatment Evaluation Study

The Conveyance and Treatment Study was concerned with alternative methods of addressing issues associated with West Fork interceptor capacity. The two lower West Fork interceptors that convey wastewater to the Village Creek Wastewater Treatment Plant (VCWWTP) are approaching or slightly exceeding capacity and require diversion and/or construction of additional parallel lines. In addition to collection system improvements, the study examined and proposed upgrades to the VCWWTP required to accommodate projected flows and investigated the possibility of constructing a new wastewater treatment facility. Pertinent to the City of Fort Worth Reclaimed Water Plan is the consideration by the Conveyance and Treatment Study of opportunities for reclaimed water usage and the implementation of conveyance options best suited for reuse. Five reuse projects were identified and a feasibility analysis was conducted for each.

2.6.1 Projects Evaluated

Three alternatives for West Fork improvements were evaluated, in addition to recommendations for improvements at VCWWTP and propositions for a new satellite wastewater treatment facility, Fossil Creek Satellite Wastewater Treatment Plant (FCSWWTP). In the following sections, improvements at and/or development of wastewater treatment facilities will only be discussed as they relate to the RWP. It should be noted that the costs presented here do not include any credit for potential benefits.

2.6.1.1 Alternatives for Reuse Projects

Reuse Alternative 1 includes a pipeline from FCSWWTP to serve direct nonpotable needs at the Iron Horse Golf Course and the Diamond Oaks Country Club. The probable unit cost for this project is $2.52 per 1000 gallons.

Reuse Alternative 2 is also a direct reuse project serving several golf courses and parks to the south and west of FCSWWTP. The probable unit cost for this project is $3.48 per 1000 gallons.

Reuse Alternative 3 is a variation of Alternative 2; it serves a number of parks and golf courses but the potential customers extend farther to the south than Alternative 2. The probable unit cost for this project is $2.30 per 1000 gallons.

Reuse Alternative 4 is a direct reuse project that serves golf courses and a cemetery to the south and east of FCWWTP. The probable unit cost for this project is $3.80 per 1000 gallons.

Reuse Alternative 5 is the only indirect reuse project examined. It includes the construction of a pipeline to convey reuse water for supply augmentation of Eagle Mountain Lake. The probable unit cost for this project is $2.47 per 1000 gallons.

At the time of this report, City of Fort Worth's rate for potable water used for irrigation was $2.46 per 1000 gallons, and the cost of raw water was approximately $0.60 per 1000 gallons. Therefore, Alternatives 1 and 3 appeared to be the most cost effective.

2.6.1.2 Alternatives for West Fork Improvements

Alternative A proposes the construction of a third parallel pipeline for continued conveyance of all wastewater to VCWWTP. Depending on the VCWWTP expansion approach, the opinion of probable present worth cost of Alternative A was either $154.1 or $165.1 million dollars.

Alternative B diverts excess flow to the new FCSWWTP and improves the interceptor system between the Riverside WWTP, which is out of service, and the FCSWWTP. Improvements at VCWWTP would still be necessary, but would not be as extensive as those for Alternative A. The opinion of probable present worth cost is $169.3 million dollars.

Alternative C diverts excess flow to both the Riverside WWTP for short-term storage and to the FCSWWTP for treatment. Again, the level of improvements at VCWWTP is significantly reduced. The opinion of probable present worth cost for Alternative C is $164.8 million dollars.

2.6.2 Recommendations and Insights Related to Current Study

Alternative C was chosen as the preferred option. It would provide relief from the interceptor system and delay the implementation of wet-weather facilities at VCWWTP, provide operational flexibility, and allow for industrial rather than residential risk assessment criteria to be employed. More important to this examination is Alternative C's facilitation of providing reclaimed water to a number of customers. The construction of FCSWWTP shortens the distance of transmission to the reclaimed water users in question when compared to VCWWTP; Alternative B would also provide this opportunity, but scheduling issues regarding other elements of the alternatives drove the choice of Alternative C. In addition, the Conveyance Study promotes the position that implementation of a reuse project will alleviate some of the potable water demand of the City of Fort Worth.

2.7 Draft 2004 Comprehensive Plan

The 2004 Comprehensive Plan for the City of Fort Worth summarizes the recommended policies and planning decisions for growth and development. This multi-faceted report addresses the issues that face Fort Worth as population increases, and includes data on population and financial trends, land use, environmental quality, annexing policies, as well as many of the other arenas that comprise city management. The projects evaluated are extensive and far-reaching, and the vast majority are not directly related to the Reclaimed Water Plan. Only those pertaining to water reuse will be addressed by this report.

2.7.1 Projects Evaluated

Because of the breadth of scope, the projects evaluated were very generally discussed. Support and continuance of current policies, among which included providing potable water as required and assuring an adequate amount of raw water sources, were addressed by the following anticipated actions:

- Provide an update the Water Master Plan by March, 2004.
- Complete the Comprehensive Conservation Plan by February, 2004.
- Create new reservoirs along the Sulfur River to accommodate future growth after 2020.

2.7.2 Recommendations and Insights Related to Current Study

Water reuse was never identified as part of the overall water supply plan for Fort Worth. There was one reference, however, to improvements at Village Creek WWTP. Based on other reports summarized in this chapter, this may have some impact on water reuse, particularly with respect to water supply augmentation.

2.8 Draft Mary's Creek Water Recycling Center Feasibility Study

The Mary's Creek Water Recycling Center (MCWRC) Feasibility Study discussed significant projected growth in the part of Fort Worth within Mary's Creek Basin and its impact on expected potable water demands. In particular, needs of the new planned developments, Walsh Ranch, Brown Ranch, and Murrin West Fork Ranch, were considered. While the 1998 *Wastewater Collection System Master Plan 2000-2020* planned for all wastewater flows from this area to be diverted to the Village Creek WWTP (VCWWTP), it was recognized that the implementation of a recycling center would serve two purposes: 1) defer expansion of VCWWTP and 2) address the mandate by the State of Texas in Senate Bill 1094 to pursue water conservation strategies. The scope of this study, therefore, focused on long-term solutions for providing water through a water recycling center that would serve to augment current supplies, provide direct reuse potential, or both. An array of parameters, such as distance from reuse customers, the impact such a recycling center would have on deferring expenditures on water infrastructure, social impacts, and public acceptance, were employed in identifying potential sites and treatment processes.

2.8.1 Projects Evaluated

Two sites for MCWRC were evaluated and three alternatives for reuse potential from MCWRC were examined. In addition, the advantages and disadvantages of designing for conventional treatment versus employing submerged membrane bioreactors were compared.

2.8.1.1 Siting the Recycling Center

Two possible sites, one on Mary's Creek and one on the Clear Fork branch of the Trinity River, were evaluated based on a number of selection criteria and needs. The WRC should (be):

- Located in an undeveloped area of 75-100 acres to allow for adequate facility space, a buffer zone, and room for expansion.
- Near the existing collection system with enough projected wastewater flow to provide a significant reuse supply.
- Near reclaimed water users
- At a great enough distance from developed areas to assuage public aesthetic concerns
- Near a potential effluent discharge point
- Sited on gently sloping terrain conducive to the hydraulic needs of a treatment facility.
- Easily permitted according to state requirements
- Have low potential for adverse environmental issues
- Sited on enough area outside the 100-year flood plain to minimize U.S. Army Corps of Engineers (USACE) involvement.
- Close to a roadway
- Have minimal property owners

Based on meeting the above criteria, the Mary's Creek site was chosen as the preferred option, primarily because it is much closer to potential reuse water customers, making the conveyance of reuse water more cost effective.

2.8.1.2 Alternatives for MCWRC

Three alternatives were evaluated to determine the best use for the MCWRC.

Alternative A represented the null option, one in which no recycling center would be constructed and all flows would be diverted to VCWWTP. The opinion of probable present worth cost for this alternative was $23.1 million, based on necessary downstream improvements to the interceptor system and VCWWTP.

Alternative B would allow most of the wastewater flow generated in the Mary's Creek Basin to be diverted to a WRC, treated, and used to supply water for both large individual irrigators and smaller, residential irrigators through a dual use system, and/or water supply augmentation. Initially, the treatment facility would need to be sized at 6 MGD, with upgrades to 9 MGD by 2015. The opinion of probable present worth cost is $27.2 million, with a unit cost of $0.25 per 1000 gallons.

Alternative C fixes the amount of wastewater flow to a WRC to 3 MGD, which would supply the large irrigators only. The opinion of probable present worth cost is $26.4 million, with a unit cost of $0.28 per 1000 gallons.

2.8.2 Recommendations and Insights Related to Current Study

Alternative B, although the most initially expensive option, was chosen. An indirect reclaimed water system would transport water from the MCWRC to a discharge point on the Clear Fork of the Trinity River upstream of Benbrook Lake, from which the Tarrant Regional Water District (TRWD) draws raw water. The reuse water would serve to augment supplies at a cost competitive to what the TRWD incurs; MCWRC water was calculated to be $0.25 per 1000 gallons, in comparison to TRWD's raw water cost of approximately $0.65 per 1000 gallons (costs are given in 2004 dollars). It should be noted that this cost is based on the use of conventional treatment and that the solids are returned to the interceptor system for treatment at VCWWTP. The cost of implementing a direct reuse system to residents of Walsh, Brown, and Murrin West Fork Ranches, however, proved prohibitively expensive and was removed from the scope of Alternative B. Further examination of possible direct reuse options was recommended by the study, since it would have a greater impact on reducing potable water demand. Diverting the majority of Mary's Creek Basin flow from the existing interceptor system defers the need to make improvements in that system, defers the need for expansion at VCWWTP, defers the need for identifying new raw water sources, and provides operational flexibility in wastewater conveyance and treatment. The MCWRC Feasibility study did caution that if growth in the Mary's Creek Basin was slower than anticipated, the economic benefits would be reduced; lower wastewater flows to the center would mean a higher cost of treatment per gallon, making the center less competitive.

2.9 2005 Fort Worth Water Master Plan

The scope of the Fort Worth Water Master Plan was to evaluate the existing facilities and recommend appropriate improvements to the system based on future demands. A hydraulic model of the distribution system was developed and calibrated with field data; the model was then used to evaluate system performance for future demand scenarios. All elements of the distribution system were analyzed relative to the nine pressure planes into which it is divided. Currently, Fort Worth's water treatment maximum day capacity is rated at 450 MGD, which includes projects currently underway to expand capacity. The 2014 maximum day demand will be 546 MGD; the distribution system demands are expected to increase from a current maximum day demand of 398 to 697 MGD by the year 2025. Many recommended improvements were made in order to accommodate these flows, but very few of these upgrades discussed reuse as an option or a goal. A critical element in the master plan is the development of the population projections based on the most recent information of all reports summarized in this chapter. The populations developed by the master plan will be used in subsequent sections of the water reuse study, and so a brief discussion of their calculation is warranted.

2.9.1 Development of Population Projections

2.9.1.1 Population Growth Rates and Population Distribution Within the Water System

Historical data was obtained from the North Central Texas Council of Governments (NCTCOG). Projected growth rates based on these data averaged 3.2 % per year through the year 2025. For future populations, projected service area boundaries, preliminary plats and future land use data were employed in confirming NCTCOG projections. Because the NCTCOG populations are slightly higher than those presented in Senate Bill 1, the former will be used in the interest of making conservative estimates. A more detailed explanation of the data analysis undertaken for determining populations can be found in Chapter 3.

2.9.2 Recommendations and Insights Related to Current Study

By 2030, the projected demands for the Tarrant Regional Water District will reach a total of 595,554 acre-feet per year. In order to best meet these demands, the Water Master Plan mentions reuse projects that will supplement the raw water supplies in the Richland-Chambers and Cedar Creek Reservoirs through diversions in the Trinity, but does not provide further details.

2.10 Conclusions

While only a few of the documents consider detailed reuse implementation programs, the mention of reclaimed water use in many large-scale, city wide planning reports demonstrates a promising interest in the realization of water reuse projects. The construction of a satellite wastewater treatment plant would not only provide reuse water for direct and indirect purposes but would also alleviate the need for upgrades at Village Creek WWTP. The Mary's Creek Water Recycling Center would serve as a source of reuse water to various customers identified by several of the reports summarized above. Critical to the execution of these water reuse projects is the knowledge of future demands as a function of population and land use projections, further exploration of to whom or what industries this reuse water would be diverted, and finally, the comparative costs of reuse water production and potential savings incurred by the use of reclaimed water. The benefits of employing reuse water are becoming more and more widely known, and it is important to couple the interest in reclaimed water with the best information in order to optimize the possibilities. The following chapters present population projections, customers, costs, and water quality considerations necessary for an efficient and environmentally beneficial reclaimed water program for the City of Fort Worth.

CHAPTER 3: POPULATION PROJECTIONS, WATER SUPPLY, WATER DEMAND AND TREATED WASTEWATER AVAILABILITY

3.1 Introduction

As populations in the Fort Worth area grow to numbers beyond those previously projected, meeting potable water demands with alternative supplies becomes an increasingly more attractive alternative. Water reclamation is a viable and proven option to offset the increasing needs. In order to best identify the appropriate distribution of reclaimed water use potential, it is important to determine future populations and estimate the potable water demands of those populations. In addition to having an impact on the water needs, population projections also help to define the potential supply of treated effluent that would be available for reuse. The following chapter examines population projections from the Texas Water Development Board (TWDB), as well as the North Central Texas Council of Governments (NCTCOG) and the Fort Worth Water Master Plan, then employs these numbers in approximating both the supplies and demands that future populations provide.

3.2 Population Projections

Several sources for population projections were examined. The TWDB is tasked with developing a water plan in accordance with Texas Senate Bill 1, which guides their development of population assessment. The NCTCOG uses traffic survey zones (TSZs) coupled with historical growth rates in making their estimates. The Fort Worth Water Master Plan (Master Plan) used projections from other master plans and historical usage rates, in addition to NCTCOG TSZs and comparative densities of other cities in developing its populations. Each approach is considered in more detail in the following sections, and the comparison between all three is summarized in Table 3-1 and Figure 3-1. For the purposes of the Fort Worth Reclaimed Water Plan, the population projections generated in the 2005 Fort Worth Water Master Plan will be employed. Thus, it is important to examine the assumptions made and basis on which these projections were calculated.

3.2.1 Texas Water Development Board Approach to Population Projections

The Region C Water Planning Group, under the guidance of the TWDB, is responsible for the development of population estimates used in resource planning for Region C. TWDB uses U.S. Census data, such as birth and death rates and migration estimates, with NCTCOG data and input from water customers, to develop a representation of potential future residents. Current TWDB projections are made through the year 2060.

3.2.2 North Central Texas Council of Government Approach to Population Projection

NCTCOG uses data acquired through the traffic survey zones and land-use models that rely on household numbers and employment rates. Projections do not extend beyond the year 2030, and local governments are invited to review the TSZ and provide input before finalization.

3.2.3 City of Fort Worth Master Plan Approach to Population Projections

The City of Fort Worth used a number of sources for a final estimate of population, which was projected to the planning year 2025. Historical data were obtained from NCTCOG and a historical growth rate was calculated for the time periods between 1980-2002 and 1995-2002. The rate between the latter set of years was slightly higher, a difference between 2 and 2.5 %, respectively. NCTCOG data were again employed to determine the anticipated growth rates for three time periods: 2004-2009, 2009-2014, and 2014-2025. The rates were adjusted after reviewing preliminary plats and developers' plans that had been submitted to the City of Fort Worth; the rates averaged 3.2 % per year through the year 2025. Projected populations were based on these growth rates coupled with future service area boundaries, continuation of historical trends, land use, and the densities of other comparable metropolitan areas. It was also important to establish populations relative to the pressure planes in the water distribution system. For this, NCTCOG population data for 2000 and 2002 were divided by traffic survey zones (TSZs) and overlaid on the pressure plane boundaries. Projected service area boundaries for the years 2009, 2014 and 2025 were employed in establishing the pressure plane boundaries for future planning years, and TSZ projections were used in these estimated pressure plane populations. The impetus behind this approach was the realization that, although Senate Bill 1 population projections are widely used in planning, they are considerably lower than those used by the described method. A desire for more conservative population estimates led to the calculation approach employed by the Master Plan. Table 3-1 provides a side-by-side comparison of the actual numbers employed by each entity, and Figure 3-1 shows the difference between these estimation methods graphically.

Table 3-1: Comparison of Projected Populations Resulting from Various Approaches

Year	***TWDB***	***NCTCOG***	***MP***
2000	534,650	524,535	534,694
2010	613,940	624,956	693,342
2020	694,306	727,416	929,741
2025		784,263	1,047,940
2030	814,237	826,665	

3.2.4 Population Projections for the Reclaimed Water Plan

As one can see from Figure 3-1, using the Senate Bill 1 projections could lead to an underestimation of demand which could have implications not just for water reuse programs but for general water planning issues. In addition, it has been demonstrated that Fort Worth is in fact growing at a rate more closely resembling that of the Master Plan projections. Therefore, it was determined that the estimates employed by the Master Plan would also be used for the Reclaimed Water Plan. For the planning year 2025, the estimated population of Fort Worth was determined to be 1,047,940, almost double the population of 2005.

3.3 Water Supply and Demand

Approximately 60% of the water supplied by the Tarrant Regional Water District (TRWD) is provided to Fort Worth and its wholesale customers. Rapid growth in Fort Worth has placed a greater demand on the existing supply and has created a desire for alternative sources to meet projected needs. An assessment of existing and future supplies relative to the estimated requirements is essential in determining where reuse projects can best alleviate some of the demands placed on the potable water supply.

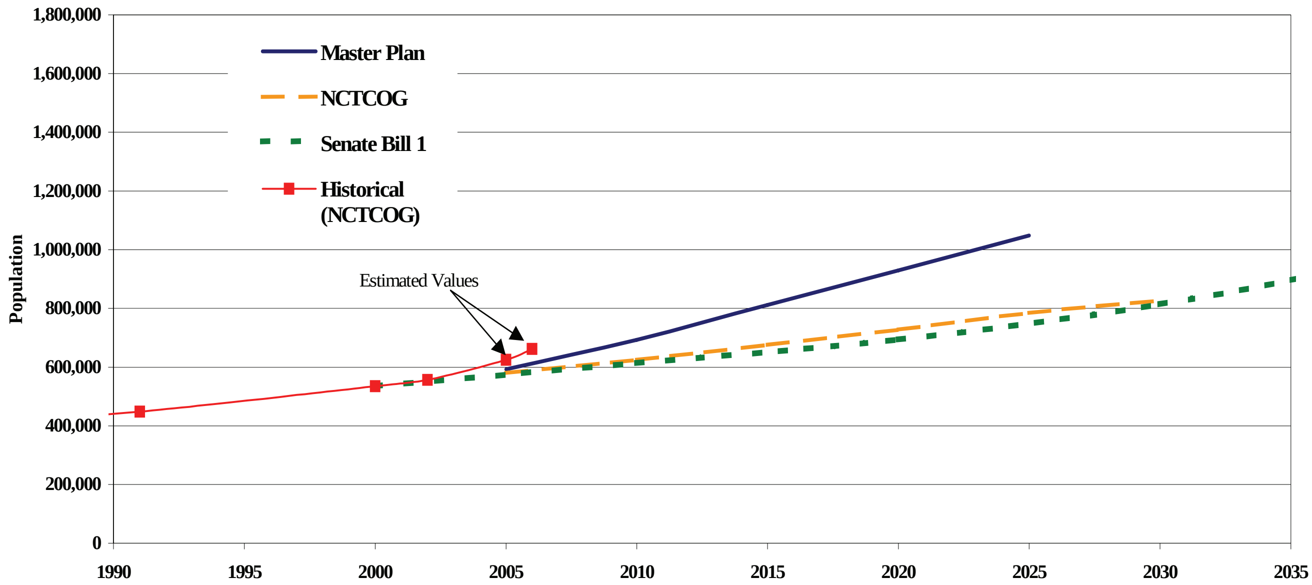

Figure 3-1: Comparison of Population Projections for Fort Worth

3.3.1 Existing and Future Water Supply

The TRWD supply originates from two major reservoirs in East Texas, Trinity River West Fork reservoirs and storage lakes within Tarrant County. Estimates place the current annual water supply at 458,000 acre-feet, which is anticipated to decline slightly to 426,000 acre-feet by 2030. Total *planned* annual supply, however, increases from 458,000 to approximately 655,000 acre-feet by 2030, and a substantial portion of this increase is attributable to reuse projects. Table 3-2 summarizes the sources and quantities of water supplies available to the Tarrant Regional Water District, in addition to planned new supplies and their relative contribution.

3.3.2 Existing and Future Water Demands

Based on the Senate Bill 1 Regional Water Planning estimates, demands on Tarrant Regional Water District supplies are expected to almost double from approximately 321,000 acre-feet in 2000 to 591,000 in 2030. However, other water master plans indicate that these projections underestimate the growth in the cities of Fort Worth, Arlington, and Mansfield. The demands that these cities exert on TRWD supplies are significant, and, therefore, the more rapid growth has implications for the implementation timeline of reuse projects. The Fort Worth Water Master Plan projects that Richland-Chambers augmentation would need to begin a year earlier than originally planned, and Cedar Creek augmentation a full three years ahead of the current schedule. Table 3-3 compares the Senate Bill and Master Plan projections through 2030; the master plan does not project beyond 2030 so no data is shown for this document.

Table 3-2: Summary of Currently Available Safe Yield Supplies to the TRWD*

Source (ac-ft/yr)	***Year***					
	2010	***2020***	***2030***	***2040***	***2050***	***2060***
West Fork System (Lake Bridgeport, Lake Worth, Eagle Mountain Lake)	108,500	107,000	105,500	104,000	102,500	101,000
Cedar Creek (CC)	175,000	175,000	175,000	175,000	175,000	175,000
Richland-Chambers (RC)	210,000	210,000	210,000	210,000	210,000	205,650
Lake Benbrook	6,834	6,834	6,834	6,834	6,834	6,834
Adjustment for Safe Yield	-53,298	-62,395	-71,493	-80,590	-89,688	-94,435
Total Current Supply	***447,036***	***436,439***	***425,841***	***415,244***	***404,646***	***394,049***
Water Management Strategies						
Conservation	11,653	26,391	38,319	50,086	63,480	79,793
Third Pipeline and Reuse						
Additional Richland-Chambers Yield	21,556	28,612	35,668	37,465	37,465	37,465
Additional Cedar Creek Yield		24,933	27,650	30,367	33,083	35,800
RC Reuse	63,000	63,000	63,000	63,000	63,000	63,000
CC Reuse		52,500	52,500	52,500	52,500	52,500
Total, Third Pipeline and Reuse	84,556	169,045	178,818	183,332	186,048	188,765
Marvin Nichols Reservoir			140,000	140,000	280,000	280,000
Toledo Bend Reservoir					100,000	100,000
Oklahoma Water						50,000
Total Supply from Strategies	96,209	195,436	357,137	373,418	629,528	698,558
Total Supplies	543,245	631,875	782,978	788,662	1,034,174	1,092,607
Total from Conservation and Reuse	96,209	195,436	217,137	233,418	249,528	268,558
Percent from Conservation and Reuse	18%	31%	28%	30%	24%	25%

*Adapted from the 2006 Region C Water Plan

Table 3-3: Comparison of Senate Bill 1 (SB1) and Master Plan (MP) Projections for Water Demand (all values shown are in acre-feet per year)

Customer	Year										
	2000		2010		2020		2030		2040	2050	2060
	SB 1	MP	SB 1	MP	SB 1	MP	SB 1	MP	SB 1	SB 1	SB 1
Ft. Worth and Customers	192,187	192,543	233,786	263,745	279,635	336,069	326,725	408,044	382,561	460,463	552,762
Arlington	55,152	60,228	74,124	78,264	86,242	94,472	92,062	94,473	94,528	96,465	97,915
TRA Tarrant County	36,134	36,134	43,475	43,475	48,554	48,554	51,121	51,121	52,603	53,731	54,749
Mansfield	6,734	5,885	17,924	14,371	23,987	24,014	29,449	33,653	35,006	38,594	39,052
Other West*	24,253	24,253	44,503	44,503	57,688	57,688	70,729	70,729	82,709	95,753	109,904
East**	6,257	6,257	16,379	16,379	18,603	18,603	20,620	20,620	22,560	25,040	28,177
Total	320,718	325,300	430,191	460,737	514,709	579,400	590,706	678,640	669,967	770,046	882,559
Other Potential Supplies	0	0	3,500	0	4,603	1,053	4,848	1,248	7,820	8,920	10,045
Total With Supplies	320,718	325,300	433,691	460,737	519,312	580,453	595,554	679,888	677,787	778,966	892,604

*Denton, Ellis, Jack, Johnson, Parker, Tarrant, Wise

**Freestone, Henderson, Kaufman, Navarro

Figure 3-2 displays these results graphically.

The projections described above were for all customers of the Tarrant Regional Water District. Projections specific to Fort Worth and its wholesale customers were approximated in the Master Plan for average day, maximum day, and peak hour scenarios. Projected total demands were calculated by multiplying the estimated future population by a historical per capita usage rate; historical average usage was assumed to be constant over time. Peak day factors were also calculated from historical data and were used to determine projected peak demands for planning years. Wholesale demands were determined based on surveys of the wholesale customers; in the event that the customer did not respond to the survey, historical data and NCTCOG data were used to approximate water demands. All demands were represented relative to the individual pressure planes, and distinction between coincidental and non- coincidental maximum demands was made; the former reflects city-wide demand regardless of whether each individual pressure plane experienced the same peak day, while the latter assumes that all planes experienced maximum demand on the same day. Table 3-4 shows the total projected non-coincidental demands, which include both retail and wholesale customers.

3.3.3 Treated Wastewater Availability

In order to evaluate the viability of the proposed reclaimed water projects, the potential supply of effluent should be established. The majority of wastewater flow from Fort Worth is treated at the Village Creek Wastewater Treatment Plant (VCWWTP), with a small fraction being diverted to the TRA Denton Creek Regional Wastewater System (DCRWS) and TRA Central Regional Wastewater System. Due to their consideration as reclaimed water sources, only flows for VCWWTP and DCRWS will be summarized here.

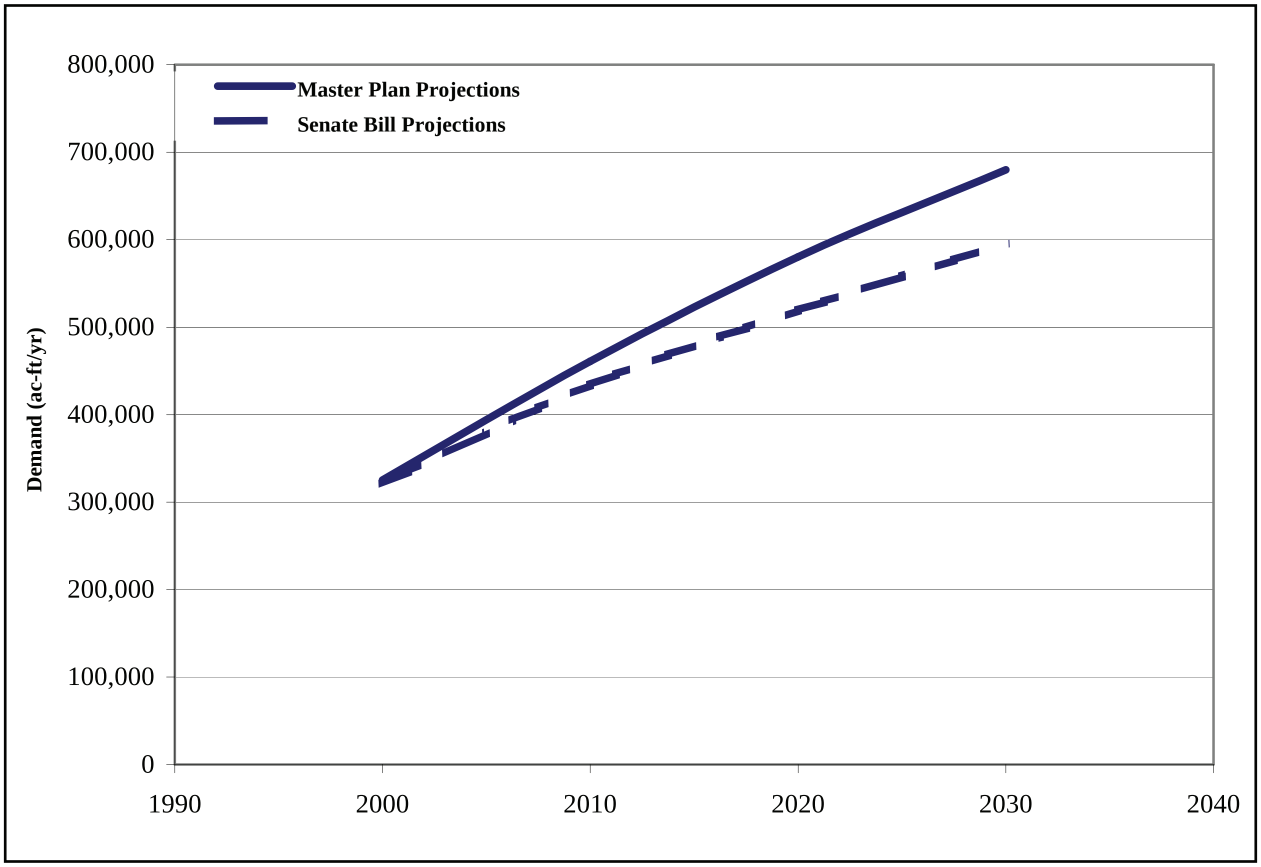

Figure 3-2: Comparison of Senate Bill 1 and Master Plan Projections for Water Demand

Table 3-4: Projected Total Non-Coincidental Water Demands for the City of Fort Worth

Total Water Demands for City of Fort Worth				
Year	***Average Day (MGD)***	***Maximum Day (MGD)***	***Average Day (ac-ft/yr)***	***Maximum Day (ac-ft/yr)***
2002	160	366	179,200	409,920
2010	235	490	263,200	548,800
2020	300	629	336,000	704,480
2025	332	697	371,840	780,640

3.3.3.1 Wastewater Flow Projections for Areas Served by City of Fort Worth WWTPs

Treated wastewater availability is a function of projected wastewater flows to, in this case, Village Creek WWTP. The wastewater collection system master plan, discussed in Section 2.3, estimates wastewater flows to Village Creek through the year 2020, summarized in Table 3-5, and also estimates population served by VCWWTP.

Table 3-5: Projected Wastewater Flows for Village Creek WWTP*

Year	***Wastewater Flow (MGD)***		
	Annual Average	***Maximum Month***	***Peak 2-hour***
1990	116	147	355
1995	122	155	375
2000	129	164	395
2005	130	165	418
2010	143	182	461
2015	150	190	482
2020	158	200	511
*Adapted from the Wastewater Master Plan, 1998			

At the time of the Wastewater Master Plan, the contract between Village Creek and the City of Arlington was assumed to expire in 2001. There is therefore not as great a difference in projected flows between the years 2000 and 2005 as the growth in service area population was offset by the removal of Arlington customers.

It is evident from Table 3-5 that there is ample supply of available treated effluent to meet significant future reuse needs. Chapter 4 discusses in more detail the possible reclaimed water uses and customers that VCWWTP could serve in the future.

Figure 3-3 shows the historical average monthly flows for Village Creek WWTP between mid-2002 to the present, compared to the Wastewater Master Plan's historical and predicted annual average flows. For the period during which flow data are shown, it Figure 3-3 indicates that the Master Plan provides a conservative estimate of flows. However, 2005 and 2006 have been very dry years and the more recent data may not reflect typical conditions.

3.3.3.2 Wastewater Flow Projections for Denton Creek Regional Wastewater System

The possibility of utilizing reuse water from the Denton Creek Regional Wastewater System (DCRWS) was also examined as part of the Fort Worth Reclaimed Water Plan. Denton Creek serves parts of northern Fort Worth in addition to several other customer cities, and it is therefore ideally geographically located for the economical conveyance of reuse water to certain areas.

Population and flow projections were prepared for the DCRWS Master Plan (APAI, January, 2006) and are pertinent to the amount of treated effluent available for reuse applications. At the time of this report, the DCRWS was experiencing average daily flows of approximately 3 MGD, which is 60% of its permitted 5 MGD capacity. Currently, the plant is undergoing evaluation for expansion to 10 MGD, and projected annual average daily flow at 2013 is approximately 12 MGD. Table 3-6 shows projected flow rates through 2013.

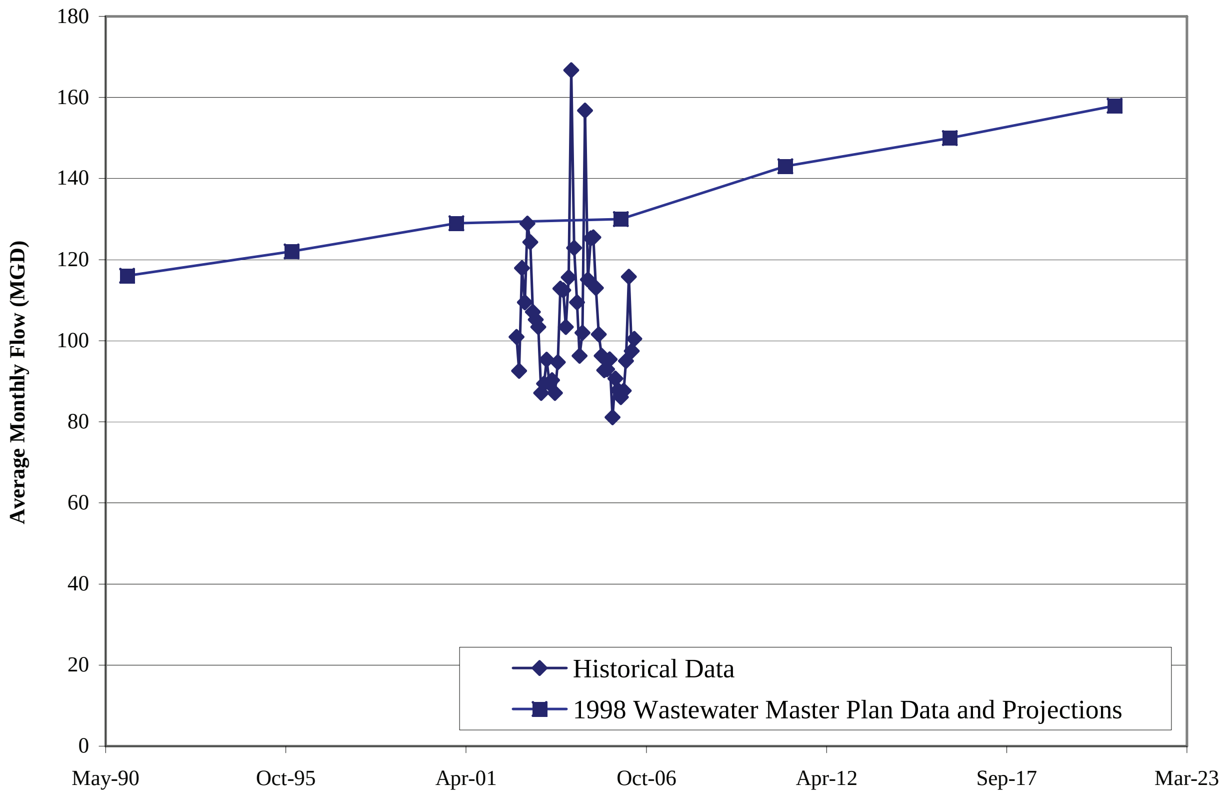

Figure 3-3: Comparison of Wastewater Master Plan Data and Projections to Recent Flow Measurements, Village Creek WWTP

Table 3-6: Projected Annual Average Flow Rates for DCRWS (MGD)*

Year	***Average Daily Flow (ADF)***	***Average Dry Daily Flow (ADDF)***	***Min Month***
2006	3.81	2.40	3.05
2007	4.92	3.10	3.94
2008	6.16	3.88	4.93
2009	7.37	4.65	5.90
2010	8.51	5.36	6.80
2011	9.63	6.07	7.70
2012	10.80	6.80	8.64
2013	11.94	7.52	9.55

*Adapted from the Denton Creek Master Plan Update Draft (APAI, 2006)

Projections for average daily dry weather flow and diurnal flow variations were also evaluated in order to estimate the quantity of reclaimed water that is available during dry weather periods and under minimum daily flow conditions. The diurnal flow curve indicates that, for any particular day, the DCRWS receives its lowest flows between 10:00 AM and 1:00 PM. During this time, the flow rate into the plant is approximately 83% of that day’s average flow. The average daily dry weather flows are projected to increase from 2.40 MGD in the year 2006 to 7.52 MGD in the year 2013. Therefore, based on the diurnal flow curve, the minimum diurnal flow during dry weather is projected to increase from 1.99 MGD in the year 2006 to 6.24 MGD in 2013. These quantities represent the minimum amount of reclaimed water that is projected to be available from DCRWS.

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CHAPTER 4: POTENTIAL RECLAIMED WATER USERS AND DEMANDS

4.1 General

In order to determine the feasibility of any reclaimed water project, an analysis of potential customers is required. Potential reclaimed water users were identified through a combination of sources including the City of Fort Worth water customer database, survey data, meetings with potential reclaimed water users, and previous studies. The potential reclaimed water users were then compared and ranked based on the amount of reclaimed water that could potentially be supplied to each user. Potential users were then analyzed based on location to identify potential projects, or alternatives, for further analysis. The potential users and demands that have been identified are further described in this chapter. The development and evaluation of each alternative is included in Chapter 6.

4.2 Potential Reclaimed Water Use Categories

Potential reclaimed water users can be divided into several general categories. Water use characteristics for each user will vary depending upon the type of usage, or category. The typical characteristics include seasonal variations in water usage, and the frequency of water use – both daily and hourly. These characteristics were used to help define monthly, daily, and hourly peaking factors. Several assumptions were made regarding the peaking factors for each of the categories of water use, and are discussed in the following sections for each category. The equations used to determine the peak month, peak day, and peak hour water demands are as follows:

Peak Month Demand = (Annual Average Demand) * (Peak Month Factor)

(The peak month demand is the average daily demand during the maximum month.)

Peak Day Demand = (Peak Month Demand) * (Peak Day Factor)

(The peak day demand is the average hourly demand of the peak day during the maximum month.)

Peak Hour Demand = (Peak Day Demand) * (Peak Hour Factor)

(The peak hour demand is the maximum hourly demand during the peak day of the maximum month.)

For all categories, except for the "commercial process" category, water usage is expected to increase during the summer months. This is because most of the potential reclaimed water use considered in this report is related to irrigation. Irrigation use typically peaks during the months of June through September, and may sometimes include May and October as well. The peak monthly reclaimed water demand is projected to be 22 percent of the annual reclaimed water demand volume. Thus, the monthly peaking factor is assumed to be equal to 2.64, unless specific data is available for individual users. The selection of this peaking factor is consistent with previous studies prepared for the City of

Fort Worth[8]. The monthly peaking factor is multiplied by the annual average irrigation demand to determine the peak monthly demand flows.

Although not always the case, the water usage for most commercial processes is not expected to increase during any particular time of year. Commercial process demands are assumed to be more constant throughout the year. Because of this somewhat constant demand, the monthly peaking factor is assumed to be 1.0.

4.2.1 Commercial Irrigation

There is a potential to provide reclaimed water for those business or commercial enterprises that utilize water for irrigation purposes. All customers identified in the commercial irrigation category were assumed to irrigate on a daily basis for a period of 4 hours per day, unless specific information was available. This results in a peak day factor of 1.0, and a peak hour factor of 6.0.

4.2.2 Commercial Processes

Commercial processes include those business or commercial enterprises that utilize water for their processes, such as cooling water, manufacturing or power generation purposes. All customers identified in the commercial processes category were assumed to use water on a continuous basis, or 24 hours per day on a daily basis, unless specific information was available. These customers are assumed to use the same amount of water regardless of the time of year or time of day. This results in a peak day factor, and peak hour factor, of 1.0.

This type of demand flow will help to ensure continuous operation of the system and reduce the need for flushing operations. However, many of the commercial process demands identified were small in comparison to the larger users in other categories.

4.2.3 Golf Course Irrigation

Golf courses are typically ideal places to initiate reclaimed water practices. Golf courses tend to be large water users due to heavy irrigation. Many of the courses have water features, or ponds, that could be used as storage facilities for reclaimed water to be used during irrigation. If existing ponds were used for reclaimed water storage, then the peaking factor for the reclaimed water system would be reduced. However, many courses would not allow significant variations in the water surface elevation of these ponds, as this could affect the aesthetics of the course. For this reason, ponds are not considered for storage in this analysis, and it is assumed that golf courses would be irrigated on a daily basis for 12 hours per day, unless specified otherwise. This results in a peak day factor of 1.0, and peak hour factor of 2.0. If it is determined by the City and the respective golf course, that its water features could be used as temporary storage, then the peaking factors could be adjusted, resulting in a more economical design.

[8] Draft Mary's Creek Water Recycling Center Feasibility Study. Alan Plummer Associates, Inc. June 2004.

4.2.4 Parks and Recreational Facilities

The "parks and recreational facilities" category includes public and private parks, and recreational areas, such as sport complexes. These areas usually have a lot of green space that requires irrigation to maintain public areas and sports fields. Parks and recreational areas, similar to golf courses, are usually excellent locations to implement reclaimed water projects. Parks and recreational areas are assumed to irrigate once every three days for a period of 8 hours, unless specific information was available. This results in a peak day factor of 3.0, and a peak hour factor of 3.0.

4.2.5 Public Facilities

Public facilities are considered to be City-owned facilities, such as public libraries or courthouses. This category does not include City-owned parks or golf courses, which are included in separate categories. The public facilities are assumed to irrigate once every three days for a period of 8 hours, unless specific information was available. This schedule is similar to the parks and recreational areas, however the annual average water demand is typically much less. This results in a peak day factor of 3.0, and peak hour factor of 3.0.

4.2.6 Residential Irrigation

Installation of a reclaimed water system in a previously developed residential area would be a costly endeavor. However, installing a dual water system during initial development could result in a very feasible application. The City has had previous discussions with developers in the Mary's Creek Basin regarding installation of a dual water system during development. In these areas, the residential irrigation was based on the total acreage of residential areas. Residential areas are assumed to irrigate on a daily basis for a period of 4 hours per day, unless specific information was available. This results in a peak day factor of 1.0, and peak hour factor of 6.0. These assumptions are made based on considering the entire residential area as a whole, rather than individual home owners. While an individual homeowner may reasonably irrigate once every three to five days for a period of 2 hours, not every homeowner irrigates on the same exact day at the same time.

4.2.7 Schools and Universities

Potential reclaimed water customers will also include schools and universities, where reclaimed water could also be used for irrigation purposes. Schools are assumed to irrigate once every three days for a period of 8 hours, unless specific information was available. This results in a peak day factor of 3.0, and a peak hour factor of 3.0.

4.2.8 Gas Well Drilling

Recent advances in gas drilling technology have allowed the natural gas industry to tap into gas deposits in the Barnett Shale, located in Fort Worth, Tarrant County and several surrounding counties. As part of the drilling operations, water is used to break up the rock and shale so that the deposits of natural gas can be released. The water used for this process, referred to as "frac water", does not need to be potable. Both the Texas Railroad Commission and the TCEQ have approved use of reclaimed water for hydraulic fracturing. Approximately 2.5 million gallons of water are required during the fracturing process. This water is typically stored in "frac ponds" on site. The City has had some initial discussions with drillers regarding the use of reclaimed water for their operations. As js discussed in Section 4.3, some frac water usage has been included in the projected demands for the Northern Service area. In addition, the City is currently constructing a facility just north of Village Creek WWTP, from which trucks can obtain reclaimed water for use in fracturing operations.

4.2.9 Summary

The typical peaking factors for monthly, daily, and hourly water demands are summarized in Table 4-1. These peaking factors are used unless specific information is available for a particular customer.

Table 4-1: Peaking Factors

Category	Peak Month Factor	Peak Day Factor	Peak Hour Factor
Commercial Irrigation	2.64	1.0	6.0
Commercial Process	1.0	1.0	1.0
Golf Courses	2.64	1.0	2.0
Parks and Recreational Facilities	2.64	3.0	3.0
Public Facilities	2.64	3.0	3.0
Residential Irrigation	2.64	1.0	6.0
Schools and Universities	2.64	3.0	3.0

4.3 Potential Reclaimed Water Users and Demands

This section provides a summary of potential reclaimed water users and demands identified during the course of this study.

4.3.1 Historical Data Analysis

The City of Fort Worth provided metering data for the top 100 water customers located within the City's service area. These data were contained in a spreadsheet that included customer name, address of service, meter type, and monthly water usage for the year 2004. The meter type classifications listed were "commercial", "commercial apartments", "commercial monitored", "industrial", "industrial monitored", "departmental billing", and "not for profit" meters. Additional metering information was provided for those few customers with a secondary irrigation meter.

However, not all of the customers reported are potential reclaimed water users. It can be reasonably assumed that a portion of the water usage is for potable uses. The data were reviewed to identify potential irrigation and process water demands. For the customers without irrigation meters, the monthly water usage records were consulted to determine irrigation practices. Water usage during the summer months (typically June through September) was compared to usage during the winter months. Significant increases during summer months are indicative of the irrigation practices for each user. Commercial and commercial apartment meters represent approximately 40 percent and 10 percent of the historical data, respectively. Irrigation practices could be observed in many of these users.

Approximately 33 percent of the historical data represented industrial meters. Many of these customers are involved in food and beverage processing, and were considered to be unlikely candidates for reclaimed water. However, this group also includes industries that could potentially use reclaimed water in various production processes, such as cooling water.

A summary of the Top 100 customers, as provided by the City, is presented in Appendix A. Water usage data provided by the City was measured in CCF (100 cubic feet). For the reader’s convenience, the annual volume has been converted to million gallons (MG) as well.

4.3.2 Customer Surveys and Meetings

To supplement the information obtained from the historical data analysis, the City surveyed several potential reclaimed water users. The City requested additional information from these water users regarding estimated water usage for irrigation or other purposes. The City then met with those customers to discuss potential reclaimed water demands. As a result of these efforts, more reliable data were obtained regarding potential reclaimed water demands for several customers. Some of the customers contacted by the City warrant further discussion, as provided in the following sections.

4.3.3 Non-Wholesale Customers and Surrounding Cities

The Cities of Euless and Arlington are not potable water customers of the City of Fort Worth. However, both cities expressed interest in participating in a regional reclaimed water project to meet some of their water demands. City of Fort Worth staff met with each city to determine feasible locations where reclaimed water could be used and the reliable water demand. The locations and reclaimed water demands identified are included in Table 4-2. The total water demand for each city was determined by the respective city; however, certain assumptions were made to distribute the water demand to specific users. For Euless, the peak hour demand was calculated based upon the peaking factors listed in Table 4-1. Based upon the information received from Arlington, it is assumed that Arlington would provide storage capacity in order to meet peak hour demands. This could be achieved through the use of existing ponds or construction of new storage tanks.

4.3.4 Alliance Area Development in North Tarrant County

The Hillwood Properties are being developed in northern Tarrant County. The existing development is primarily located in the Alliance Gateway Phase 1 area near Hwy 377 and Hwy 170. Future expansion will include additional phases of the Alliance Gateway, as well as expansion along either side IH-35W between Hwy 170 and SH 114. These areas are projected to reach build-out by the year 2020. Reclaimed water could be used in these areas for commercial irrigation and for evaporation makeup water in several area ponds and water features. City staff met with the Hillwood Properties developers to discuss implementation of a reclaimed water supply. In response, the developer projected reclaimed water demand, based on projected growth. The developer also identified potential pond sites to store reclaimed water to be used for irrigation. The projected annual average reclaimed water demand is listed in Table 4-3. The peak demands were then calculated based upon the peaking factors listed in Table 4-1. The developer also identified potential pond sites to store reclaimed water to be used for irrigation. Therefore, it is assumed that the identified ponds would provide adequate storage capacity to meet peak day and peak hour demands, and that only the peak month demand would be supplied to storage ponds.

Table 4-2: Non-Wholesale Customers Projected Water Demands

Wholesale Water Customer	Annual Average Demand (MGD)	Peak Day Demand (MGD)
City of Arlington:		
Chester Ditto Golf Course	*0.17*	*0.5*
JW Dunlop Sports Center	*0.01*	*0.1*
River Legacy Park	*0.04*	*0.4*
Total City of Arlington	***0.22***	***1.0***
City of Euless:	0.75	2.5
Softball World	*0.02*	*0.17*
Texas Star	*0.21*	*0.67*
Texas Star Golf Course	*0.52*	*1.67*
Total City of Euless	***0.75***	***2.5***

Table 4-3: Hillwood Properties Projected Water Demands

Hillwood Properties	Annual Average Demand (MGD)
Alliance Center East Association	*0.36*
Alliance Center West Association	*1.12*
Alliance Lone Star Association	*0.43*
Alliance Gateway Phase 1 Association	*0.24*
Alliance Gateway Phase 2 Assocation	*0.44*
Alliance Gateway Phase 3 Association	*0.56*
Circle T Ranch / Westlake	*0.96*
Frac Water (for natural gas drilling)	*0.05*
Total Development	4.16

4.3.5 Mary's Creek Basin

As discussed in Chapter 2, the City has recently conducted a study in the Mary's Creek Basin[9] in western Tarrant County. The draft report, prepared by APAI, identified existing and future developments planned in the Mary's Creek Basin, and projected reclaimed water demands for the years 2010, 2020, and 2030. These developments include Walsh Ranch, Brown Ranch, and others. City staff met with the developers in this area, who have indicated that they would install a dual water system for the implementation of reclaimed water supplies, if the City would make reclaimed water available. The inclusion of a dual water system during initial development increases the feasibility of a reclaimed water system by expanding service to many small water customers, in addition to large water customers. This is typically not feasible in an existing development due to the cost of retrofitting the potable water system and replacement of infrastructure. The potential customers identified in the Mary's Creek Basin study include residential, commercial, public facilities, schools, golf courses, and parks. The reclaimed water demands obtained from the draft report are included in Appendix B, and a summary is provided in Table 4-4. It is assumed that each of the users in the Mary's Creek Basin would not have their own storage, so the distribution system should be capable of delivering peak hour demands and at sufficient pressures. However, due to elevation changes across the Mary's Creek Basin, booster pump stations and storage tanks will be required. The booster pump stations and storage tanks will have sufficient capacity to supply peak hour demands to users. This will allow the main pump station and pipelines to be sized for the lesser peak month demands, thereby saving cost.

Table 4-4: Mary's Creek Basin Projected Water Demands for Year 2030

Mary's Creek Basin	Annual Average Demand (MGD)	Peak Day Demand (MGD)
Blue Haze Elementary	0.01	0.05
Lost Creek Golf Course	0.18	0.47
Leonard Golf Links	0.05	0.38
New Commercial	0.14	0.38
New Golf Course	0.74	1.94
New Public Facility	0.04	0.29
New Park	0.20	1.57
New Residential	2.07	5.47
New School(s)	0.13	1.02
Other Development	0.23	1.82
Tannahill Intermediate	0.01	0.10
Total Development	3.79	13.48

[9] Draft Mary's Creek Water Recycling Center Feasibility Study. Alan Plummer Associates, Inc. June 2004.

4.3.6 Trinity River Vision Central City Project

The Trinity River Vision Central City Project is currently in the planning stages and includes a major flood control project in downtown Fort Worth, which will also isolate a portion of the current river and establish an urban lake to be used for a variety of boating and water activities. City staff met with Trinity River Vision Project staff and consultants to discuss the potential for providing reclaimed water to the Central City Project. Preliminary information provided to the City indicated that the planned Central City Project could require a 0.75-MGD water supply (annual average) to off-set evaporative losses from the project. During the summer months, this demand could increase to 2.5 MGD. There is also a potential to supply reclaimed water for irrigation within the Central City Project. However, estimates of this demand were not available at the time of this report.

4.3.7 City of Fort Worth – Parks and Community Services Department

The Parks and Community Services Department (PACSD) was consulted to determine the viability of reclaimed water at many city-owned facilities. The PACSD provided historical information and projected annual average water demands for city-owned parks and recreational facilities. A summary of the data provided is included in Table 4-5. Peak demands were then calculated based upon the peaking factors in Table 4-1. It is assumed that storage will not be available, and thus peak hour demands must be provided to each user.

4.3.8 Other Sources of Information

As described in Chapter 2, an earlier study by Freese & Nichols, Inc. (FNI) (Technical Memorandum No. 12[10]) identified and evaluated the feasibility of several reclaimed water alternatives. This memorandum identified several potential reclaimed water customers and their respective annual and peak water demands. However, the information from this report was used only to supplement the data from the other sources. In the event that two sources of information reported differing amounts of projected water demand, the most recent information was considered to be more accurate.

4.3.9 Proposal to Obtain Additional Information

The City of Fort Worth has made efforts to meet with some of the potential reclaimed water customers. However, not all potential customers included in the recommended alternatives were contacted. Prior to implementation of any of the recommended projects, reliable information should be obtained by contacting those customers, through telephone contacts, meetings or by standard letter and questionnaire. A standard transmittal letter and questionnaire have been developed, and are included in Appendices C and D, respectively. Analysis of the responses to the questionnaire will provide a more reliable basis for identifying viable reclaimed water customers and quantifying potential usage.

[10] Technical Memorandum No. 12 – Effluent Reuse Alternative Identification and Feasibility Analysis. Freese and Nichols. November 1996.

Table 4-5: Parks and Community Services Department

City-Owned Facilities	Annual Average Demand (MGD)
Buck Sansom Park	0.007
Delga Park	0.005
Gateway Park	0.051
Hallmark Park	0.014
Handley Park	0.007
Harmon Park	0.022
LeBlanc Park	0.014
Northside Park	0.007
North Park	0.051
Oakland Lake Park	0.007
Rockwood BB	0.014
Rolling Hills Soccer Complex	0.154
Sycamore Park	0.036
Silversage Park	0.007
Summerfield Park	0.008
West Park	0.029
Z. Boaz South Park	0.697
Meadowbrook Golf Course	0.074
Sycamore Golf Course	0.031
Z. Boaz Golf Course	0.075

4.4 Top 125 Potential Reclaimed Water Users

The potential reclaimed water users, identified in Section 4.3, were ranked based on their projected annual average reclaimed water demand, with the largest user being ranked first. The largest 125 potential reclaimed water users were then plotted on a map to show their general location. A summary of the 125 largest potential reclaimed water users is included in Table 4-6, and the locations of these customers are shown in Figure 4-1. An analysis of the largest users and the development of alternatives for reclaimed water systems is presented in Chapter 6.

Table 4-6: Top 125 Potential Reclaimed Water Users

Rank #	Customer Name	Facility Type	Annual Average (MGD)	Peak Month (MGD)	Peak Day (MGD)	Peak Hour (MGD)	Source
1	Texas Utilities Handley Plant	Industrial	2.740	2.740	2.740	2.740	a
2	D/FW International Airport	Irrigation	1.530	4.560	4.560	12.180	b
3	Alliance Center West Assoc.	Irrigation	1.120	2.960	2.960	17.750	b
4	Circle T Ranch / Westlake	Irrigation	0.960	2.530	2.530	15.190	b
5	Trinity River Vision	Irrigation	0.760	2.500	2.500	7.500	b
6	City of Euless	Park	0.750	2.390	2.500	7.500	b
7	South Z Boaz Park	Park	0.697	1.840	5.519	16.557	c
8	Alliance Gateway Phase 3 Assoc.	Irrigation	0.560	1.480	1.480	8.900	b
9	Pecan Valley Park	Park	0.535	1.412	4.236	12.707	a
10	Alliance Gateway Phase 2 Assoc.	Irrigation	0.440	1.170	1.170	7.030	b
11	Alliance Lone Star Association	Irrigation	0.430	1.130	1.130	6.770	b
12	Alcon Laboratories	Industrial	0.379	1.000	1.000	3.000	b
13	Alliance Center East Assoc.	Irrigation	0.360	0.950	0.950	5.730	b
14	Diamond Oaks GC	Golf Course	0.247	0.651	0.651	1.302	a
15	Pecan Valley GC	Golf Course	0.247	0.651	0.651	1.302	a
16	Riverside GC	Golf Course	0.242	0.638	0.638	1.276	a
17	Alliance Gateway Phase 1 Assoc.	Irrigation	0.240	0.620	0.620	3.730	b
18	City of Arlington	Park	0.220	0.670	1.000	2.500	b
19	Great Southwest GC	Golf Course	0.212	0.560	0.560	1.120	a
20	Greenwood Cemetary	Cemetary	0.208	0.550	1.649	4.947	a
21	Forest Park	Park	0.206	0.544	1.632	4.895	a
22	Marion Samson Park	Park	0.204	0.538	1.614	4.843	a
23	Shady Oaks GC	Golf Course	0.192	0.508	0.508	1.015	a
24	Miller Brewing Company	Food/Bev	0.190	0.250	0.250	0.250	b
25	Cobb Park	Park	0.167	0.440	1.319	3.958	a
26	Rolling Hills Soccer Complex	Park	0.154	0.406	1.217	3.652	c
27	Carswell GC (Hawk's Creek)	Golf Course	0.153	0.404	0.404	0.807	a
28	Fossil Creek GC	Golf Course	0.148	0.391	0.391	0.781	a
29	Rolling Hills GC	Golf Course	0.148	0.947	0.947	1.894	a
30	Fort Worth Botanical Gardens	Park	0.134	0.353	1.059	3.177	a
31	Mount Olivet Cemetary	Cemetary	0.132	0.281	0.842	2.525	a
32	Lockheed Martin Tactical A/S	Industrial	0.131	0.345	0.345	1.036	d
33	Walnut Creek GC	Golf Course	0.131	0.345	0.345	0.690	a
34	Willow Springs GC	Golf Course	0.131	0.345	0.345	0.690	a
35	Iron Horse GC	Golf Course	0.131	0.345	0.345	0.690	a
36	Carter Park	Park	0.129	0.341	1.024	3.073	a
37	Laurel Land Cemetary	Cemetary	0.123	0.325	0.976	2.929	a
38	Tandy Hills Park	Park	0.115	0.245	0.736	2.209	a
39	Oakmont Park	Park	0.112	0.295	0.885	2.656	a
40	Shady Valley GC	Golf Course	0.110	0.701	0.701	1.403	a
41	Rockwood GC	Golf Course	0.108	0.286	0.286	0.573	a
42	Heritage Park	Park	0.099	0.260	0.781	2.343	a
43	Mrs. Bairds Bakeries	Food/Bev	0.097	0.097	0.097	0.097	d
44	Woodhaven GC	Golf Course	0.090	0.579	0.579	1.157	a
45	Glen Garden GC	Golf Course	0.086	0.228	0.228	0.456	a
46	Shannon Rose Hill Cemetary	Cemetary	0.082	0.175	0.526	1.578	a
47	Mira Vista GC	Golf Course	0.081	0.215	0.215	0.430	a
48	Southwestern Baptist Seminary	School	0.079	0.208	0.623	1.869	d
49	Z Boaz Golf Course	Golf Course	0.075	0.864	0.864	1.728	c
50	Marine Creek Linear Park	Park	0.061	0.162	0.486	1.458	a

Table 4-6: Top 125 Potential Reclaimed Water Users (continued)

Rank #	Customer Name	Facility Type	Annual Average (MGD)	Peak Month (MGD)	Peak Day (MGD)	Peak Hour (MGD)	Source
51	Meadowbrook Golf Course	Golf Course	0.061	0.864	0.864	1.728	c
52	Trinity Park	Park	0.060	0.157	0.472	1.416	d
53	Wildwood Park / Camp Joy Park	Park	0.059	0.156	0.469	1.406	a
54	Stratford Park	Park	0.055	0.117	0.351	1.052	a
55	Mosque Point Park	Park	0.055	0.145	0.434	1.302	a
56	Windswept Circle Park	Park	0.053	0.139	0.417	1.250	a
57	Gateway Park	Park	0.051	0.135	0.406	1.217	c
58	North Park	Park	0.051	0.135	0.406	1.217	c
59	Lake Como Park	Park	0.050	0.133	0.399	1.198	a
60	Harris Methodist Hospital	Hospital	0.050	0.050	0.050	0.050	d
61	Fort Worth Water Gardens	Park	0.045	0.117	0.117	0.235	d
62	Greenbriar Park	Park	0.044	0.116	0.347	1.042	a
63	Overton Park	Park	0.044	0.116	0.347	1.042	a
64	The Meridian Apartments	Apartment	0.040	0.105	0.105	0.316	d
65	Sycamore Park	Park	0.036	0.095	0.284	0.852	c
66	FW Zoological Association	Commercial	0.036	0.094	0.094	0.282	d
67	American Airlines	Commercial	0.033	0.087	0.087	0.521	d
68	Sycamore Creek GC	Golf Course	0.031	0.083	0.083	0.165	c
69	Bell Helicopter Textron	Industrial	0.031	0.031	0.031	0.093	d
70	West Park	Park	0.029	0.076	0.227	0.682	c
71	Union Pacific Railroad	Industrial	0.027	0.072	0.072	0.217	d
72	Texas Motor Speedway	Commercial	0.027	0.071	0.214	0.641	d
73	American Airlines	Commercial	0.027	0.071	0.071	0.212	d
74	US Bureau of Engraving	Industrial	0.026	0.026	0.026	0.026	d
75	Motorola Inc.	Industrial	0.026	0.068	0.068	0.205	d
76	Harmon Field Park	Park	0.022	0.057	0.170	0.511	c
77	Fortress Properties Ltd.	Industrial	0.021	0.057	0.057	0.170	d
78	City Center Development Co.	Commercial	0.020	0.054	0.054	0.162	d
79	Trammell Crow Company	Commercial	0.019	0.049	0.049	0.148	d
80	Cook Childrens	Hospital	0.018	0.018	0.018	0.053	d
81	Hallmark Park	Park	0.014	0.038	0.114	0.341	c
82	Rockwood Park	Park	0.014	0.038	0.114	0.341	c
83	LeBlanc Park	Park	0.014	0.038	0.114	0.341	c
84	Coca Cola Bottling	Food/Bev	0.014	0.014	0.014	0.014	d
85	CMD Realty Investors	Commercial	0.014	0.036	0.036	0.107	d
86	Tri Vest Cameron Creek Ltd.	Apartment	0.013	0.035	0.035	0.105	d
87	Tarrant County Junior College	School	0.013	0.035	0.105	0.314	d
88	MDC Parkcreek Residencys, Ltd.	Apartment	0.013	0.035	0.035	0.104	d
89	JPS Health Network	Hospital	0.012	0.032	0.032	0.095	d
90	Fort Worth Osteopathic Hosp. Inc.	Hospital	0.012	0.031	0.031	0.094	d
91	FMC - Carswell	Hospital	0.011	0.030	0.030	0.090	d
92	River Park Place Joint Venture	Commercial	0.011	0.029	0.029	0.086	d
93	Ridgmar Associates	Commercial	0.010	0.027	0.027	0.082	d
94	Synthetic Products Co.	Industrial	0.010	0.026	0.026	0.078	d
95	Alliance WE Ltd. Partnership	Apartment	0.009	0.024	0.024	0.073	d
96	Hospitality International Inc.	Hotel	0.008	0.022	0.022	0.065	d
97	Summerfield Park	Park	0.008	0.022	0.065	0.195	c
98	CWS Communities LP	Apartment	0.008	0.021	0.021	0.064	d
99	Will Rogers Memorial CN	Commercial	0.008	0.021	0.021	0.063	d
100	Goft Hotel Partners	Hotel	0.008	0.021	0.021	0.063	d

Table 4-6: Top 125 Potential Reclaimed Water Users (continued)

Rank #	Customer Name	Facility Type	Annual Average (MGD)	Peak Month (MGD)	Peak Day (MGD)	Peak Hour (MGD)	Source
101	All Saints Hospital	Hospital	0.008	0.008	0.023	0.069	d
102	Buck Sansom Park	Park	0.007	0.019	0.057	0.170	c
103	Handley Park	Park	0.007	0.019	0.057	0.170	c
104	Northside Park	Park	0.007	0.019	0.057	0.170	c
105	Oakland Lake Park	Park	0.007	0.019	0.057	0.170	c
106	Silversage Park	Park	0.007	0.019	0.057	0.170	c
107	Kettle Cooked Foods	Food/Bev	0.007	0.007	0.007	0.007	d
108	Burnett Plaza Associate	Commercial	0.007	0.018	0.018	0.055	d
109	Fort Tower One Assoc.	Commercial	0.007	0.018	0.018	0.053	d
110	Trisept Inc. Property Management	Commercial	0.006	0.016	0.016	0.049	d
111	Plaza Medical Center	Hospital	0.006	0.016	0.016	0.048	d
112	Beltex Corp.	Food/Bev	0.006	0.006	0.006	0.017	d
113	Quail Run / Heritage Financial	Apartment	0.005	0.014	0.014	0.042	d
114	Delga Park	Park	0.005	0.014	0.041	0.122	c
115	Ball Metal Container Corp.	Industrial	0.005	0.005	0.005	0.015	d
116	Chez Orleanais DBA	Industrial	0.005	0.013	0.013	0.038	d
117	Fort Worth Club	Commercial	0.005	0.012	0.012	0.036	d
118	Broadway Plaza at Cityview	Commercial	0.004	0.011	0.011	0.034	d
119	Premium WC Inc.	Industrial	0.004	0.011	0.011	0.033	d
120	Puson GCH, LPDI	Commercial	0.004	0.011	0.011	0.032	d
121	Thomas Turner DBA Ridgecrest	Apartment	0.003	0.008	0.008	0.024	d
122	Southwestern Bell Telephone Co.	Commercial	0.003	0.008	0.008	0.024	d
123	Southwest Regional Library	Irrigation	0.002	0.005	0.005	0.014	d
124	Seminary South Branch Library	Irrigation	0.000	0.000	0.000	0.001	d
125	Ridglea Library	Irrigation	0.000	0.000	0.002	0.005	c

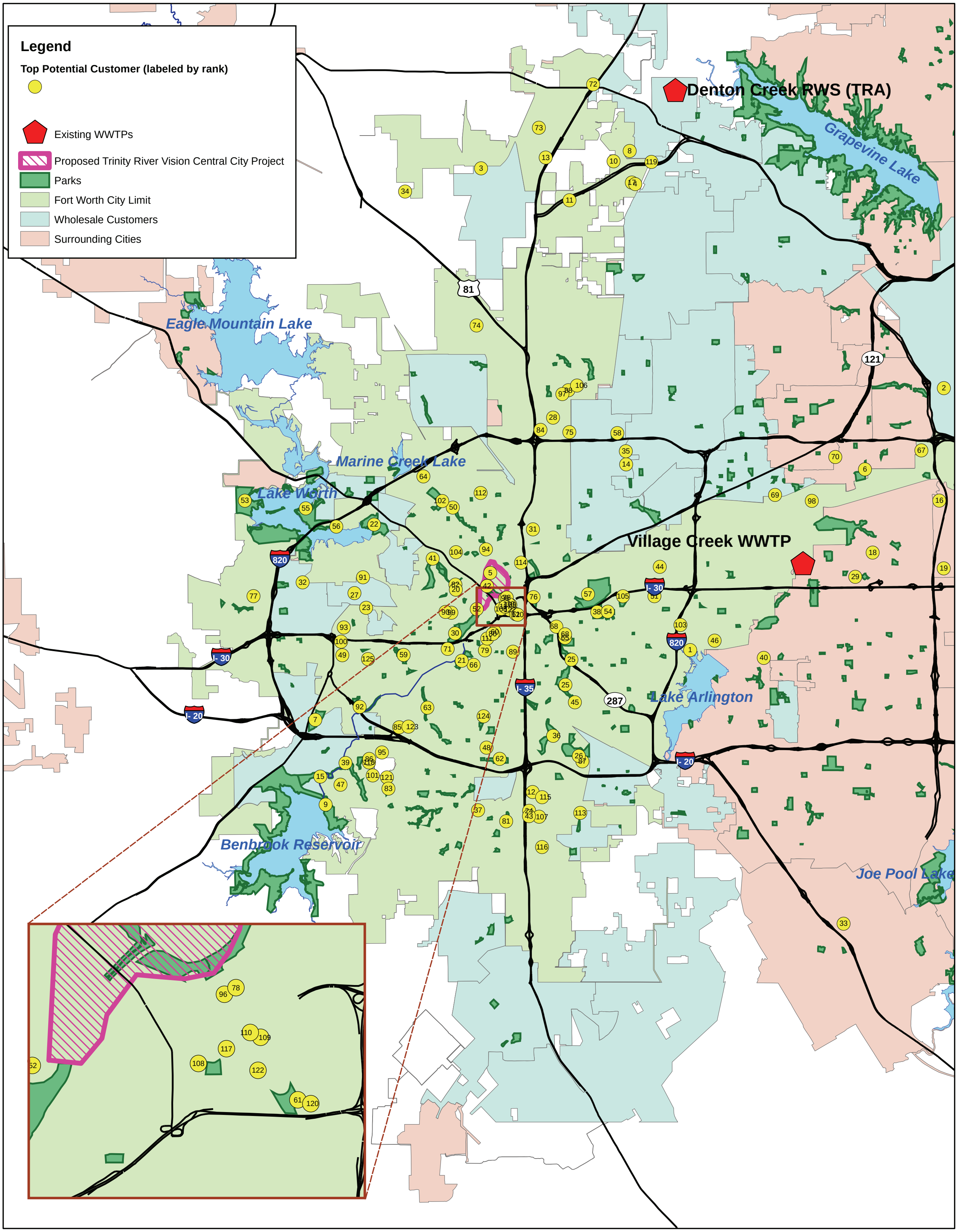
a – Technical Memorandum No. 12

b – Customer Input / Survey

c – City of Fort Worth Parks and Community Services Dept.

d – City of Fort Worth Water Accounts Billing History

Figure 4-1
City of Fort Worth
Top Potential Reclaimed Water Customers



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ALAN PLUMMER ASSOCIATES, INC.

City of Fort Worth
Reclaimed Water Priority and Implementation Plan
FINAL 5/21/07

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CHAPTER 5: RECLAIMED WATER QUALITY CONSIDERATIONS

5.1 Summary of Texas Reclaimed Water Regulations

There are currently no regulations specific to indirect potable reuse or recycled water for the state of Texas, but there are some parameters for direct nonpotable applications. In the state of Texas, the TCEQ regulates the use of reclaimed water for nonpotable uses only after the notification by a water producer of the intent to provide reclaimed water for specified purposes. Regulations are found in Title 30, Chapter 210 of the Texas Administrative Code, which defines two types of reuse water based on its level of contact with the public. Quality requirements are based on the intended use and the potential for human contact with the water. For those uses in which there is a high potential for public contact (e.g. parks or school ground irrigation), Type I requirements apply. Reclaimed uses for which there is controlled access to the usage site are classified as Type II. More specific uses and the requisite water quality parameters are defined below.

<u>Type I Potential Uses</u>

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

<u>Type II Potential Uses</u>

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

Table 5-1: Water Quality Parameters for Different Water Reuse Applications

	Type I	***Type II***
Quality Standards (30 day average)	• BOD_5/$CBOD_5$ = 5mg/L • Turbidity = 3 NTU • Fecal coliform < 20 or < 75 CFU/100 mL (single grab)	• BOD_5 = 20 mg/L • $CBOD_5$ = 15 mg/L • Fecal coliform < 200 or < 800 CFU/100 mL (single grab) • For a pond system: BOD_5 = 30 mg/L, Fecal Coliform < 200 or < 800 CFU/100 mL (single grab)
Sampling/Analysis Frequency	Twice per week	Once per week

5.2 Effluent Water Quality

5.2.1 Village Creek WWTP

Village Creek currently employs conventional liquids treatment processes consisting of screening, primary clarification, biological treatment, final clarification, filtration, and disinfection. The plant's current treatment processes easily meet Type I requirements consistently. The turbidity is an order of magnitude lower than required, and the CBOD stays well below the 5 mg/L limit. However, as the plant flows increase toward the design capacity, some additional treatment capacity (such as additional filters) may be required for a sustained Type I effluent quality. Figure 5-1 shows Village Creek effluent quality data for the relevant reuse parameters for 2006.

5.2.2 Denton Creek RWS

The Denton Creek Regional Wastewater System (DCRWS) uses mostly conventional treatment for the liquids train, with the exception of splitting clarified influent between activated sludge basins (ABs) and sequencing batch reactors (SBRs). Flow from both the ABs and the SBRs is blended, filtered and disinfected before discharge. Disinfection is performed using ultraviolet radiation.

Because DCRWS is not currently supplying reuse water for any applications, data for turbidity is not yet available. However, water quality data for other parameters, including CBOD and fecal coliform, are plotted in Figures 5-2 and 5-3.

The DCRWS data indicate that CBOD concentrations are consistently below the Type I limit. On several occasions the fecal coliform single grab data were above the Type I limit. However, it is anticipated that these excursions can be corrected with tighter control of UV disinfection operations and/or chlorination of the reclaimed water.

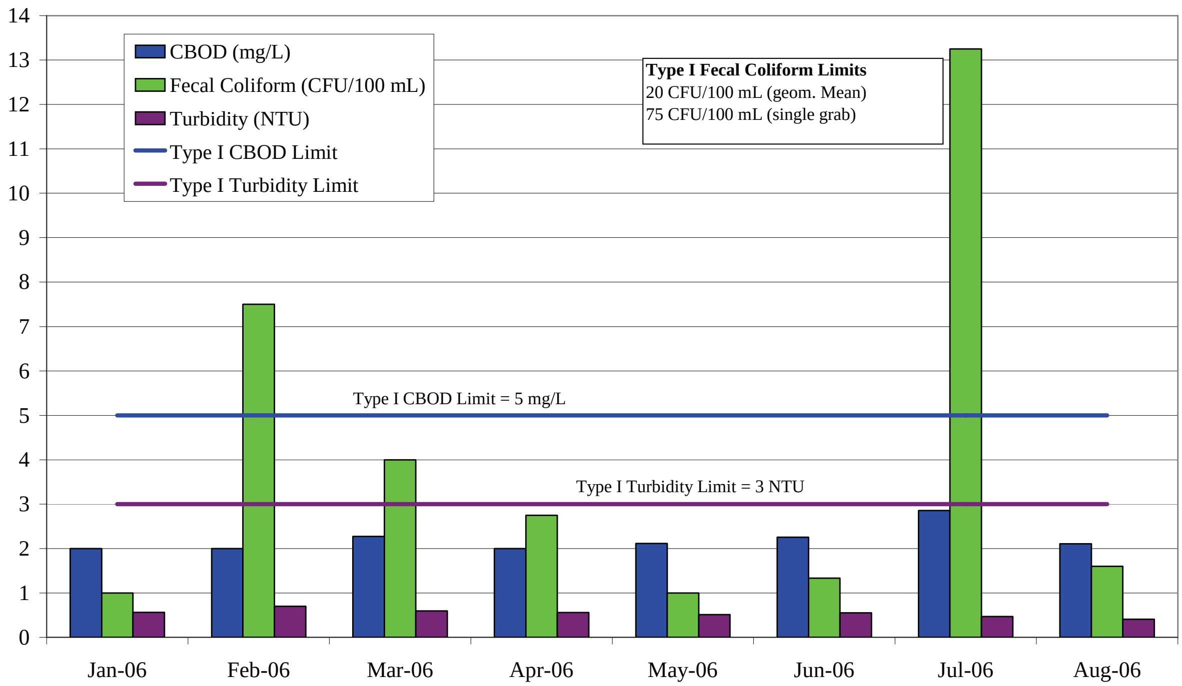

Figure 5-1: Village Creek Water Quality Data for Reuse Constituents

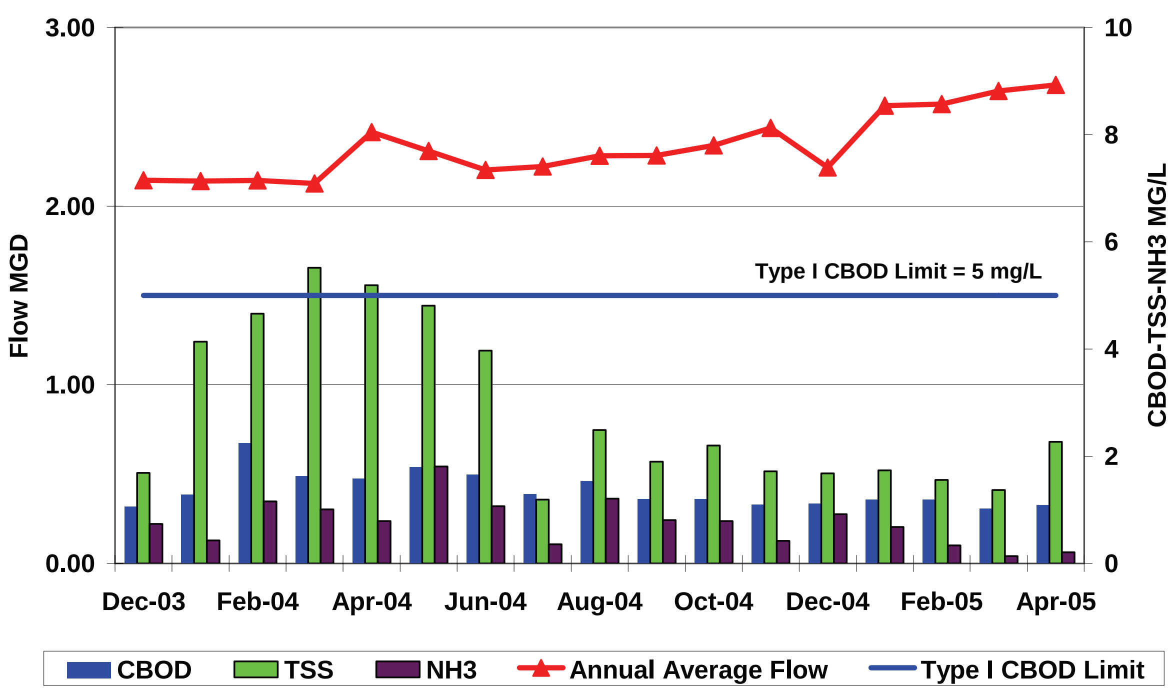

Figure 5-2: CBOD, NH3 and TSS Data for DCRWS

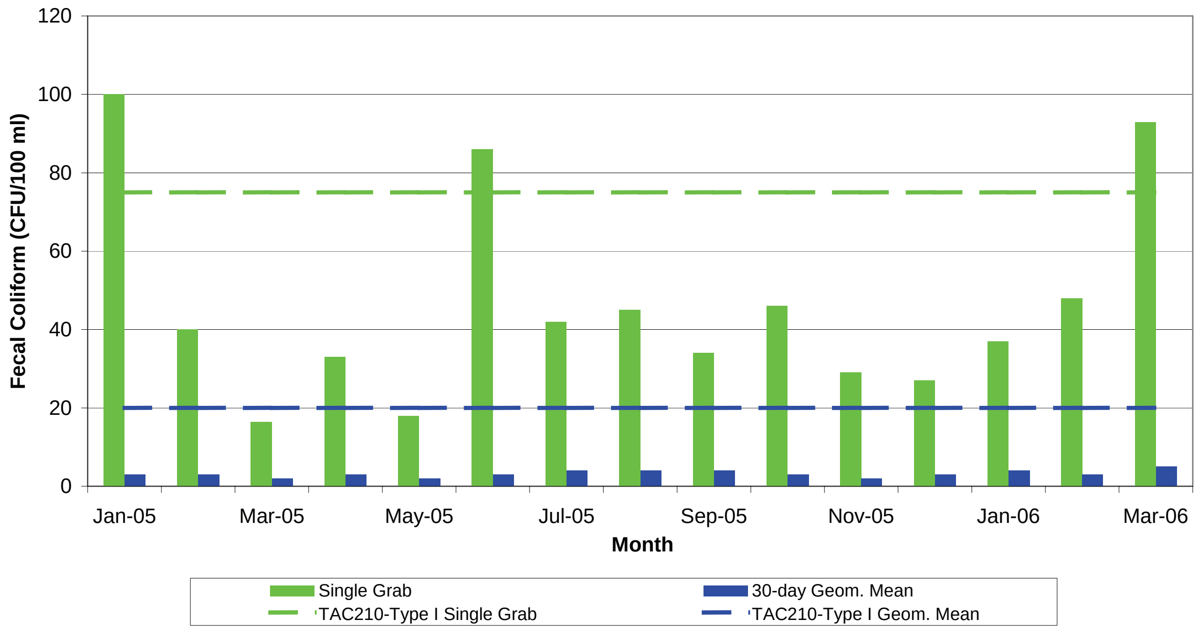

Figure 5-3: Fecal Coliform Data for DCRWS

5.3 Additional Quality Parameters for Specific Uses of Reclaimed Water

Unfortunately, data for the DCRWS effluent with regard to the following discussion were not available.

5.3.1 Irrigation

Many reuse applications involve using treated effluent to irrigate parks, golf courses and crops. In these instances, it is beneficial and desirable that the effluent contains a level of nutritive constituents, such as nitrogen and phosphorous, that contribute positively to the health of lawns and green spaces. Figure 5-4 shows the levels of some of these constituents measured in Village Creek effluent.

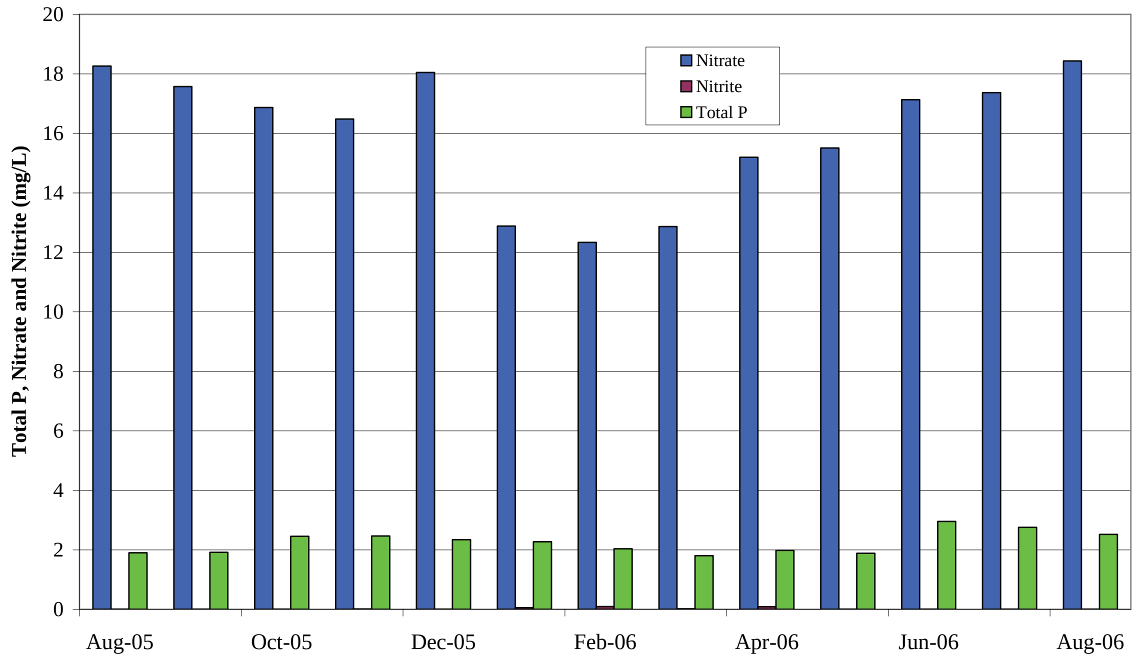

Figure 5-4: Nutritive Constituents in Village Creek Treated Effluent

Total phosphorous levels, nitrite and nitrate concentrations were included on these figures in order to show the potential nutritive qualities the effluent might have for irrigation; however, there are additional parameters such as total dissolved solids (TDS) that, in high concentrations, have adverse effects on vegetation. Dissolved solids can inhibit the uptake of water in plants, or contribute to the inadvertent uptake of high concentrations of salts, which damage plant tissues. A commonly used surrogate for the level of salts that comprise the overall TDS is chloride, which can begin to adversely affect the health of plants at levels approximating the 200-300 mg/L range. Village Creek data, not shown here, indicate that on average the chloride concentrations reach only 100 mg/L. Because of the concerns surrounding solids and salts, restrictions can be placed on golf course irrigation water when TDS concentrations reach greater than 450 mg/L. At concentrations greater than 2,000 mg/L, the use of reclaimed water may be discontinued altogether until the levels of solids are reduced.

5.3.2 Industrial Cooling Water

In the event that reclaimed water is to be used in industrial cooling towers, it may be necessary to provide additional treatment beyond what the treatment plant affords. Dissolved solids in the water can precipitate out and result in clogging or corrosion of pipes. Often, membrane filtration is a prerequisite for making reuse water attractive to industry for these purposes. One of the more critical parameters for industrial reuse applications is total hardness, measured as the sum of calcium and magnesium levels, because it often dictates the extent to which deposits are formed in cooling tower piping. The average total hardness of the Village Creek effluent in 2005 was approximately 165 mg/L; for 2006 it was slightly higher at 176 mg/L. It is often the case that industries have on-site softening systems which could treat the effluent to acceptable levels. Other cations may be present, however these should not be in any significant quantity as the alkalinity of the water was comparable to the hardness levels: 133 and 132 mg/L for 2005 and 2006 respectively. For other metals, such as copper and zinc, acceptable levels should be determined by individual industrial customers, but these elements were not detected in levels that are particularly hazardous to aquatic or human life. Again, it is likely that specific testing will have to be conducted depending on the reclaimed water customer and the effluent use. Figure 5-5 shows the total alkalinity and hardness for VCWWTP effluent.

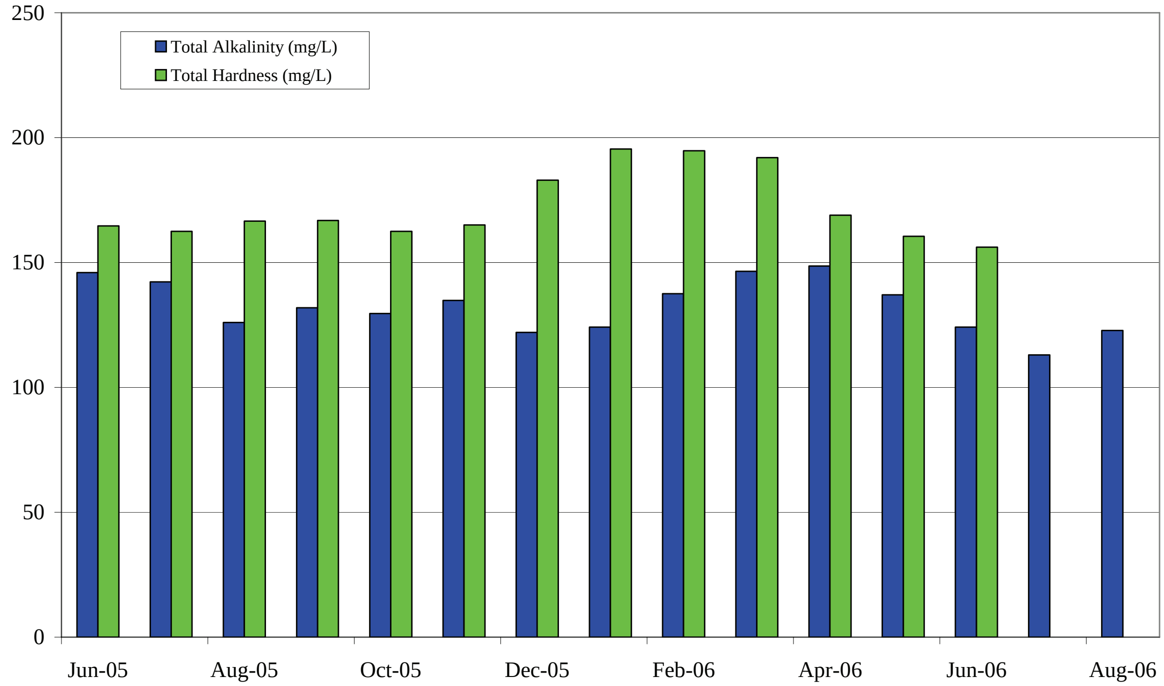

Figure 5-5: Total Alkalinity and Total Hardness of Village Creek WWTP Treated Effluent

5.3.3 Make-Up Water (Augmentation)

Another application of Type I reclaimed water is the augmentation of recreational impoundments and aesthetic water features such as park fountains. Because of the potentially high level of human exposure in recreational waters, additional testing for bacteria or viruses (e.g. E. coli) or more frequent testing may be warranted. In addition, reduction of nutrient levels may be necessary to minimize algae growth in ponds or lakes.

5.3.4 Other Reuse Applications

There are many possible uses for reclaimed water. Car washes, wetland augmentation, and athletic field irrigation have also been identified as possible users of reclaimed water. Some industrial uses require a highly treated product which would exceed Type I standards; other uses may have to be evaluated individually in order to ascertain acceptable levels for use. Nevertheless, Type I standards provide a public health and environmental standard that meets most reuse needs.

5.4 Potential Future Water Quality Requirements for City of Fort Worth WWTP Effluent

It is difficult to predict what new federal or state requirements may be applied to discharge permits in the future. As plants move into more recycled water projects, total dissolved solids (TDS) levels may become an issue, and there are some TPDES permits with TDS limits in them at this time. The EPA has also required all states to incorporate some form of nutrient standards into the surface water quality standards. Thus, in the future, discharges permits will likely include a phosphorous limit, and possibly a nitrogen limit; however this has more of an impact on conventional discharge than on most reuse applications. As these regulations are implemented, there are several types of treatment technologies, such as denitrifying filters, that are readily available for use at either of the treatment plants discussed. It should be noted, though, that direct reuse programs reduce the nutrient loading to the receiving streams. Therefore, even with the possible tightening of effluent permit limits, reuse could help reduce the impact more stringent permitting requirements would have on the WWTPs with regard to the requisite treatment process alterations to meet future limits.

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CHAPTER 6: SERVICE AREAS AND POTENTIAL PROJECTS

6.1 Introduction

This chapter presents information related to the identification of potential service areas, and the development of conceptual treatment and conveyance alternatives for each service area. Following identification of reclaimed water service areas, an initial, screening-level evaluation of probable cost, based on reclaimed water source, was performed. With the exception of the Eastern and Western System service areas (defined in the following section), two source alternatives were considered for each service area. One alternative considered constructing a water recycling center (WRC) within the service area and one alternative considered conveying treated wastewater from either the Village Creek WWTP (VCWWTP) or the Trinity River Authority's Denton Creek Regional Wastewater System (DCRWS) to the service area. Results of this initial economic evaluation are discussed in this chapter. Based on this initial evaluation, a preferred alternative was selected for each service area and was then used as the basis for the more detailed feasibility evaluation discussed in Chapter 7.

6.2 Reclaimed Water Service Areas

The identification and ranking of potential reclaimed water customers is presented in Chapter 4. The potential customers were evaluated based on location and ranking to identify areas with the potential for high reclaimed water use. Emphasis was placed on locating large customers and clusters of smaller customers. Individual projects to serve the potential customers were then conceptualized and grouped together to form reclaimed water service areas. The following five reclaimed water service areas were identified, and are generally shown on Figure 6-1:

1. Central System
2. Eastern System
3. Northern System
4. Southern System
5. Western System

Within each of these service areas, the potential reclaimed water customers were identified, and are included in Tables 6-1 through 6-5. The annual average water demand and required system capacity are listed in each of these tables. The required system capacity was determined based upon which flow rate (peak month, peak day, or peak hour) that the system is designed to convey to each user. The potential reclaimed water demands for each customer, and peaking factors, are as developed in Chapter 4. Based on the projected demands, conceptual design alternatives were developed for each of the reclaimed water service areas. The assumptions for available storage capacity and system pressure requirements are also listed in these tables. At all golf courses, and a few other potential customers, it is assumed that existing ponds could be used for storage and that the customer would supply additional pumping capacity to achieve the desired system pressure. For most users, other than golf courses, a minimum system pressure of 60 psi is provided.

Figure 6-1
City of Fort Worth
Reclaimed Water Service Areas

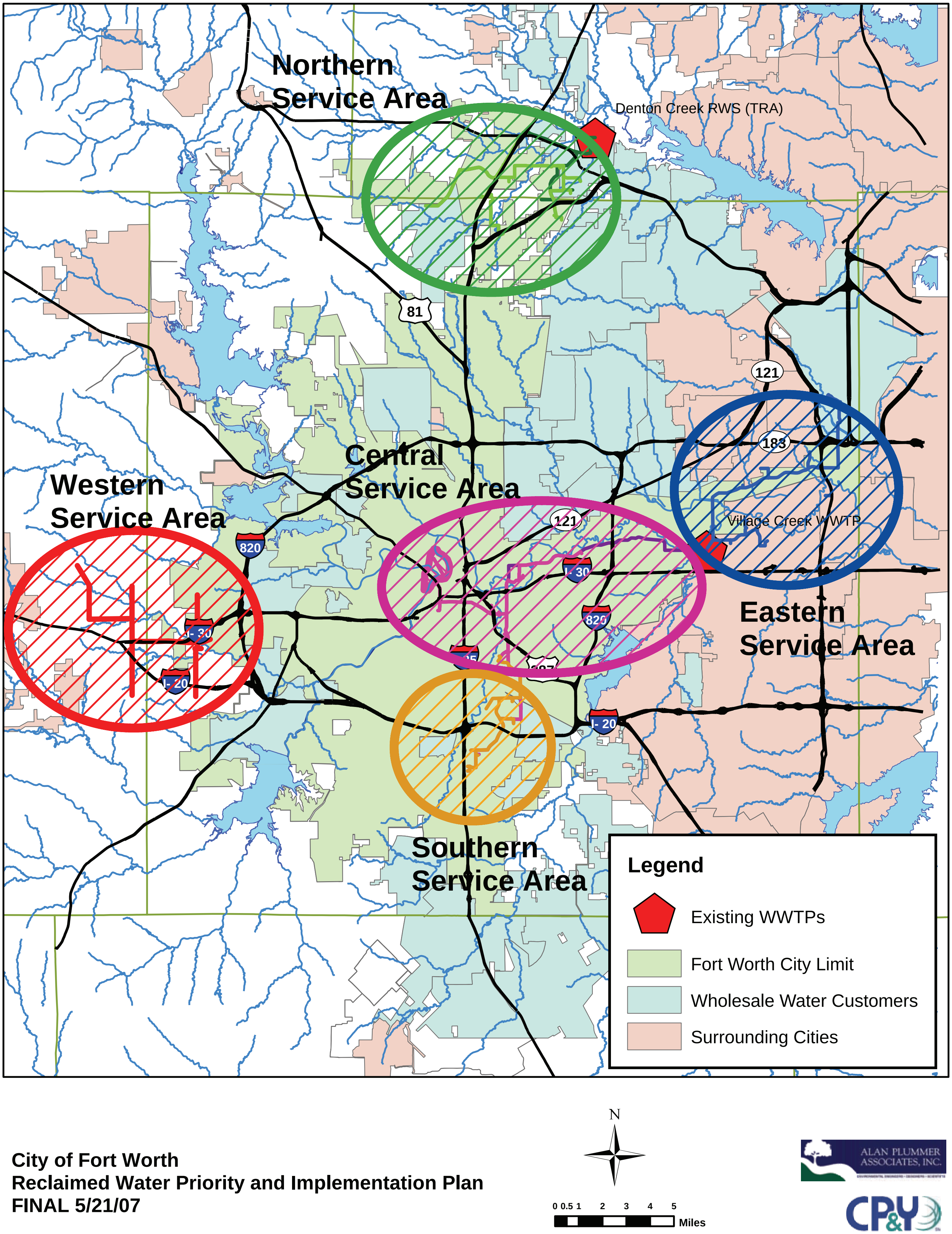


Table 6-1: Central System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand	System Capacity	Required System Pressure	Available Storage
	(MGD)	(MGD)	(psi)	
Cobb Park(1)	0.17	3.96	60	No
Gateway Park	0.05	1.21	60	No
Harris Methodist Hospital	0.05	0.05	60	No
Meadowbrook GC	0.06	1.73	0	Yes
Sycamore Creek GC	0.03	0.74	0	Yes
Sycamore Park	0.04	0.86	60	No
Trinity River Vision Project(2)	0.76	7.50	17(3)	No
Woodhaven GC	0.09	1.16	0	Yes
Total	**1.25**	**17.20**		

(1) Cobb Park is also included in the Southern System Service Area
(2) The water demands for the Trinity River Vision Project include evaporative make-up water only, and could be expanded in the future to include irrigation water demand, once that data is available from the developers.
(3) The required pressure is that amount required to fill a ground storage tank at the Trinity River Vision Project site.

Table 6-2: Eastern System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand	System Capacity	Required System Pressure	Available Storage
	(MGD)	(MGD)	(psi)	
American Airlines	0.03	0.52	60	No
City of Arlington				
JW Dunlop Sports Center	*0.01*	*0.10*	*60*	*No*
River Legacy Park	*0.04*	*0.40*	*0*	*Yes*
Chester Ditto Golf Course	*0.17*	*0.50*	*0*	*Yes*
City of Euless				
Texas Star Golf Course	*0.52*	*3.33*	*0*	*Yes*
Texas Star	*0.21*	*2.00*	*60*	*No*
Softball World	*0.02*	*0.50*	*60*	*No*
D/FW International Airport	1.53	6.06	0	Yes
Riverside GC	0.24	1.28	0	Yes
Total	**2.77**	**14.69**		

Table 6-3: Northern System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand	System Capacity	Required System Pressure	Available Storage
	(MGD)	(MGD)	(psi)	
Alliance Center East Assoc.	0.36	0.95	0	Yes
Alliance Center West Assoc.	1.12	2.96	0	Yes
Alliance Gateway Phase I Assoc.	0.24	0.62	10	Yes
Alliance Gateway Phase II Assoc.	0.44	1.17	10	Yes
Alliance Gateway Phase III Assoc.	0.56	1.48	10	Yes
Alliance Lonestar Association	0.43	1.13	0	Yes
Circle T Ranch / Westlake	0.96	2.53	0	Yes
Frac Water (Gas Drilling)	0.05	0.05	0	N/A
Texas Motor Speedway	0.03	0.07	0	Yes
Total	**4.19**	**10.97**		

Table 6-4: Southern System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand	System Capacity	Required System Pressure	Available Storage
	(MGD)	(MGD)	(psi)	
Alcon Laboratories	0.38	3.00	60	No
Ball Metal Container	0.01	0.01	60	No
Cobb Park[(1)]	0.17	3.96	60	No
Glen Garden GC	0.09	0.46	0	Yes
Miller Brewing Co.	0.19	0.25	60	No
Mrs. Bairds Bakeries	0.10	0.10	60	No
Rolling Hills Soccer	0.15	3.65	60	No
Tarrant County College	0.01	0.31	60	No
Total	**1.09**	**11.73**		

(1) Cobb Park is also included in the Central System Service Area

Table 6-5: Western System Reclaimed Water Service Area Demands

Potential Customer	Ann. Avg. Water Demand(1)	System Capacity(2)	Required System Pressure	Available Storage
	(MGD)	(MGD)	(psi)	
Blue Haze Elementary	0.01	0.15	60	No
East of Walsh Ranch	0.16	3.92	60	No
Leonard Golf Links	0.05	1.15	0	Yes
Lost Creek GC	0.18	0.93	0	Yes
New Commercial	0.14	2.25	60	No
New Golf Course	0.74	3.89	0	Yes
New Park	0.20	4.72	60	No
New Public Facility	0.04	0.86	60	No
New Residential	2.07	32.84	60	No
New School	0.13	3.06	60	No
Tannahill Intermediate	0.01	0.29	60	No
West of Walsh Ranch	0.06	1.52	60	No
Total	**3.79**	**10.00**		

(1) Annual average water demands as reported in the June 2004 Draft Feasibility Study for the Mary's Creek Water Recycling Center
(2) Intermediate storage tanks and booster pump stations are included in the Western System Service Area to meet system pressure requirements and reduce overall system capacity requirements.

6.3 Sources of Reclaimed Water

The source of reclaimed water for each of the service areas is treated effluent from either an existing wastewater treatment plant (WWTP) or a proposed Water Recycling Center (WRC). With the exception of the Eastern System, which only considered Village Creek WWTP as a source and the Western System which only considered a WRC, alternatives for each service area were evaluated using a WWTP and a WRC as the source of supply.

6.3.1 Existing Wastewater Treatment Plants

The City of Fort Worth owns and operates the Village Creek WWTP, which currently treats an average of approximately 110 million gallons per day (MGD). This flow is adequate to supply all of the reclaimed water demands in the City. As discussed in Chapter 5, the effluent quality of the Village Creek WWTP is appropriate for either Type I or Type II uses.

The Denton Creek Regional Wastewater System (DCRWS) is owned and operated by the Trinity River Authority (TRA). As discussed in Chapter 5, flow projections for the average daily flow, average daily dry weather flow, and diurnal flow were evaluated to determine the amount of reclaimed water that could be potentially available. This information indicated that DCRWS is currently discharging approximately 3 MGD on an annual average basis. By 2013 the average annual discharge is projected to be 12 MGD. The minimum flow available (for dry weather, minimum diurnal flow conditions) is estimated to be approximately 2 MGD under current conditions and is projected to increase to about 6.2 MGD by 2013. These flows are adequate to supply the projected reclaimed water demands in the Northern System service area.

6.3.2 Water Recycling Centers

Water recycling centers (WRCs) are small treatment facilities located near an existing trunk sewer that can treat a portion of the flow in the line and deliver it to a nearby recycled water user. Solids are typically returned to the collection system and handled at the main WWTP. The use of WRCs can have several advantages, including:

- WRCs can be located close to the point of service;
- They can treat only the flow needed for reclaimed water sales;
- They can defer the need to expand existing WWTPs.

Within each service area, potential WRC sites were located in the general proximity of potential customers and adjacent to existing wastewater interceptors. Site selection was based on evaluation of aerial maps, sites considered in other City of Fort Worth studies, and input from City staff. Detailed site evaluations were not performed. Alternatives using a WRC were developed for every service area, except the Eastern System service area, which was assumed to be served by VCWWTP. WRCs were sized to provide enough capacity to meet the projected reclaimed water demands for the service area. In all cases it was assumed that the solids would be returned to the collection system and treated at either VCWWTP or DCWRS.

6.4 Screening-Level Evaluation of Service Area Conceptual Projects

An initial, screening-level evaluation of conceptual treatment and conveyance projects for each service area was performed. The purpose of this screening-level evaluation was to determine whether each service area could be served more economically from a WRC or an existing WWTP. However, since the Eastern System is located close to VCWWTP, no alternative with a WRC was considered for this service area. Similarly, since the Western System is located so far away from an existing WWTP, no alternative using an existing WWTP was considered for this service area. The following section presents each of the alternatives considered and summarizes the screening-level economic evaluation performed to identify the preferred alternative in each service area. Screening-level costs were based on an evaluation of each system and on the demand projections presented in Section 6.2. Proposed pipeline and treatment plant sizing for these alternatives is included in the detailed cost sheets included in Appendix E. In addition, a memorandum summarizing the assumptions used for the costs is provided in Appendix F. All costs are based on a capital recovery period of 20 years and an annual interest rate of 5.5%. In developing the cost analysis, it was assumed that the City would be responsible for construction of all pump stations, storage tanks, water recycling centers, and pipelines measuring 10-inches in diameter or larger. It is assumed that any pipelines less than 10-inches in diameter will be constructed by the respective customer. In some cases, larger pipelines are assumed to be constructed by the customer as well, and these are discussed in the detailed descriptions of each alternative provided in Section 6.5. For the screening evaluation, all costs for constructing and operating the WRCs are included in order to compare the WRC alternatives with the alternatives that receive water from an existing WWTP. However, as will be discussed in Chapter 7, the WRC costs are not included in the total reclaimed water system costs for the feasibility evaluation, as they are assumed to be costs that are supported by the wastewater system.

6.4.1 Central and Southern System Service Areas

Although initially considered separately, alternatives that take advantage of shared pipelines to provide reclaimed water to both the Central and Southern service areas were also evaluated, and determined to be more cost effective. Therefore, alternatives for these service areas are considered together in this section.

The Central System service area extends west from the Village Creek WWTP to the downtown Fort Worth area near the IH-35W and IH-30 intersection, and as far south as Cobb Park. Potential reclaimed water customers in this area include several parks and golf courses, Harris Methodist Hospital, and the Trinity River Vision project corridor. Each customer and its annual average water demand is listed in Table 6-1.

The largest potential customer in the Central System is the Trinity River Vision Central City Project. Although not anticipated until around 2015, the Central City Project may provide many opportunities for reclaimed water use through irrigation and evaporation make-up water. Make-up water is primarily needed to maintain a constant water surface elevation in the planned urban lake, but can also be used to replace any water lost to evaporation in water features such as fountains and decorative ponds.

The Southern System service area is generally located along IH-35W, south of IH-20, with only a couple of customers located north of IH-20. This area is mainly an industrial area, and the primary customer is Alcon Laboratories. Other potential reclaimed water customers include Miller Brewing Company, Rolling Hills Soccer Complex, Mrs. Baird’s Bakery, Glen Garden Golf Course, Tarrant County Junior College, and the Ball Metal Container Corporation. A complete listing of customers in the Southern System Service Area is included in Table 6-4.

A map showing the alternatives considered for the Central System and Southern System service areas is provided in Figure 6-2. As mentioned above, initially these service areas were evaluated separately. However, early in this evaluation it was determined that a combined Central/Southern System was more economical for providing service to the entire area. A total of three alternatives are summarized here. The first two consider service to the entire Central/Southern service areas from either a WRC located at the abandoned City of Fort Worth Riverside WWTP near Gateway Park, or from VCWWTP. A separate WRC alternative for the Southern System is also presented. Each of these alternatives is summarized below:

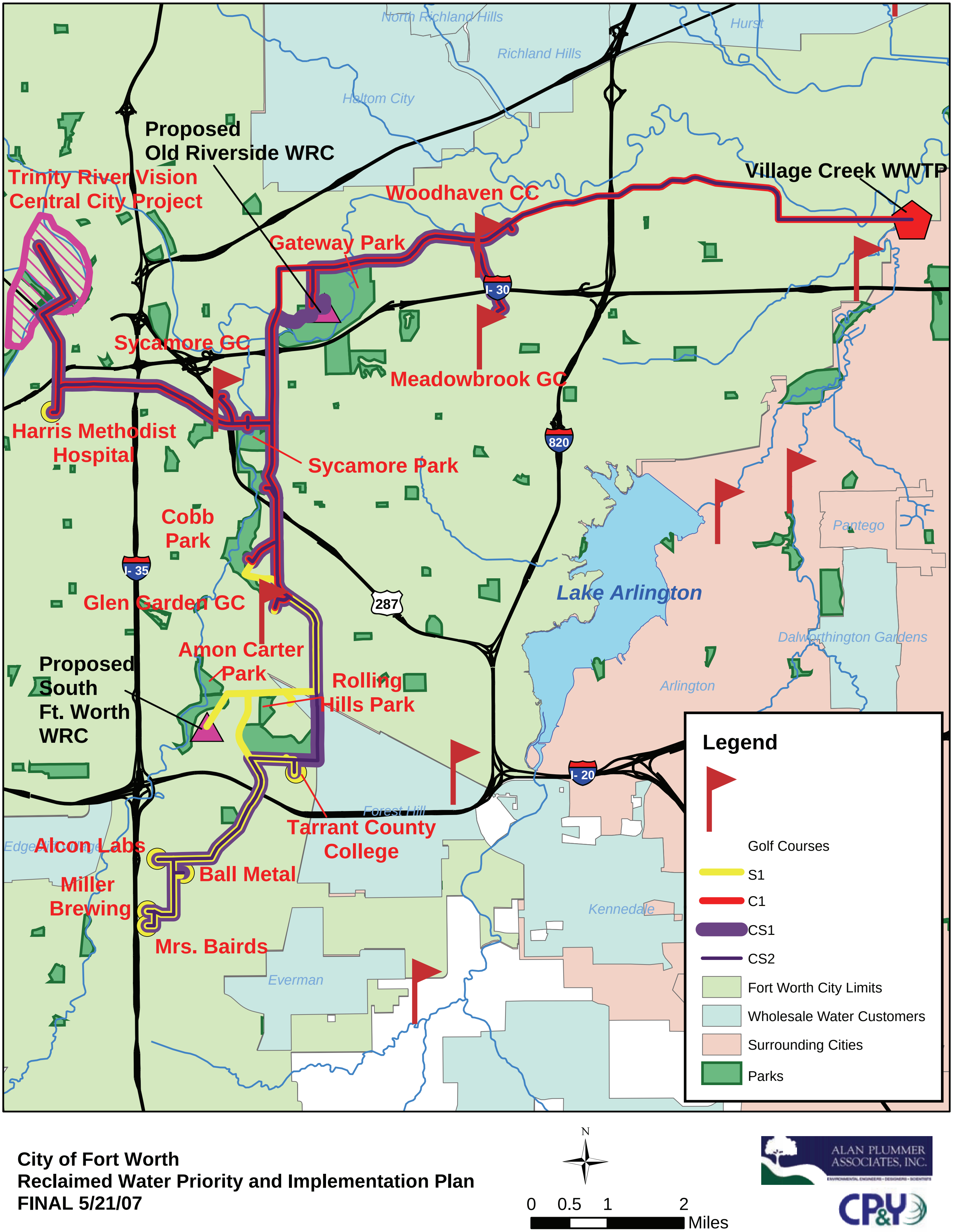
6.4.1.1 Central System Alternative 1 (C1)

Alternative C1 serves the Central System customers only, from the VCWWTP, as shown on Figure 6-2.

6.4.1.2 Southern System Alternative 1 (S1)

Alternative S1 serves the Southern System customers only, from a proposed WRC located near Amon Carter Park, east of IH-35 and north of IH-20, as shown in Figure 6-2.

Figure 6-2
Central/Southern Alternatives



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6.4.1.3 Central/Southern System Alternative 1 (CS1)

Alternative CS1 includes a proposed WRC at the site of the abandoned City of Fort Worth Riverside WWTP. Treated effluent from the WRC would serve all customers within the Central and Southern service areas, as shown on Figure 6-2.

6.4.1.4 Central/Southern System Alternative 2 (CS2)

Alternative CS2 uses treated effluent from VCWWTP to serve all customers within the Central and Southern service areas, as shown on Figure 6-2.

6.4.1.5 Preferred Central/Southern System Alternative

Table 6-6 summarizes the opinion of probable cost for each of the Central/Southern System alternatives presented here. The lowest cost alternative is CS2. However, while Alternative S1 has not been evaluated in further detail as a recommended alternative, this screening evaluation indicates that it is still economically viable. If desired, it could be implemented much more quickly to provide reclaimed water to the Southern service area than a combined alternative. In addition, Alternative S1 may be more attractive in the future as technology for WRCs advances and more cost-effective treatment facilities become available.

Table 6-6: Summary of Costs, Central/Southern System Alternatives (without benefits)

Alt.	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service	O&M	Energy	Purchase Cost	Overall Unit Cost
	MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
C1	1.25	17.21	$32.70	$2,736,000	$316,000	$60,000	N/A	$3.22
S1	1.10	11.74	$21.75	$1,820,000	$176,000	$221,000	N/A	$2.87
CS1	2.18	19.47	$56.93	$4,764,000	$398,000	$439,000	N/A	$3.45
CS2	2.18	14.47	$40.75	$3,410,000	$412,000	$135,000	N/A	$2.40

[1] Net Present Value of capital cost after accounting for interest during construction.

Based on the evaluation of probable costs presented in Table 6-6, the preferred alternative for the Central and Southern service areas is Alternative CS2, which provides reclaimed water to both areas from VCWWTP.

6.4.2 Eastern System Service Area

The Eastern System service area extends east from the Village Creek WWTP into the City of Arlington, and northeast into the City of Euless, Centreport and D/FW International Airport. Potential reclaimed water customers in this area include the Cities of Arlington and Euless, D/FW International Airport, American Airlines, and the Riverside Golf Course. Each customer and its annual average water demand are listed in Table 6-2.

The largest potential customers in the Eastern System are the Cities of Arlington and Euless, and the D/FW International Airport. Both Arlington and Euless have expressed an immediate interest in developing reclaimed water sources to supply irrigation water to some of their City-owned parks and golf courses. Likewise, D/FW International Airport has expressed an interest in using reclaimed water for irrigation of the Bear Creek Golf Course and other areas. Preliminary discussions with developers in the Centreport area, near D/FW Airport indicate that there may be potential for use of reclaimed water in this area as well.

Since the Eastern System is so close to VCWWTP, no alternative with a WRC was evaluated for this service area. Therefore, only one alternative was considered, and is summarized below. A map of this alternative is shown in Figure 6-3.

6.4.2.1 Eastern System Alternative 1 (E1)

Alternative E1 uses treated effluent from VCWWTP to serve customers in the Cities of Arlington, Euless and Grand Prairie, as well as the Centreport and D/FW areas (see Figure 6-3).

6.4.2.2 Preferred Eastern System Alternative

Since only one alternative was considered for the Eastern System, Alternative E1 is the preferred alternative. Table 6-7 summarizes the opinion of probable costs for this alternative.

Table 6-7: Summary of Costs, Eastern System Alternative (without benefits)

Alt.	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service	O&M	Energy	Purchase Cost	Overall Unit Cost
	MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
E1	2.77	14.69	$15.52	$1,298,000	$215,000	$95,000	N/A	$0.82

[1] Net Present Value of capital cost after accounting for interest during construction.

6.4.3 Northern System Service Area

The Northern System Service Area is located in northern Tarrant County around the Alliance Gateway industrial area and extends from IH-35W to SH-377 and from SH-170 to SH-114. Potential reclaimed water customers in this area include several industrial zones in the Alliance Gateway area, Texas Motor Speedway, and “frac” water for gas drilling operations. The Northern System is projected to supply the most reclaimed water of any of the alternatives considered in this study. Each customer and its annual average water demand is listed in Table 6-3.

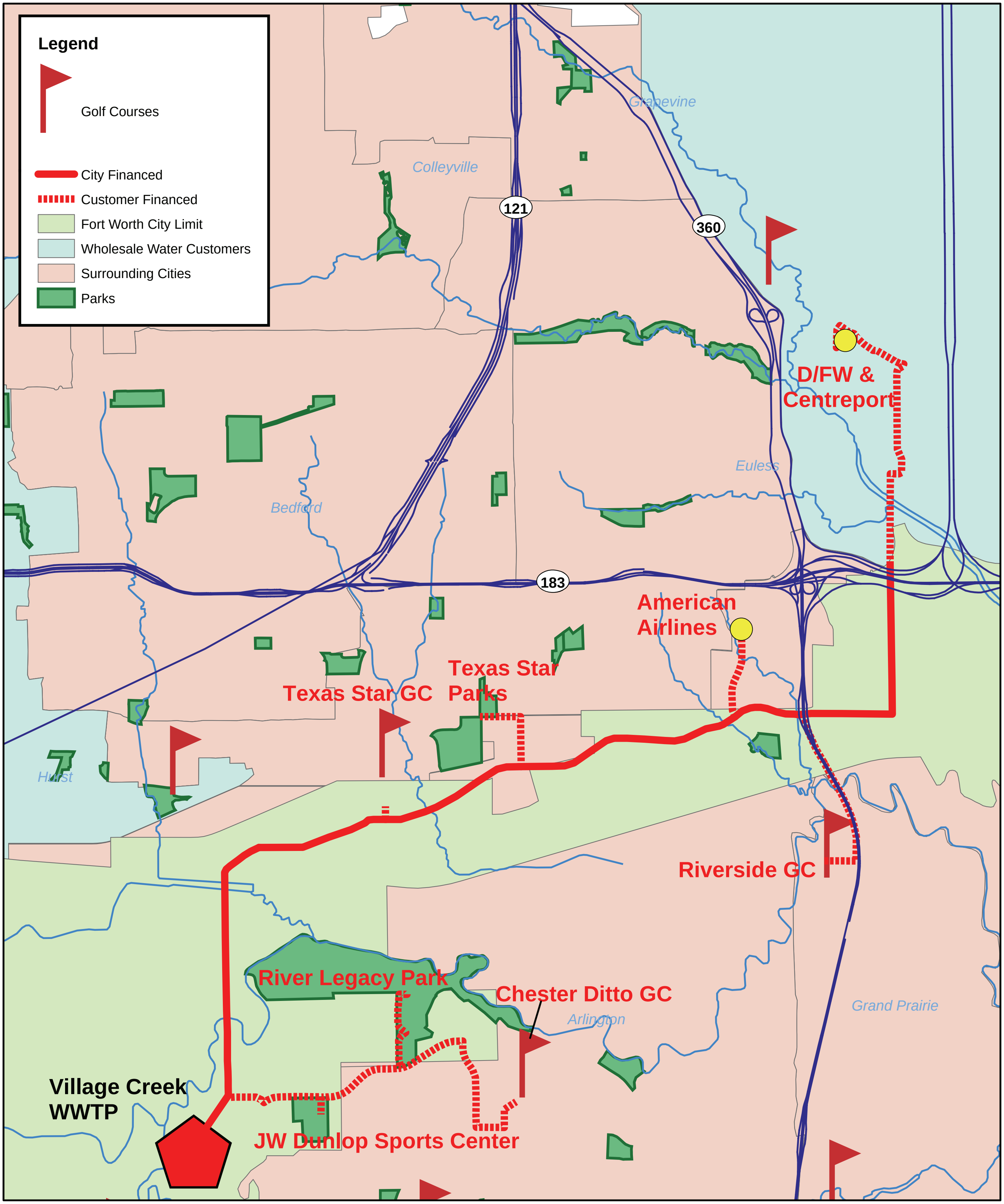
The largest potential customers in the Northern System are the various associations within the Alliance industrial area. The Alliance area is a large industrial area being developed by Hillwood Properties. Hillwood Properties was contacted and provided input during the development of the Northern System Service Area alternative. Reclaimed water could be used in these areas for commercial irrigation and make-up water for water features. The various industrial areas within the Alliance development will have multiple water features (ponds and fountains) to which reclaimed water can be supplied.

A map showing the alternatives considered for the Northern System Service Area is provided as Figure 6-4. Two alternatives were evaluated and are described below.

6.4.3.1 Northern System Alternative 1 (N1)

Alternative N1 serves the Northern System customers from a WRC located east of IH-35, as shown in Figure 6-4.

Figure 6-3
Eastern System Alternative



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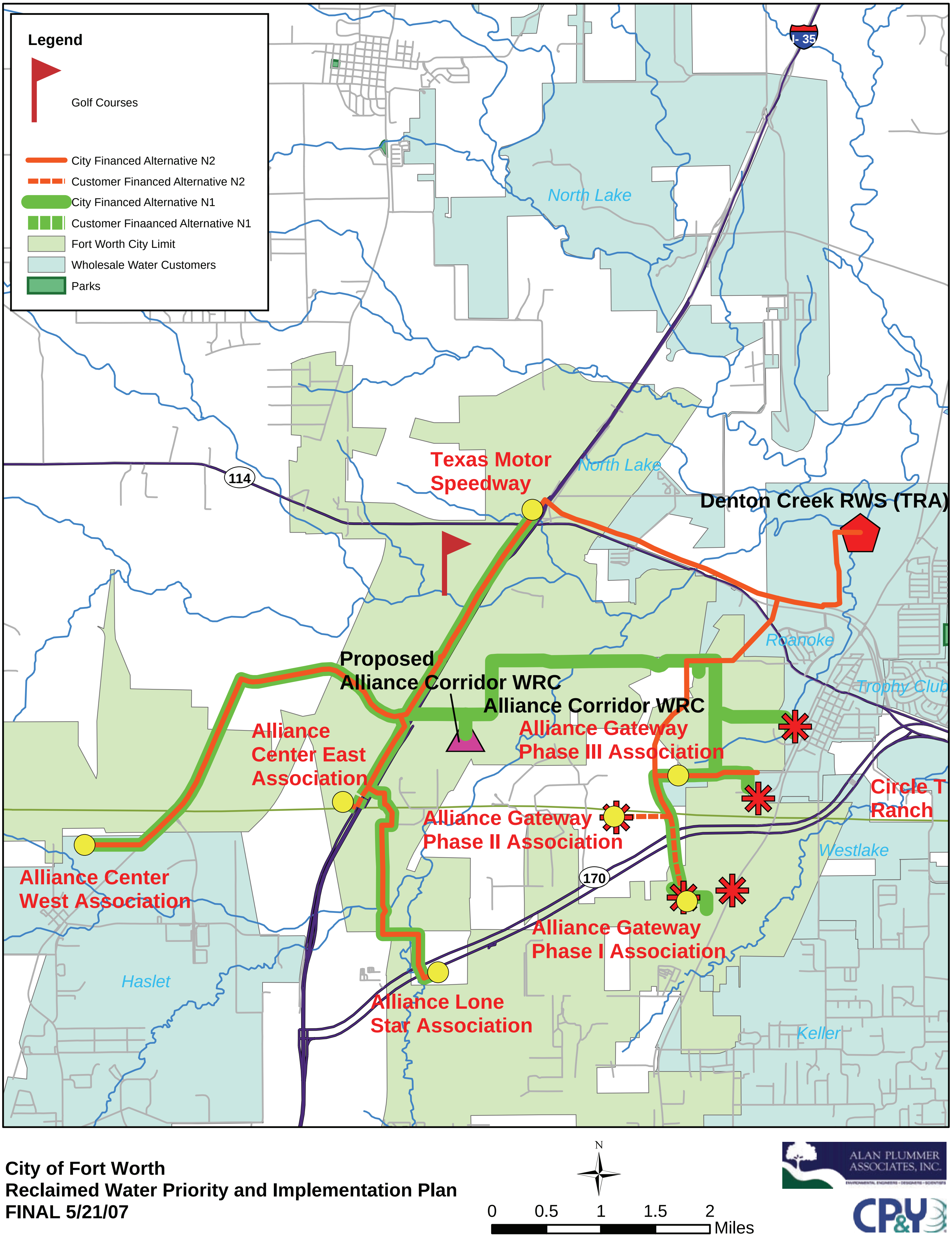
N

0 0.5 1 2 Miles

Figure 6-4
Northern System Alternatives



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6.4.3.2 Northern System Alternative 2 (N2)

Alternative N2 serves the Northern System customers from the TRA Denton Creek Regional Wastewater System (DCRWS), as shown in Figure 6-4.

6.4.3.3 Preferred Northern System Alternative

Table 6-8 summarizes the opinion of probable cost for the Northern System alternatives. Due to the close proximity of this service area to DCRWS, providing reclaimed water from this facility is significantly more economical than constructing a WRC. Therefore, Alternative N2 is the preferred alternative for this service area.

Table 6-8: Summary of Costs, Northern System Alternatives (without benefits)

Alt.	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service	O&M	Energy	Purchase Cost	Overall Unit Cost
	MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
N1	4.19	11.07	$54.45	$4,556,000	$304,000	$679,000	N/A	$1.84
N2	4.19	11.07	$17.09	$1,430,000	$188,000	$103,000	$0.25	$0.81

[1] Net Present Value of capital cost after accounting for interest during construction.

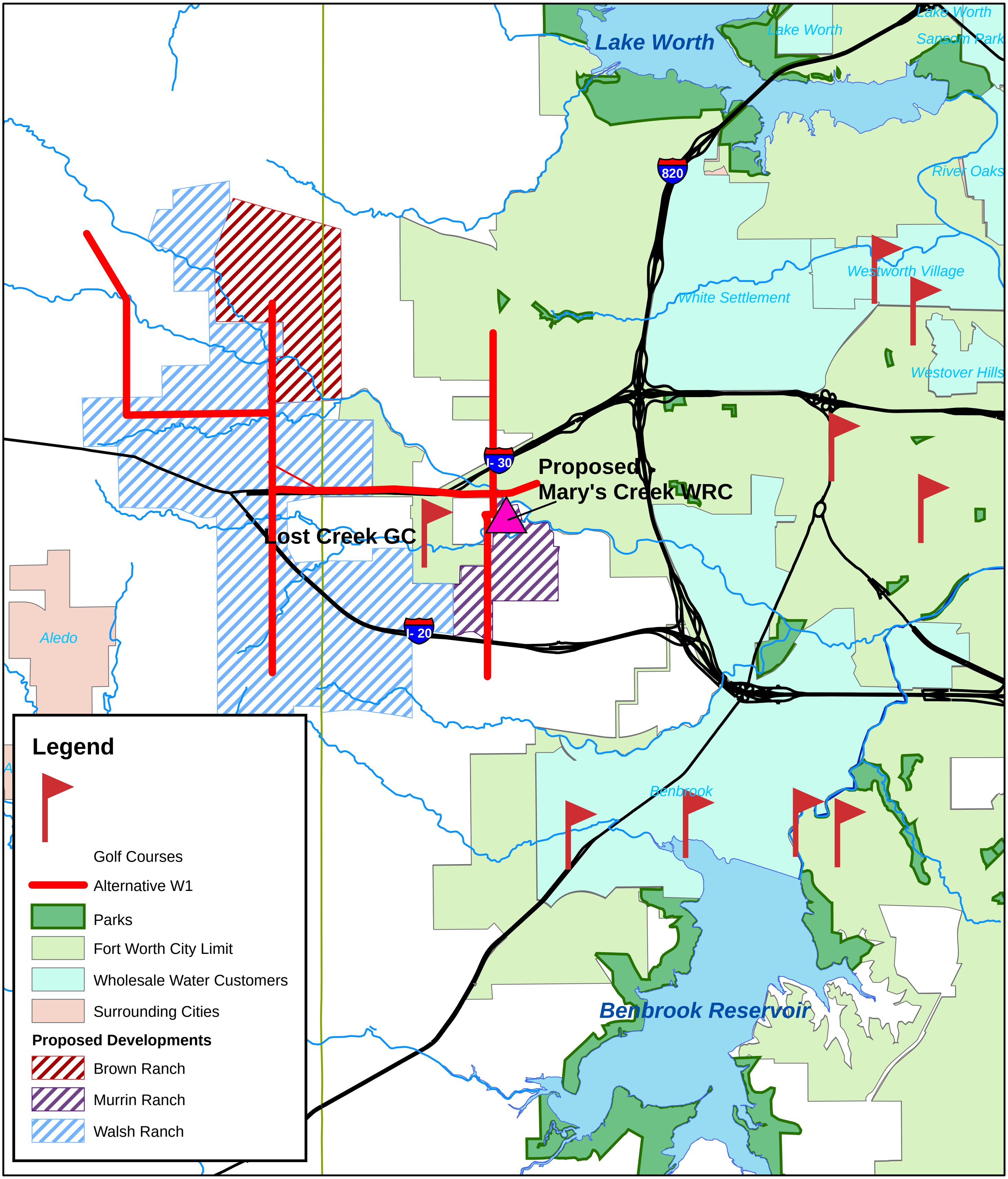
6.4.4 Western System Service Area

The Western System Service Area is located in the western portion of Fort Worth around the Mary's Creek Basin, including Walsh Ranch, Brown Ranch and Murrin Ranch. This area extends west of West Loop 820 and covers a large area north and south of IH-20 and IH-30. Since this area is mostly undeveloped at this time, there is an opportunity to install a dual water supply system as land is developed. As discussed in Chapter 2, the City is concurrently conducting a preliminary study of this region, and the initial findings of that study have been incorporated into the development of the Western System.

Potential reclaimed water users in this service area include large areas of commercial and residential irrigation, golf courses or green spaces, schools, as well as other public facilities. Potential reclaimed water customers, type of water usage, and peak flow supply are included in Table 6-5.

Since the Western System Service Area is so far from existing WWTPs, no existing WWTP alternative was considered for this system. Therefore, only one alternative has been evaluated, and is described below. A map of the Western System is provided in Figure 6-5.

Figure 6-5
Western Alternative



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6.4.4.1 Western System Alternative 1 (W1)

Alternative W1 serves the proposed developments within the Mary's Creek Basin from a WRC located between IH-20 and IH-30, as shown in Figure 6-5. As will be discussed in a later section, due to timing of flow availability in this area, it is anticipated that initially raw water from a TRWD raw water line will be used to provide nonpotable water service to this area. It should also be noted that initially, Alternative W1 included service to Z Boaz Park, Z Boaz Golf Course and Hawks Creek Golf Course. Service to these areas increased the unit cost of service significantly and, therefore, was eliminated from the alternative. However, these customers could be considered for service in the future.

6.4.4.2 Preferred Western System Alternative

Since only one alternative was considered for the Western System, Alternative W1 is the preferred alternative. Table 6-9 summarizes the opinion of probable costs for this alternative.

Table 6-9: Summary of Costs, Western System Alternative (without benefits)

Alt.	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service	O&M	Energy	Purchase Cost	Overall Unit Cost
	MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
W1	3.79	18.12	$72.79	$6,091,000	$455,000	$772,000	N/A	$3.03

[1] Net Present Value of capital cost after accounting for interest during construction.

6.4.5 Summary of Screening-Level Evaluation

Table 6-10 presents a summary of the opinions of probable cost for all alternatives considered in the screening-level evaluation to identify the preferred alternative in each service area. Alternatives N2 and E1 provide reclaimed water at the lowest unit cost, primarily due to the proximity of these service areas to existing wastewater treatment facilities.

Table 6-10: Summary of Costs for All Service Areas (without benefits)

Alt.	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service	O&M	Energy	Purchase Cost	Overall Unit Cost
	MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
C1	1.25	17.21	$32.70	$2,736,000	$316,000	$60,000	N/A	$3.22
S1	1.10	11.74	$21.75	$1,820,000	$176,000	$221,000	N/A	$2.87
CS1	2.18	19.47	$56.93	$4,764,000	$398,000	$439,000	N/A	$3.45
CS2	2.18	14.47	$40.75	$3,410,000	$412,000	$135,000	N/A	$2.40
E1	2.77	14.69	$15.52	$1,298,000	$215,000	$95,000	N/A	$0.82
N1	4.19	11.07	$54.45	$4,556,000	$304,000	$679,000	N/A	$1.84
N2	4.19	11.07	$17.09	$1,430,000	$188,000	$103,000	$0.25	$0.81
W1	3.79	18.12	$72.79	$6,091,000	$455,000	$772,000	N/A	$3.03

[1] Net Present Value of capital cost after accounting for interest during construction.

6.5 Preferred Alternative Facilities and Phasing

This section describes the planned facilities and proposed project phasing for each of the preferred alternatives identified in Section 6.4. Construction to be completed by the City has been separated into phases denoted by a number (i.e. Phase 1, 2, etc.). Pipelines to be constructed by a customer are included as separate phases denoted by a number and character (i.e. Phase 2a, 2b, etc.).

6.5.1 Central/Southern System Service Area

As discussed above, implementation of the Southern System Service Area was determined to be more cost effective if constructed as part of the Central System Service Area. Therefore, the Central System Service Area was expanded to include the Southern System Service Area.

The main trunk line of the Central/Southern System is an 11.1-mile long, 36/30-inch diameter transmission main constructed primarily within existing City easements and right-of-way (ROW). The Central/Southern System is proposed to be constructed in nine phases. Refer to Figure 6-6 for a map of the phasing for the Central/Southern System Service Area.

- Phase 1 includes a 14.5-MGD pump station constructed at the Village Creek WWTP, 5.8 miles of 36-inch transmission main along Randol Mill Road, and a 10-inch pipeline to the Woodhaven Golf Course.

- Phase 2 includes a 0.5-mile long, 30-inch diameter extension of the transmission main along Randol Mill Road, and a 10-inch pipeline to the Meadowbrook Golf Course.

- Phase 3 includes the remaining 4.8 miles of 30-inch transmission main along 1st Street and Beach/Mitchell Street, and a 16-inch pipeline to Cobb Park along Berry Street.

- Phase 4 includes a 0.3-mile long, 16-inch transmission main along Vickery Blvd., and a 10-inch pipeline to provide reclaimed water to Gateway Park.

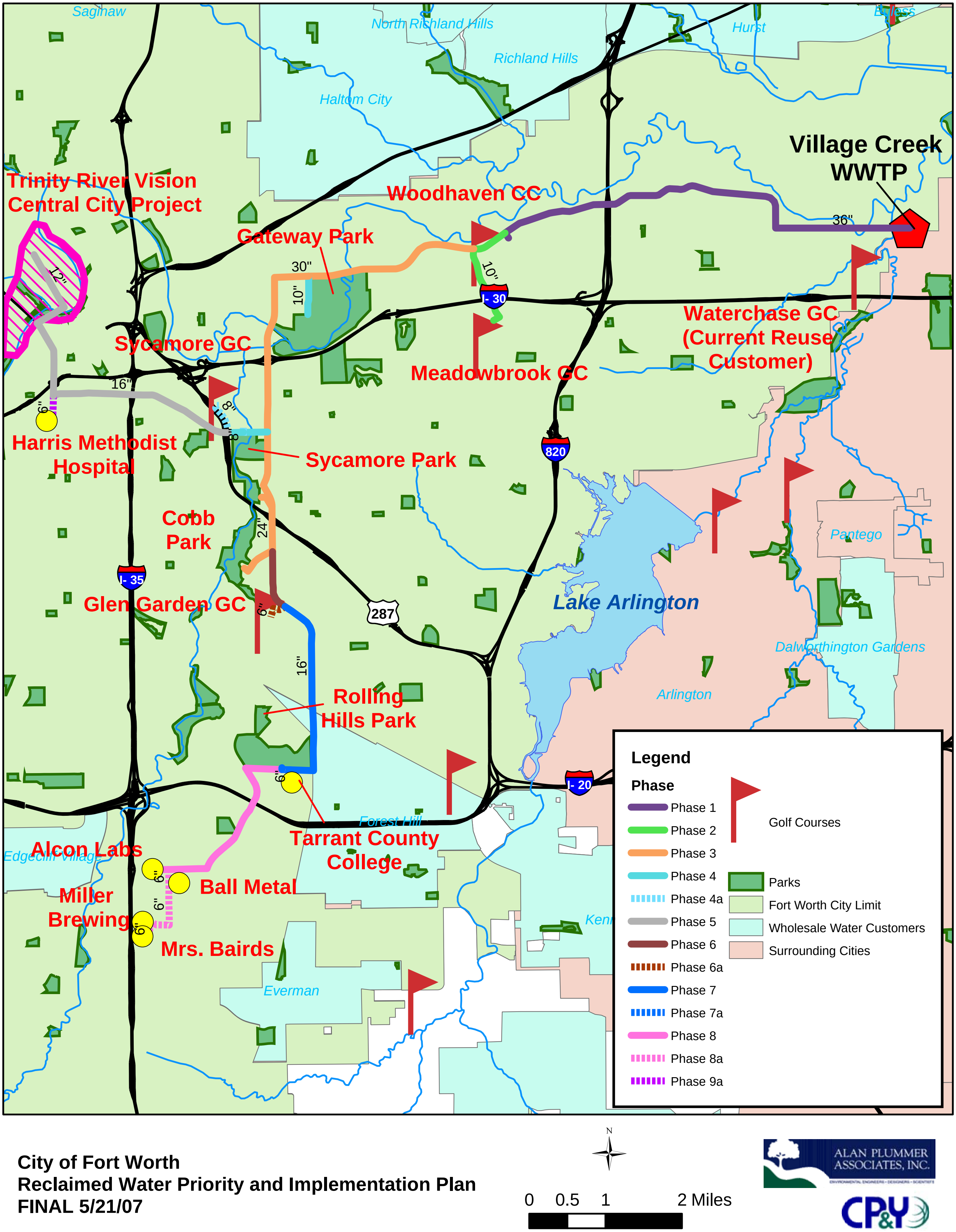
    - Phase 4A includes 8-inch pipelines, to be constructed by others, to distribute reclaimed water to Sycamore Park and the Sycamore Golf Course.

- Phase 5 includes construction of a 2.4-mile long, 16-inch transmission main along Vickery Blvd, and a 12-inch pipeline along Henderson Street and Main Street to provide reclaimed water to the Trinity River Vision project corridor. A 2-MG ground storage tank and 7.5-MGD booster pump station will be constructed at the Trinity River Vision project location. Construction of a ground storage tank will allow for a decreased pumping and pipeline capacity from VCWWTP. The savings in reduced pipeline and pumping costs was determined to more than compensate for the additional cost of a ground storage tank and booster pump station.

- Phase 6 includes a 0.8-mile long extension of the 16-inch transmission main along Mitchell Street.

    - Phase 6A, to be constructed by the Glen Garden Golf Course, includes a 6-inch pipeline to supply reclaimed water to the Glen Garden Golf Course.

Figure 6-6
Central/Southern Alternative (Alt. CS2) Phasing



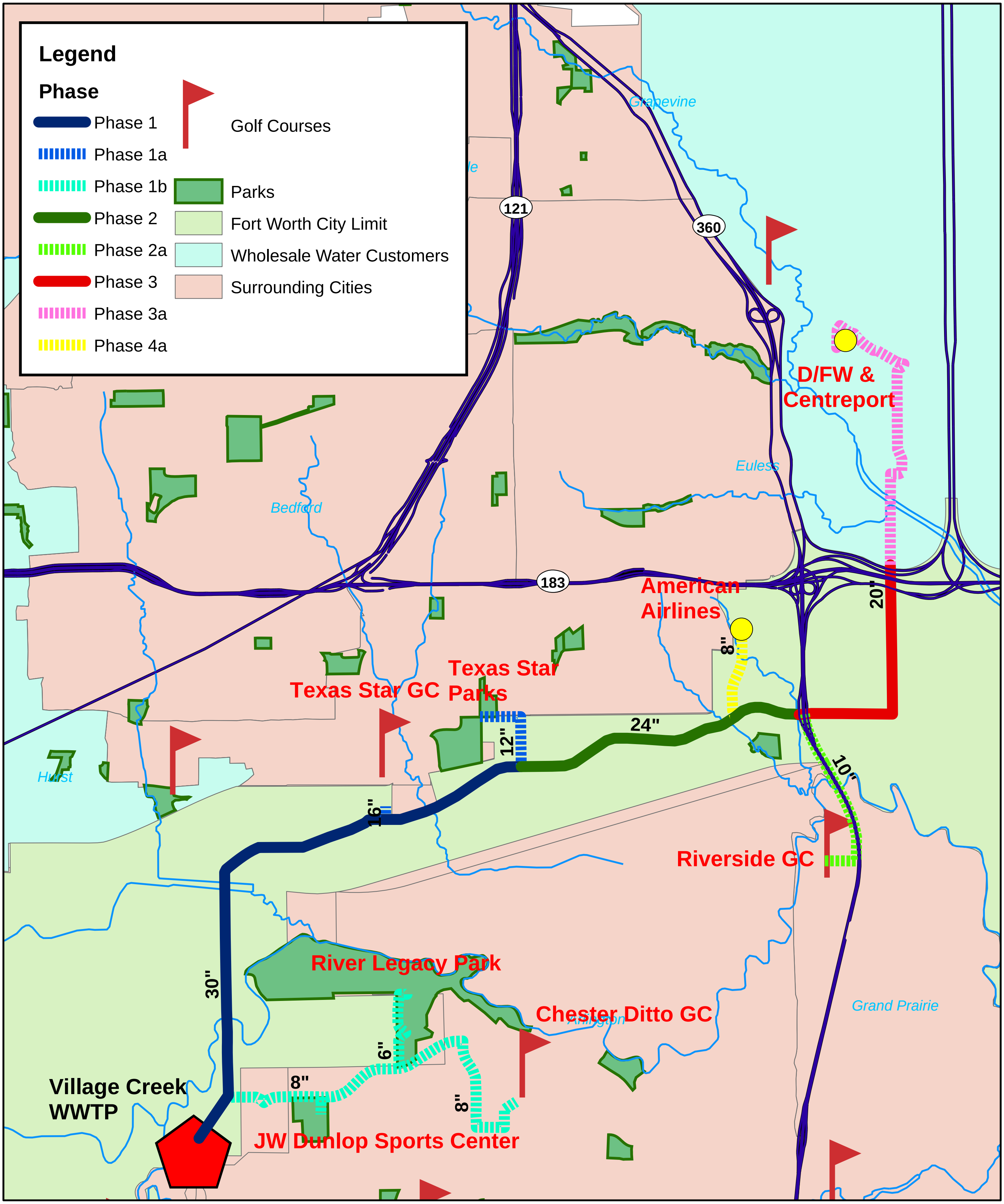
- Phase 7 includes a 16-inch pipeline along Mitchell and Wichita Streets, and construction of a 7-MGD booster pump station near Rolling Hills Park. A 0.1-mile long, 20-inch transmission main will then extend from the booster pump station towards the west with a short 16-inch pipeline to serve Rolling Hills Park.
    - Phase 7A, to be constructed by Tarrant County College (TCC), includes a 6-inch pipeline to supply Tarrant County College on E. Seminary Dr.
- Phase 8 includes 2.08 miles of 16-inch transmission main along Campus Drive to Alcon Laboratories.
    - Phase 8A, to be constructed by others, includes 6-inch pipelines to supply reclaimed water to Ball Metal Container Corporation, Miller Brewery, and Mrs. Baird's Bakery.
- Phase 9A, to be constructed by Harris Methodist Hospital, is a 6-inch pipeline from the Phase 5 pipeline to the Harris Methodist Hospital on Pennsylvania Road.

6.5.2 Eastern System Service Area

To take advantage of an existing pump station and storage tank at the Village Creek WWTP, the Eastern System was developed as two separate systems. The City of Arlington would be on a separate pipeline system from the remaining customers, and would be supplied using an existing 4-MGD pump station at Village Creek WWTP. The remaining customers would be supplied using a second transmission main and pump station. The Eastern System is proposed to be constructed in four phases. Refer to Figure 6-7 for a map of the Eastern System Service Area.

- Phase 1 includes a 14-MGD pump station constructed at the Village Creek WWTP, and 2.1 miles of 30-inch transmission main north along Greenbelt Road and east along Trinity Blvd. Phase 1 also includes two sub-phases, 1A and 1B, to be constructed by the Cities of Arlington and Euless.
    - Phase 1A includes 16-inch and 12-inch pipelines, constructed by the City of Euless, to convey reclaimed water from the Phase 1 pipeline to the Texas Star, Softball World, and the Texas Star Golf Course.
    - Phase 1B includes 8-inch and 6-inch pipelines, constructed by the City of Arlington, to convey reclaimed water from the Village Creek WWTP to the J.W. Dunlop Sports Center, River Legacy Park, and Chester Ditto Golf Course.
- Phase 2 includes 1.8 miles of 24-inch, and 0.8 miles of 20-inch, transmission main to Grand Prairie along Trinity Rd.
    - Phase 2A is a 10-inch pipeline, constructed by the City of Grand Prairie to supply reclaimed water to the Riverside Golf Course on Hwy 360.

Figure 6-7
Eastern Alternative Phasing



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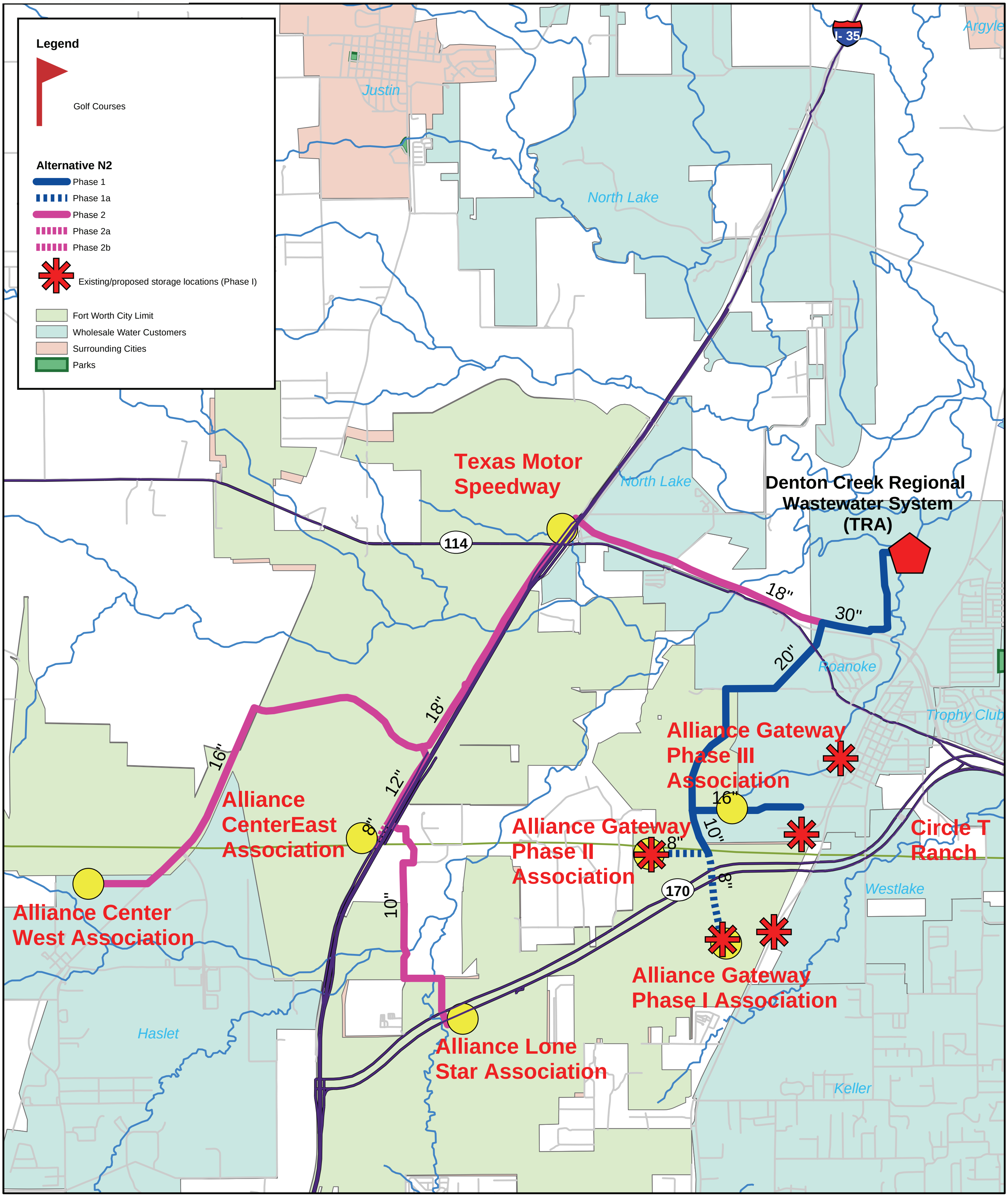
- Phase 3 includes a 20-inch pipeline to the D/FW International Airport.
    - Phase 3A is a 20-inch pipeline, constructed by the D/FW International Airport, from the Phase 3 pipeline to Trigg Lake and along S. Airfield Drive to the Bear Creek Golf Course.
- Phase 4A, to be constructed by American Airlines, includes an 8-inch pipeline to supply reclaimed water to American Airlines on American Blvd. from the Phase 2 pipeline.

6.5.3 Northern System Service Area

For this service area, the screening-level evaluation of alternatives determined that it is more cost effective to purchase reclaimed water from the TRA DCRWS than to construct a WRC. A description of the Northern System is presented below. Refer to Figure 6-8 for a map of the Northern System Service Area.

- Phase 1 includes construction of an 11-MGD pump station and a 0.5-MGD storage tank at the DCRWS facility, and the following pipelines to serve the Alliance Gateway Associations and the Circle T Ranch:
    - A 1.4-mile long, 30-inch transmission main from the DCRWS to SH-114;
    - A 2.3-mile long, 20-inch transmission main along future roadways from SH-114 to Henrietta Creek Road;
    - A 1.2-mile long, 16-inch transmission main constructed along Independence Parkway to the Alliance Gateway Phase 1 Association;
    - A 16-inch pipeline to supply Alliance Gateway Phase 3 Association and Circle T Ranch;
    - A 10-inch pipeline to supply the Alliance Gateway Phase 1 and Phase 2 Associations; and
    - Phase 1a includes 8-inch pipelines to supply Alliance Gateway Phase 1 and 2 Associations.
- Phase 2 includes construction of a 4.9-mile long, 18-inch transmission main along SH-114 and IH-35W to supply reclaimed water to the Alliance Lone Star and Alliance Center Associations, as well as to the Texas Motor Speedway. The 18-inch transmission main on SH-114 and IH-35W distributes water by:
    - Construction of a 4.9-mile long, 18-inch transmission main along SH-114 and IH-35W;
    - Construction of a 16-inch pipeline along Eagle Parkway and FM Road 158 to the Alliance Center West Association;

Figure 6-8
Northern System Alternative Phasing



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- Construction of a 12-inch pipeline along IH-35W to the Alliance Center East Association; and
- Construction of a 10-inch pipeline along Old Denton Road to supply reclaimed water to the Alliance Lone Star Association on SH-170.

Phase 2 also includes two sub-phases, to be constructed by the customers:

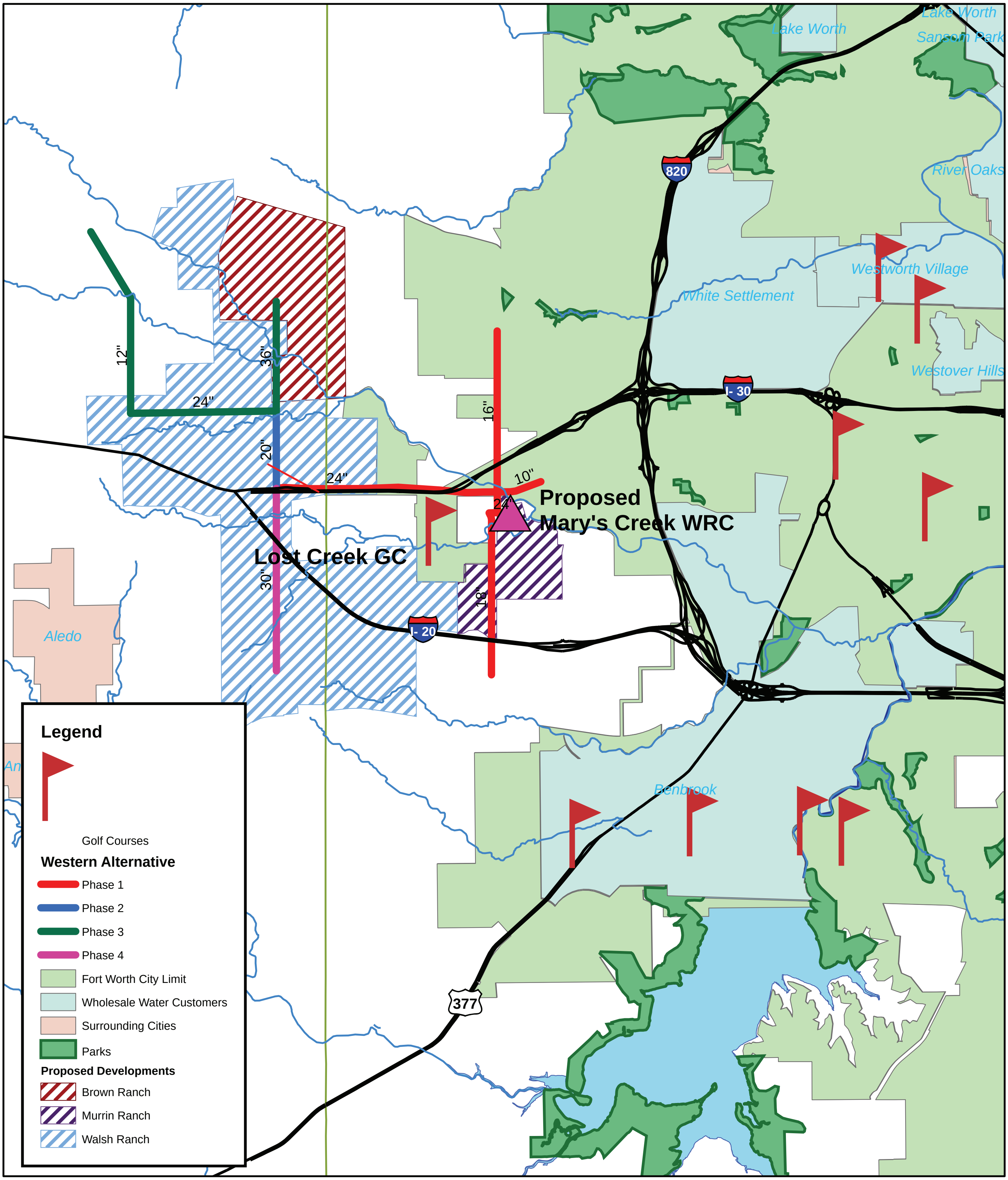
- Phase 2A includes a 6-inch pipeline to supply reclaimed water to the Texas Motor Speedway from IH-35W.
- Phase 2B includes an 8-inch pipeline to supply reclaimed water to the Alliance Center East Association from IH-35W.

6.5.4 Western System Service Area

As discussed in Section 6.4, due to the long distance between the Village Creek WWTP and the Western System Service Area, a new WRC is proposed to be constructed in the Mary's Creek Basin to serve the Western System. Construction of the Western System has been split into six phases. Refer to Figure 6-9 for a map of the Western System Service Area.

- Phase 1 includes construction of an 18.5-MGD pump station and a 2.5-MG storage tank at the proposed site for the Mary's Creek WRC. The Mary's Creek Basin area is still an undeveloped area; thus sufficient wastewater flows do not exist to supply the potential reclaimed water customers. Therefore, construction of the WRC has been delayed and initially, water would be supplied from a Tarrant Regional Water District (TRWD) raw water pipeline . The existing TRWD raw water pipeline is located adjacent to, and east of, the proposed WRC site. Raw water (and following Phase 5, reclaimed water) will then be distributed to potential customers nearest the proposed WRC site through the following:
    - A 0.3-mile long, 30-inch transmission main from the proposed WRC site to Camp Bowie Blvd.;
    - A 10-inch pipeline to supply reclaimed water to potential customers to the east along Camp Bowie Blvd.;
    - A 16-inch pipeline to supply reclaimed water to potential customers immediately north of the proposed WRC site;
    - An 18-inch pipeline to supply reclaimed water to potential customers immediately south of the proposed WRC site; and
    - A 2.8-mile long, 24-inch transmission main to supply reclaimed water to potential customers immediately west of the proposed WRC along Camp Bowie Blvd. and IH-30.
- Phase 2 includes constructing a 21-MGD booster pump station (BPS1) and a 2-MG storage tank at the end of the Phase 1 24-inch pipeline on IH-30, and a 1.0-mile long, 20-inch pipeline to deliver reclaimed water to potential customers immediately north.

Figure 6-9
Western System Alternative Phasing



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- Phase 3 includes construction of a 30-MGD booster pump station (BPS2) and a 4.0-MG storage tank at the end of the Phase 2 pipeline, and the following pipelines:
    - A 1.2-mile long, 36-inch pipeline to the north from BPS2; and
    - A 2.0-mile long, 24-inch pipeline to the west from BPS2, and then a 2.2-mile long, 12-inch pipeline extending to the north
- Phase 4 includes construction of a 2.1-mile long, 30-inch pipeline from BPS1 to potential customers in the south.
- Phase 5 includes construction of the first phase of the proposed WRC to supply 5 MGD of reclaimed water. The TRWD raw water pipeline will still be used to provide additional water as the Mary's Creek Basin area continues to develop.

Phase 6 includes construction of the second phase of the proposed WRC to expand its capacity to a total of 10 MGD. Once completed, raw water from the TRWD pipeline will no longer be needed.

Figure 6-10 shows all of the proposed Fort Worth reclaimed water projects (see insert).

Figure 6-10
City of Fort Worth
Reclaimed Water Project Recommended Alternatives
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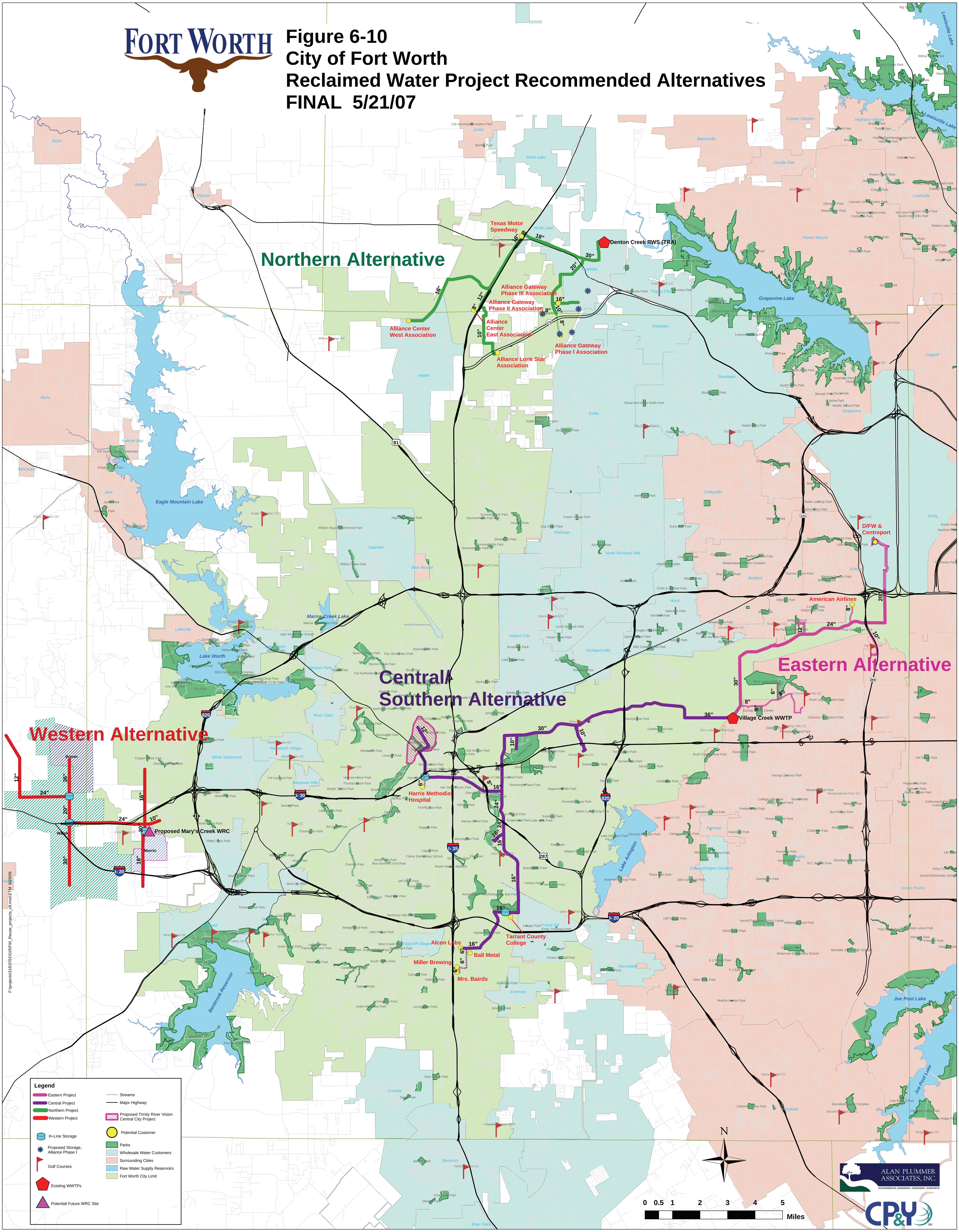

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CHAPTER 7: PROJECT FEASIBLITY EVALUATION

7.1 Introduction

This chapter presents a summary of the feasibility evaluation for the conceptual projects in each service area recommended for further study, based on the screening-level analysis discussed in Chapter 6. The feasibility evaluation includes an assessment of probable construction and operation and maintenance costs for each project and the system as a whole, an evaluation of potential benefits of the reclaimed water system, a review of potential financing strategies and funding opportunities, and development of a recommended initial rate structure for the City of Fort Worth reclaimed water system. In addition, this chapter includes a discussion of administrative, regulatory and public relations issues that may impact project feasibility.

7.2 Opinion of Probable Costs

The opinion of probable costs for each of the service area alternatives was presented in Chapter 6. A summary of costs for the recommended alternatives is provided in Table 7-1. Detailed cost breakdowns for each alternative are provided in Appendix E. .A memorandum defining the assumptions used to develop these costs is provided in Appendix F. The values shown in Table 7-1 reflect the estimated cost to construct and operate each project to serve the projected demands defined in Chapter 6. Credit for benefits is applied to these costs in Section 7.4. It should be noted that, for those systems that receive treated effluent from the VCWWTP, no operational cost for treatment of the wastewater was included. This cost was attributed to the wastewater system since this treatment would have to occur regardless of whether a reclaimed water system is developed. Based on initial discussions with the Trinity River Authority (TRA), it was assumed that treated effluent from DCRWS could be purchased from TRA at a cost of $0.25/1000 gallons. In addition, treatment costs for the Mary's Creek WRC were also attributed to the wastewater system since treatment at this facility would reduce the amount of water treated at VCWWTP. However, due to anticipated higher energy costs for MBR treatment, some additional operational costs were attributed to the reclaimed water system for the Mary's Creek WRC.

Table 7-1: Summary of Costs, Recommended Alternatives- Without Benefits and Without Cost of Western System WRC

Alt.	Service Area	Annual Avg. Demand	Peak System Demand	Capital Cost[1]	Debt Service[2]	O&M	Energy	Purchase Cost[3]	Overall Unit Cost[4]
		MGD	MGD	$MM	$/yr	$/yr	$/yr	$/1000G	$/1000G
E1	Eastern	2.77	14.69	$15.52	$1,298,000	$215,000	$95,000	$0.00	$0.82
N2	Northern	4.19	11.07	$17.09	$1,430,000	$188,000	$103,000	$0.25	$0.81
W1	Western	3.79	18.12	$39.95	$3,343,000	$455,000	$772,000	$0.00	$1.85
CS2	Central/ Southern	2.18	14.47	$40.75	$3,410,000	$412,000	$135,000	$0.00	$2.40
Total, All Projects		12.93	58.35	$113.30	$9,481,000	$1,270,000	$1,105,000	$0.08	$1.39

[1] Net Present Value of capital cost after accounting for interest during construction.
[2]Assumes a capital recovery period of 20 years and an annual interest rate of 5.5%
[3]Purchase cost applies to water purchased from TRA's DCRWS for the Northern System
[4]Assumes 50-year project life

7.3 Benefits of Reclaimed Water Projects

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

7.3.1 Reduction of Potable Water Demand

One leading driver for the implementation of reuse projects is the impact reuse has on potable water demand. Replacing potable water with reuse water for irrigation of crops, parks, golf courses, and other green spaces results in a savings of potable water for more critical uses. This is particularly relevant in states such as Texas, when summer usage can be significantly greater than that of winter consumption due to irrigation demands. Water reuse has also been identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature. Demonstrated efforts to implement these best management practices are critical to the development of other water supplies. Therefore, in addition to other water conservation efforts, development of a water reuse program will provide for efficient use of the City's water resources and will assist TRWD in securing necessary future water supplies to meet anticipated growth within the City of Fort Worth and surrounding areas. Figure 7-1 shows estimates of the per capita reduction in potable demand that could result from development of the reclaimed water program.

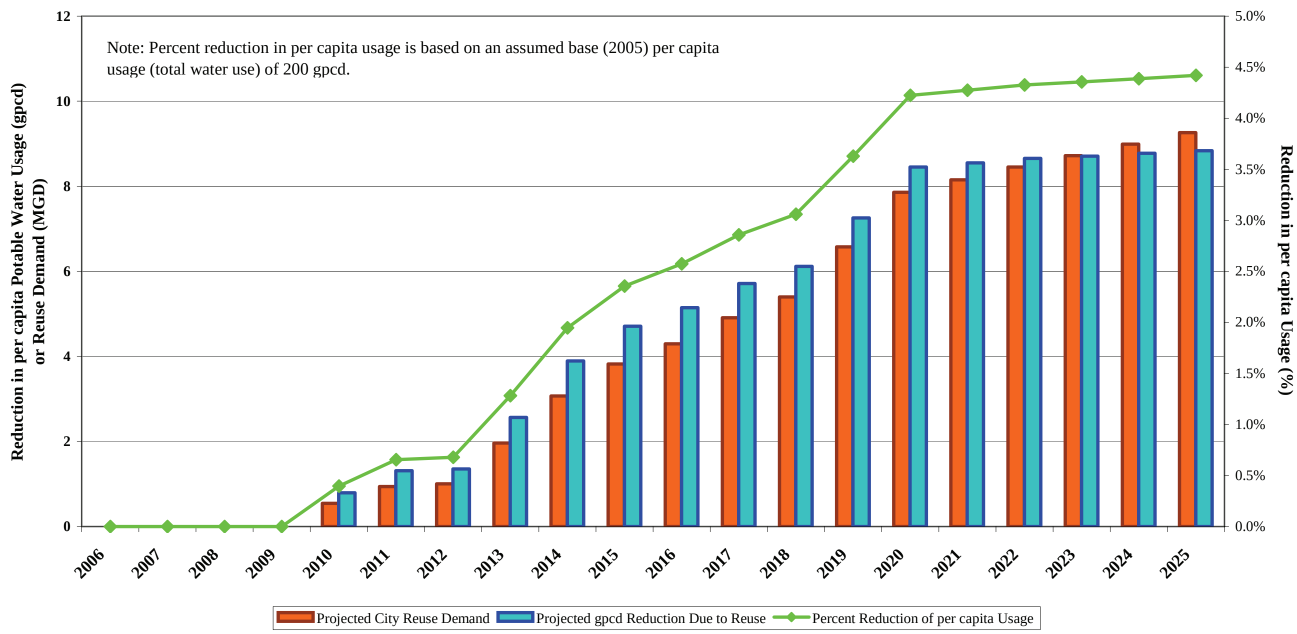

Figure 7-1: Projected Reduction in Per Capita Potable Water Usage Due to Reuse

By year 2025, the projected reclaimed water demand is anticipated to contribute to a reduction of about 8.8 gpcd in potable water usage, which is approximately 4.4% of the current assumed per capita usage of 200 gpcd.

7.3.2 Reclaimed Water as a Water Supply Source

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

7.3.3 Reduction in Load to Receiving Streams

By diverting wastewater effluent prior to discharge and supplying nonpotable demands, nutrient and BOD loads to receiving streams are reduced. This reduction in loading can have permitting implications for dischargers, who may be able to defer future permit requirements that are more stringent. This impact is particularly important in light of the EPA's current effort to begin incorporating nutrient criteria into surface water quality standards. Although the TCEQ is still exploring different strategies for the development of nutrient criteria, it is likely that these criteria will be established within the next several years. For irrigation uses, elevated nutrient levels are typically desirable and can decrease the amount of required fertilization. Therefore, even with more stringent requirements for receiving streams, it is likely that nutrient reduction would not be necessary for reclaimed water primarily used for irrigation, potentially resulting in reduced treatment costs in the future.

7.3.4 Deferral of Water and Wastewater Treatment Plant Expansions

The reduction in potable water demand has implications for the potential improvements needed at Fort Worth water treatment plants. The North Holly Water Treatment Plant (WTP) has no space for further expansion and space at the South Holly WTP is limited. A 35 MGD expansion for the Eagle Mountain WTP is planned to meet the growing demands of the northern Tarrant County region, but the 2005 Water Master Plan predicts that several more expansion projects or new facilities will be needed in the next 10 years. Figure 7-2 demonstrates the difference that reuse water projects can make by comparing treatment plant capacities with and without reclaimed water use.

Figure 7-2 shows the potable water demand by pressure plane through the planning year 2025. The required treatment capacity of Fort Worth WTPs, as determined by the 2005 Water Master Plan (MP) is denoted by the red line; the capacity needed with reuse projects is shown in green. As can be seen, there is a marked difference between the capacity required with and without the reclaimed water system. By the year 2025, this difference is close to 70 MGD. Any deferral of WTP improvements also results in the deferral of costs that would otherwise be incurred by the City of Fort Worth. Additionally, improvements needed for storage and pumping facilities, piping and other water distribution system facilities benefit from a reduced potable demand, particularly when this demand is reduced during peak usage periods. The quantitative benefit to the City of deferring the WTP improvements identified above was determined to be approximately $9.7 million in 2006 dollars and is accounted for when computing the net cost of reclaimed water in Section 7.4. Details of this benefit deferral calculation are provided in Appendix G. Due to the difficulty of identifying specific facility deferrals within the water distribution system, and their anticipated relatively low value, no quantitative evaluation of deferring these facilities was performed.

Wastewater plants can also benefit from water reuse projects if the latter involves the construction of a satellite water recycling plant. Typically, recycling plants intercept a portion of the wastewater flow but return the solids to the collection system. In this case, no solids handling facilities or conveyance is necessary on-site, thereby reducing the initial capital expenditure for the water recycling center. Downstream, the wastewater flow to the primary WWTP (e.g. Village Creek WWTP) is reduced and the expansion of treatment units can be deferred. No quantitative evaluation of these deferrals was performed. However, as discussed earlier, wastewater treatment costs were not attributed to the reclaimed water system.

7.3.5 Deferral of Collection System Improvements

If the reuse project involves a satellite recycling center that diverts a portion of flow out of the collection system, system expansion may not be immediately necessary. As discussed in Section 2.3, in the Wastewater Collection System Master Plan, one of the preferred alternatives was the construction of a satellite plant (the Fossil Creek WWTP) for precisely this reason. The plant proposed in the Master Plan would be large enough to eliminate the need to expand the collection system and the treatment units at the VCWWTP. The proposed Mary's Creek Water Recycling Center for the Western System alternative will provide a similar benefit, although significant deferral of collection system improvements will not be realized immediately due to relatively low initial flows. No quantitative evaluation of this benefit was performed.

7.3.6 Reduction in Raw Water Requirements and Deferral of Reservoir Construction

One of the primary benefits of direct, nonpotable reuse projects is the reduction of overall raw water supply that is necessary to meet future demands. TRWD currently pumps water from East Texas out of the Richland Chambers and Cedar Creek Reservoirs. However, as discussed above, reclaimed water provides a "new" water supply or source to meet the growing demands of Fort Worth customers. By meeting the needs of water users, reuse water defers the need for the acquisition of supplies elsewhere. While the Regional Water Plan referenced several options that may become necessary to augment raw water supply for TRWD, such as construction of the Marvin Nichols Reservoir or a pipeline from Toledo Bend Reservoir, reuse projects would reduce the volume of water that would need to be imported or acquired in the future. In addition, the operational costs of pumping raw water from East Texas or from other future water sources further away can be significant and are passed on to TRWD customers, including the City of Fort Worth. The deferral of future reservoir construction or other strategies will reduce costs for TRWD as a whole and also benefit the City indirectly. Consequently, reuse results in the deferral of both capital expenditures and operational costs for raw water conveyance.

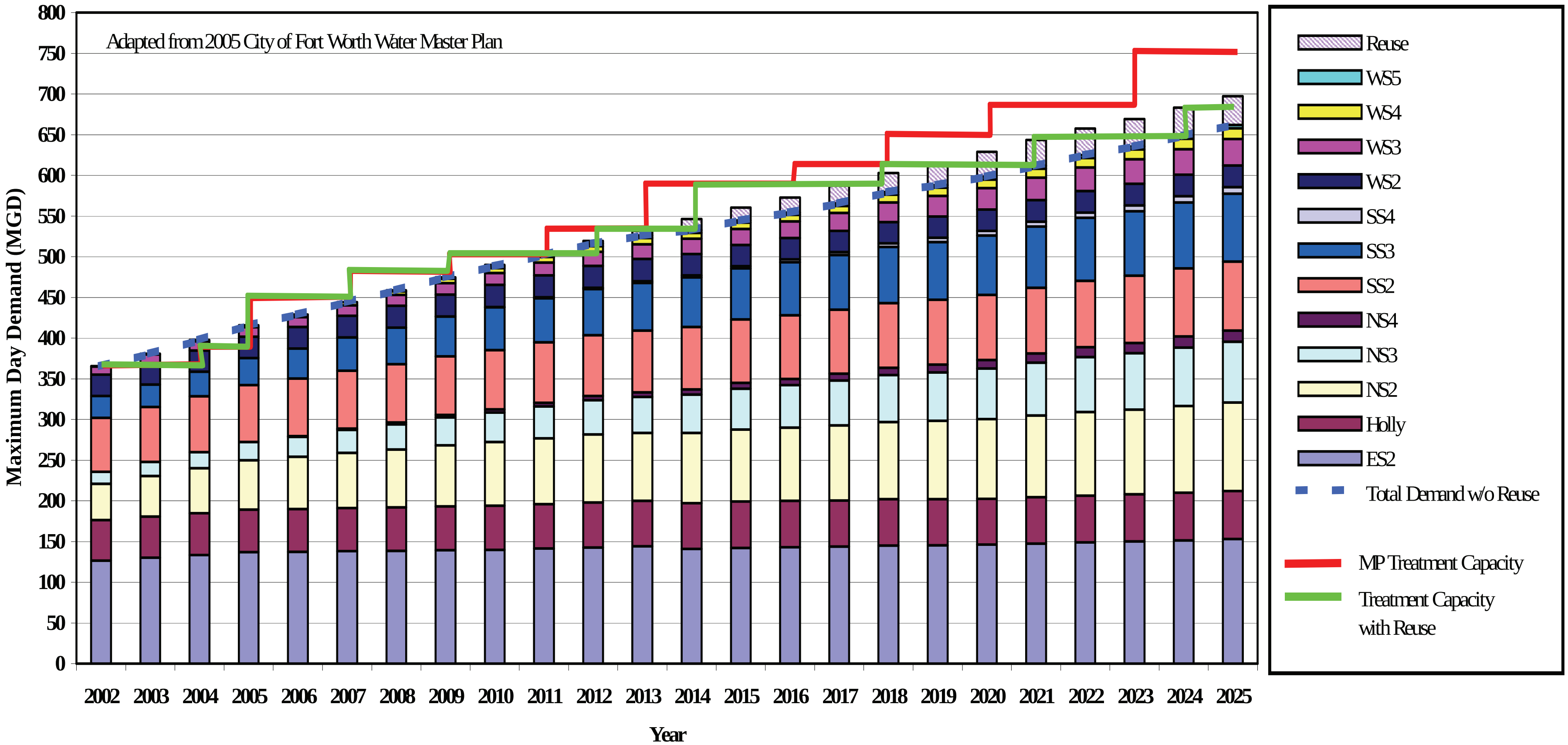

Figure 7-2: City of Fort Worth Projected Water Treatment Needs With and Without Reuse Projects

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A direct benefit to the City resulting from reduced raw water usage is the cost of the raw water. Currently the City pays TRWD $0.65/1000 gallons for raw water. Any raw water usage that is offset by reclaimed water usage by the City or its wholesale water customers can be attributed as a direct benefit of the reclaimed water system and is accounted for in computing the net cost of reclaimed water in the following section.

7.4 Net Cost of Reclaimed Water

As discussed in the previous section, a number of benefits can be attributed to the development of reclaimed water systems. Many of these benefits do not have a direct monetary value and are difficult to quantify in terms of a cost savings to the City. However, as referenced above, deferral of WTP facility expansions and avoidance of raw water costs were two benefits that were directly quantifiable and can be credited to the cost of the reclaimed water system. Table 7-2 provides a summary of the net opinion of probable cost with these benefits credited. With benefits, the system-wide cost of the reclaimed water is estimated to be approximately $0.73/1000 gallons based on full utilization of the projected demands.

Table 7-2: Summary of Costs, Recommended Alternatives, Including Benefits

Alt.	Service Area	Annual Avg. Demand	Peak System Demand	Identified Capital Benefits[1]	Capital Cost[2]
		MGD	MGD	$MM	$MM
E1	Eastern	2.77	14.69	$2.08	$13.44
N2	Northern	4.19	11.07	$3.14	$13.94
W1	Western	3.79	18.12	$2.84	$37.10
CS2	Central/ Southern	2.179	14.47	$1.63	$39.12
Total, All Projects		12.93	58.35	$9.70	$103.61

Alt.	Service Area	Debt Service[3]	O&M	Energy	Purchase Cost[4]	Operational Benefits[5]	Overall Unit Cost[6]
		$/yr	$/yr	$/yr	$/1000G	$/1000G	$/1000G
E1	Eastern	$1,125,000	$215,000	$95,000	N/A	$0.37	$0.39
N2	Northern	$1,167,000	$188,000	$103,000	$0.25	$0.65	$0.10
W1	Western	$3,105,000	$455,000	$772,000	N/A	$0.65	$1.13
CS2	Central/ Southern	$3,273,000	$412,000	$135,000	N/A	$0.65	$1.68
Total, All Projects		$8,670,000	$1,270,000	$1,105,000	$0.08	$0.59	$0.73

[1]Includes credit for deferral of WTP expansions (see Section 7.3.4)- benefit distributed based on annual average demand of each project.
[2] Net Present Value of capital cost after accounting for interest during construction.
[3]Assumes a capital recovery period of 20 years and an annual interest rate of 5.5%.
[4]Purchase cost applies to water purchased from TRA's DCRWS for the Northern System.
[5]Includes credit for purchase of raw water. On Eastern system, only water used by wholesale customers is credited.
[6]Assumes 50-year project life.

7.4.1 Potential Impact of Capital Contributions

A sensitivity analysis was performed to evaluate the impact that capital contributions (from developers or other entities) could have on the net cost of reclaimed water. The net cost of reclaimed water for each project and for all projects as a whole was computed assuming capital contributions ranging from 5% to 30% of the total capital cost of the projects. The impact on the overall unit water cost (50-year) and the pre-amortized unit cost (prior to retirement of the debt) was evaluated and is summarized in Figure 7-3.

7.5 Financing Strategies and Funding Opportunities

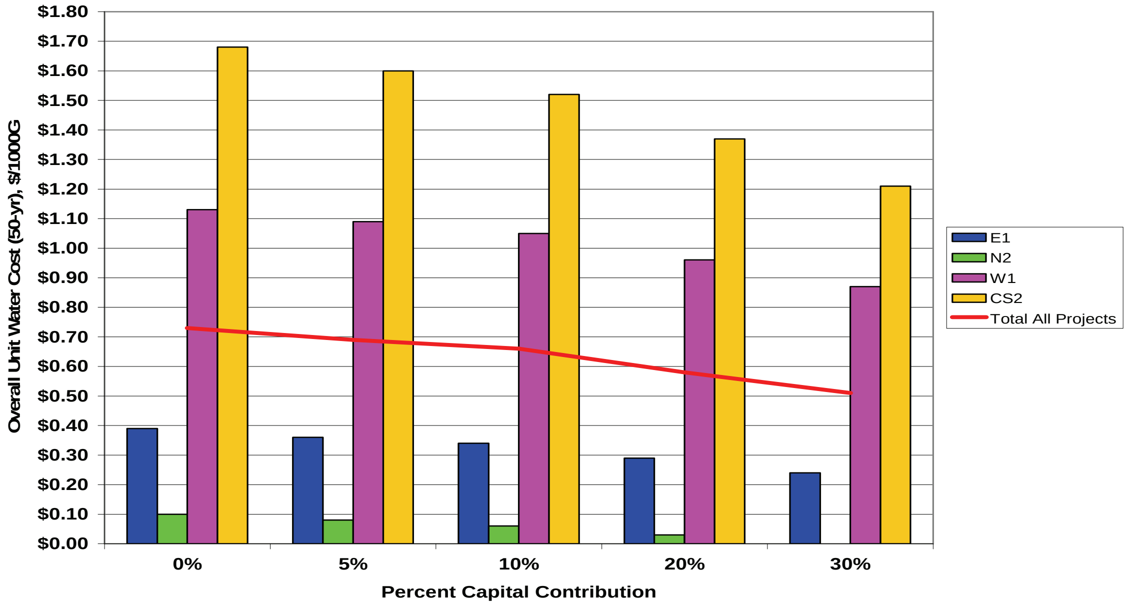
As a consequence of the increased appreciation of the benefits of reclaimed water, there are several funding opportunities being made available to cities and utilities who seek to implement reuse programs. A number of existing water reuse programs that have been implemented around the country were researched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

7.5.1 Capital Cost Financing

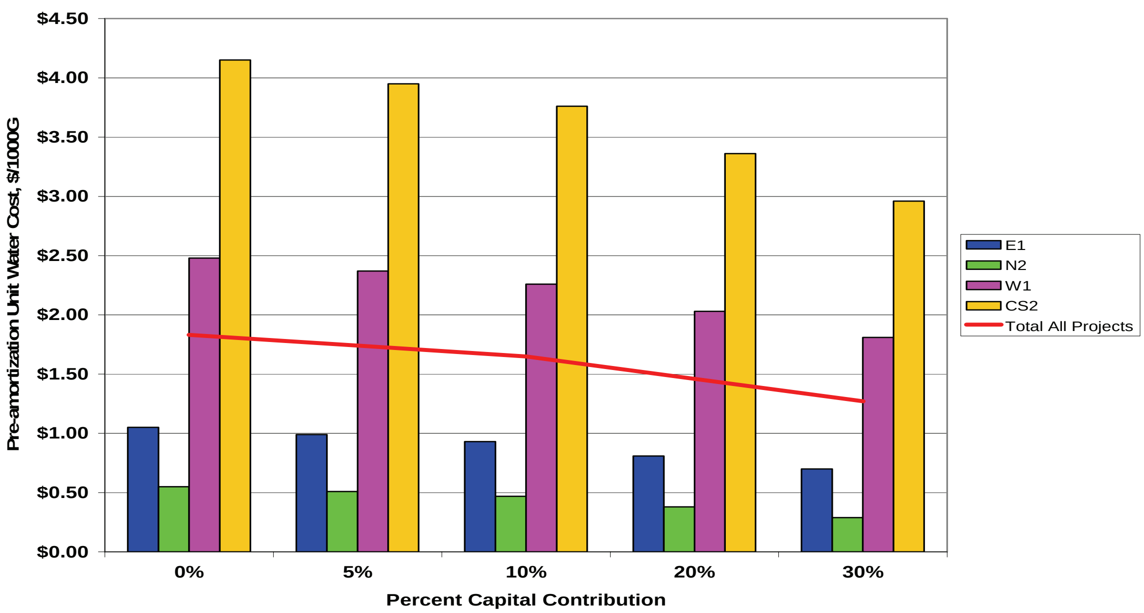
In most of the case studies evaluated, a combination of federal and state grants and loans funded the up-front capital expenditures. With these sorts of sources, eligibility requirements have to be met, and most of these programs explicitly state that funds cannot be employed for any O&M needs. Some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

7.5.1.1 Federal Funding Programs

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



(a) Overall Unit Cost



(b) Pre-amortized Unit Cost

Figure 7-3: Impact of Capital Contributions on Unit Cost of Reclaimed Water

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

7.5.1.2 State Funding Programs

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

Another program available through the TWDB is the State Participation Program, which enables the TWDB to assumed a temporary ownership interest in regional projects when the local sponsors are unable to assume debt for the optimally sized facility. While this program has typically been used for water system construction, the TWDB has indicated that it can also be applied to reuse projects if excess capacity is provided in the reuse facilities to meet anticipated future demands. The goal of this program is to allow for the “right sizing” of projects in consideration of future growth. For new water supply projects, the TWDB will fund up to 80% of the costs and for other projects up to 50% of the costs. Only excess capacity can be funded through this program. A sample breakdown of annual payments with and without a state participation loan is provided in Appendix H for a fictitious $10 million project.

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

7.5.2 Debt Repayment and Operations and Maintenance Financing

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

7.5.3 Preliminary Reclaimed Water Rates for the City of Fort Worth

Several meetings were held with City staff to discuss approaches to establishing a rate for users of reclaimed water. During these meetings, the following guidelines were established:

- The reclaimed water rate should be low enough to be marketable and to attract new customers to the system;
- The reclaimed water rate should not be lower than the going cost of raw water (currently $0.65/1000 gallons) and should not be higher than the going rate for potable water (currently $2.37 - $4.01 per 1000 gallons depending on class and tier);
- The reclaimed water rate should be based on a cost-of-service evaluation of the entire reclaimed water system as a whole;
- City of Fort Worth retail and wholesale water customers (hereafter referred to as “in-system” customers) should pay a lower rate for reclaimed water than other “out-of-system” customers.
- Sales contracts with reclaimed water users should be formulated in a way that allows for modification of the rates annually, based on updates to the cost-of-service evaluation.

In order to determine the basis and range of rates being used in Texas and nationally, a review of reclaimed water rates was carried out and is summarized in Table 7-3. As can be seen, there is a wide range of rates nationally as well as a variety of methods for establishing a given rate. In Texas, reclaimed water rates for those cities that have relatively large established reclaimed water programs range between $0.86 - $1.20 per thousand gallons.

A water reuse rate study completed by the American Water Works Association in 2000 determined that, on average, reuse rates around the country were 69% of potable rates. These charges do not necessarily reflect the practice of purposely setting reuse rates relative to potable rates, however. In many instances, cost of production, capital expenditures, etc. that were a consequence of reclaimed water programs were taken into consideration. El Paso does set its rates as a percentage of potable water, but the utility also varies the percentage based on the level of reclaimed water treatment, so as to commensurately recover the cost (see “Comments” in Table 7-3).

Table 7-3: Summary of Reclaimed Water Rates for Selected Utilities

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

Based on the guidelines presented above, and the review of water rates presented in Table 7-3, the City staff recommended a preliminary initial reclaimed water rate of $0.75/1000 gallons for in-system customers. Based on a similar structure for water rates, staff also recommended that out-of-system rates be increased by 25% to a rate of 1.25 x $0.75 = $0.94/1000 gallons. This rate has not yet been approved by the City and, as discussed above, would be subject to modification based on future cost-of-service evaluations.

7.5.4 **Projected Payback Periods for Reclaimed Water Projects**

As a part of the feasibility evaluation, projected payback periods for each of the reclaimed water projects were evaluated, based on the project phasing defined in Chapter 6. The payback period was defined as the time elapsed between the initial capital investment in the project and the break-even point, i.e. when the total cumulative revenue from the project is equal to the total cumulative expenditures (including debt service and operation and maintenance costs). It should be noted that the estimated payback period is very sensitive to financing assumptions, such as interest rate and inflation. For this evaluation, the following assumptions were made:

- Capital Recovery Period = 20 years for City financing and 34 years for state participation financing
- Project Life = 50 years
- Annual interest rate = 5.5%

- Annual inflation rate = 4.0%
- Investment return rate = 5.0%
- Initial (2006) commodity charge for raw water = $0.65 per 1000 gallons
- Initial (2006) commodity charges for reclaimed water = $0.75 per 1000 gallons (in-system) and $0.94 per 1000 gallons (out-of-system)

In addition, it was assumed that the commodity charges for both raw water and reclaimed water increased at the annual inflation rate. For simplicity, all operation and maintenance costs (including energy) were also inflated at this rate.

Two financing options were evaluated. The first used a loan with equal annual debt service payments, based on the assumptions outlined above. The second assumed that the City would obtain state participation funding for 50% of each project from the TWDB (see Section 7.5.1.2). These two options were developed to illustrate the differences between each of these financing approaches. Note that the actual percentage of each project that could be financed through state participation depends on availability of funds and on how the TWDB defines existing and future capacity for reclaimed water projects. In addition, it should be emphasized that these examples are provided for comparative purposes only and are based on conceptual level costs and the simplified assumptions defined above. Actual financing conditions may vary significantly from those presented here.

Figure 7-4 summarizes the payback period for each service area, based on the evaluation of the two financing options. The payback period is defined as the number of years from the beginning of the project required to accumulate benefits and revenue to offset cumulative project costs. Following the payback period, the project has paid off accumulated debt and generates sufficient benefits and revenue to offset annual debt service payments and operations and maintenance costs. As mentioned above, this evaluation is very sensitive to the financial assumptions defined above. For example, if the commodity charges for reclaimed water and raw water increase at a slower rate than the rate of inflation, the payback period can increase significantly and may not ever be reached. Conversely, if the rates increase more rapidly than inflation, the payback period is reduced. For example, if the commodity charges increase at a rate of 5%, the payback period for all projects as a whole is reduced by approximately 5 years.

Figure 7-4 indicates that the projects for the Northern System Service Area and Eastern System Service Area have relatively short payback periods as compared to the projects in the Western and Central/Southern Service Areas. A graphical representation of the costs, benefits and payback period for all the projects as a whole, is provided in Figure 7-5. Figure 7-5 shows that, although the payback point does not vary greatly between the two financing options, the accumulated debt is significantly less with state participation (as indicated by the red line). Similar graphs for each individual alternative are provided in Appendix I.

As can be seen from Figure 7-5, the primary benefit of the state participation financing is to defer debt service payments early in the project when the customer base is not yet developed. This reduces the amount of cumulative debt incurred, but does not have a significant impact on the overall cost of the projects.

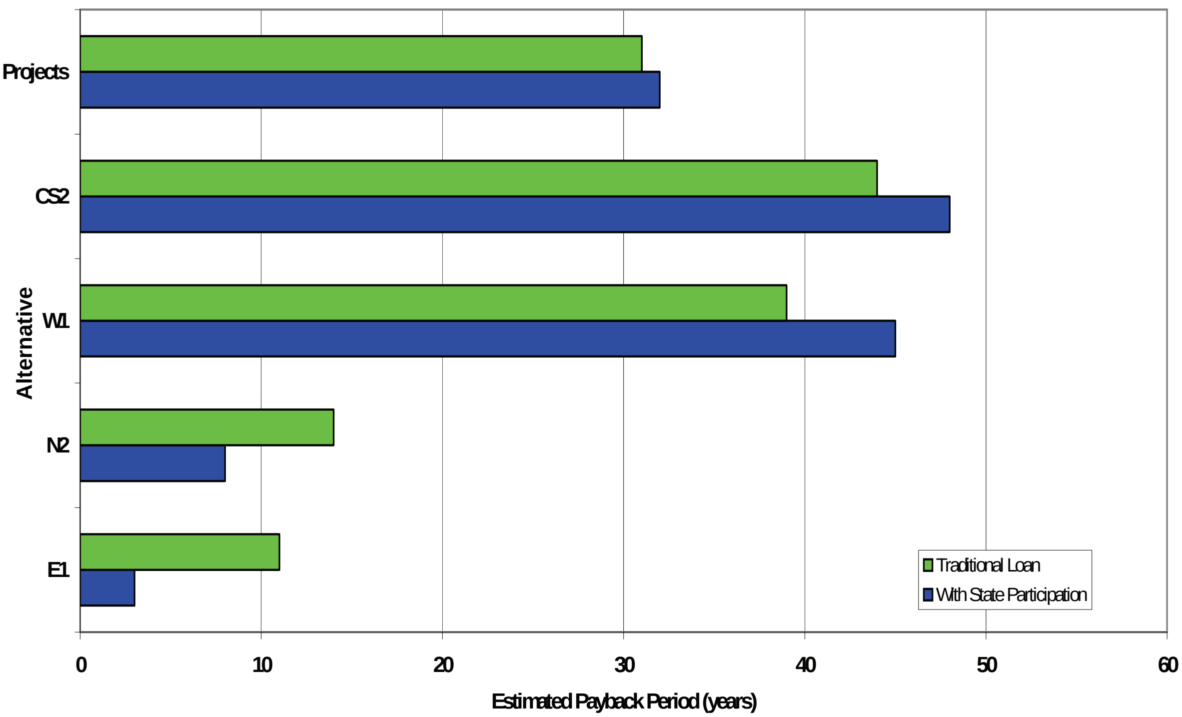
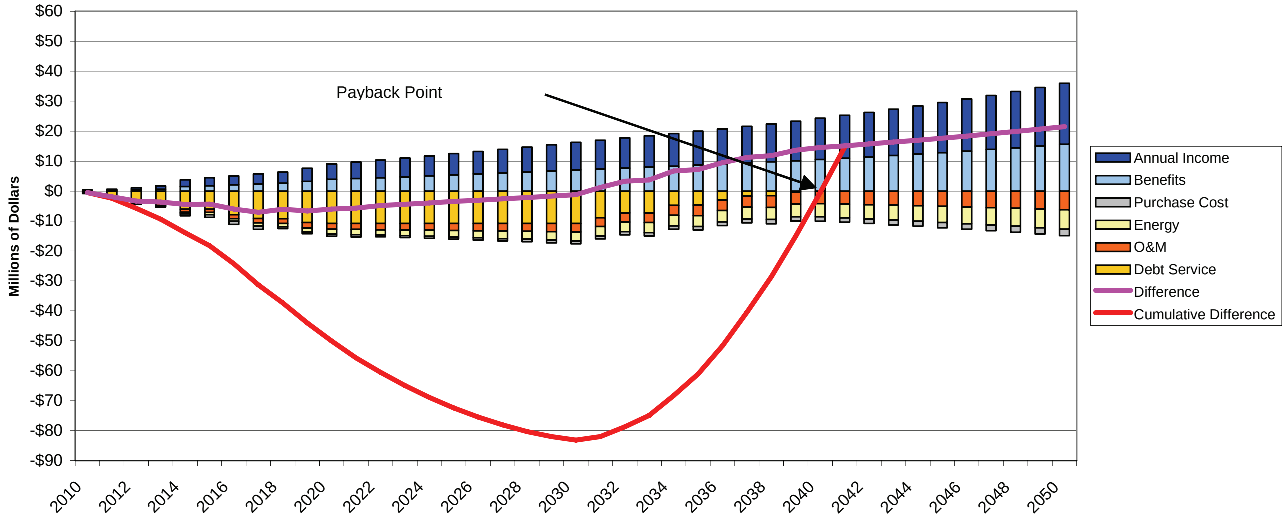


Figure 7-4: Summary of Payback Period for Reclaimed Water Projects

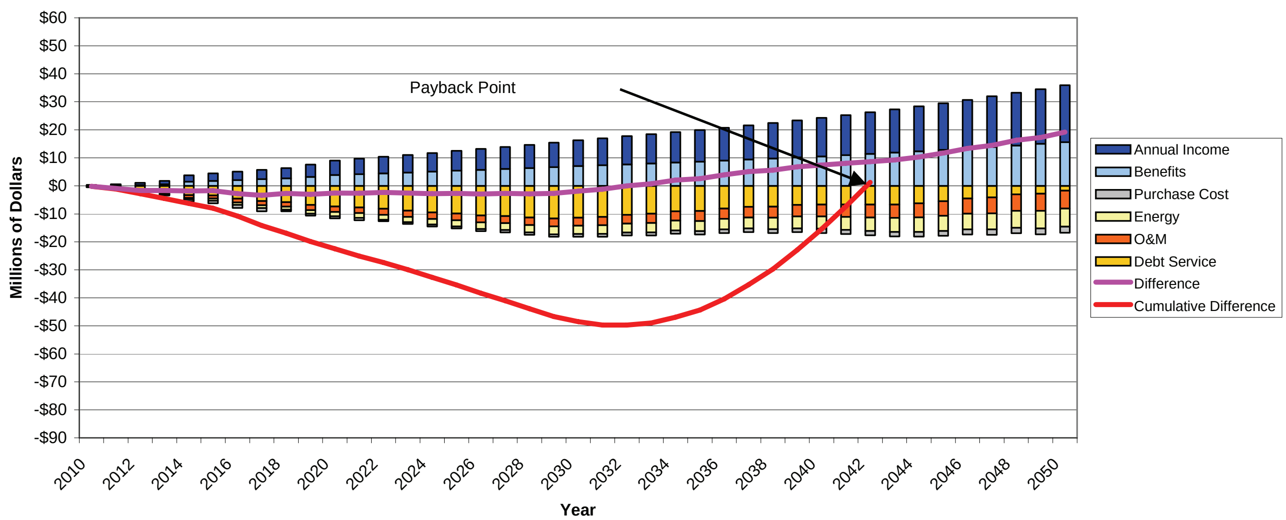
7.6 Feasibility Evaluation Summary

As presented in this chapter, reclaimed water projects provide a number of benefits, many of which are difficult to quantify in terms of a direct financial benefit. Based on the financial evaluation of the individual projects and the reclaimed water system as a whole (including all 4 recommended projects), the following conclusions can be made:

- The Northern and Eastern System projects are the most cost-effective and provide the greatest near-term benefits. These projects will serve customers that have expressed a serious interest in receiving reclaimed water as soon as facilities can be constructed.
- The Central/Southern and Western System projects require more initial cost support than the Northern and Eastern System projects.
- The Central/Southern System project is the most expensive on a unit cost basis. However, there is some potential to supply additional demands in this service area, for example within the proposed Central City Project, and to additional smaller irrigation customers along the route. The proposed facilities provide some additional capacity, particularly if users can be encouraged to provide on-site storage.



(a) Traditional Loan



(b) State Participation Financing

Figure 7-5: Traditional vs. State Participation Financing, System-wide

When evaluated as a system, the reclaimed water projects provide significant benefit to the City in terms of reduction in per capita potable water usage, achieving water conservation goals, and deferral of water and wastewater system facility expansions. Implementation of the reclaimed water system will demonstrate the City's commitment to efficient use of its water resources. This commitment is critical to the success of acquiring new water supply sources necessary to support future growth within the City of Fort Worth and in other communities within TRWD's service area.

Based on this evaluation, it is recommended that the City proceed with implementation of the reclaimed water system, including all four projects. The City should continue to explore alternative financing approaches, including federal or state grant or loan programs, and participation from customers and/or developers. It should be noted that the cost analysis performed here was based on the projected demands presented in Chapter 6. Experience with other established reclaimed water systems suggests that once facilities are in place, demand for reclaimed water often exceeds projected values. Although the "if we build it, they will come" strategy does not come without risk, most reclaimed water systems must, to some extent, rely on uncommitted future demands to justify initial implementation.

CHAPTER 8: PUBLIC INFORMATION PLAN

8.1 Introduction

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

8.2 Public Relations Issues Associated with Reclaimed Water Projects

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

8.3 Examples of Public Outreach Programs in Other Communities

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

8.3.1 Projects that Benefited from a Public Outreach Program

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

8.3.1.1 El Paso Water Utilities, Texas

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

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

8.3.1.2 Irvine Ranch Water District, California

The Irvine Ranch Water District (IRWD) was formed in 1961 to provide water and irrigation to a rapidly growing community. Two years after its inception, the IRWD made the decision to begin collecting and treating wastewater as well as producing reclaimed water. By 1967, this reclaimed water was being supplied to agricultural users to irrigate crops. As part of its aggressive water conservation program, the IRWD has since broadened its use of reclaimed water. Reclaimed water is now used on crops, golf courses, parks, school grounds, greenbelts, street medians, and freeway landscaping. Furthermore, it is supplied to local high-rise office buildings and individual homeowners for flushing toilets and is scheduled to be supplied to office towers and other buildings for similar use.

These highly successful, innovative projects have placed this community among the nation's water reuse leaders. Much of this success is a result of an aggressive public outreach program that is part of the IRWD's water conservation program. This outreach program includes: 1) a residential tour program, 2) an in-school education program, and 3) newsletters and brochures.

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

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

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

8.3.1.3 Orange County, California

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

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

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

8.3.1.4 Phoenix, Arizona

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

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

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

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

8.3.1.5 Pinellas County, Florida

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

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

8.3.1.6 Scottsdale, Arizona

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

8.3.1.7 St. Petersburg, Florida

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

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

8.3.1.8 Yelm, Washington

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

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

8.3.2 Projects that Suffered Due to Poor Public Outreach

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

8.3.2.1 Cape Coral, Florida

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

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

8.3.2.2 City of San Diego, California

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

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

Shortly after moving from the concept to the design phase, the City changed the project team from the Water Repurification project team to the Wastewater Department. This change may have sent a mixed message to the public and caused them to view the project as a wastewater disposal rather than as a water supply solution. As the project neared final approval, key election dates were ignored and final approval of the project by the City Council was scheduled concurrently with several competitive elections. Consequently, final approval was delayed until after these competitive elections. Misinformation generated by various political candidates running for office was not promptly addressed by members of the proposed project and resulted in the misinformation being perceived as the truth. Early education efforts and relationships with the media were not maintained and resulted in negative media coverage. Finally, early efforts to identify all interested stakeholders overlooked a group of residents that lived outside the City's jurisdiction. As a result, these residents, who had not received any mailings with accurate information, began to aggressively oppose the project at various public meetings. As a result of the collapse of the public information program and failure to include several key stakeholders, the San Diego project was defeated and delayed several years.

8.4 City of Fort Worth Reclaimed Water Priority and Implementation Plan Public Meetings

The City of Fort Worth has conducted three public meetings related to the Recycled Water Implementation Plan. The first public meeting was held early in the study and provided information about the project team and the scope of work to be performed. The second meeting was held following development of the initial project alternatives and provided information about proposed service areas and preliminary project costs. The third public meeting was held following submission of the draft report and presented a summary of the final recommended alternatives, feasibility evaluation and implementation plan. (FILL IN MORE AFTER THIS MEETING) A brief description of the topics discussed at each of these meetings and the public response is presented below.

Public Meeting No. 1- July 20, 2005

This meeting provided an overview of the study goals and objectives and summarized the specific project tasks. Background information related to reclaimed water was also presented. A questionnaire was provided and, if attendees were interested in receiving reclaimed water in the future, they were encouraged to fill out the questionnaire and return it to the City. Those in attendance were very supportive of the study and were interested in the project schedule and potential timing for future implementation of projects.

Public Meeting No. 2- March 23, 2006

At this meeting, preliminary project alternatives for each service area were presented. The approach to identifying potential customers and defining the service areas was discussed. Preliminary opinions of probable cost were also summarized. Again, attendees were very supportive of the proposed alternatives. There was some discussion about financing of the projects and potential phasing of facilities. Potential regional support of the reclaimed water system was also discussed.

Public Meeting No. 3- April 4, 2007

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

8.5 Public Information Committee

In order to facilitate communications with community leaders about the proposed reclaimed water program, a public information committee (PIC) was established. The reclaimed water PIC is a subcommittee of the City's water conservation advisory committee. City staff and its consultant met with the committee on XX occasions during the course of this study. A summary of meeting dates and topics discussed with the committee is provided below.

PIC Meeting No. 1- August 25, 2005

At this meeting, general background information related to reclaimed water was presented, together with an overview of the project scope for the current study. The agenda included a review of reclaimed water definitions, national, regional and local perspectives on the use of reclaimed water, regulatory issues and financing of reclaimed water projects. The role of the PIC was also discussed.

PIC Meeting No. 2- November 29, 2005

The focus of this meeting was on a discussion of policies and procedures for reclaimed water programs. A review of policies and procedures for other reclaimed water programs in Texas was presented, followed by a discussion of considerations associated with developing policies and procedures for the City of Fort Worth program.

PIC Meeting No. 3- January 26, 2006

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

In addition to these focused meetings, the PIC was invited to attend each of the public meetings described above. As the City moves forward with implementation of the reclaimed water program, it is recommended that meetings with the PIC continue.

8.6 Proposed Public Information Program

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

Potential components of a public information program include:

- Identification of and partnership with allies
    - ✓ Identification of a "public champion"
- Engagement of stakeholder groups
    - ✓ Identification of target stakeholders
    - ✓ Stakeholder workshops
- Development of a broad-based awareness campaign
    - ✓ Identification of key messages
    - ✓ Production of collateral materials and tools
- Development of media relations program
    - ✓ Media packets
    - ✓ Briefings

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

8.6.1 Public Announcements and Responses

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

Upon release of project announcements of a reclaimed water project in the press, the public and City leaders may have questions or be asked questions about the project. City staff and leaders will need to be aware of and have been briefed on the project to respond knowledgeably to public inquiries. A "Glossary of Terms" that relate to reclaimed water projects are included in Appendix J. An example of "Frequently Asked Questions" about reclaimed water uses is included in Appendix K.

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

8.6.2 Public Information Documents

Several draft public information documents have been developed as a part of this project. These include the following:

- Draft logo for the reclaimed water program
- Draft information for incorporation into the City's website, including general information about the reclaimed water program, the application process for potential users, and frequently asked questions;
- Draft "Do not drink" sign for display at reclaimed water user sites.

Examples of each of these documents are provided in Appendix L.

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CHAPTER 9: RECLAIMED WATER IMPLEMENTATION PLAN

9.1 Introduction

The primary objectives of this project are to provide recommendations and evaluate the feasibility of reclaimed water projects for the City of Fort Worth and to develop an implementation plan for the viable reclaimed water projects. Advancement of Fort Worth's Reclaimed Water Program will involve the development of a number of policies and procedures and establishment or modification of ordinances supporting the program. The development of the program will also build upon the experience of the Waterchase Golf Course reclaimed water project, which has been in operation since 1999. Additionally, an organizational structure will need to be established to provide the leadership, marketing, and operations infrastructure necessary for a successful program.

The City has already taken significant steps towards establishing the administrative framework for its reclaimed water program. As a part of this project, a reclaimed water workgroup was established that included members from the City's water and wastewater divisions, as well as a legal representative. The specific goals and accomplishments of this workgroup are discussed in Section 9.2.2.

9.2 Implementation Plan

This section discusses the various actions and proposed schedule for further developing the City of Fort Worth Reclaimed Water Program and pursuing the implementation of recommended reclaimed water projects. The proposed projects and associated costs are summarized in Table 9-1. The next steps for implementation are outlined in Table 9-2. A summary of the proposed project phasing timeline is provided in Figure 9-1 and a detailed timeline is presented in Figure 9-2.

9.2.1 Administrative Actions

The following are recommended administrative actions that are fundamental to the reclaimed water program. Many of the recommendations included in this section have already been implemented by the reclaimed water workgroup, as will be discussed in Section 9.2.2.

9.2.1.1 Reclaimed Water Program Organization

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

It is recommended that the City identify a program manager and a marketing person who will be responsible for implementation of the Reclaimed Water Program. The initial focus of these staff members will be on establishing the required policies and procedures, securing customer contracts, developing and implementing the public information/public awareness campaign, and coordinating with other City programs, such as the water conservation program.

Table 9-1: Summary of Recommended Reclaimed Water Projects and Costs

Alt.	Service Area	Annual Avg. Demand	Peak System Demand	Identified Capital Benefits[1]	Capital Cost[2]		
		MGD	MGD	$MM	$MM		
E1	Eastern	2.77	14.69	$2.08	$13.44		
N2	Northern	4.19	11.07	$3.14	$13.94		
W1	Western	3.79	18.12	$2.84	$37.10		
CS2	Central/ Southern	2.179	14.47	$1.63	$39.12		
Total, All Projects		12.93	58.35	$9.70	$103.61		
Alt.	**Service Area**	**Debt Service[3]**	**O&M**	**Energy**	**Purchase Cost[4]**	**Operational Benefits[5]**	**Overall Unit Cost[6]**
		$/yr	$/yr	$/yr	$/1000G	$/1000G	$/1000G
E1	Eastern	$1,125,000	$215,000	$95,000	N/A	$0.37	$0.39
N2	Northern	$1,167,000	$188,000	$103,000	$0.25	$0.65	$0.10
W1	Western	$3,105,000	$455,000	$772,000	N/A	$0.65	$1.13
CS2	Central/ Southern	$3,273,000	$412,000	$135,000	N/A	$0.65	$1.68
Total, All Projects		$8,670,000	$1,270,000	$1,105,000	$0.08	$0.59	$0.73

[1]Includes credit for deferral of WTP expansions (see Section 7.3.4)- benefit distributed based on annual average demand of each project.
[2] Net Present Value of capital cost after accounting for interest during construction.
[3]Assumes a capital recovery period of 20 years and an annual interest rate of 5.5%.
[4]Purchase cost applies to water purchased from TRA's DCRWS for the Northern System.
[5]Includes credit for purchase of raw water. On Eastern system, only water used by wholesale customers is credited.
[6]Assumes 50-year project life.

The City will need to determine which operational responsibility associated with the reclaimed water program will be assigned to wastewater and water operations. Sample assignments are provided below, but can be modified to accommodate specific City organizational priorities:

Wastewater Operations

- Responsibility for wastewater treatment functions, whether at the existing WWTP or at water recycling centers (Note: Remote booster disinfection may be performed by the water operations group.)

Table 9-2: Reclaimed Water Implementation Steps

FISCAL YEAR 2006-2007
● Perform Administrative Actions
● Initiate actions to establish reclaimed water program organizational structure.
● Develop and adopt policies and procedures.
● Update City ordinances (i.e. rates, financial provisions).
● Develop and adopt reclaimed water standard contract.
● Pursue state/federal funding opportunities
● Negotiate and finalize agreement with TRA for DCRWS reclaimed water.
● Identify any specific water quality requirements for potential customers. If necessary, perform testing for additional parameters at WWTP.
● Initiate Public and Water Customer Reclaimed Water Awareness Program.
● Initiate reclaimed water marketing and sales activities.
● Perform routing delineation and surveying for Northern System, Phase 1 pipeline and pump station.
● Perform environmental permitting for Northern System, Phase 1 pipeline and pump station.
FISCAL YEAR 2007-2008
● Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
● Continue Public and Water Customer Reclaimed Water Awareness Program.
● Continue reclaimed water marketing and sales activities.
● Begin and complete right-of-way acquisition and design for Northern System, Phase 1 pipeline and pump station.
● Perform routing delineation and surveying for the Western System, Phase 1 pipeline and pump station.
● Perform environmental permitting for the Western System, Phase 1 pipeline and pump station.
FISCAL YEAR 2008-2009
● Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
● Continue Public and Water Customer Reclaimed Water Awareness Program.
● Continue reclaimed water marketing and sales activities.
● Perform routing delineation and surveying for Eastern System, Phase 1 pipeline and pump station.
● Perform environmental permitting for Eastern System, Phase 1 pipeline and pump station.
● Begin construction of Northern System, Phase 1 pipeline and pump station.
● Begin and complete right-of-way acquisition and design for Western System, Phase 1 pipeline and pump station.
FISCAL YEAR 2009-2010
● Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
● Continue Public and Water Customer Reclaimed Water Awareness Program.
● Continue reclaimed water marketing and sales activities.
● Begin and complete right-of-way acquisition and design for Eastern System, Phase 1 pipeline and pump station.
● Complete construction of Northern System, Phase 1 pipeline and pump station.
● Perform routing delineation and surveying for Northern System, Phase 2 pipeline.
● Perform environmental permitting for Northern System, Phase 2 pipeline.
● Begin construction of Western System, Phase 1 pipeline and pump station.
● Perform routing delineation and surveying for Western System, Phase 2 pipeline and pump station.
● Perform environmental permitting for Western System, Phase 2 pipeline and pump station.
FISCAL YEAR 2010-2011
● Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
● Continue Public and Water Customer Reclaimed Water Awareness Program.
● Continue reclaimed water marketing and sales activities.
● Begin construction of Eastern System, Phase 1 pipeline and pump station.
● Begin and complete right-of-way acquisition and design for Northern System, Phase 2 pipeline.
● Complete construction for Western System, Phase 1 pipeline and pump station.
● Begin and complete right-of-way acquisition and design for Western System, Phase 2 pipeline.
● Perform routing delineation and surveying for Western System, Phase 3 pipeline and pump station.
● Perform environmental permitting for Western System, Phase 3 pipeline and pump station.

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Table 9-2: Reclaimed Water Implementation Steps (cont'd)

FISCAL YEAR 2011-2012
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Complete construction of Eastern System Phase 1 pipeline and pump station.
• Perform routing delineation and surveying for Eastern System Phase 2 and 3 pipelines.
• Perform environmental permitting for Eastern System Phase 2 and 3 pipelines.
• Begin construction of Northern System, Phase 2 pipeline.
• Begin construction for Western System, Phase 2 pipeline and pump station.
• Begin and complete right-of-way acquisition and design for Western System, Phase 3 pipeline and pump station.
• Perform routing delineation and surveying for Western System, Phase 4 pipeline.
• Perform environmental permitting for Western System, Phase 4 pipeline.
FISCAL YEAR 2012-2013
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Begin and complete right-of-way acquisition and design for Eastern System Phase 2 pipeline.
• Begin and complete right-of-way acquisition and design for Eastern System Phase 3 pipeline.
• Complete construction of Northern System, Phase 2 pipeline.
• Complete construction of Western System, Phase 2 pipeline and pump station.
• Begin construction of Western System, Phase 3 pipeline and pump station.
• Begin and complete right-of-way acquisition and design for Western System, Phase 4 pipeline.
• Perform routing delineation and surveying for Central System, Phase 1 pipeline and pump station.
• Perform environmental permitting for Central System, Phase 1 pipeline and pump station.
FISCAL YEAR 2013-2014
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue Reclaimed water marketing and sales activities.
• Begin and complete construction of Eastern System, Phase 2 pipeline.
• Begin and complete construction of Eastern System, Phase 3 pipeline.
• Complete construction of Western System, Phase 3 pipeline and pump station.
• Begin construction of Western System, Phase 4 pipeline.
• Begin preliminary studies for Western System, Phase 7 WRC.
• Begin and complete right-of-way acquisition and design for Central System, Phase 1 pipeline and pump station.
• Perform routing delineation and surveying for Central System, Phase 2, 3 and 4 pipelines.
• Perform environmental permitting for Central System, Phase 2, 3 and 4 pipelines.
FISCAL YEAR 2014-2015
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Complete construction of Western System, Phase 4 pipeline.
• Complete preliminary studies for Western System, Phase 5 WRC.
• Begin design of Western System, Phase 5 WRC.
• Begin construction of Central System, Phase 1 pipeline and pump station.
• Begin and complete right-of-way acquisition and design for Central System, Phase 2, 3 and 4 pipelines.
FISCAL YEAR 2015-2016
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Complete design of Western System, Phase 5 WRC.
• Complete construction of Central System, Phase 1 pipeline and pump station.
• Begin and complete construction of Central System, Phase 2 pipeline.
• Begin construction of Central System, Phase 3 pipeline.
• Begin and complete construction of Central System, Phase 4 pipeline.
• Perform routing delineation and surveying for Central System, Phase 5 and 6 pipelines.
• Perform environmental permitting for Central System, Phase 5 and 6 pipelines.

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Table 9-2: Reclaimed Water Implementation Steps (cont'd)

FISCAL YEAR 2016-2017
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Begin construction of Western System, Phase 5 WRC.
• Complete construction of Central System, Phase 3 pipeline.
• Begin and complete right-of-way acquisition and design for Central System, Phase 5 pipeline.
• Begin and complete right-of-way acquisition and design for Central System, Phase 6 pipeline.
• Perform routing delineation and surveying for Central System, Phase 7 pipeline and pump station.
• Perform environmental permitting for Central System, Phase 7 pipeline and pump station.
FISCAL YEAR 2017-2018
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Complete construction of Western System, Phase 5 WRC.
• Begin construction of Central System, Phase 5 pipeline.
• Begin and complete construction of Central System, Phase 6 pipeline.
• Begin and complete right-of-way acquisition and design for Central System, Phase 7 pipeline and pump station.
• Perform routing delineation and surveying for Central System, Phase 8 pipeline.
• Perform environmental permitting for Central System, Phase 8 pipeline.
FISCAL YEAR 2018-2019
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Begin and complete preliminary studies for Western System, Phase 6 WRC expansion.
• Complete construction of Central System, Phase 5 pipeline.
• Begin construction of Central System, Phase 7 pipeline and pump station.
• Begin and complete right-of-way acquisition and design for Central System, Phase 8 pipeline.
FISCAL YEAR 2019-2020
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Begin and complete design of Western System, Phase 6 WRC expansion.
• Complete construction of Central System, Phase 7 pipeline and pump station.
• Begin construction of Central System, Phase 8 pipeline.
FISCAL YEAR 2020-2021
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Begin construction for Western System, Phase 6 WRC expansion.
• Complete construction of Central System, Phase 8 pipeline.
FISCAL YEAR 2021-2022
• Continue Wastewater Treatment Plant testing of additional parameters, as necessary.
• Continue Public and Water Customer Reclaimed Water Awareness Program.
• Continue reclaimed water marketing and sales activities.
• Complete construction for Western System, Phase 6 WRC expansion.

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Figure 9-1: Reclaimed Water Implementation Plan Phasing

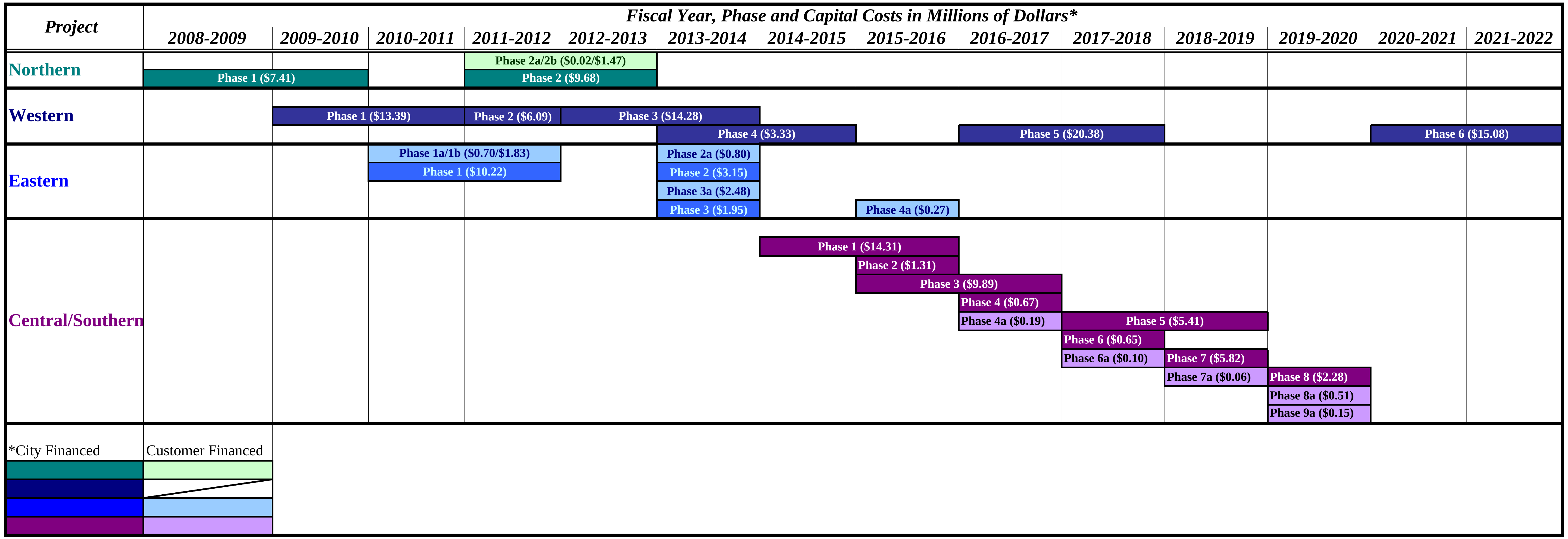

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Figure 9-2: Reclaimed Water Implementation Plan Detailed Timeline

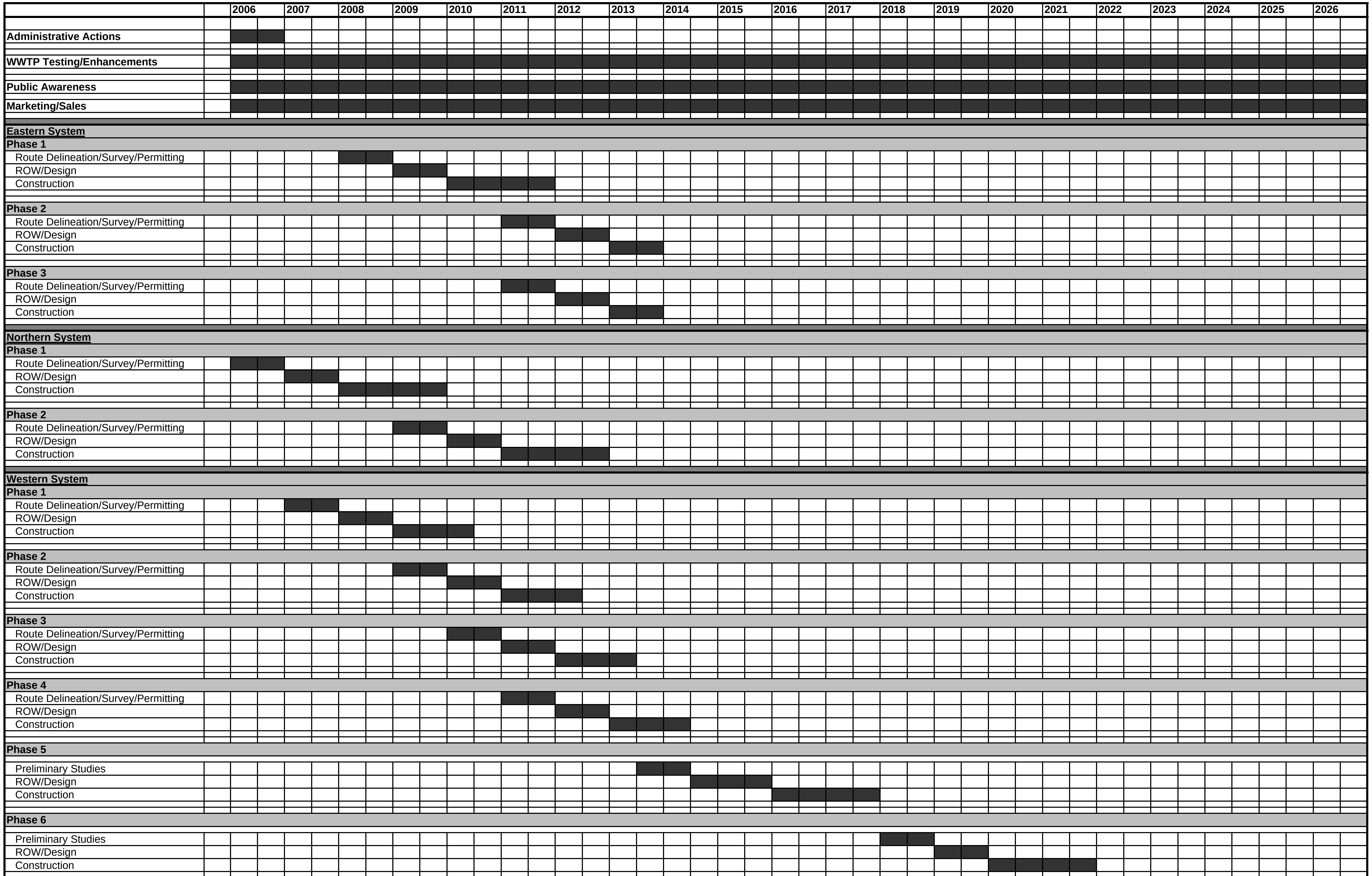

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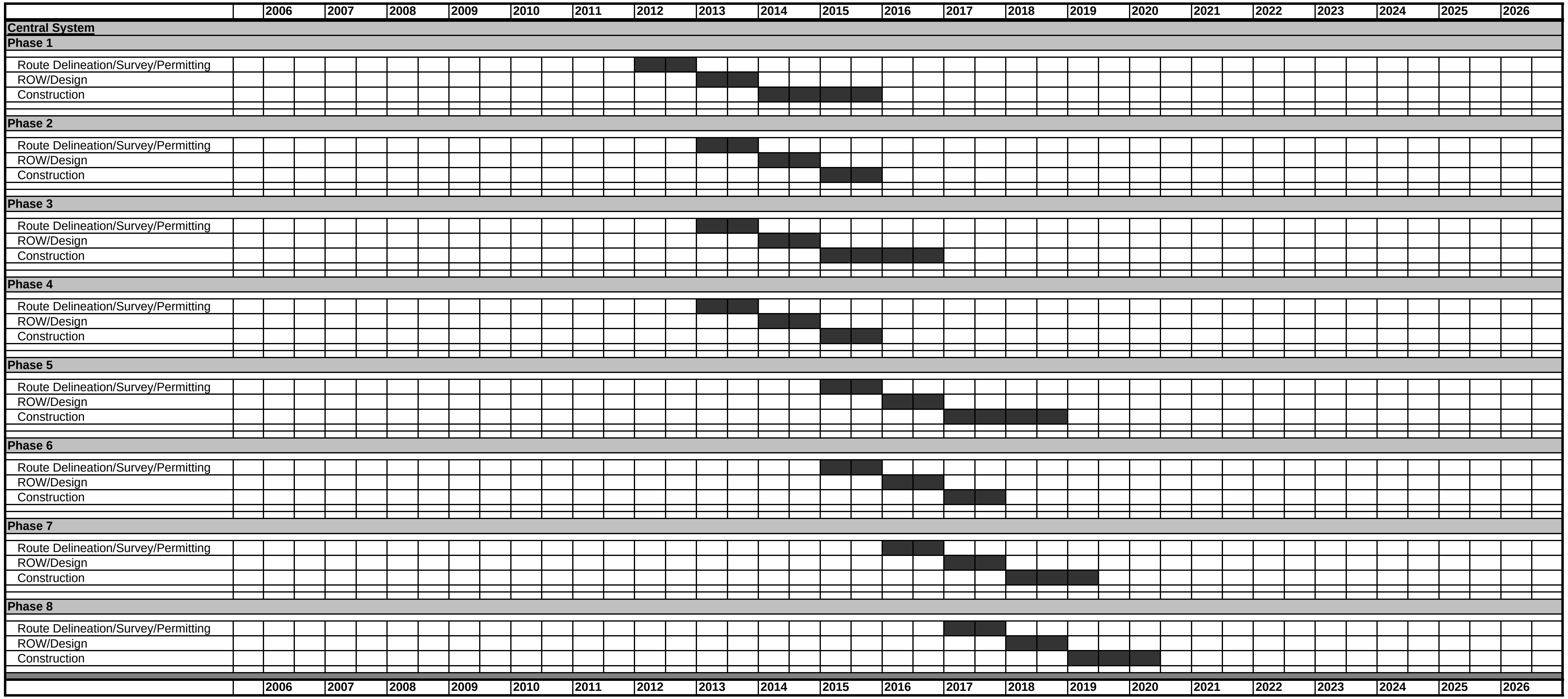
Figure 9-2: Reclaimed Water Implementation Plan Detailed Timeline



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Water Operations

- Take over custody of the treated effluent when it enters reclaimed water pumping facilities, storage facilities, or distribution pipeline.
- Operate and maintain the reclaimed water storage and pumping facilities.
- Operate and maintain the reclaimed water distribution system including pipelines, tie-ins, metering facilities, and cross-connection inspection.

9.2.1.2 Policies and Procedures

The Reclaimed Water Program will require the development and implementation of a number of policies and procedures. The following presents a number of considerations that are typically addressed by policies and procedures for reclaimed water programs.

- Infrastructure technical design specifications
- Cross-connection control requirements
- Funding sources and rules
- Rate structure
- Site inspection authority
- Enforcement policies
- Reclaimed Water Program operation and maintenance manual
- Reclaimed Water User manual
- Emergency Response Plan

The development of reclaimed water program policies and procedures should be coordinated with existing City of Fort Worth policies and procedures.

9.2.1.3 Update City Ordinances to Include Reclaimed Water Provisions

Several aspects of the reclaimed water program may require modification of existing ordinances or creation of new ordinances. Some possible considerations relative to City ordinances include:

- Establishment of pricing structure and pricing policies for reclaimed water.
- Potential restrictions on the use of raw water within the targeted reclaimed water service areas.
- Potential requirements for the use of reclaimed water for specific user groups within the targeted reclaimed water service areas.

- Potential requirements for developers to install dual distribution systems in new developments within the targeted reclaimed water service areas.

9.2.1.4 Reclaimed Water Customer Contract

A standard contract to be executed with reclaimed water customers should be developed and adopted. The contract should include provisions necessary to address the following issues as well as other considerations typically included in City water customer contracts.

- Delineation of the City's and customer's responsibilities
- Intended uses and description of areas of application of reclaimed water
- Prohibited uses of reclaimed water
- Quantities of reclaimed water
- Price of reclaimed water
- Compliance with City rules, regulations, policies, and procedures
- Compliance with TCEQ rules and regulations
- Right for the City to review and comment on customers' reclaimed water systems
- Right for City and plumbing inspection
- Enforcement provisions
- Facilities construction
- Delivery of reclaimed water
- Quantity and unit measurement
- Quality to be provided
- Pressure requirements
- Payments by purchaser
- Suspension of service
- Obligation of the parties
- Remedies upon default
- Procedures for contract amendment

It is important that the contract includes provisions that protect the potable water system from cross connection with the recycled water.

9.2.1.5 Waterchase Golf Course Reclaimed Water Project Experience

As discussed elsewhere in this report, the City has been providing reclaimed water to the Waterchase Golf Course since 1999. The City can use this project as a development tool and building block for future reclaimed water projects. Much has been learned during the development and implementation of this project, and many of the assumptions and policies can be reviewed and refined based on this experience and provide beneficial knowledge for future operations and maintenance practices.

Specifically, the City should evaluate the existing reclaimed water use agreement with Waterchase to identify any items that require amendment for subsequent user agreements. The City should also review the policies and procedures being used for the Waterchase project and refine them as necessary for future projects.

Another benefit that can be derived from the Waterchase Golf Course Project is development of information and actual operating and maintenance experience that can be used in marketing and public information campaigns. Public acceptance of recycled water projects will be critical to their success. Developing a track record of safe, reliable and beneficial operations will contribute to the success of Fort Worth's future public acceptance efforts.

9.2.1.6 Wastewater Treatment Plant Testing Program

Based on a review of historical effluent data at Village Creek WWTP (VCWWTP) and TRA's Denton Creek Regional Wastewater System (DCRWS), both plants have demonstrated the ability to meet the quality requirements for both Type I and Type II reclaimed water applications (see Chapter 5). In Type I applications, there is likely public contact in areas irrigated with reclaimed water. In Type II projects, public contact is controlled. However, as flows from these plants increase, and approach their rated design capacities, careful observations should be made of the CBOD and turbidity levels. Any trends of increased concentrations should be addressed, possibly with optimization of operations or additional treatment capacity. Under the current flow and loading conditions, the effluent from either plant could be used for Type I or Type II reclaimed water projects.

In addition to monitoring of parameters required for regulatory compliance, when marketing new users and negotiating customer agreements, the City should inquire about any specific water quality expectations or requirements, particularly for industrial customers. As necessary, the City may need to provide additional water quality data or undertake special monitoring programs to quantify concentrations of other constituents of interest to specific customers.

9.2.1.7 Chapter 210 Reclaimed Use Notification

At the commencement of the study, the City held a reclaimed water authorization for Type II reclaimed water service to the Waterchase Golf Course. As a part of this study, the City submitted a general reclaimed water notification to the TCEQ to cover both Type I and Type II uses of reclaimed water throughout a much larger service area. The notification identified a number of potential uses for the reclaimed water. Official authorization for this notification was received from the TCEQ on August 28, 2006. A copy of the reuse authorization is included as Appendix M.

9.2.1.8 Public Information/Public Awareness Campaign

Since well-designed public outreach programs have been demonstrated to play a significant role in the success of reclaimed water projects, an important component of the City's implementation plan will be developing an effective public outreach program. Such a program would inform stakeholders, solicit their input, and develop and enhance their support for the beneficial use of reclaimed water. It is anticipated that this effort would continue the use of a Public Information Committee (PIC), specific to reclaimed water, as has already been established for this project (see Section 8.5).

Public Announcements and Response

To ensure that City of Fort Worth reclaimed water projects are not misrepresented in the public domain, press releases should be used as a means of disseminating the project parameters and goals accurately.

Upon release of a reclaimed water project announcement to the press, the public and City leaders may have questions or be asked questions about the project. City staff and leaders need to be made aware of and be briefed on the project to respond knowledgeably to public inquiries. An example of "Frequently Asked Questions" about reclaimed water uses is included in Appendix K. A "Glossary of Terms" that relate to reclaimed water projects is also included in Appendix J.

Coordination with Water Conservation Program

The City's water conservation awareness program is ongoing and complementary to this project. The findings and recommendations of the Reclaimed Water Priority and Implementation Plan should be coordinated with and incorporated into the City's water conservation efforts.

Stakeholder Workshops

The City of Fort Worth will work with and inform its customer cities and other stakeholders of the scope and implications of the reclaimed water program. In addition to potential involvement on the Public Information Committee, it is recommended that customer cities and other stakeholders be invited to participate in workshops to inform, encourage, and build consensus on the reclaimed water program.

9.2.1.9 Reclaimed Water Marketing Efforts

Identifying potential customers and understanding their needs and expectations are vital to successfully marketing reclaimed water. Many of the potential customers identified in this report have already been contacted directly in order to provide them with information about the reclaimed water program and to obtain specific information related to quantity and quality requirements. A standard transmittal letter and questionnaire have been developed and are provided in Appendices C and D, respectively. The City should continue to contact and meet with potential customers in order to keep them apprised of progress with the reclaimed water program and to develop updated information regarding customer interest and quantity/quality requirements.

In conjunction with other polices and procedures, reclaimed water marketing material should be developed. Various marketing schemes and philosophies may be employed such as:

- News Media Applications
- Web Site Development
- Public Television Announcements
- Video Development
- Public Presentations
- Special Promotional Events (perhaps also incorporating water conservation)

As discussed in Chapter 8, some initial marketing materials were developed as a part of this project, including web site information, brochures and signs. Marketing surveys may also be employed to develop marketing materials through surveys to potential customers, businesses, stakeholders, and the general public.

9.2.2 Reclaimed Water Workgroup Goals and Accomplishments

As discussed above, a reclaimed water workgroup was established in order to begin the process of developing the appropriate administrative framework to support the reclaimed water program. The workgroup held 9 meetings between October 31, 2006 and March 8, 2007. The primary goals of the workgroup were as follows:

1. Identify and develop a general description of administrative documents necessary for the reclaimed water program;
2. Development of draft administrative documents identified in item 1, above. Draft documents developed by the workgroup include:
    a. A reclaimed water ordinance that defines the purpose of the program, application procedures, user and provider responsibilities, and prohibitions;
    b. A standard service agreement for reclaimed water users;
    c. The rate and fee structure for the reclaimed water program.
3. Identify existing City documents that require modification to incorporate aspects of the reclaimed water program. Establish and procedure and timeline for modification of these documents.

Copies of the draft reclaimed water ordinance and standard service agreements are included in Appendices N and O, respectively. It should be noted that in addition to the projects recommended in this report, the City is planning the construction of a truck depot at its Village Creek WWTP. Reclaimed water will be available at this depot to permitted haulers for transport to user sites. The ordinance and service agreement documents incorporate special provisions to address this reclaimed water hauling program.

The rate structure adopted by the workgroup is the same as the structure discussed in Section 7.5.3. These rates include an in-system volume charge of $0.75/1000 gallons and an out-of-system volume charge of $0.94/1000 gallons. In addition it was decided that the same general fee structure used for the potable water system would be used for the reclaimed water system. The reclaimed water rates will be incorporated into the City's existing ordinance for water and wastewater rates.

The ordinance and service agreement documents, together with the rate structure are scheduled to be taken to the City Council for approval in April 2007. Adoption of these documents by the City Council will provide the necessary foundation to begin contracting with users once facilities have been constructed.

With respect to item 3, above, several documents are currently being revised in order to incorporate design standards and installation policies that are unique to the reclaimed water program. These documents include:

- *Water and Wastewater Installation Policy*
- *Policies and Procedures for Processing Water and Wastewater Projects for Design and Construction*

As a part of the workgroup meetings, a reclaimed water implementation team was established to oversee the modifications to these documents and to identify additional policies and procedures required for implementation of the reclaimed water program. In addition, the implementation team has had several meetings to facilitate communication about the reclaimed water program to other City departments.

9.3 Summary- Recommended Reclaimed Water Projects

This study has identified four direct, nonpotable reclaimed water projects that can be implemented to serve the City of Fort Worth and surrounding communities (see Table 9-1). The feasibility evaluation has indicated that these projects are viable and provide a number of benefits to the City, its wholesale customers, its raw water provider (Tarrant Regional Water District), and surrounding communities participating in the reclaimed water program. In addition, a partnership with Trinity River Authority to use treated effluent from the Denton Creek Regional Wastewater System for the Northern service area may help TRA to defer upgrades necessary to comply with more stringent TPDES permitting requirements.

As a part of this project, the City has taken significant steps toward the implementation of its reclaimed water program. Development of the ordinance and service agreement documents, together with modifications to existing policy and procedure documents to incorporate specific provisions of the reclaimed water program are well underway.

The recommendation to implement the four proposed reclaimed water projects is based on the likelihood of customer interest and feasibility of the projects. Potential customers in both the Northern and Eastern service areas have expressed a serious interest in purchasing reclaimed water as soon as it is available. In addition, the developer of the Walsh Ranch area in the Western service area has indicated willingness to install dual distribution systems for that area. The City needs to pursue further discussions with these potential customers to finalize their commitment to reclaimed water use. Other potential customers identified in this report should also be contacted directly to confirm their interest, needs and expectations.

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APPENDIX A SUMMARY OF TOP 100 WATER CUSTOMERS PROVIDED BY CITY OF FORT WORTH

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TOP WATER USER DATA PROVIDED BY CITY OF FORT WORTH

	Class	Customer Name	Street Address						Size	Dec-04	Nov-04	Oct-04	Sep-04	Aug-04	Jul-04	Jun-04	May-04	Apr-04	Mar-04	Feb-04	Jan-04	CCF
1	IM	MILLER BREWING COMPANY	7111		SOUTH	FWY			two 10"	117701.5	109811.8	98174.6	105776.8	113494.0	115625.1	108219.0	106994.8	101383.4	99380.6	99643.9	80986.1	1257191.4
									two 2"													
2	IM	LOCKHEED MARTIN TACTICAL A/S	8000		CLIFFORD	ST			10"	33760.6	37214.1	49074.6	53520.1	55821.1	56468.2	42016.6	46935.4	41726.4	30023.7	30010.3	28397.9	504968.9
3	C	FORT WORTH ZOOLOGICAL ASSOC	2500		FOREST	DR	S		10"	10613.0	12701.0	15110.0	14866.0	17216.0	11568.0	16036.0	14582.0	16258.0	11176.0	12100.0	17424.0	169650.0
4	IM	COCA COLA BOTTLING	5622		SANDSHELL	DR			6"	14090.0	13280.0	13645.0	17055.0	14625.0	14985.0	16588.0	16239.0	15698.0	14210.0	11705.0	16145.0	178265.0
								irr	one 2"	210.3	659.4	1371.6	860.3	992.4	639.0	406.0	719.8	443.3	140.9	123.3	185.5	6751.8
5	IM	NAVAL AIR STATION FT WORTH JRB	6350		NIMITZ	DR			6"	8060.0	6670.0	6805.0	7925.0	8770.0	12105.0	11567.0	10767.0	10891.0	10310.0	11515.0	12025.0	117410.0
6	IM	DANNON COMPANY	400		BRADNER	AV		A	6"	10755.1	9771.0	11286.1	11530.6	105934.4	10605.0	9941.6	11219.5	10304.7	30023.7	8723.9	11165.0	241260.6
7	IM	BELL HELICOPTER TEXTRON	600	E	HURST	BLVD			10"	9509.0	8152.0	10080.0	10508.0	13701.0	7212.0	16663.0	9170.0	3718.0	9479.0	10089.0	10637.0	118918.0
8	C	TARRANT COUNTY	100		BURNETT	ST			8"	10246.0	9693.0	9332.0	11250.0	9812.0	10207.0	11108.0	9613.0	10068.0	8994.0	9285.0	10342.0	119950.0
9	IM	KETTLE COOKED FOODS	7401		WILL ROGERS	BLVD			4"	10533.5	12246.0	13676.7	14401.0	13856.5	15561.3	10748.4	13676.3	14134.3	12729.3	12928.1	9837.5	154328.9
								irr	one 2"	0.3	162.1	788.8	547.9	346.6	230.1	283.5	246.4	277.5	172.5	131.3	213.5	3400.5
10	IM	KRO-053-000	901		OAK GROVE	RD			6"	10336.5	7928.5	8472.0	7571.0	9775.0	7185.0	8552.0	9491.0	8858.0	7732.0	7675.0	8770.0	102346.0
11	IM	CON AGRA FOODS	1734	E	EL PASO	ST			6"	12541.4	10957.2	14458.1	10330.5	10719.4	18538.6	16476.5	17017.9	14118.9	10479.7	11338.7	8364.4	155341.3
12	C	HARRIS METHODIST HOSPITAL	616	S	LAKE	ST			two 10"	15109.0	7382.0	6652.0	7802.0	117953.0	6996.0	12589.3	3370.0	0.0	4792.0	6328.0	7982.0	196955.3
13	NP	FEDERAL CORRECTIONAL INST	3150		HORTON	RD			6"	8790.0	7280.0	7860.0	8975.0	8360.0	6794.0	7635.0	7726.0	7420.0	6795.0	7455.0	7945.0	93035.0
14	IM	RODRIGUEZ FOODS INC	899	N	HOUSTON	ST			4"	6216.0	5153.0	4292.0	6410.0	5623.0	4544.0	4317.0	6871.0	7205.0	7306.0	7477.0	7588.0	73002.0
15	IM	PREMIUM WC INC	5651		ALLIANCE GATEWAY	FRWY			4"	9422.7	7728.9	7712.7	11088.3	8599.3	9677.7	8284.0	7623.9	7519.1	7164.5	5943.6	7582.2	98346.9
								irr	one 2"	0.8	114.2	304.9	459.6	594.9	241.5	103.9	4.7	173.6	55.2	0.1	0.1	2053.5
16	DB	FOURNIER FILTER PLANT	1402		11TH	AV			6"	9629.0	8628.0	8477.0	8372.0	10212.0	8031.0	7237.0	7803.0	822.0	3897.0	5898.0	6732.0	85738.0
17	C	AMERICAN AIRLINES	2000		EAGLE	PKWY			one 10"	6240.0	7690.0	9350.0	10780.0	8720.0	10510.0	8706.0	6822.0	5077.0	5405.0	6975.0	6685.0	92960.0
									two 8"	domestic												
18	IM	SYNTHETIC PRODUCTS CO	504	NE	21ST	ST			4"	8819.2	9822.9	7718.8	9589.3	10405.5	10761.9	10075.0	8801.4	9257.0	6863.6	7454.7	6626.0	106195.3
19	IM	FIVE STAR FOODS	3709	E	1ST	ST			4"	4936.2	6733.8	7891.0	7344.1	7372.7	7575.6	7629.7	4716.1	6421.6	7390.3	6568.9	6480.6	81060.6
20	C	FMC-CARSWELL	1347		DEPOT	AV			8"	7181.8	5651.2	6162.4	6660.6	8192.9	7448.9	7049.6	5862.5	5736.9	5546.6	6719.2	5990.0	78202.6
21	IM	ALCON LABORATORIES	6113		SOUTH	FWY		A	6"	5215.0	5065.0	4560.0	5330.0	5490.0	5375.0	5063.0	4607.0	4555.0	5025.0	6490.0	5975.0	62750.0
22	CA	HOUSING AUTHORITY OF FT WORTH	1100		LUELLA	ST		A	4	5295.3	4716.9	4749.9	5356.0	5472.3	5686.1	5642.1	5858.9	5365.9	5039.5	4854.8	5887.3	63925.0
23	IM	ALCON LABORATORIES	261	E	ALTAMESA	BLVD			10"	6058.0	8248.0	8870.0	10256.0	10327.0	8757.0	9206.0	6183.0	6561.0	3303.0	4597.0	5740.0	88106.0
24	IM	BUNGE CORP	400	E	EXCHANGE	AV			10"	2839.0	2577.0	2356.0	2857.0	2932.0	3417.0	3494.0	3848.0	3658.0	4347.0	4496.0	5628.0	42449.0
25	C	TARRANT COUNTY GREENBAY	5136		NORTHEAST	PKWY		A	2" & 4"	1763.0	3899.0	3832.0	4419.0	4003.3	4455.0	377.8	3989.0	4384.0	3890.0	3879.0	5519.0	44410.1
		ADDED to list	5136		NORTHEAST	PKWY			2" & 4"													
								irr.	1/ 1/2"	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	C	OZARKA WATER COMPANY	4250		CAMBRIDGE	RD			2" & 4"	3783.7	4111.0	4780.0	4964.8	5605.2	4765.0	3260.0	4754.0	4659.0	4662.0	4085.0	5263.0	54692.7
27	C	JPS HEALTH NETWORK	1505		ST LOUIS	AV			two 6"	4863.0	5170.0	5509.0	5121.0	6094.0	4572.0	5096.0	4941.0	5355.0	4729.0	4817.0	5227.0	61494.0
28	IM	ADMIRAL LINEN SERVICE	1340	E	BERRY	ST		C	6"	6665.0	5685.0	5311.0	5354.0	5562.0	4910.0	5413.0	5320.0	5316.0	4984.0	5204.0	5183.0	64907.0
29	IM	ALCON LABORATORIES	6203		SOUTH	FWY			6"	6388.0	5921.0	6283.0	6390.0	4413.0	5517.0	6146.0	5997.0	5742.0	5412.0	5809.0	5154.0	69172.0
30	C	TRAMMELL CROW COMPANY	1720	N	ENDERLY	PL			6"	5552.0	5556.0	6064.0	7040.0	7345.0	7395.0	10210.0	7064.0	5480.0	4924.0	4750.0	5108.0	76488.0
31	C	PLAZA MEDICAL CENTER	1612	W	HUMBOLT	ST			4"	3915.9	3142.5	3003.7	3430.9	3747.3	5361.4	5255.8	4324.4	5015.3	4259.1	4492.3	4937.1	50885.7
32	IM	US BUREAU OF ENGRAVING	9000		BLUE MOUND	RD			10"	7330.0	5150.0	6915.0	9080.0	9130.0	8945.0	7509.0	7313.0	5868.0	5880.0	4220.0	4930.0	82270.0
33	NP	TEXAS CHRISTIAN UNIVERSITY	2900	S	UNIVERSITY	DR			8"	9212.0	11843.0	13452.0	12658.0	11313.0	6485.0	3660.0	6829.0	7098.0	6420.0	6572.0	4898.0	100440.0
34	IM	ALCON LABORATORIES	250	E	ALTAMESA	BLVD			6"	4257.0	4846.0	5479.0	6965.0	6868.0	6529.0	6517.0	5009.0	4497.0	4527.0	3874.0	4786.0	64154.0
								irr,	one 6"	3.7	419.9	2341.7	3031.1	3674.6	905.6	2127.8	1502.3	549.0	0.0	292.0	159.0	15006.7
35	DB	TRINITY PARK	2351	W	7TH	ST			2"	526.0	70.1	6117.5	3832.0	4132.7	2726.8	1144.7	2200.1	1117.2	52.5	2475.4	4677.2	29072.2
36	IM	TEXAS AMERICAN FOOD SER	1302		NORTH PARK	DR			3"	3896.5	4088.0	4290.2	4297.3	4223.3	4656.0	4056.0	4468.1	4131.5	3897.3	3623.5	4628.4	50256.1
37	C	HUGULEY MEMORIAL HOSPITAL	11701		SOUTH	FWY			8"	4470.3	4214.3	4688.7	4880.1	4853.6	4439.5	4636.6	4259.9	4331.8	3530.0	4494.8	4054.0	52853.6
38	C	HOSPITALITY INTERNATIONAL INC	200		MAIN	ST			8"	2879.0	3212.0	3043.0	4284.0	4105.2	4551.7	4553.0	4031.1	3708.9	3484.5	3679.5	3612.6	45144.5
39	C	FORT TOWER ONE ASSOC	816		COMMERCE	ST			4"	3626.0	3598.0	3370.0	4403.0	4174.0	4060.0	4494.0	3617.0	3196.0	3207.0	3458.0	3510.0	44713.0
40	CA	TRINITY TERRACE APTS	901		FOURNIER	ST			4"	1485.0	1159.0	2138.0	1749.0	1980.0	1809.0	1857.0	1624.0	1726.0	1531.0	1442.9	3485.1	21986.0
41	IM	ALCON LABORATORIES	300	E	ALTAMESA	BLVD		B	6"	3736.5	2142.5	2461.8	2217.2	2711.7	3398.1	3800.4	4866.7	4779.6	4374.8	4783.4	3475.9	42748.6
42	C	HARRIS HOSPITAL SW	6101		JOHN RYAN	DR			6"	4220.0	5005.0	4850.0	3860.0	3970.0	4430.0	3420.0	3515.0	3015.0	2905.0	2610.0	3375.0	45175.0
43	C	TARRANT COUNTY COLLEGE	5301		C A ROBERSON	BLVD			8"	2363.0	3257.1	5223.5	5742.8	4481.4	2073.4	2173.1	2415.3	1794.2	1012.6	1017.8	3334.4	34888.6
44	C	AMERICAN AIRLINES	14000		FAA	BLVD			6"	3042.5	4842.0	6229.4	6659.8	8674.0	5319.3	8086.6	4945.5	4297.3	3734.7	4516.3	3230.8	63578.2
45	C	SOUTHWESTERN BELL TELEPHONE CO	1116		HOUSTON	ST			6"	1414.0	1317.0	1863.0	2185.0	2917.0	2383.0	1784.0	1865.0	1441.0	2019.0	1588.0	3217.0	23993.0
46	IM	MRS BAIRDS BAKERIES	7301		SOUTH	FWY		C	4"	4193.5	3473.2	5243.5	4267.2	4563.7	4031.0	5441.7	3935.7	2480.0	3827.8	2835.1	3122.5	47414.9
47	CA	HOUSING AUTHORITY OF FT WORTH	1521		ETTA	ST			4"	3316.8	2485.7	2536.5	2821.0	2611.8	2559.8	2460.9	2505.0	2433.4	2373.0	2630.2	3001.7	31735.8
48	C	AMERICAN AIRLINES	4255		AMON CARTER	BLVD		H	8"	1563.0	2313.0	2816.0	4115.0	4472.0	5108.0	2789.0	4376.0	2781.0	2748.0	1725.0	2845.0	37651.0

	Class	Customer Name			Street Address				Size	Dec-04	Nov-04	Oct-04	Sep-04	Aug-04	Jul-04	Jun-04	May-04	Apr-04	Mar-04	Feb-04	Jan-04	CCF
49	C	FORT WORTH ZOOLOGICAL ASSOC	2110		ROCKRIDGE	TER			6"	2996.0	2377.0	2710.0	2972.0	3164.0	2750.0	2567.0	2420.0	2643.0	2408.0	2429.0	2697.0	32133.0
50	NP	JPS HEALTH NETWORK	1501	S	JENNINGS	AV			4"	2225.0	2651.0	3826.0	3602.0	4539.0	2297.0	3908.0	2483.0	2401.0	1564.0	1878.0	2682.0	34056.0
51	IM	BELTEX CORP	3801	N	GROVE	ST			4"	3284.0	2631.0	3017.0	3699.0	3676.0	3868.0	3099.0	3459.0	2976.0	2942.0	3236.0	2544.0	38431.0
52	CA	THOMAS TURNER DBA RIDGECREST	6001		OAKMONT	TRL			6"	2194.0	2340.0	1674.0	1766.0	1950.0	2469.0	3986.2	1163.8	1987.0	1868.0	2046.0	2539.0	25983.0
53	C	CITY CENTER DEVELOPMENT CO	201		COMMERCE	ST			6"	2659.0	2492.0	3535.0	4803.0	4952.0	5600.0	5328.0	3735.0	3175.0	2927.0	2556.0	2532.0	44294.0
54	CA	WESTCHESTER RETIREMENT COM	550	S	SUMMIT	AV			4"	2327.8	2241.2	2397.4	2448.5	2781.1	2345.0	2489.7	2621.6	2413.0	2435.6	2221.3	2458.3	29180.5
55	C	BROADWAY PLAZA AT CITYVIEW	5301		BRYANT IRVIN	RD			two 6"	2853.0	3554.0	3016.0	3706.0	4085.0	3300.0	2774.0	2908.0	2176.0	2185.0	2031.0	2442.0	35030.0
56	CA	THE MERIDIAN APTS	4450		MARINE CREEK	PKWY			two 6"	1549.9	3767.3	3598.5	4358.4	3848.4	3892.9	2937.0	3133.1	2552.5	1602.4	1591.4	2403.2	35235.0
								irr.	two 2"	108.3	1016.5	890.5	1097.5	965.7	923.0	631.2	698.0	139.3	121.2	147.7	372.6	7111.5
										156.0	1561.0	1488.4	1853.0	1613.7	1500.1	992.7	1138.5	998.0	204.7	245.7	616.1	12367.9
57	CA	CLAYTON MOBILE HOME PARKS INC	5550		PARKER HENDERSON	RD			6"	1445.0	2039.0	1727.0	1864.0	1685.0	1544.0	1504.0	1868.0	1709.0	1505.0	1679.0	2284.0	20853.0
58	IM	UNION PACIFIC RAILROAD	3150		KIMZEY	ST			10"	2187.6	2229.1	2703.5	3125.1	2280.3	6450.3	7518.0	8246.2	6645.2	2142.6	2223.0	2265.2	48016.1
59	IM	KRO-053-000	151	W	TERRELL	AV			4"	2507.3	3718.7	3580.0	3413.0	4163.0	2990.0	3131.0	2795.0	2432.0	2196.0	2088.0	2249.0	35263.0
60	C	COOK CHILDRENS MEDICAL CENTER	700		6TH	AV			6"	2013.0	2090.0	2303.0	2271.0	2188.0	2107.0	2040.0	2394.0	2135.0	19637.0	2190.0	2181.0	43549.0
61	C	HOLIDAY INN NORTH	2540		MEACHAM	BLVD		A	6"	1635.0	1787.0	2120.0	1899.0	1938.0	2004.0	2074.0	1727.0	1959.0	1553.0	1416.0	2110.0	22222.0
62	CA	ALLIANCE WE LTD PARTNERSHIP	5405		OVERTON RIDGE	BLVD			6"	2317.0	2407.0	2177.0	2522.0	1934.0	2393.0	2188.0	2430.0	1859.0	1902.0	1807.0	2104.0	26040.0
								irr	one 2"	0.1	716.4	830.0	867.9	790.6	557.7	190.0	240.1	0.0	16.3	65.6	225.9	4500.6
63	C	CINTAS CORPORATION	3450		NORTHERN CROSS	BLVD			3"	2395.9	2354.0	2457.1	2664.8	2305.2	2400.6	2234.0	2321.8	2625.1	2151.4	2070.3	2091.8	28072.0
64	CA	MDC PARKCREEK RESIDENCYS, LTD	6960	N	BEACH	ST			two 4"	1950.4	1746.8	1709.8	2284.7	1918.4	2085.7	1712.5	1655.8	1647.4	1875.4	1700.6	2048.1	22335.6
								irr	two 2"	79.3	403.1	668.1	461.8	579.3	357.4	227.0	215.3	146.9	2.5	4.2	116.7	3261.6
										97.9	538.1	646.6	478.0	672.9	337.8	230.6	140.3	0.0	0.0	0.0	0.0	3142.2
65	CA	TRI VEST CAMERON CREEK LTD	5255		BRYANT IRVIN	RD		A	two 8"	2391.0	2538.0	2389.0	2859.0	2466.0	2348.0	1963.0	2042.0	1699.0	1756.0	1625.0	1973.0	26049.0
								irr.	two 2"	191.7	254.7	727.1	1178.2	1095.0	465.8	426.3	480.1	177.6	0.0	109.1	237.0	5342.6
										4.7	42.5	297.9	459.0	235.1	0.0	0.0	0.0	0.1	0.0	16.3	77.6	1133.2
66	C	TRISEPT INC PROPERTY MGT	701		MAIN	ST			6"	2029.0	2160.0	2500.0	3046.0	3215.0	3334.0	3243.0	2688.0	2597.0	1968.0	1748.0	1967.0	30495.0
67	C	RIVER PARK PLACE JOINT VENTURE	3451		RIVERPARK	DR			4" & 6"	2553.7	2773.8	3069.6	3222.8	2726.5	2663.3	2953.2	2655.0	1310.9	1252.1	1465.0	1917.3	28563.2
68	DB	WATER GARDENS	1600		COMMERCE	ST			4"	1901.4	2227.3	1564.4	2525.2	2481.5	1315.5	2025.6	1872.9	1711.7	1242.9	1000.3	1849.5	21718.2
69	IM	CHEZ ORLEANAIS DBA	8905		FORUM	WY		C	two 2"	1517.1	1037.1	1535.0	3210.1	748.9	2627.9	2475.0	1680.9	2130.1	1793.9	1796.7	1786.7	22339.4
70	CA	BORTS, MARTIN	1350	E	SEMINARY	DR			2"	1576.2	1477.4	1969.3	2045.5	2153.7	1729.2	1734.4	1524.2	1577.8	1670.7	1997.6	1781.4	21237.4
								irr.	one 2"	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	IM	AKZO NOBEL	611	E	NORTHSIDE	DR			three 2"	1199.8	1279.4	1033.7	1924.4	1607.8	926.1	2424.1	1312.6	1387.6	2489.3	2086.3	1761.3	19432.4
72	C	COOK CHILDREN'S	1410		PRUITT	ST			4"	1468.6	1852.7	2505.4	3680.1	3859.8	4201.2	3903.3	3106.2	2159.6	1777.0	1321.2	1758.8	31593.9
73	IM	OBIM FRESH CUT FRUIT COMPANY	715	E	9TH	ST			three 2"	2964.2	1992.2	2204.6	2386.7	1865.5	1879.7	1904.7	1923.3	1744.2	1619.6	1186.1	1694.1	23364.9
74	C	TEXAS MOTOR SPEEDWAY	3601		HIGHWAY 114				10"	1250.0	1445.0	2680.0	2995.0	4100.0	2858.0	3619.0	2733.0	5378.0	1630.0	1355.0	1680.0	31723.0
75	C	BURNETT PLAZA ASSOCIATE	800		CHERRY	ST			6"	1711.0	1886.1	2174.5	2955.8	2660.0	3003.4	2557.8	2009.1	1901.9	1621.1	1525.2	1679.2	25685.1
76	IM	NAVAL AIR STATION FT WORTH JRB	6360		NIMITZ	DR			8"	8366.0	4322.0	6799.0	6277.0	7057.0	1115.7	1884.9	1153.4	790.2	809.3	328.6	1633.7	40536.8
77	C	ALL SAINTS HOSPITAL	7100		OAKMONT	BLVD			6"	1735.0	2155.0	2135.0	2375.0	2235.0	2225.0	1040.0	2765.0	1520.0	1395.0	1315.0	1565.0	22460.0
78	C	GOFT HOTEL PARTNERS	6900		CALMONT	AV			4"	2410.3	3000.2	3186.4	3129.6	3929.7	2998.6	3111.8	2034.8	2406.1	1908.1	1503.0	1553.1	31171.7
79	CA	QUAIL RUN/HERITAGE FINANCIAL	8028		WICHITA	ST			6"	641.0	2471.0	2361.0	2482.0	2570.0	1784.0	2386.0	1582.0	1504.0	1431.0	1604.0	1518.0	22334.0
80	CA	CWS COMMUNITIES LP	10900		TRINITY	BLVD			two 6"	2752.5	2086.4	2893.7	3404.9	3375.6	2222.6	2076.1	1958.2	1188.8	909.3	1427.4	1471.4	25766.9
81	C	RIDGMAR ASSOCIATES	1810		GREEN OAKS	RD			4"	1744.7	1852.6	2278.4	3011.5	3539.5	3358.1	2765.3	2069.1	1772.9	1458.5	1221.3	1455.6	26527.5
82	C	PUSON GCH, LPDI	1700		CALHOUN	ST		A	6"	1548.0	1692.0	1551.0	1682.0	2921.0	2795.0	2260.0	1614.0	2223.0	2132.0	1560.0	1441.0	23419.0
83	IM	BALL METAL CONTAINER CORP	6600		WILL ROGERS	BLVD			4"	3467.8	2426.8	3032.1	3543.0	3441.3	3155.1	3841.0	321.2	2067.4	1933.1	1748.0	1436.2	30413.0
								irr.	two 2"	129.1	65.3	94.4	139.0	114.3	95.5	147.0	89.4	0.0	0.0	33.0	165.9	1072.9
										172.2	161.4	138.2	225.0	177.0	127.6	207.4	88.8	0.2	,20	0.0	103.0	1400.8

	Class	Customer Name			Street Address			Size	Dec-04	Nov-04	Oct-04	Sep-04	Aug-04	Jul-04	Jun-04	May-04	Apr-04	Mar-04	Feb-04	Jan-04	CCF
85	C	FORT WORTH CLUB	751		TAYLOR	ST		3"	1738.9	1542.4	1659.7	2200.6	2033.8	2048.6	2128.7	1745.7	1601.9	1498.8	1286.8	1427.1	20913.0
87	C	CMD REALTY INVESTORS	4100		INTERNATIONAL	PLZ		8"	1110.0	1780.5	1950.6	2705.8	2959.6	3136.4	2609.0	2234.6	1597.0	1074.7	1264.7	1312.9	23735.8
88	C	PUBLIC SCHOOL 005	5716		RAMEY	AV		2"	3285.7	3638.7	1995.8	1364.4	1539.4	2652.2	811.8	1851.2	1454.1	1928.7	1599.0	1236.3	23357.3
89	NP	NORTHWEST INDEPENDENT SCHOOL	2301		TEXAN	DR	B	6" & 8"	372.2	625.4	2906.1	4741.9	9325.4	4178.3	1837.4	2179.0	1043.4	650.6	821.1	1227.9	29908.7
		ADDED to list	2301		TEXAN	DR	C	8"													
90	IM	LONE STAR BEVERAGE COMPANY	2924	W	LANCASTER	AV	C	three 2"	1161.6	1169.1	1343.0	1422.7	1498.9	1412.3	1540.1	1282.1	1519.7	1747.9	1767.1	1174.6	17039.1
								& 1 1/2"													
91	NP	TEXAS CHRISTIAN UNIVERSITY	3600		KENT			6"	4040.0	3340.0	3420.0	2660.0	1620.0	1383.0	1273.0	2564.0	2620.0	2250.0	2040.0	1120.0	28330.0
92	DB	WILL ROGERS MEMORIAL CN	3411		CAMP BOWIE	BLVD		6"	333.0	3493.0	1803.0	2187.0	3186.0	3913.0	2576.0	1828.0	1617.0	644.0	1665.0	1067.0	24312.0
93	C	ELECTRONIC DATA SYSTEM 69822	13901		ELM	ST		4"	1444.2	1358.0	5977.0	2266.0	2406.0	2471.5	1686.5	1611.1	1748.3	2591.7	3643.9	1061.1	28265.3
94	CA	RESERVE AT OAK HILL	2450		OAK HILL	CIR		two 6"	1863.8	1663.5	1556.8	964.4	1376.3	1556.0	1351.9	1654.1	1918.6	1498.6	1426.0	1008.3	17838.3
95	IM	MOTOROLA INC	5555	N	BEACH	ST		6"	928.0	1844.0	3580.0	3770.0	6176.0	3263.0	2926.0	1916.0	1338.0	863.8	915.2	975.0	28495.0
97	NP	SOUTHWESTERN BAPTIST SEMINARY	2010	W	FULLER	AV		6"	1132.0	3184.0	5807.0	5196.0	4821.0	2369.0	3423.0	2962.0	2194.0	872.0	1202.0	847.0	34009.0
98	I	FORTRESS PROPERTIES LTD	101		ACADEMY	BLVD		two 10"	973.6	4351.4	3473.2	3763.2	3531.7	2887.8	3187.7	2630.5	1588.9	908.7	1115.9	494.0	28906.6
99	DB	ROLLING HILLS SOCCER	2797		JOE B RUSHING	RD	A	4"	5.0	400.0	5385.0	4285.0	4755.0	3262.0	3958.0	625.0	885.0	35.0	575.0	420.0	24590.0
100	NP	SOUTHWESTERN BAPTIST SEMINARY	1720	W	FULLER	AV		6"	218.0	2498.0	7839.0	7618.0	8098.0	2922.0	3166.0	2155.0	1422.0	320.0	1008.0	384.0	37648.0
101	C	FT WORTH OSTEOPATHIC HOSP INC	1000		MONTGOMERY	ST		4"	1233.0	1186.0	2376.0	3235.0	2802.0	2926.0	2995.0	3471.0	2285.0	1860.0	2330.0	102.0	26801.0
102	C	HARRIS METHODIST HOSPITAL	1250		COOPER	ST		10"	4672.0	4070.0	4104.0	4413.0	3760.0	1835.0	3993.0	1311.0	4867.0	417.0	5421.0	19.0	38882.0

Legend:

c = commercial

ca = commercial appartments

cm = commercial monitored

I = industrial

im = industrial monitored

db = departmental billing

np = not for profit

APPENDIX B RECLAIMED WATER DEMANDS FROM DRAFT FEASIBILITY STUDY- MARY'S CREEK RECYCLING CENTER

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APPENDIX C DRAFT TRANSMITTAL LETTER

Date
Customer Name
Address
Fort Worth, Texas

Subject: Nonpotable Water Uses

The City of Fort Worth is assessing potential uses for reclaimed water in the Fort Worth area by evaluating existing nonpotable water uses of major Fort Worth water customers. The City is currently in the early stages of planning for a reclaimed water system for Fort Worth and is interested in obtaining information from potential customers.

The State of Texas through the Texas Commission of Environmental Quality (TCEQ) has established a standard for reclaimed water in 30 TAC Chapter 210, "Use of Reclaimed Water." The TCEQ identifies two types of reclaimed water uses: Type 1 includes uses where the public may come in contact with the water and Type 2 where the public would not come in contact with the water. The following quality standards for reclaimed water are identified in Section 210.33. The Type 1 standards are currently being met by the City of Fort Worth:

TCEQ Standards for Recycled Water

	Type 1	Type 2
BOD [mg/l]	5	20
CBOD [mg/l]	5	15
Turbidity [NTU]	3	---
Fecal Coliform [CFU/100 ml] (*)	20	200
Max. Fecal Coliform [CFU/100 ml] (**)	75	800

(*) Geometric Mean
(**) Single Grab Sample

As a major water customer, you have been contacted to determine your water requirements for industrial, cooling, process, irrigation or other nonpotable purposes. The attached questionnaire is provided to understand your existing water quantity and quality needs and to assess the potential for reclaimed water to meet those needs in the future. Your responding to this questionnaire will not alter your existing water service in any way.

Please take a few moments to complete the enclosed questionnaire and return it in the enclosed self-addressed stamped envelope. Your assistance is greatly appreciated.

Regards,

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APPENDIX D SAMPLE STANDARD QUESTIONNAIRE

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CITY OF FORT WORTH
RECLAIMED WATER SERVICE QUESTIONNAIRE

Type of Service:

Single Family [ ]   Commercial [ ]   Multi-Family [ ]

City Facility [ ]   Institutional [ ]   Industrial [ ]   Other [ ] ____________

User/owner information:

User name: ____

Relationship to property: ____

Mailing address: ____

Telephone number: ____

Project/Site name and address: ____

Owner name: ____

Owner address: ____

Owner telephone number: ____

Type of Use (check each use):

[ ] Landscape irrigation (acreage of property to be irrigated: _____ acres)
[ ] Commerical   [ ] Construction   [ ] Other(s)
[ ] Industrial   [ ] Agricultural   [ ] Cooling

Estimated Demand:

Maximum gallons per year required: ______________________ gallons per year
Maximum gallons per minute required: _____________________gallons per minute
Maximum gallons per day required: ________________________gallons per day
Minimum pressure required: ____________ psi.   Size of meter required: ___________

Please mail or fax this form to:

Chris Harder
Fort Worth Water Department
Water Engineering
1000 Throckmorton Street
Fort Worth, TX 76102
Fax: 817-392-8195

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APPENDIX E DETAILED COST BREAKDOWNS FOR RECOMMENDED RECLAIMED WATER ALTERNATIVES

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City of Fort Worth - Summary of Recycled Water Alternatives

Alternative	Description	Phase	Year Bid	Const. Period	Annual Avg. Demand [MGD]	Peak System Demand[1] [MGD]	Capital Costs [$MM]	Identified Benefits [$MM]	Interest During Const. [$MM]	Total Cost/ NPV[2] [$MM]	Future Value [$MM]
E-1	**Village Creek WWTP to supply customers in east Fort Worth**				2.77	14.69	$20.25	$0.00	$1.16	$21.41	$26.34
	VC Pump Station and Transmission Main to Euless (30" and 24", 4.4 miles)	1	2010	24 months			$9.48	$0.00	$0.74	$10.22	$11.96
	Distribution Pipeline to Euless (16" and 12", 1.0 miles)	1a	2010	12 months			$0.68	$0.00	$0.03	$0.70	$0.82
	Distribution Pipeline to Arlington (8" and 6", 4.1 miles)	1b	2010	12 months			$1.76	$0.00	$0.07	$1.83	$2.14
	Transmission Main to Grand Prairie (24" and 20", 2.6 miles)	2	2013	12 months			$3.04	$0.00	$0.12	$3.15	$4.15
	Distribution Pipeline to Grand Prairie (10", 1.4 miles)	2a	2013	12 months			$0.77	$0.00	$0.03	$0.80	$1.05
	Transmission Main to DFW Airport (20", 1.8 miles)	3	2013	12 months			$1.87	$0.00	$0.07	$1.95	$2.56
	Distribution Pipeline to DFW Airport (20", 2.5 miles)	3a	2013	12 months			$2.38	$0.00	$0.09	$2.48	$3.26
	Distribution Pipeline to American Airlines (8", 0.7 miles)	4a	2015	12 months			$0.26	$0.00	$0.01	$0.27	$0.39
	City of Fort Worth Costs						**$14.39**		**$0.93**	**$15.32**	**$18.67**
	Customers Costs						**$5.86**		**$0.22**	**$6.09**	**$7.67**
N-2	**Denton Creek WWTP to supply customers in north Fort Worth**				4.19	11.07	$18.50	$0.00	$1.45	$19.95	$23.08
	DC Pump Station and Transmission Main to Alliance Gateway (20", 14", 12", 10", and 8", 7.3 miles)	1	2008	24 months			$6.87	$0.00	$0.54	$7.41	$8.011
	Phase 1a	1a	2008	24 months			$1.28	$0.00	$0.10	$1.38	$1.495
	Distribution Pipeline to A.C. Association/TMS (18", 16", 12" and 10", x.x miles)	2	2011	24 months			$8.98	$0.00	$0.70	$9.68	$11.775
	Distribution Pipeline to TMS (6", 0.1 miles)	2a	2011	24 months			$0.01	$0.00	$0.00	$0.02	$0.018
	Distribution Pipeline to A.C. East Association (8", 0.3 miles)	2b	2011	24 months			$1.36	$0.00	$0.11	$1.47	$1.784
	City of Fort Worth Costs						**$15.84**		**$1.24**	**$17.09**	**$19.79**
	Customers Costs						**$2.66**		**$0.21**	**$2.86**	**$3.30**
W-1	**10 mgd WRC to supply customers in Mary's Creek only**				3.79	18.12	$67.50	$0.00	$5.05	$72.55	$101.21
	Pump Station and Distribution Pipelines: 1-E, 1-W, 2-N, 2-S (30", 24", 18", 14", and 10", 7.8 miles)	1	2009	24 months			$12.42	$0.00	$0.97	$13.39	$15.07
	Pump Station and Distribution Pipelines: 3-NB (20", 1.0 miles)	2	2011	12 months			$5.86	$0.00	$0.22	$6.09	$7.41
	Pump Station and Distribution Pipelines : 3-NA, 4, 5 (36", 24", and 12", 5.4 miles)	3	2012	24 months			$13.24	$0.00	$1.04	$14.28	$18.07
	Distribution Pipelines: 3-S (30", 2.1 miles)	4	2013	24 months			$3.09	$0.00	$0.24	$3.33	$4.38
	Construct 5 mgd WRC	5	2016	24 months			$18.90	$0.00	$1.48	$20.38	$30.17
	Expand WRC to 10 mgd	6	2020	24 months			$13.99	$0.00	$1.10	$15.08	$26.12
	City of Fort Worth Costs						**$67.50**		**$5.05**	**$72.55**	**$101.21**
	Customers Costs										
CS-2	**VCWWTP to supply customers in central & southern FW**				2.179	14.47	$38.77	$0.00	$2.58	$41.35	$60.60
	VC Pump Station and Transmission Main to Woodhaven GC (36" and 10", 5.9 miles)	1	2014	24 months			$13.27	$0.00	$1.04	$14.31	$19.58
	Transmission Main to Meadowbrook GC (30" and 10", 1.6 miles)	2	2015	12 months			$1.26	$0.00	$0.05	$1.31	$1.86
	Transmission Main to Cobb Park (30", 24", and 16", 7.8 miles)	3	2015	24 months			$9.17	$0.00	$0.72	$9.89	$14.08
	Transmission Main and Distribution Pipeline to Gateway Park (16" and 10", 1.1 miles)	4	2016	12 months			$0.64	$0.00	$0.02	$0.67	$0.99
	Distribution Pipelines to Sycamore Park and Sycamore GC (8", 0.6 miles)	4a	2016	12 months			$0.18	$0.00	$0.01	$0.19	$0.28
	Trqansmission Main to Trinity River Vision (16" and 12", 4.7 miles)	5	2017	24 months			$5.02	$0.00	$0.39	$5.41	$8.33
	Transmission Main to Glen Garden GC (16", 0.8 miles)	6	2017	12 months			$0.63	$0.00	$0.02	$0.65	$1.01
	Distribution Pipeline to Glen Garden GC (6", 0.3 miles)	6a	2017	12 months			$0.10	$0.00	$0.00	$0.10	$0.16
	Booster Pump Station and Transmission Main to TCJC (20" and 16", 2.8 miles)	7	2018	12 months			$5.61	$0.00	$0.21	$5.82	$9.32
	Distribution Pipeline to TCJC (6", 0.2 miles)	7a	2018	12 months			$0.06	$0.00	$0.00	$0.06	$0.10
	Transmission Main to Rolling Hills and Alcon Lab. (16", 2.8 miles)	8	2019	12 months			$2.19	$0.00	$0.08	$2.28	$3.79
	Distribution Pipelines to Ball Metal Co., Miller Brewery, and Mrs. Bairds (6", 1.5 miles)	8a	2019	12 months			$0.49	$0.00	$0.02	$0.51	$0.84
	Distribution Pipeline to Harris Meth. Hosp (6", 0.5 miles)	9a	2019	12 months			$0.15	$0.00	$0.01	$0.15	$0.25
	City of Fort Worth Costs						**$37.79**		**$2.55**	**$40.34**	**$58.96**
	Customers Costs						**$0.98**		**$0.04**	**$1.01**	**$1.64**

Peak demand of all users assuming non-coincidental flows (peak hour for users without storage + peak month for users with storage)

Total cost if project constructed in Year 2006

Phases idenfied by *"a"* or *"b"* to be constructed and paid for by customer

	City + Customer Costs							
	Cost ($MM)	NPV ($MM)	Future ($MM)	*E-1, N-2, W-1, CS-2	Central	East	North	West
2006	$ -	$ -	$ -					
2007	$ -	$ -	$ -					
2008	$ 8.15	$ 8.79	$ 9.51	($1.10 / $1.19 / $1.28 to be paid by customers)			Phase 1	
2009	$ 12.42	$ 13.39	$ 15.07					Phase 1
2010	$ 11.92	$ 12.76	$ 14.93	($1.59 / $1.65 / $1.93 to be paid by customers)		Phase 1		
2011	$ 16.21	$ 17.25	$ 20.98	($1.18 / $1.28 / $1.55 to be paid by customers)			Phase 2	Phase 2
2012	$ 13.24	$ 14.28	$ 18.07					Phase 3
2013	$ 11.15	$ 11.70	$ 15.40	($2.30 / $2.39 / $3.14 to be paid by customers)		Phase 2,3		Phase 4
2014	$ 13.27	$ 14.31	$ 19.58		Phase 1			
2015	$ 10.70	$ 11.47	$ 16.33	($0.23 / $0.24 / $0.34 to be paid by customers)	Phase 2,3	Phase 4		
2016	$ 19.73	$ 21.24	$ 31.44	($0.16 / $0.16 / $0.24 to be paid by customers)	Phase 4			Phase 5
2017	$ 5.75	$ 6.17	$ 9.49	($0.09 / $0.09 / $0.24 to be paid by customers)	Phase 5,6			
2018	$ 5.67	$ 5.89	$ 9.42	($0.05 / $0.05 / $0.08 to be paid by customers)	Phase 7			
2019	$ 2.83	$ 2.94	$ 4.89	($0.53 / $0.55 / $0.92 to be paid by customers)	Phase 8,9			
2020	$ 13.99	$ 15.08	$ 26.12					Phase 6
2021	$ -	$ -	$ -					
2022	$ -	$ -	$ -					
2023	$ -	$ -	$ -					
2024	$ -	$ -	$ -					
2025	$ -	$ -	$ -					
2026	$ -	$ -	$ -					
2027	$ -	$ -	$ -					
2028	$ -	$ -	$ -					
2029	$ -	$ -	$ -					
2030	$ -	$ -	$ -					
Total	$ 145.02	$ 155.26	$ 211.22					

Hydraulic Evaluation
Eastern System (Alternative E-1)

Pipe Sizing and Estimated Cost

Velocity: 5 ft/sec C = 130

ID #	From	To	Phase	Annual Av.Demand (mgd)	Peak Demand (mgd)	Design Capacity (mgd)	Calculated Diameter[1] (in)	Design Diameter (in)	Pipeline: Distance (mile)	Pipeline: Length (ft)	Pipeline: Unit Cost[2]	Pipeline: Cost	ROW (ft)	Land: Area[3] (acre)	Land: Unit Cost	Land: Cost	Total Pipeline Cost	Pipeline Maintenance Costs[4]	Start Elevation (ft)	End Elevation (ft)	Static Head (ft)	Max. Cap. Velocity (ft/sec)	Head Loss (ft)	Req. Pressure Head (ft)	TDH
1	VCWWTP	1	1	2.55	13.69	13.69	27.9	30	2.12	11200	$ 200.00	$2,240,000	20	5.1	$30,000	$153,000	$2,393,000	$27,000	472	534	62	4.3	21.21		83.21
2	1	2	1	2.55	13.69	13.69	27.9	30	1.10	5800	$ 200.00	$1,160,000	20	2.7	$30,000	$81,000	$1,241,000	$14,000	534	495	-39	4.3	10.98		-28.02
3	2	3	1	2.03	10.36	10.36	24.2	24	1.14	6000	$ 170.00	$1,020,000	20	2.8	$30,000	$84,000	$1,104,000	$12,000	495	498	3	5.1	20.10		23.10
4	3	4	2	1.8	7.86	7.86	21.1	24	1.80	9500	$ 170.00	$1,615,000	20	4.4	$30,000	$132,000	$1,747,000	$19,000	498	498	0	3.9	19.09		19.09
5	4	5	2	1.77	7.34	7.34	20.4	20	0.76	4000	$ 140.00	$560,000	20	1.8	$30,000	$54,000	$614,000	$7,000	498	499	1	5.2	17.20		18.20
6	5	6	3	1.53	6.06	6.06	18.5	20	1.80	9500	$ 140.00	$1,330,000	20	4.4	$30,000	$132,000	$1,462,000	$16,000	499	526	27	4.3	28.65		55.65
7	1	Bell Helicopter	5	0	0	0.00	0.0	8	0.00	0	$ 45.00	$0	0	0.0	$30,000	$0	$0	$0	534	520	-14	0.0	0.00	138	124.00
8	2	Texas Star GC	1a	0.52	3.33	3.33	13.7	16	0.19	1000	$ 104.00	$104,000	0	0.0	$30,000	$0	$104,000	$1,000	495	492	-3	3.7	2.95	0	-0.05
9	3	Texas Star	1a	0.23	2.5	2.50	11.9	12	0.85	4500	$ 81.00	$365,000	20	2.1	$30,000	$63,000	$428,000	$4,000	498	524	26	4.9	31.70	138	195.70
10	4	AA	4a	0.03	0.52	0.52	5.4	8	0.72	3800	$ 45.00	$171,000	15	1.3	$30,000	$39,000	$210,000	$2,000	498	560	62	2.3	10.53	138	210.53
11	5	Riverside GC	2a	0.24	1.28	1.28	8.5	10	1.44	7600	$ 67.00	$509,000	20	3.5	$30,000	$105,000	$614,000	$6,000	499	463	-36	3.6	37.66	0	1.66
12	6	DFW	3a	1.53	6.06	6.06	18.5	20	2.46	13000	$ 140.00	$1,820,000	0	0.0	$30,000	$0	$1,820,000	$22,000	526	542	16	4.3	39.21	0	55.21
												$10,894,000		28.1		$843,000	$11,737,000	$130,000							
13	VCWWTP	7	1b	0.22	1	1.00	7.5	8	0.55	2900	$ 45.00	$131,000	0	0.0	$30,000	$0	$131,000	$2,000	472	488	16	4.4	26.97		42.97
14	7	8	1b	0.21	0.9	0.90	7.1	8	0.93	4900	$ 45.00	$221,000	0	0.0	$30,000	$0	$221,000	$3,000	488	495	7	4.0	37.50		44.50
15	8	9	1b	0.17	0.5	0.50	5.3	8	0.55	2900	$ 45.00	$131,000	0	0.0	$30,000	$0	$131,000	$2,000	495	491	-4	2.2	7.47		3.47
16	7	Dunlop S.C	1b	0.01	0.1	0.10	2.4	6	0.19	1000	$ 39.00	$39,000	0	0.0	$30,000	$0	$39,000	$0	488	495	7	0.8	0.53	138	145.53
17	8	RLP	1b	0.04	0.4	0.40	4.8	6	0.72	3800	$ 39.00	$148,000	0	0.0	$30,000	$0	$148,000	$2,000	495	469	-26	3.2	26.30	0	0.30
18	9	Chester Ditto	1b	0.17	0.5	0.50	5.3	8	1.19	6300	$ 45.00	$284,000	0	0.0	$30,000	$0	$284,000	$3,000	491	538	47	2.2	16.23	0	63.23
												$11,848,000		28.1		$843,000	$12,691,000	$142,000							

Pump Station Cost

ID #	Pump Station No.	Name		Capacity (mgd)	Design Diameter (in)	Max. Cap. Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure Head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Pump Station Cost[6]
	1a	VCWWTP to DFW		13.69			156	70	0	226	726	541	
1		VCWWTP	1	13.69	30	4.3	21.2	62.0					
2		1	2	13.69	30	4.3	11.0	-39.0					
3		2	3	10.36	24	5.1	20.1	3.0					
4		3	4	7.86	24	3.9	19.1	0.0					
5		4	5	7.34	20	5.2	17.2	1.0					
6		5	6	6.06	20	4.3	28.7	27.0					
12		6	DFW	6.06	20	4.3	39.2	16.0					
	1b	VCWWTP to AA		13.69			82	88	138.0	308	987	736	$2,479,000
1		VCWWTP	1	13.69	30	4.3	21.2	62.0					
2		1	2	13.69	30	4.3	11.0	-39.0					
3		2	3	10.36	24	5.1	20.1	3.0					
4		3	4	7.86	24	3.9	19.1	0.0					
10		4	AA	0.52	8	2.3	10.5	62.0					
	2a	VCWWTP to Chester Ditto		1			88	66	0.0	154	36	27	
13		VCWWTP	7	1	8	4.4	27.0	16.0					
14		7	8	0.9	8	4.0	37.5	7.0					
15		8	9	0.5	8	2.2	7.5	-4.0					
18		9	Chester Ditto	0.5	8	2.2	16.2	47.0					
	2b	VCWWTP to Dunlop S.C		1			28	23	138.0	189	44	33	$380,000
13		VCWWTP	7	1	8	4.4	27.0	16.0					
16		7	Dunlop S.C	0.1	6	0.8	0.5	7.0					
		VCWWTP Storage Tank		0									
												Total:	**$2,859,000**

Pump Station Annual Operation and Maintenance Cost

ID #	Pump Station No.	Name		Annual Av.Demand (mgd)	Pipe Length (ft)	Design Diameter (in)	Average Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Unit Power Cost ($/kWh)	Annual Power Cost	Annual Maint. Cost[7]
	1a	VCWWTP to DFW		2.55				10.20	70	0.0	80	48	36	$0.10		
1		VCWWTP	1	2.55	11200	30	0.80	0.94	62.0							
2		1	2	2.55	5800	30	0.80	0.49	-39.0							
3		2	3	2.03	6000	24	1.00	0.98	3.0							
4		3	4	1.8	9500	24	0.89	1.25	0.0							
5		4	5	1.77	4000	20	1.26	1.24	1.0							
6		5	6	1.53	9500	20	1.09	2.24	27.0							
12		6	DFW	1.53	13000	20	1.09	3.06	16.0							
	1b	VCWWTP to AA		2.55				3.71	88	138.0	230	137	102	$0.10	$90,000	$74,000
1		VCWWTP	1	2.55	11200	30	0.80	0.94	62.0							
2		1	2	2.55	5800	30	0.80	0.49	-39.0							
3		2	3	2.03	6000	24	1.00	0.98	3.0							
4		3	4	1.8	9500	24	0.89	1.25	0.0							
10		4	AA	0.03	3800	8	0.13	0.05	62.0							
	2a	VCWWTP to Chester Ditto		0.22				7.38	66	0.0	73	4	3	$0.10		
13		VCWWTP	7	0.22	2900	8	0.98	1.63	16.0							
14		7	8	0.21	4900	8	0.93	2.53	7.0							
15		8	9	0.17	2900	8	0.75	1.01	-4.0							
18		9	Chester Ditto	0.17	6300	8	0.75	2.20	47.0							
	2b	VCWWTP to Dunlop S.C		0.22				1.64	23	138.0	163	8	6	$0.10	$5,000	$11,000
13		VCWWTP	7	0.22	2900	8	0.98	1.63	16.0							
16		7	Dunlop S.C	0.01	1000	6	0.08	0.01	7.0							
		VCWWTP Storage Tank		0												$0
														Total:	$95,000	$85,000

Summary of Estimated Cost

Phase	ID #	From	To	Design Capacity mgd	Capital Cost: WRC Cost	Pump Station & Storage Tank	Pipeline	Land	Contingency & Fees	Permitting & Mitigation	Total Capital Cost	Annual Operation and Maintenance Cost: Energy Cost	Pipe Maint.	PS Equip. Maint.	Total O & M
1	1	VCWWP	1	13.69		$2,479,000	$2,240,000	$153,000	$1,540,000	$47,000	$6,459,000	$90,000	$27,000	$74,000	$191,000
1	2	1	2	13.69			$1,160,000	$81,000	$348,000	$12,000	$1,601,000		$14,000		$14,000
1	3	2	3	10.36			$1,020,000	$84,000	$306,000	$10,000	$1,420,000		$12,000		$12,000
2	4	3	4	7.86			$1,615,000	$132,000	$485,000	$16,000	$2,248,000		$19,000		$19,000
2	5	4	5	7.34			$560,000	$54,000	$168,000	$6,000	$788,000		$7,000		$7,000
3	6	5	6	6.06			$1,330,000	$132,000	$399,000	$13,000	$1,874,000		$16,000		$16,000
5	7	1	Bell Helicopter	0			$0	$0	$0	$0	$0		$0		$0
1a	8	2	Texas Star GC	3.33			$104,000	$0	$31,000	$1,000	$136,000		$1,000		$1,000
1a	9	3	Texas Star	2.5			$365,000	$63,000	$110,000	$4,000	$542,000		$4,000		$4,000
4a	10	4	AA	0.52			$171,000	$39,000	$51,000	$2,000	$263,000		$2,000		$2,000
2a	11	5	Riverside GC	1.28			$509,000	$105,000	$153,000	$5,000	$772,000		$6,000		$6,000
3a	12	6	DFW	6.06			$1,820,000	$0	$546,000	$18,000	$2,384,000		$22,000		$22,000
1b	13	VCWWTP	7	1		$380,000	$131,000	$0	$172,000	$5,000	$688,000	$5,000	$2,000	$11,000	$18,000
1b	14	7	8	0.9			$221,000	$0	$66,000	$2,000	$289,000		$3,000		$3,000
1b	15	8	9	0.5			$131,000	$0	$39,000	$1,000	$171,000		$2,000		$2,000
1b	16	7	Dunlop S.C	0.1			$39,000	$0	$12,000	$0	$51,000		$0		$0
1b	17	8	RLP	0.4			$148,000	$0	$44,000	$1,000	$193,000		$2,000		$2,000
1b	18	9	Chester Ditto	0.5			$284,000	$0	$85,000	$3,000	$372,000		$3,000		$3,000
						$2,859,000	$11,848,000	$843,000	$4,555,000	$146,000	$20,251,000	$95,000	$142,000	$85,000	$322,000

Pump Station Cost - Averages

Years	Amortized Capital Costs, 20 Yrs @ 5.5%	Annual Power Cost ($)	Annual O&M Cost (Excluding Power)	Total ($)
1-20	$1,695,000	$95,000	$227,000	40,340,000
20-50	0	$95,000	$227,000	9,660,000
			Total =	$50,000,000

Average Cost = $1,000,000 Per Year
Average Cost = $0.99 Per 1000 Gallons

Assumptior 1. Maximum pipeline velocity is 5 ft/s.
2. Pipeline cost was developed by CPY
3. Land cost developed separately.
4. Pipeline maintenance costs assumed 1% of construction cost.
5. Power based upon pump wire to water efficiency of 75%.
6. Pump station costs developed separately.
7. PS equipment maintenance costs 2.5% of PS construction costs.

Hydraulic Evaluation
Northern System (Alternative N-2)

Pipe Sizing and Estimated Cost

Velocity: 5 ft/sec | C = 130

ID #	From	To	Phase	Annual Avg. Demand (mgd)	Peak Demand (mgd)	Design Capacity (mgd)	Calculated Diameter[1] (in)	Design Diameter (in)	Pipeline					Land			Total Pipeline Cost	Pipeline Maintenance Costs[4]	Start Elevation (ft)	End Elevation (ft)	Static Head (ft)	Max. Cap. Velocity (mgd)	Head Loss (ft)	Req. Pressure Head (ft)	TDH
									Distance (mile)	Length (ft)	Unit Cost[2]	Cost	ROW (ft)	Area[3] (acre)	Unit Cost	Cost									
	TRA WWTP	Total		4.19	11.07																				
	TRA WWTP	Frac Water	1	0.05	0.15																				
1	TRA WWTP	1	1	4.14	10.92	10.92	24.9	30	1.35	7800	$ 200.00	$1,560,000	20	3.6	$30,000	$108,000	$1,668,000	$17,000	565	618	53	3.4	10		63
2	1	2	2	1.94	5.11	5.11	17.0	18	2.65	14000	$ 124.00	$1,736,000	20	6.4	$30,000	$192,000	$1,928,000	$19,000	618	625	7	4.5	51		58
3	2	3	2	1.91	5.04	5.04	16.9	18	1.16	6100	$ 124.00	$756,000	20	2.8	$30,000	$84,000	$840,000	$8,000	625	596	-29	4.4	22		-7
4	3	4	2	1.91	5.04	5.04	16.9	18	1.04	5500	$ 124.00	$682,000	20	2.5	$30,000	$75,000	$757,000	$8,000	596	671	75	4.4	20		95
5	4	5	2	0.79	2.08	2.08	10.9	12	0.76	4000	$ 81.00	$324,000	20	1.8	$30,000	$54,000	$378,000	$4,000	671	662	-9	4.1	20		11
6	1	6	1	2.20	5.81	5.81	18.2	20	2.31	12200	$ 140.00	$1,708,000	20	1.7	$30,000	$51,000	$1,759,000	$19,000	618	705	87	4.1	34		121
7	6	7	1	0.68	1.79	1.79	10.1	10	0.42	2200	$ 67.00	$147,000	20	1.0	$30,000	$30,000	$177,000	$2,000	705	710	5	5.1	20		25
8	2	TX Motor Speedway	2a	0.027	0.071	0.07	2.0	6	0.06	300	$ 39.00	$12,000	0	0.0	$30,000	$0	$12,000	$0	625	623	-2	0.6	0	0	-2
9	4	A.C West Association	2	1.121	2.958	2.96	13.0	16	3.98	21000	$ 104.00	$2,184,000	20	0.9	$30,000	$27,000	$2,211,000	$24,000	671	703	32	3.3	50	0	82
10	5	A.C East Association	2b	0.362	0.955	0.96	7.4	8	0.28	1500	$ 45.00	$68,000	0	0.0	$30,000	$0	$68,000	$1,000	662	669	7	4.2	13	0	20
11	5	Alliance Lone Star Assoc.	2	0.427	1.128	1.13	8.0	10	2.46	13000	$ 67.00	$871,000	20	3.3	$30,000	$99,000	$970,000	$10,000	662	673	11	3.2	51	0	62
12	6	Alliance Gateway Ph3 (A)	1	1.521	4.014	4.01	15.1	16	0.81	4300	$ 104.00	$447,000	20	2.0	$30,000	$60,000	$507,000	$5,000	705	670	-35	4.4	18	20	3
13	7	Alliance Gateway Ph2	1a	0.444	1.172	1.17	8.2	8	0.53	2800	$ 45.00	$126,000	15	1.0	$30,000	$30,000	$156,000	$1,000	710	695	-15	5.2	35	0	20
14	7	Alliance Gateway Ph1 (A)	1a	0.236	0.622	0.62	5.9	8	0.76	4000	$ 45.00	$180,000	15	1.4	$30,000	$42,000	$222,000	$2,000	710	695	-15	2.8	15	20	20
												$10,801,000		28.4		$852,000	$11,653,000	$120,000							

Pump Station Cost

ID #	Pump Station No.	Name		Capacity (mgd)	Design Diameter (in)	Max. Cap. Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure Head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Pump Station Cost[6]
	1a	TRA WWTP to Alliance Gateway Ph1 (A)		10.92			80	130	20	230	587	438	$0
1		TRA WWTP	1	10.92	30	3.4	9.7	53.0					
6		1	6	5.808	20	4.1	34.0	87.0					
7		6	7	1.794	10	5.1	20.4	5.0					
14		7	Alliance Gateway Ph1 (A)	0.622	8	2.8	15.4	-15.0					
	1b	TRA WWTP to Alliance Gateway Ph2		10.92			99	130	0	229	585	437	$0
1		TRA WWTP	1	10.92	30	3.4	9.7	53.0					
6		1	6	5.808	20	4.1	34.0	87.0					
7		6	7	1.794	10	5.1	20.4	5.0					
13		7	Alliance Gateway Ph2	1.172	8	5.2	34.9	-15.0					
	1c	TRA WWTP to A.C. West Association		10.92			153	138	0	291	743	554	$2,074,000
1		TRA WWTP	1	10.92	30	3.4	9.7	53.0					
2		1	2	5.112	18	4.5	51.5	7.0					
3		2	3	5.041	18	4.4	21.9	-29.0					
4		3	4	5.041	18	4.4	19.7	75.0					
9		4	A.C West Association	2.958	16	3.3	49.8	32.0					
	1d	TRA WWTP to Alliance Lone Star Association		10.92			174	108	0	282	720	537	$0
1		TRA WWTP	1	10.92	30	3.4	9.7	53.0					
2		1	2	5.112	18	4.5	51.5	7.0					
3		2	3	5.041	18	4.4	21.9	-29.0					
4		3	4	5.041	18	4.4	19.7	75.0					
5		4	5	2.083	12	4.1	20.1	-9.0					
11		5	Alliance Lone Star Assoc.	1.128	10	3.2	51.0	11.0					
		TRA WWTP Storage Tank		0.50									$500,000
												Total:	**$2,574,000**

Pump Station Annual Operation and Maintenance Cost

ID #	Pump Station No.	Name		Annual Av.Demand (mgd)	Pipe Length (ft)	Design Diameter (in)	Average Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Unit Power Cost ($/kWh)	Annual Power Cost	Annual Maint. Cost[7]
	1a	TRA WWTP to Alliance Gateway Ph1 (A)		4.14				13.20	130	20.0	163	158	118	$0.10	$0	$0
1		TRA WWTP	1	4.138	7800	30	1.30	1.61	53.0							
6		1	6	2.201	12200	20	1.56	5.64	87.0							
7		6	7	0.68	2200	10	1.93	3.38	5.0							
14		7	Alliance Gateway Ph1 (A)	0.236	4000	8	1.05	2.57	-15.0							
	1a	TRA WWTP to Alliance Gateway Ph2		4.14				16.42	130	0.0	146	142	106	$0.10	$0	$0
1		TRA WWTP	1	4.138	7800	30	1.30	1.61	53.0							
6		1	6	2.201	12200	20	1.56	5.64	87.0							
7		6	7	0.68	2200	10	1.93	3.38	5.0							
13		7	Alliance Gateway Ph2	0.444	2800	8	1.97	5.79	-15.0							
	1b	TRA WWTP to A.C. West Association		4.14				25.29	138	0.0	163	158	118	$0.10	$103,000	$62,000
1		TRA WWTP	1	4.138	7800	30	1.30	1.61	53.0							
2		1	2	1.937	14000	18	1.70	8.53	7.0							
3		2	3	1.91	6100	18	1.67	3.62	-29.0							
4		3	4	1.91	5500	18	1.67	3.27	75.0							
9		4	A.C West Association	1.121	21000	16	1.24	8.25	32.0							
	1b	TRA WWTP to Alliance Lone Star Association		4.14				28.80	108	0.0	137	133	99	$0.10	$0	$0
1		TRA WWTP	1	4.138	7800	30	1.30	1.61	53.0							
2		1	2	1.937	14000	18	1.70	8.53	7.0							
3		2	3	1.91	6100	18	1.67	3.62	-29.0							
4		3	4	1.91	5500	18	1.67	3.27	75.0							
5		4	5	0.789	4000	12	1.55	3.33	-9.0							
11		5	Alliance Lone Star Assoc.	0.427	13000	10	1.21	8.44	11.0							
		TRA WWTP Storage Tank		4												$6,000
														Total:	$103,000	$68,000

Summary of Estimated Cost

Phase	ID #	From	To	Design Capacity mgd	Capital Cost: WRC Cost	Pump Station & Storage Tank	Pipeline	Land	Contingency & Fees	Permitting & Mitigation	Total Capital Cost	Annual Operation and Maintenance Cost: Energy Cost	Pipe Maint.	PS Equip. Maint.	Total O & M
1	1	TRA WWTP	1	10.92		$1,744,000	$1,560,000		$748,000	$33,000	$4,085,000	$103,000	$17,000	$68,000	$188,000
2	2	1	2	5.112			$1,736,000		$347,000	$17,000	$2,100,000		$19,000		$19,000
2	3	2	3	5.041			$756,000		$151,000	$8,000	915000		$8,000		$8,000
2	4	3	4	5.041			$682,000		$136,000	$7,000	825000		$8,000		$8,000
2	5	4	5	2.083			$324,000		$65,000	$3,000	$392,000		$4,000		$4,000
1	6	1	6	5.808			$1,708,000		$342,000	$17,000	$2,067,000		$19,000		$19,000
1	7	6	7	1.794			$147,000		$29,000	$1,000	$177,000		$2,000		$2,000
2a	8	2	TX Motor Speedway	0.071			$12,000		$2,000	$0	$14,000		$0		$0
2	9	4	A.C West Association	2.958			$2,184,000		$437,000	$22,000	$2,643,000		$24,000		$24,000
2b	10	5	A.C East Association	0.955			$68,000		$14,000	$1,000	$83,000		$1,000		$1,000
2	11	5	Alliance Lone Star Assoc.	1.128			$871,000		$174,000	$9,000	$1,054,000		$10,000		$10,000
1	12	6	Alliance Gateway Ph3 (A)	4.014			$447,000		$89,000	$4,000	$540,000		$5,000		$5,000
1a	13	7	Alliance Gateway Ph2	1.172			$126,000		$25,000	$1,000	$152,000		$1,000		$1,000
1a	14	7	Alliance Gateway Ph1 (A)	0.622			$180,000		$36,000	$2,000	$218,000		$2,000		$2,000
2		Expand Pump Station				$830,000			$208,000	$8,000	$1,046,000				
1a		Easement Acquisition (Phase 1)						$321,000			$321,000				
2b		Easement Acquisition (Phase 2)						$531,000			$531,000				
1a		Engineering - Pipelines (Phase 1)							$417,000		$417,000				
2b		Engineering - Pipelines (Phase 2)							$663,000		$663,000				
1a		Engineering - Pump Station (Phase 1)							$174,000		$174,000				
2b		Engineering - Pump Station (Phase 2)							$83,000		$83,000				
						$2,574,000	$10,801,000	$852,000	$4,140,000	$133,000	$18,500,000	$103,000	$120,000	$68,000	$291,000

Pump Station Cost - Averages

Years	Amortized Capital Costs, 20 Yrs @ 5.5%	Annual Power Cost ($)	Annual O&M Cost (Excluding Power)	Total ($)
1-20	$1,548,000	$103,000	$188,000	36,780,000
20-50	0	$103,000	$188,000	8,730,000
			Total =	$45,510,000

Average Cost =	$910,000	Per Year
Average Cost =	$0.60	Per 1000 Gallons
Purchase Cost =	$0.25	Per 1000 Gallons
Total Cost =	$0.85	Per 1000 Gallons

Assumptior 1. Maximum pipeline velocity is 5 ft/s.
2. Pipeline cost was developed by CPY
3. Land cost developed separately.
4. Pipeline maintenance costs assumed 1% of construction cost.
5. Power based upon pump wire to water efficiency of 75%.
6. Pump station costs developed separately.
7. PS equipment maintenance costs 2.5% of PS construction costs.

Hydraulic Evaluation
Western System (Alternative W-1)

Pipe Sizing and Estimated Cost

Velocity: 5 ft/sec | C = 130

ID #	From	To	Phase	Annual Av.Demand (mgd)	Peak Demand (mgd)	Design Capacity (mgd)	Calculated Diameter[1] (in)	Design Diameter (in)	Pipeline: Distance (mile)	Pipeline: Length (ft)	Pipeline: Unit Cost[2]	Pipeline: Cost	ROW (ft)	Land: Area[3] (acre)	Land: Unit Cost	Land: Cost	Total Pipeline Cost	Pipeline Maintenance Costs[4]	Start Elevation (ft)	End Elevation (ft)	Static Head (ft)	Max. Cap. Velocity (mgd)	Head Loss (ft)	Req. Pressure Head (ft)	TDH
1	WRC	ST1	1	3.79	10.00	10.00	23.8	24	0.11	600	$ 170.00	$102,000	20	0.3	$30,000	$9,000	$111,000	$1,000	732	732	0	4.9	1.88		1.88
2	ST1	Junction 1 (Line 1S)	1	3.49	12.8	12.80	26.9	30	0.25	1300	$ 200.00	$260,000	20	0.6	$30,000	$18,000	$278,000	$3,000	732	730	-2	4.0	2.17		0.17
3	Junction 1	1-E (Line 1E)	1	0.05	1.15	1.15	8.1	10	0.57	3000	$ 67.00	$201,000	20	1.4	$30,000	$42,000	$243,000	$2,000	730	760	30	3.3	12.19	138	180.19
4	Junction 1	2-N (Line 2N)	1	0.10	2.37	2.37	11.6	16	1.93	10200	$ 104.00	$1,061,000	20	4.7	$30,000	$141,000	$1,202,000	$12,000	730	898	168	2.6	16.03	138	322.03
5	ST1	2-S (Line 2S)	1	0.30	5.42	5.42	17.5	18	2.20	11600	$ 124.00	$1,438,000	20	5.3	$30,000	$159,000	$1,597,000	$16,000	732	890	158	4.7	47.54	138	343.54
6	Junction 1	ST2 (Line 1W)	1	3.34	9.28	9.28	22.9	24	2.75	14500	$ 170.00	$2,465,000	20	6.7	$30,000	$201,000	$2,666,000	$27,000	730	900	170	4.6	39.62	138	347.62
7	ST2	ST3 (Line 3NB)	2	2.08	7.02	7.02	20.0	20	0.97	5100	$ 140.00	$714,000	20	2.3	$30,000	$69,000	$783,000	$8,000	900	850	-50	5.0	20.20	138	108.20
8	ST3	3-NA (Line 3NA)	3	1.24	21.44	21.44	34.9	36	1.19	6300	$ 230.00	$1,449,000	20	2.9	$30,000	$87,000	$1,536,000	$16,000	850	830	-20	4.7	11.27	138	129.27
9	ST2	3-S (Line 3S)	4	1.08	13.86	13.86	28.0	30	2.12	11200	$ 200.00	$2,240,000	20	5.1	$30,000	$153,000	$2,393,000	$25,000	900	985	85	4.4	21.70	138	244.70
10	ST3	4-MCR (Line 4MCR)	3	0.74	8.62	8.62	22.1	24	1.95	10300	$ 170.00	$1,751,000	20	4.7	$30,000	$141,000	$1,892,000	$19,000	850	1000	150	4.2	24.55	138	312.55
11	4-MCR	5-MCR (Line 5MCR)	3	0.06	1.52	1.52	9.3	12	2.22	11700	$ 81.00	$948,000	20	5.4	$30,000	$162,000	$1,110,000	$10,000	1000	950	-50	3.0	32.80	138	120.80
12	1-E	2	0	0	0.00	0.00	0.0	36	0.00	0	$ 230.00	$0	20	0.0	$30,000	$0	$0	$0	760	764	4	0.0	0.00		4.00
13	2	3	0	0	0	0.00	0.0	12	0.00	0	$ 81.00	$0	20	0.0	$30,000	$0	$0	$0	764	740	-24	0.0	0.00		-24.00
14	3	4	0	0	0	0.00	0.0	8	0.00	0	$ 45.00	$0	15	0.0	$30,000	$0	$0	$0	740	649	-91	0.0	0.00		-91.00
15	4	6	0	0	0	0.00	0.0	8	0.00	0	$ 45.00	$0	15	0.0	$30,000	$0	$0	$0	649	610	-39	0.0	0.00		-39.00
16	2	South Z-Boaz Park	0	0	0.00	0.00	0.0	30	0.00	0	$ 200.00	$0	20	0.0	$30,000	$0	$0	$0	764	649	-115	0.0	0.00	138	23.00
17	3	Z-Boaz GC	0	0	0.00	0.00	0.0	10	0.00	0	$ 67.00	$0	20	0.0	$30,000	$0	$0	$0	740	700	-40	0.0	0.00		-40.00
18	6	Carswell GC (Hawks Creek)	0	0	0.00	0.00	0.0	8	0.00	0	$ 45.00	$0	15	0.0	$30,000	$0	$0	$0	610	610	0	0.0	0.00		0.00
												$12,629,000		39.4		$1,182,000	$13,811,000	$139,000							

Pump Station Cost

ID #	Pump Station No.	Name		Capacity (mgd)	Design Diameter (in)	Max. Cap. Velocity (fps)	Headloss (mgd)	Static Head (ft)	Req. Pressure Head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Pump Station Cost[6]
		WRC		**10**									
	1a	ST1 to Hawk's Creek		18.22			14	-122	0	-108	-459	-342	
2		ST1	Junction 1 (Line 1S)	12.8	30	4.0	2.2	-2					
3		Junction 1	1-E (Line 1E)	1.15	10	3.3	12.2	30					
12		1-E	2	0	36	0.0	0.0	4					
13		2	3	0	12	0.0	0.0	-24					
14		3	4	0	8	0.0	0.0	-91					
15		4	6	0	8	0.0	0.0	-39					
21		6	Carswell GC (Hawks Creek)	0	8	0.0	0.0	0					
	1b	ST1 to 1-W		18.22			42	168	138	348	1483	1106	$3,063,000
2		ST1	Junction 1 (Line 1S)	12.8	30	4.0	2.2	-2.0					
6		Junction 1	ST2 (Line 1W)	9.28	24	4.6	39.6	170.0					
	1c	ST1 to 2-N		18.22			18	166	138	322	1374	1025	
2		ST1	Junction 1 (Line 1S)	12.8	30	4.0	2.2	-2.0					
4		Junction 1	2-N (Line 2N)	2.37	16	2.6	16.0	168.0					
	1d	ST1 to South Z-Boaz Park		18.22			14	-83	138	69	296	221	
2		ST1	Junction 1 (Line 1S)	12.8	30	4.0	2.2	-2					
3		Junction 1	1-E (Line 1E)	1.15	10	3.3	12.2	30					
12		1-E	2	0	36	0.0	0.0	4					
16		2	South Z-Boaz Park	0	30	0.0	0.0	-115					
	1e	ST1 to 2-S		18.22			48	158	138	344	1465	1092	
5		ST1	2-S (Line 2S)	5.42	18	4.7	47.5	158					
	2a	ST2 to ST3		20.88			20	-50	138	108	529	394	
7		ST2	ST3 (Line 3NB)	7.02	20	5.0	20.2	-50.0					
	2b	ST2 to 3-S		20.88			22	85	138	245	1196	892	$2,732,000
9		ST2	3-S (Line 3S)	13.86	30	4.4	21.7	85.0					
		ST2 Storage Tank		2.0									$840,000
	3a	ST3 to 3-NA		30.06			11	-20	138	129	909	678	
8		ST3	3-NA (Line 3NA)	21.44	36	4.7	11.3	-20.0					
	3b	ST3 to 5-MCR		30.06			57	100	138	295	2078	1550	$3,714,000
10		ST3	4-MCR (Line 4MCR)	8.62	24	4.2	24.6	150.0					
11		4-MCR	5-MCR (Line 5MCR)	1.52	12	3.0	32.8	-50.0					
		ST3 Storage Tank		4.0									$1,740,000
												Total:	**$12,089,000**

Pump Station Annual Operation and Maintenance Cost

ID #	Pump Station No.	Name		Annual Av.Demand (mgd)	Pipe Length (ft)	Design Diameter (in)	Average Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Unit Power Cost ($/kWh)	Annual Power Cost	Annual Maint. Cost[7]
	1a	ST1 to Hawk's Creek		3.79				0.23	-122	0	-122	-108	-81	$0.10		
2		ST1	Junction 1 (Line 1S)	3.49	1300	30	1.10	0.20	-2.0							
3		Junction 1	1-E (Line 1E)	0.05	3000	10	0.14	0.04	30.0							
12		1-E	2	0	0	36	0.00	0.00	4.0							
13		2	3	0	0	12	0.00	0.00	-24.0							
14		3	4	0	0	8	0.00	0.00	-91.0							
15		4	6	0	0	8	0.00	0.00	-39.0							
21		6	Carswell GC (Hawks Creek)	0	0	8	0.00	0.00	0.0							
	1b	ST1 to 1-W		3.79				6.17	168	138	312	277	206	$0.10	$181,000	$92,000
2		ST1	Junction 1 (Line 1S)	3.49	1300	30	1.10	0.20	-2.0							
6		Junction 1	ST2 (Line 1W)	3.34	14500	24	1.64	5.97	170.0							
	1c	ST1 to 2-N		3.79				0.24	166	138	304	270	201	$0.10		
2		ST1	Junction 1 (Line 1S)	3.49	1300	30	1.10	0.20	-2.0							
4		Junction 1	2-N (Line 2N)	0.1	10200	16	0.11	0.05	168.0							
	1d	ST1 to South Z-Boaz Park		3.79				0.23	-83	138	55	49	37	$0.10		
2		ST1	Junction 1 (Line 1S)	3.49	1300	30	1.10	0.20	-2.0							
3		Junction 1	1-E (Line 1E)	0.05	3000	10	0.14	0.04	30.0							
12		1-E	2	0	0	36	0.00	0.00	4.0							
16		2	South Z-Boaz Park	0	0	30	0.00	0.00	-115.0							
	1e	ST1 to 2-S		3.79				0.22	158	138	296	263	196	$0.10		
5		ST1	2-S (Line 2S)	0.3	11600	18	0.26	0.22	158.0							
	2a	ST2 to ST3		3.16				2.12	-50.0	138	90	67	50	$0.10		
7		ST2	ST3 (Line 3NB)	2.08	5100	20	1.48	2.12	-50.0							
	2b	ST2 to 3-S		3.16				0.19	85.0	138	223	165	123	$0.10	$108,000	$82,000
9		ST2	3-S (Line 3S)	1.08	11200	30	0.34	0.19	85.0							
		ST2 Storage		2.0												$10,000
	3a	ST3 to 3-NA		1.98				0.06	-20.0	138	118	55	41	$0.10		
8		ST3	3-NA (Line 3NA)	1.24	6300	36	0.27	0.06	-20.0							
	3b	ST3 to 5-MCR		1.98				0.34	100	138	238	110	82	$0.10	$72,000	$111,000
10		ST3	4-MCR (Line 4MCR)	0.74	10300	24	0.36	0.26	150.0							
11		4-MCR	5-MCR (Line 5MCR)	0.06	11700	12	0.12	0.08	-50.0							
		ST3 Storage		4.0												$21,000
														Total:	**$361,000**	**$316,000**

Summary of Estimated Cost

ID #	From	To	Design Capacity mgd	Capital Cost							Annual Operation and Maintenance Cost			
				WRC Cost	Pump Station & Storage	Pipeline	Land	Contingency & Fees	Permitting & Mitigation	Total Capital Cost	Energy Cost	Pipe Maint.	PS Equip. Maint.	Total O & M
1	WRC	ST1	10		$3,390,000	$102,000	$9,000	$1,217,000	$35,000	$4,753,000	$181,000	$1,000	$92,000	$274,000
2	ST1	Junction 1 (Line 1S)	12.8			$260,000	$18,000	$78,000	$3,000	$359,000		$3,000		$3,000
3	Junction 1	1-E (Line 1E)	1.15			$201,000	$42,000	$60,000	$2,000	$305,000		$2,000		$2,000
4	Junction 1	2-N (Line 2N)	2.37			$1,061,000	$141,000	$318,000	$11,000	$1,531,000		$12,000		$12,000
5	ST1	2-S (Line 2S)	5.42			$1,438,000	$159,000	$431,000	$14,000	$2,042,000		$16,000		$16,000
6	Junction 1	ST2 (Line 1W)	9.28			$2,465,000	$201,000	$740,000	$25,000	$3,431,000		$27,000		$27,000
7	ST2	ST3 (Line 3NB)	7.02		$3,572,000	$714,000	$69,000	$1,464,000	$43,000	$5,862,000	$108,000	$8,000	$92,000	$208,000
8	ST3	3-NA (Line 3NA)	21.44		$5,454,000	$1,449,000	$87,000	$2,344,000	$69,000	$9,403,000	$72,000	$16,000	$132,000	$220,000
9	ST2	3-S (Line 3S)	13.86			$2,240,000	$153,000	$672,000	$22,000	$3,087,000		$25,000		$25,000
10	ST3	4-MCR (Line 4MCR)	8.62			$1,751,000	$141,000	$525,000	$18,000	$2,435,000		$19,000		$19,000
11	4-MCR	5-MCR (Line 5MCR)	1.52			$948,000	$162,000	$284,000	$9,000	$1,403,000		$10,000		$10,000
12	1-E	2	0			$0	$0	$0	$0	$0		$0		$0
13	2	3	0			$0	$0	$0	$0	$0		$0		$0
14	3	4	0			$0	$0	$0	$0	$0		$0		$0
15	4	6	0			$0	$0	$0	$0	$0		$0		$0
16	2	South Z-Boaz Park	0			$0	$0	$0	$0	$0		$0		$0
17	3	Z-Boaz GC	0			$0	$0	$0	$0	$0		$0		$0
18	6	Carswell GC (Hawks Creek)	0			$0	$0	$0	$0	$0		$0		$0
		WRC Expansion	5	$0	$1,790,000	$0		$627,000	$18,000	$2,435,000	$577,000			$577,000
		WRC Expansion	5	$0	$0	$0		$0	$0	$0				$0
		WRC Expansion	0	$0		$0		$0	$0	$0				$0
				$0	$14,206,000	$12,629,000	$1,182,000	$8,760,000	$269,000	$37,046,000	$938,000	$139,000	$316,000	$1,393,000

Pump Station Cost - Averages

Years	Amortized Capital Costs, 20 Yrs @ 5.5%	Annual Power Cost ($)	Annual O&M Cost (Excluding Power)	Total ($)
1-20	$3,100,000	$938,000	$455,000	89,860,000
20-50	0	$938,000	$455,000	41,790,000
			Total =	$131,650,000

Average Cost = $2,633,000 Per Year
Average Cost = $1.90 Per 1000 Gallons

Assumptior 1. Maximum pipeline velocity is 5 ft/s.
2. Pipeline cost was developed by CPY
3. Land cost developed separately.
4. Pipeline maintenance costs assumed 1% of construction cost.
5. Power based upon pump wire to water efficiency of 75%.
6. Pump station costs developed separately.
7. PS equipment maintenance costs 2.5% of PS construction costs.

Hydraulic Evaluation
Central System (Alternative CS-2)

Pipe Sizing and Estimated Cost

Velocity: 5 ft/sec — C = 130

ID #	From	To	Phase	Annual Avg. Demand (mgd)	Peak Demand (mgd)	Design Capacity (mgd)	Calculated Diameter[1] (in)	Design Diameter (in)	Pipeline: Distance (mile)	Pipeline: Length (ft)	Pipeline: Unit Cost[2]	Pipeline: Cost	ROW (ft)	Land: Area[3] (acre)	Land: Unit Cost	Land: Cost	Total Pipeline Cost	Pipeline Maintenance Costs[4]	Start Elevation (ft)	End Elevation (ft)	Static Head (ft)	Max. Cap. Velocity (mgd)	Head Loss (ft)	Req. Pressure Head (ft)	TDH
1	VCWWTP	1	1	2.18	14.47	14.47	28.7	36	5.80	30600	$ 230.00	$7,038,000	0	0.0	$30,000	$0	$7,038,000	$77,000	472	516	44	3.2	26		70
2	1	2	2	2.09	13.31	13.31	27.5	30	0.49	2600	$ 200.00	$520,000	0	0.0	$30,000	$0	$520,000	$6,000	516	503	-13	4.2	5		-8
3	2	3	3	2.03	11.58	11.58	25.6	30	2.31	12200	$ 200.00	$2,440,000	0	0.0	$30,000	$0	$2,440,000	$27,000	503	542	39	3.7	17		56
4	3	3A	3	1.98	10.37	10.37	24.3	30	2.52	13300	$ 200.00	$2,660,000	0	0.0	$30,000	$0	$2,660,000	$29,000	542	589	47	3.3	15		62
5	3A	4	3	1.10	6.22	6.22	18.8	24	1.02	5400	$ 170.00	$918,000	20	2.5	$30,000	$75,000	$993,000	$10,000	589	588	-1	3.1	7		6
6	3A	12	4	0.88	4.15	4.15	15.3	16	0.34	1800	$ 104.00	$187,000	0	0.0	$30,000	$0	$187,000	$2,000	589	547	-42	4.6	8		-34
7	4	5	3	1.10	6.22	6.22	18.8	24	0.59	3100	$ 170.00	$527,000	20	1.4	$30,000	$42,000	$569,000	$6,000	588	646	58	3.1	4		62
8	5	6	6	0.93	2.26	2.26	11.3	16	0.80	4200	$ 104.00	$437,000	20	1.9	$30,000	$57,000	$494,000	$5,000	646	646	0	2.5	6		6
9	6	7	7	0.84	1.80	1.80	10.1	16	2.61	13800	$ 104.00	$1,435,000	20	6.3	$30,000	$189,000	$1,624,000	$16,000	646	683	37	2.0	13		50
10	7	7A	7	0.83	7.01	7.01	19.9	20	0.21	1100	$ 140.00	$154,000	20	0.5	$30,000	$15,000	$169,000	$2,000	683	678	-5	5.0	4		-1
11	7A	8	8	0.68	3.36	3.36	13.8	16	0.40	2100	$ 104.00	$218,000	20	1.0	$30,000	$30,000	$248,000	$2,000	678	686	8	3.7	6		14
12	8	9	8	0.68	3.36	3.36	13.8	16	2.08	11000	$ 104.00	$1,144,000	20	5.1	$30,000	$153,000	$1,297,000	$13,000	686	702	16	3.7	33		49
13	9	10	8a	0.30	0.36	0.36	4.5	6	0.17	900	$ 39.00	$35,000	15	0.3	$30,000	$9,000	$44,000	$0	702	705	3	2.8	5		8
14	10	11	8a	0.29	0.35	0.35	4.5	6	0.85	4500	$ 39.00	$176,000	15	1.5	$30,000	$45,000	$221,000	$2,000	705	708	3	2.8	24		27
15	12	13	4	0.84	3.29	3.29	13.7	16	0.19	1000	$ 104.00	$104,000	0	0.0	$30,000	$0	$104,000	$1,000	547	552	5	3.6	3		8
16	13	14	5	0.81	2.55	2.55	12.0	16	2.42	12800	$ 104.00	$1,331,000	0	0.0	$30,000	$0	$1,331,000	$15,000	552	628	76	2.8	23		99
17	1	Woodhaven GC	1	0.09	1.16	1.16	8.1	10	0.08	400	$ 67.00	$27,000	0	0.0	$30,000	$0	$27,000	$0	516	530	14	3.3	2	0	16
18	2	Meadowbrook GC	2	0.06	1.73	1.73	9.9	10	1.08	5700	$ 67.00	$382,000	20	2.6	$30,000	$78,000	$460,000	$4,000	503	547	44	4.9	49	0	93
19	3	Gateway Park	4	0.05	1.21	1.21	8.3	10	0.57	3000	$ 67.00	$201,000	0	0.0	$30,000	$0	$201,000	$2,000	542	515	-27	3.4	13	138	124
20	4	Cobb Park (A)	3	0.17	3.96	3.96	15.0	16	0.15	800	$ 104.00	$83,000	20	0.4	$30,000	$12,000	$95,000	$1,000	588	589	1	4.4	3	138	142
21	5	Cobb Park (B)	3	0.17	3.96	3.96	15.0	16	0.45	2400	$ 104.00	$250,000	20	1.1	$30,000	$33,000	$283,000	$3,000	646	615	-31	4.4	10	138	117
22	6	Glen Garden GC	6a	0.09	0.46	0.46	5.1	6	0.30	1600	$ 39.00	$62,000	15	0.6	$30,000	$18,000	$80,000	$1,000	646	646	0	3.6	14	0	14
23	7	Tarrant Junior College	7a	0.01	0.31	0.31	4.2	6	0.19	1000	$ 39.00	$39,000	15	0.3	$30,000	$9,000	$48,000	$0	683	665	-18	2.4	4	138	124
24	7A	Rollling Hills Park	7	0.15	3.65	3.65	14.4	16	0.02	100	$ 104.00	$10,000	20	0.0	$30,000	$0	$10,000	$0	678	678	0	4.0	0	138	138
25	9	Alcon Laboratories	8	0.38	3.00	3.00	13.0	16	0.28	1500	$ 104.00	$156,000	20	0.7	$30,000	$21,000	$177,000	$2,000	702	688	-14	3.3	4	138	128
26	10	Ball Metal Corp.	8a	0.01	0.01	0.01	0.8	6	0.09	500	$ 39.00	$20,000	15	0.2	$30,000	$6,000	$26,000	$0	705	704	-1	0.1	0	138	137
27	11	Miller Brewery	8a	0.19	0.25	0.25	3.8	6	0.09	500	$ 39.00	$20,000	15	0.2	$30,000	$6,000	$26,000	$0	708	711	3	2.0	1	138	142
28	11	Mrs. Bairds Bakery	8a	0.1	0.1	0.10	2.4	6	0.28	1500	$ 39.00	$59,000	15	0.5	$30,000	$15,000	$74,000	$1,000	708	711	3	0.8	1	138	142
29	12	Sycamore GC (A)	4a	0.03	0.74	0.74	6.5	8	0.08	400	$ 45.00	$18,000	0	0.0	$30,000	$0	$18,000	$0	547	547	0	3.3	2	0	2
30	13	Sycamore GC (B)	4a	0.03	0.74	0.74	6.5	8	0.44	2300	$ 45.00	$104,000	0	0.0	$30,000	$0	$104,000	$1,000	552	554	2	3.3	12	0	14
31	12	Sycamore Park	4a	0.04	0.86	0.86	7.0	8	0.08	400	$ 45.00	$18,000	0	0.0	$30,000	$0	$18,000	$0	547	547	0	3.8	3	138	141
32	14	Harris Meth. Hosp.	9a	0.05	0.05	0.05	1.7	6	0.45	2400	$ 39.00	$94,000	15	0.8	$30,000	$24,000	$118,000	$1,000	628	646	18	0.4	0	138	156
33	14	Trinity River Vision	5	0.76	2.50	2.50	11.9	12	2.27	12000	$ 81.00	$972,000	20	5.5	$30,000	$165,000	$1,137,000	$11,000	628	529	-99	4.9	85	40	26
												$21,839,000		33.4		$1,002,000	$22,841,000	$240,000							

Pump Station Cost

ID #	Pump Station No.	Name		Capacity (mgd)	Design Diameter (in)	Max. Cap. Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure Head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Pump Station Cost[6]
	1a	VCWWTP to Cobb Park (B)		14.47			84	143	138	365	1236	922	
1		VCWWTP	1	14.47	36	3.2	26.4	44.0					
2		1	2	13.31	30	4.2	4.7	-13.0					
3		2	3	11.58	30	3.7	16.9	39.0					
4		3	3A	10.37	30	3.3	15.1	47.0		3.5			
5		3A	4	6.22	24	3.1	7.0	-1.0		0.2			
7		4	5	6.22	24	3.1	4.0	58.0		0.7			
21		5	Cobb Park (B)	3.96	16	4.4	9.8	-31.0					
	1b	VCWWTP to Harris Meth. Hosp.		14.47			97	174	138	409	1386	1034	$2,952,000
1		VCWWTP	1	14.47	36	3.2	26.4	44.0					
2		1	2	13.31	30	4.2	4.7	-13.0					
3		2	3	11.58	30	3.7	16.9	39.0					
4		3	3A	10.37	30	3.3	15.1	47.0					
6		3A	12	4.15	16	4.6	8.0	-42.0					
15		12	13	3.29	16	3.6	2.9	5.0					
16		13	14	2.55	16	2.8	23.0	76.0					
32		14	Harris Meth. Hosp.	0.05	6	0.4	0.4	18.0					
	1c	VCWWTP to Trinity Vision		14.47			182	57	40	279	943	703	
1		VCWWTP	1	14.47	36	3.2	26.4	44.0					
2		1	2	13.31	30	4.2	4.7	-13.0					
3		2	3	11.58	30	3.7	16.9	39.0					
4		3	3A	10.37	30	3.3	15.1	47.0					
6		3A	12	4.15	16	4.6	8.0	-42.0					
15		12	13	3.29	16	3.6	2.9	5.0					
16		13	14	2.55	16	2.8	23.0	76.0					
33		14	Trinity River Vision	2.5	12	4.9	84.5	-99.0					
	1d	VCWWTP to Booster Pump Station		14.47			93	211	40	344	1166	869	
1		VCWWTP	1	14.47	36	3.2	26.4	44.0					
2		1	2	13.31	30	4.2	4.7	-13.0					
3		2	3	11.58	30	3.7	16.9	39.0					
4		3	3A	10.37	30	3.3	15.1	47.0					
5		3A	4	6.22	24	3.1	7.0	-1.0					
7		4	5	6.22	24	3.1	4.0	58.0					
8		5	6	2.26	16	2.5	6.0	0.0					
9		6	7	1.8	16	2.0	13.0	37.0					
	2a	Booster to Alcon Laboratories		7.32			47	5	138	190	326	243	
10		7	7A	7.01	20	5.0	4.3	-5.0					
11		7A	8	3.36	16	3.7	6.3	8.0					
12		8	9	3.36	16	3.7	33.0	16.0					
25		9	Alcon Laboratories	3	16	3.3	3.6	-14.0					
	2b	Booster to Miller Brewery		7.32			75	28	138	241	412	307	$1,593,000
10		7	7A	7.01	20	5.0	4.3	-5.0					
11		7A	8	3.36	16	3.7	6.3	8.0					
12		8	9	3.36	16	3.7	33.0	16.0					
13		9	10	0.36	6	2.8	5.1	3.0					
14		10	11	0.35	6	2.8	24.3	3.0					
27		11	Miller Brewery	0.25	6	2.0	1.4	3.0					
	2c	Booster to Mrs. Bairds Bakery		7.32			74	28	138	240	411	306	
10		7	7A	7.01	20	5.0	4.3	-5.0					
11		7A	8	3.36	16	3.7	6.3	8.0					
12		8	9	3.36	16	3.7	33.0	16.0					
13		9	10	0.36	6	2.8	5.1	3.0					
14		10	11	0.35	6	2.8	24.3	3.0					
28		11	Mrs. Bairds Bakery	0.1	6	0.8	0.8	3.0					
		Booster Pump Station Storage Tank		2									$840,000
	3	Trinity River Vision Pump Station		7.50					40	40	70	52	$510,000
		Trinity River Vision Storage Tank		2									$840,000
												Total	**$6,735,000**

Pump Station Annual Operation and Maintenance Cost

ID #	Pump Station No.	Name		Annual Av.Demand (mgd)	Pipe Length (ft)	Design Diameter (in)	Average Velocity (ft/sec)	Headloss (ft)	Static Head (ft)	Req. Pressure head (ft)	TDH (ft)	Required Power[5] (hp)	Required Power[5] (kW)	Unit Power Cost ($/kWh)	Annual Power Cost	Annual Maint. Cost[7]
	1a	VCWWTP to Cobb Park (B)		2.18				2.79	143	138.0	284	145	108	$0.10		
1		VCWWTP	1	2.179	30600	36	0.48	0.79	44.0							
2		1	2	2.089	2600	30	0.66	0.15	-13.0							
3		2	3	2.029	12200	30	0.64	0.67	39.0							
4		3	3A	1.979	13300	30	0.62	0.70	47.0							
5		3A	4	1.099	5400	24	0.54	0.28	-1.0							
7		4	5	1.099	3100	24	0.54	0.16	58.0							
21		5	Cobb Park (B)	0.17	2400	16	0.19	0.03	-31.0							
	1b	VCWWTP to Harris Meth. Hosp.		2.18				6.11	174	138.0	318	162	121	$0.10	$106,000	$89,000
1		VCWWTP	1	2.179	30600	36	0.48	0.79	44.0							
2		1	2	2.089	2600	30	0.66	0.15	-13.0							
3		2	3	2.029	12200	30	0.64	0.67	39.0							
4		3	3A	1.979	13300	30	0.62	0.70	47.0							
6		3A	12	0.88	1800	16	0.98	0.45	-42.0							
15		12	13	0.84	1000	16	0.93	0.23	5.0							
16		13	14	0.81	12800	16	0.90	2.76	76.0							
32		14	Harris Meth. Hosp.	0.05	2400	6	0.39	0.35	18.0							
	1c	VCWWTP to Trinity Vision		2.18				15.08	57	40.0	112	57	43	$0.10		
1		VCWWTP	1	2.179	30600	36	0.48	0.79	44.0							
2		1	2	2.089	2600	30	0.66	0.15	-13.0							
3		2	3	2.029	12200	30	0.64	0.67	39.0							
4		3	3A	1.979	13300	30	0.62	0.70	47.0							
6		3A	12	0.88	1800	16	0.98	0.45	-42.0							
15		12	13	0.84	1000	16	0.93	0.23	5.0							
16		13	14	0.81	12800	16	0.90	2.76	76.0							
33		14	Trinity River Vision	0.76	12000	12	1.50	9.32	-99.0							
	1d	VCWWTP to Booster Pump Station		2.18				7.10	211	40.0	258	132	98	$0.10		
1		VCWWTP	1	2.179	30600	36	0.48	0.79	44.0							
2		1	2	2.089	2600	30	0.66	0.15	-13.0							
3		2	3	2.029	12200	30	0.64	0.67	39.0							
4		3	3A	1.979	13300	30	0.62	0.70	47.0							
5		3A	4	1.099	5400	24	0.54	0.28	-1.0							
7		4	5	1.099	3100	24	0.54	0.16	58.0							
8		5	6	0.929	4200	16	1.03	1.17	0.0							
9		6	7	0.839	13800	16	0.93	3.17	37.0							
	2a	Booster to Alcon Laboratories		0.83				2	5	138	145	28	21	$0.10		
10		7	7A	0.829	1100	20.0	0.6	0.1	-5.0							
11		7A	8	0.679	2100	16.0	0.8	0.3	8.0							
12		8	9	0.679	11000	16.0	0.8	1.7	16.0							
25		9	Alcon Laboratories	0.379	1500	16.0	0.4	0.1	-14.0							
	2b	Booster to Miller Brewery		0.83				24	28	138	190	37	27	$0.10	$24,000	$48,000
10		7	7A	0.829	1100	20.0	0.6	0.1	-5.0							
11		7A	8	0.679	2100	16.0	0.8	0.3	8.0							
12		8	9	0.679	11000	16.0	0.8	1.7	16.0							
13		9	10	0.3	900	6.0	2.4	3.7	3.0							
14		10	11	0.29	4500	6.0	2.3	17.2	3.0							
27		11	Miller Brewery	0.19	500	6.0	1.5	0.9	3.0							
	2c	Booster to Mrs. Bairds Bakery		0.83				24	28	138	190	37	27	$0.10		
10		7	7A	0.829	1100	20.0	0.6	0.1	-5.0							
11		7A	8	0.679	2100	16.0	0.8	0.3	8.0							
12		8	9	0.679	11000	16.0	0.8	1.7	16.0							
13		9	10	0.3	900	6.0	2.4	3.7	3.0							
14		10	11	0.29	4500	6.0	2.3	17.2	3.0							
28		11	Mrs. Bairds Bakery	0.1	1500	6.0	0.8	0.8	3.0							
		Booster Pump Station Storage Tank		0												$10,000
	3	Trinity River Vision Pump Station		0.76						40.0	40	7	5	$0.10	$5,000	$15,000
		Trinity River Vision Storage Tank		2												$10,000
														Total:	$135,000	$172,000

Summary of Estimated Cost

Phase	ID #	From	To	Design Capacity mgd	Capital Cost: WRC Cost	Capital Cost: Pump Station & Storage Tank	Capital Cost: Pipeline	Capital Cost: Land	Capital Cost: Contingency & Fees	Capital Cost: Permitting & Mitigation	Capital Cost: Total Capital Cost	Annual Operation and Maintenance Cost: Energy Cost	Annual Operation and Maintenance Cost: Pipe Maint.	Annual Operation and Maintenance Cost: PS Equip. Maint.	Annual Operation and Maintenance Cost: Total O & M
1	1	VCWWTP	1	14.47		$2,952,000	$7,038,000	$0	$3,145,000	$100,000	$13,235,000	$106,000	$77,000	$89,000	$272,000
2	2	1	2	13.31			$520,000	$0	$156,000	$5,000	$681,000		$6,000		$6,000
3	3	2	3	11.58			$2,440,000	$0	$732,000	$24,000	3196000		$27,000		$27,000
3	4	3	3A	10.37			$2,660,000	$0	$798,000	$27,000	3485000		$29,000		$29,000
3	5	3A	4	6.22			$918,000	$75,000	$275,000	$9,000	$1,277,000		$10,000		$10,000
4	6	3A	12	4.15			$187,000	$0	$56,000	$2,000	$245,000		$2,000		$2,000
3	7	4	5	6.22			$527,000	$42,000	$158,000	$5,000	$732,000		$6,000		$6,000
6	8	5	6	2.26			$437,000	$57,000	$131,000	$4,000	$629,000		$5,000		$5,000
7	9	6	7	1.8			$1,435,000	$189,000	$431,000	$14,000	$2,069,000		$16,000		$16,000
7	10	7	7A	7.01		$2,433,000	$154,000	$15,000	$898,000	$26,000	$3,526,000	$24,000	$2,000	$58,000	$84,000
8	11	7A	8	3.36			$218,000	$30,000	$65,000	$2,000	$315,000		$2,000		$2,000
8	12	8	9	3.36			$1,144,000	$153,000	$343,000	$11,000	$1,651,000		$13,000		$13,000
8a	13	9	10	0.36			$35,000	$9,000	$11,000	$0	$55,000		$0		$0
8a	14	10	11	0.35			$176,000	$45,000	$53,000	$2,000	$276,000		$2,000		$2,000
4	15	12	13	3.29			$104,000	$0	$31,000	$1,000	$136,000		$1,000		$1,000
5	16	13	14	2.55			$1,331,000	$0	$399,000	$13,000	$1,743,000		$15,000		$15,000
1	17	1	Woodhaven GC	1.16			$27,000	$0	$8,000	$0	$35,000		$0		$0
2	18	2	Meadowbrook GC	1.73			$382,000	$78,000	$115,000	$4,000	$579,000		$4,000		$4,000
4	19	3	Gateway Park	1.21			$201,000	$0	$60,000	$2,000	$263,000		$2,000		$2,000
3	20	4	Cobb Park (A)	3.96			$83,000	$12,000	$25,000	$1,000	$121,000		$1,000		$1,000
3	21	5	Cobb Park (B)	3.96			$250,000	$33,000	$75,000	$3,000	$361,000		$3,000		$3,000
6a	22	6	Glen Garden GC	0.46			$62,000	$18,000	$19,000	$1,000	$100,000		$1,000		$1,000
7a	23	7	Tarrant Junior College	0.31			$39,000	$9,000	$12,000	$0	$60,000		$0		$0
7	24	7A	Rollling Hills Park	3.65			$10,000	$0	$3,000	$0	$13,000		$0		$0
8	25	9	Alcon Laboratories	3			$156,000	$21,000	$47,000	$2,000	$226,000		$2,000		$2,000
8a	26	10	Ball Metal Corp.	0.01			$20,000	$6,000	$6,000	$0	$32,000		$0		$0
8a	27	11	Miller Brewery	0.25			$20,000	$6,000	$6,000	$0	$32,000		$0		$0
8a	28	11	Mrs. Bairds Bakery	0.1			$59,000	$15,000	$18,000	$1,000	$93,000		$1,000		$1,000
4a	29	12	Sycamore GC (A)	0.74			$18,000	$0	$5,000	$0	$23,000		$0		$0
4a	30	13	Sycamore GC (B)	0.74			$104,000	$0	$31,000	$1,000	$136,000		$1,000		$1,000
4a	31	12	Sycamore Park	0.86			$18,000	$0	$5,000	$0	$23,000		$0		$0
9a	32	14	Harris Meth. Hosp.	0.05			$94,000	$24,000	$28,000	$1,000	$147,000		$1,000		$1,000
5	33	14	Trinity River Vision	2.5		$1,350,000	$972,000	$165,000	$764,000	$23,000	$3,274,000	$5,000	$11,000	$25,000	$41,000
						$6,735,000	$21,839,000	$1,002,000	$8,909,000	$284,000	$38,769,000	$135,000	$240,000	$172,000	$547,000

Pump Station Cost - Averages

Years	Amortized Capital Costs, 20 Yrs @ 5.5%	Annual Power Cost ($)	Annual O&M Cost (Excluding Power)	Total ($)
1-20	$3,244,000	$135,000	$412,000	75,820,000
20-50	0	$135,000	$412,000	16,410,000
			Total =	$92,230,000

Average Cost = $1,845,000 Per Year
Average Cost = $2.32 Per 1000 Gallons

Assumptions
1. Maximum pipeline velocity is 5 ft/s.
2. Pipeline cost was developed by CPY
3. Land cost developed separately.
4. Pipeline maintenance costs assumed 1% of construction cost.
5. Power based upon pump wire to water efficiency of 75%.
6. Pump station costs developed separately.
7. PS equipment maintenance costs 2.5% of PS construction costs.

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APPENDIX F TECHNICAL MEMORANDUM SUMMARIZING ASSUMPTIONS USED IN DEVELOPING COSTS

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TECHNICAL MEMORANDUM 1

COST PROJECTIONS FOR RECYCLED WATER ALTERNATIVES

CITY OF FORT WORTH – WATER REUSE PRIORITY AND IMPLEMENTATION PLAN

TO: **Alan Plummer Associates, Inc. (APAI)**

FROM: **Chiang, Patel & Yerby, Inc. (CP&Y)**

This document is issued for interim review only under the authority of Richard L. Shaffer, P.E.

Date: **February 26, 2007**

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1 INTRODUCTION

1. Evaluation of water reuse alternatives required development of cost projections. Costs were projected in fourth quarter 2006 dollars.
2. All cost projections were reviewed by construction services and division leaders of CP&Y.
3. The cost projection procedure used to evaluate the alternatives is generally consistent with the cost estimating procedure used by Region C for evaluating water supply alternatives. Unit costs may have been adjusted to reflect updated estimates.
4. All unit costs include the contractor's mobilization, overhead and profit. The unit costs do not include engineering, contingency, financial and legal services, costs for land and rights-of-way, permits, environmental and archeological studies, or mitigation.
5. The cost estimates have two components:
    a. Initial capital costs, including engineering and construction costs, and
    b. Average annual costs, including annual operation and maintenance costs and debt service.

2 ASSUMPTIONS FOR CAPITAL COSTS

Conveyance Systems

Standard pipeline costs used for these cost projections are shown in Table TM1-1. Pump station costs were based on required horsepower capacity and are listed in Table TM1-2. The power capacity was determined from the hydraulic analyses conducted from a planning level hydraulic grade line evaluation.

Pipelines and pump stations were sized for peak pumping capacity. It was assumed that conveyance systems would convey the peak month demand for users with available storage and peak hour demand for users without any available storage. Golf course ponds are not considered available storage, since the golf course operators would not likely permit pond levels to significantly fluctuate.

- Maximum pipeline velocity for design was 5 feet per second.
- Pump efficiency was assumed to be 75%.
- Peaking factors:
  - Peak Month Factor = 2.64, unless more site specific data was available. This assumption was intended to be consistent with the City of Fort Worth's (COFW) *Draft Feasibility Study – Mary's Creek Water Recycling Center*.
  - Peak Day Factor was based on the number of days recycled water would be utilized – "1" for everyday use, "2" for every other day use, "3" for use every third day, etc., unless more site specific data was available.
  - Peak Hour Factor was based on the number of hours during the day that recycled water would be utilized – "1" for 24 hours per day use, "2" for 12 hours per day use, "3" for 8 hours per day use, "6" for 4 hours per day use, etc., unless more site specific data was available.

Water Reclamation Centers / Satellite Wastewater Treatment Plants

Water reclamation centers (WRCs) were sized for the peak day capacity. The WRC facility was assumed to be a highly compact facility designed to treat base loads with minimal peaking factors and minimal redundant equipment. Since wet weather flows continue through the collection system to the regional treatment facility, this configuration differs from typical wastewater treatment plants that are designed to treat significant peak flows. Since peaking flows and high levels of redundancy were not critical to the design, significant construction cost savings were achieved. Probable cost projections for new water reclamation centers are listed in Table TM1-3.

Other Costs

Additional costs, associated with the development and construction of alternatives, are described below. Except for the amount of annual interest accrued on unspent funds during construction, these costs are consistent with the Region C cost estimating procedure. The annual interest rate included for each alternative is based on data provided by the COFW.

- Engineering, contingency, construction management, financial and legal costs were estimated at 30 percent of construction costs for pipelines and 35 percent of construction costs for pump stations, storage tanks and water reclamation centers.

- Permitting and mitigation for transmission and treatment projects were estimated at 1 percent of the total construction costs.
- Right-of-way costs for transmission pipelines were estimated at $3,000 per acre of ROW for rural pipelines and $30,000 per acre of ROW for urban pipelines. If a small pipeline follows existing right-of ways (such as highways), no additional right-of-way cost was assumed. Large pipelines required ROW costs regardless of routing.
- Interest during construction was the total of interest accrued at the end of the construction period, using a 5.5 percent annual interest rate on total borrowed funds, less a 4 percent rate of return on investment of unspent funds. This was calculated assuming that the total estimated project cost (excluding interest during construction) would be drawn down at a constant rate per month during the construction period. Factors were determined for different lengths of time for project construction, and are presented in Table TM1-4.

3 ASSUMPTIONS FOR ANNUAL COSTS

Annual costs were projected using the following assumptions:

- Debt service for all transmission and treatment facilities was annualized over 20 years, but not longer than the life of the project. If state participation was used to fund a portion of the project, then debt service for all, or a portion, of the transmission and treatment facilities may be annualized over a period of 34 years, in accordance with state participation guidelines.
- Annual interest rate for debt service was assumed to be 5.5 percent, based on COFW data.
- Operation and Maintenance costs were calculated based on the construction costs of the capital improvement. Engineering, permitting, etc. was not included as a basis for this calculation. However, a 20% allowance for construction contingencies was included for all O&M calculations. O&M was calculated at:
    - 1 percent of the construction costs for pipelines and storage tanks,
    - 2.5 percent of the construction costs for pump stations, and
    - O&M for water reclamation centers should be based on unit costs as shown in Table TM1-3.
- Pumping costs were projected using an electricity rate of $0.10 per Kilowatt Hour. This rate is greater than the rate included in the Region C cost estimating procedure, however, is more consistent with local electricity rates.

Table TM1-1

Pipeline Costs (does not include ROW)

Diameter (Inches)	Base Installed Cost ($/Foot)	Rural Cost with Appurtenances ($/Foot)	Urban Cost with Appurtenances ($/Foot)	Assumed ROW Width (Feet)
6	$ 30.00	$ 33.00	$ 39.00	15
8	$ 34.00	$ 38.00	$ 45.00	15
10	$ 51.50	$ 57.00	$ 67.00	20
12	$ 62.00	$ 69.00	$ 81.00	20
14	$ 65.00	$ 72.00	$ 85.00	20
16	$ 80.00	$ 88.00	$ 104.00	20
18	$ 95.00	$ 105.00	$ 124.00	20
20	$ 107.00	$ 118.00	$ 140.00	20
24	$ 130.50	$ 144.00	$ 170.00	20
30	$ 153.50	$ 169.00	$ 200.00	20
36	$ 176.50	$ 195.00	$ 230.00	20
42	$ 241.00	$ 266.00	$ 314.00	30
48	$ 270.00	$ 297.00	$ 351.00	30

Notes:

1. Pipeline costs developed by CP&Y were based on cost data from pipeline suppliers
2. Pipeline material and depth are as follows:
   a. 6" - 12" C900 - PVC DR-18, 5' to 6' depth of cover
   b. 14" - 24" C905 - PVC DR-25, 6' to 7' depth of cover
   c. 30" - 48" RCCP, 6' to 7' depth of cover
3. Appurtenances assumed to be 10% of installed pipe costs
4. 15% Contractor's OH&P included in Base Cost

Table TM1-2

Pump Station Costs for Transmission Systems

25	$261,000
50	$418,000
100	$648,000
200	$972,000
300	$1,254,000
400	$1,568,000
500	$1,777,000
600	$1,881,000
700	$1,986,000
800	$2,195,000
900	$2,299,000
1,000	$2,508,000
2,000	$3,658,000
3,000	$4,389,000
4,000	$5,330,000
5,000	$6,061,000
6,000	$6,897,000
7,000	$7,524,000
8,000	$8,151,000
9,000	$8,883,000
10,000	$9,405,000

Note: Pump Station costs were based on Region C cost projections and have been adjusted for inflation

Table TM1-3

Costs for Satellite WRC

WRC Flowrate	mgd	1.0	2.0	3.0	4.0	5.0
	gpm	694	1,389	2,083	2,778	3,472
Screen		$240,000	$320,000	$400,000	$480,000	$560,000
MBR		$1,767,000	$3,131,000	$4,501,000	$5,849,000	$7,196,000
UV Disinfection		$160,000	$220,000	$280,000	$340,000	$400,000
Electrical		$250,000	$443,000	$635,000	$828,000	$1,020,000
Building		$135,000	$175,000	$205,000	$235,000	$255,000
SCADA		$125,000	$222,000	$318,000	$414,000	$510,000
Lift Station		$350,000	$668,000	$975,000	$1,250,000	$1,500,000
Storage Tank	Size (gal)	500,000	1,000,000	1,500,000	2,000,000	2,500,000
	Cost	$380,000	$500,000	$680,000	$840,000	$990,000
Odor Control		$100,000	$180,000	$255,000	$320,000	$375,000
Capital Cost		**$3,507,000**	**$5,859,000**	**$8,249,000**	**$10,556,000**	**$12,806,000**
Annual Maint. ($/1000gal)		$0.24	$0.18	$0.15	$0.13	$0.11
Annual O&M ($/year)		$87,000	$134,000	$160,000	$186,000	$206,000
Annual Energy ($/1000gal)		$0.56	$0.51	$0.47	$0.44	$0.42
Annual Energy ($/year)		$204,000	$372,000	$514,000	$640,000	$764,000
Total Annual O&M		**$291,000**	**$506,000**	**$674,000**	**$826,000**	**$970,000**

Note: Cost projections for WRC facilities were developed by CP&Y, and are based on data received from process equipment suppliers.

Table TM1-3 (cont.)

Costs for Satellite WRC

WRC Flowrate	mgd	8.0	10.0	12.0	15.0
	gpm	5,556	6,944	8,333	10,417
Screen		$800,000	$960,000	$1,152,000	$1,440,000
MBR		$10,761,000	$13,142,000	$15,709,000	$19,560,000
UV Disinfection		$592,000	$720,000	$864,000	$1,080,000
Electrical		$1,548,000	$1,900,000	$2,280,000	$2,850,000
Building		$295,000	$320,000	$345,000	$385,000
SCADA		$774,000	$950,000	$1,140,000	$1,425,000
Lift Station		$2,160,000	$2,500,000	$2,760,000	$3,000,000
Storage Tank	Size (gal)	4,000,000	4,500,000	4,750,000	5,000,000
	Cost	$1,740,000	$2,020,000	$2,170,000	$2,310,000
Odor Control		$480,000	$500,000	$600,000	$750,000
Capital Cost		**$19,150,000**	**$23,012,000**	**$27,020,000**	**$32,800,000**
Annual Maint. ($/1000gal)		$0.11	$0.11	$0.11	$0.11
Annual O&M ($/year)		$317,000	$392,000	$466,000	$577,000
Annual Energy ($/1000gal)		$0.42	$0.42	$0.42	$0.42
Annual Energy ($/year)		$1,220,000	$1,523,000	$1,827,000	$2,282,000
Total Annual O&M		**$1,537,000**	**$1,915,000**	**$2,293,000**	**$2,859,000**

Table TM1-4

Factors for Interest During Construction

Construction Period	Factor
6 months	0.018333
12 months	0.038333
18 months	0.058333
24 months	0.078333
36 months	0.118333
48 months	0.158333

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APPENDIX G BENEFIT DEFERRAL CALCULATION

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Inflation rate	4.0%
Financing period	20 years
Loan/bond interest rate	5.5%
Investment return rate	5.0%

Rolling Hills WTP Expansion 1

	Capital Cost	2005 Debt Service	2005 Debt Service	Benefit of Deferral	2006 Benefit of Deferral
	2005	20	20		$0
2005	$16,288,800	$1,363,036	$1,363,036	$0	$0
2006		$1,363,036	$1,363,036	$0	$0
2007		$1,363,036	$1,363,036	$0	$0
2008		$1,363,036	$1,363,036	$0	$0
2009		$1,363,036	$1,363,036	$0	$0
2010		$1,363,036	$1,363,036	$0	$0
2011		$1,363,036	$1,363,036	$0	$0
2012		$1,363,036	$1,363,036	$0	$0
2013		$1,363,036	$1,363,036	$0	$0
2014		$1,363,036	$1,363,036	$0	$0
2015		$1,363,036	$1,363,036	$0	$0
2016		$1,363,036	$1,363,036	$0	$0
2017		$1,363,036	$1,363,036	$0	$0
2018		$1,363,036	$1,363,036	$0	$0
2019		$1,363,036	$1,363,036	$0	$0
2020		$1,363,036	$1,363,036	$0	$0
2021		$1,363,036	$1,363,036	$0	$0
2022		$1,363,036	$1,363,036	$0	$0
2023		$1,363,036	$1,363,036	$0	$0
2024		$1,363,036	$1,363,036	$0	$0
2025				$0	$0
2026				$0	$0
2027				$0	$0
2028				$0	$0
2029				$0	$0
2030				$0	$0
2031				$0	$0
2032				$0	$0
2033				$0	$0
2034				$0	$0
2035				$0	$0
2036				$0	$0
2037				$0	$0
2038				$0	$0
2039				$0	$0
2040				$0	$0
2041				$0	$0
2042				$0	$0
2043				$0	$0
2044				$0	$0
2045				$0	$0
2046					
TOTAL		$27,260,717	$27,260,717	$0	$0

Eagle Mountain WTP Expansion					Holly WTP Expansion; new high service PS				
Capital Cost	2007 Debt Service	2007 Debt Service	Benefit of Deferral	2006 Benefit of Deferral	Capital Cost	2009 Debt Service	2009 Debt service	Benefit of Deferral	2006 Benefit of Deferral
2007	20	20		$0	2009	20	20		$0
$44,464,680					$25,833,600				
$46,243,267					$26,866,944				
$48,092,998	$4,024,390	$4,024,390	$0	$0	$27,941,622				
$50,016,718	$4,024,390	$4,024,390	$0	$0	$29,059,287				
	$4,024,390	$4,024,390	$0	$0	$30,221,658	$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0	$31,430,524	$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
	$4,024,390	$4,024,390	$0	$0		$2,528,928	$2,528,928	$0	$0
			$0	$0		$2,528,928	$2,528,928	$0	$0
			$0	$0		$2,528,928	$2,528,928	$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
	$80,487,797	$80,487,797	$0	$0		$50,578,562	$50,578,562	$0	$0

Northwest WTP and high service PS					Rolling Hills WTP Expansion 2				
Capital Cost	2011 Debt Service	2012 Debt Service	Benefit of Deferral	2006 Benefit of Deferral	Capital Cost	2013 Debt Service	2014 Debt Service	Benefit of Deferral	2006 Benefit of Deferral
2011	20	20		$598,767	2013	20	20		$749,045
$57,915,000					$73,850,400				
$60,231,600					$76,804,416				
$62,640,864					$79,876,593				
$65,146,499					$83,071,656				
$67,752,359					$86,394,523				
$70,462,453					$89,850,304				
$73,280,951	$6,132,101		$6,132,101	$4,804,661	$93,444,316				
$76,212,189	$6,132,101	$6,377,385	($245,284)	($183,035)	$97,182,088				
	$6,132,101	$6,377,385	($245,284)	($174,319)	$101,069,372	$8,457,417		$8,457,417	$6,010,529
	$6,132,101	$6,377,385	($245,284)	($166,018)	$105,112,147	$8,457,417	$8,795,714	($338,297)	($228,973)
	$6,132,101	$6,377,385	($245,284)	($158,112)		$8,457,417	$8,795,714	($338,297)	($218,069)
	$6,132,101	$6,377,385	($245,284)	($150,583)		$8,457,417	$8,795,714	($338,297)	($207,685)
	$6,132,101	$6,377,385	($245,284)	($143,412)		$8,457,417	$8,795,714	($338,297)	($197,795)
	$6,132,101	$6,377,385	($245,284)	($136,583)		$8,457,417	$8,795,714	($338,297)	($188,376)
	$6,132,101	$6,377,385	($245,284)	($130,079)		$8,457,417	$8,795,714	($338,297)	($179,406)
	$6,132,101	$6,377,385	($245,284)	($123,885)		$8,457,417	$8,795,714	($338,297)	($170,863)
	$6,132,101	$6,377,385	($245,284)	($117,986)		$8,457,417	$8,795,714	($338,297)	($162,726)
	$6,132,101	$6,377,385	($245,284)	($112,367)		$8,457,417	$8,795,714	($338,297)	($154,978)
	$6,132,101	$6,377,385	($245,284)	($107,017)		$8,457,417	$8,795,714	($338,297)	($147,598)
	$6,132,101	$6,377,385	($245,284)	($101,921)		$8,457,417	$8,795,714	($338,297)	($140,569)
	$6,132,101	$6,377,385	($245,284)	($97,067)		$8,457,417	$8,795,714	($338,297)	($133,875)
	$6,132,101	$6,377,385	($245,284)	($92,445)		$8,457,417	$8,795,714	($338,297)	($127,500)
	$6,132,101	$6,377,385	($245,284)	($88,043)		$8,457,417	$8,795,714	($338,297)	($121,429)
	$6,132,101	$6,377,385	($245,284)	($83,850)		$8,457,417	$8,795,714	($338,297)	($115,647)
	$6,132,101	$6,377,385	($245,284)	($79,857)		$8,457,417	$8,795,714	($338,297)	($110,140)
	$6,132,101	$6,377,385	($245,284)	($76,055)		$8,457,417	$8,795,714	($338,297)	($104,895)
		$6,377,385	($6,377,385)	($1,883,259)		$8,457,417	$8,795,714	($338,297)	($99,900)
			$0	$0		$8,457,417	$8,795,714	($338,297)	($95,143)
			$0	$0			$8,795,714	($8,795,714)	($2,355,917)
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
	$122,642,018	$127,547,698	($4,905,681)	$598,767		$169,148,346	$175,914,280	($6,765,934)	$749,045

Southwest WTP					Eagle Mountain WTP Expansion; expand high service PS 1				
Capital Cost	2016 Debt Service	2018 Debt Service	Benefit of Deferral	2006 Benefit of Deferral	Capital Cost	2018 Debt Service	2021 Debt Service	Benefit of Deferral	2006 Benefit of Deferral
2016	20	20		$837,707	2018	20	20		$1,613,544
$42,702,000					$56,160,000				
$44,410,080					$58,406,400				
$46,186,483					$60,742,656				
$48,033,943					$63,172,362				
$49,955,300					$65,699,257				
$51,953,512					$68,327,227				
$54,031,653					$71,060,316				
$56,192,919					$73,902,729				
$58,440,636					$76,858,838				
$60,778,261					$79,933,191				
$63,209,391					$83,130,519				
$65,737,767	$5,500,892		$5,500,892	$3,377,071	$86,455,740				
$68,367,278	$5,500,892		$5,500,892	$3,216,258	$89,913,969				
$71,101,969	$5,500,892	$5,949,765	($448,873)	($249,949)	$93,510,528	$7,824,898		$7,824,898	$4,357,196
	$5,500,892	$5,949,765	($448,873)	($238,047)	$97,250,949	$7,824,898		$7,824,898	$4,149,711
	$5,500,892	$5,949,765	($448,873)	($226,711)	$101,140,987	$7,824,898		$7,824,898	$3,952,105
	$5,500,892	$5,949,765	($448,873)	($215,915)	$105,186,627	$7,824,898	$8,801,946	($977,048)	($469,977)
	$5,500,892	$5,949,765	($448,873)	($205,634)		$7,824,898	$8,801,946	($977,048)	($447,597)
	$5,500,892	$5,949,765	($448,873)	($195,842)		$7,824,898	$8,801,946	($977,048)	($426,283)
	$5,500,892	$5,949,765	($448,873)	($186,516)		$7,824,898	$8,801,946	($977,048)	($405,984)
	$5,500,892	$5,949,765	($448,873)	($177,634)		$7,824,898	$8,801,946	($977,048)	($386,651)
	$5,500,892	$5,949,765	($448,873)	($169,175)		$7,824,898	$8,801,946	($977,048)	($368,239)
	$5,500,892	$5,949,765	($448,873)	($161,119)		$7,824,898	$8,801,946	($977,048)	($350,704)
	$5,500,892	$5,949,765	($448,873)	($153,447)		$7,824,898	$8,801,946	($977,048)	($334,004)
	$5,500,892	$5,949,765	($448,873)	($146,140)		$7,824,898	$8,801,946	($977,048)	($318,099)
	$5,500,892	$5,949,765	($448,873)	($139,181)		$7,824,898	$8,801,946	($977,048)	($302,951)
	$5,500,892	$5,949,765	($448,873)	($132,553)		$7,824,898	$8,801,946	($977,048)	($288,525)
	$5,500,892	$5,949,765	($448,873)	($126,241)		$7,824,898	$8,801,946	($977,048)	($274,786)
	$5,500,892	$5,949,765	($448,873)	($120,230)		$7,824,898	$8,801,946	($977,048)	($261,701)
	$5,500,892	$5,949,765	($448,873)	($114,505)		$7,824,898	$8,801,946	($977,048)	($249,239)
	$5,500,892	$5,949,765	($448,873)	($109,052)		$7,824,898	$8,801,946	($977,048)	($237,370)
		$5,949,765	($5,949,765)	($1,376,641)		$7,824,898	$8,801,946	($977,048)	($226,067)
		$5,949,765	($5,949,765)	($1,311,087)		$7,824,898	$8,801,946	($977,048)	($215,302)
			$0	$0			$8,801,946	($8,801,946)	($1,847,231)
			$0	$0			$8,801,946	($8,801,946)	($1,759,267)
			$0	$0			$8,801,946	($8,801,946)	($1,675,493)
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
			$0	$0				$0	$0
	$110,017,846	$118,995,302	($8,977,456)	$837,707		$156,497,967	$176,038,929	($19,540,962)	$1,613,544

Expand Northwest WTP and high service PS					Eagle Mountain WTP Expansion; expand high service PS 2					
Capital Cost	2020 Debt Service	2024 Debt Service	Benefit of Deferral	2006 Benefit of Deferral	Capital Cost	2023 Debt Service	2027 Debt Service	Benefit of Deferral	2006 Benefit of Deferral	Total 2006 Benefit of Deferral
2020	20	20		$1,916,788	2023	20			$3,980,228	$9,696,078
$51,246,000					$109,512,000					
$53,295,840					$113,892,480					
$55,427,674					$118,448,179					
$57,644,781					$123,186,106					
$59,950,572					$128,113,551					
$62,348,595					$133,238,093					
$64,842,538					$138,567,616					
$67,436,240					$144,110,321					
$70,133,690					$149,874,734					
$72,939,037					$155,869,723					
$75,856,599					$162,104,512					
$78,890,863					$168,588,693					
$82,046,497					$175,332,240					
$85,328,357					$182,345,530					
$88,741,491					$189,639,351					
$92,291,151	$7,722,862		$7,722,862	$3,900,570	$197,224,925					
$95,982,797	$7,722,862		$7,722,862	$3,714,829	$205,113,922					
$99,822,109	$7,722,862		$7,722,862	$3,537,932	$213,318,479					
$103,814,993	$7,722,862		$7,722,862	$3,369,459	$221,851,218	$18,564,361		$18,564,361	$8,099,569	
$107,967,593	$7,722,862	$9,034,656	($1,311,794)	($545,078)	$230,725,267	$18,564,361		$18,564,361	$7,713,876	
	$7,722,862	$9,034,656	($1,311,794)	($519,121)	$239,954,278	$18,564,361		$18,564,361	$7,346,548	
	$7,722,862	$9,034,656	($1,311,794)	($494,401)	$249,552,449	$18,564,361		$18,564,361	$6,996,713	
	$7,722,862	$9,034,656	($1,311,794)	($470,858)	$259,534,547	$18,564,361	$21,717,677	($3,153,316)	($1,131,859)	
	$7,722,862	$9,034,656	($1,311,794)	($448,437)		$18,564,361	$21,717,677	($3,153,316)	($1,077,961)	
	$7,722,862	$9,034,656	($1,311,794)	($427,083)		$18,564,361	$21,717,677	($3,153,316)	($1,026,629)	
	$7,722,862	$9,034,656	($1,311,794)	($406,745)		$18,564,361	$21,717,677	($3,153,316)	($977,742)	
	$7,722,862	$9,034,656	($1,311,794)	($387,376)		$18,564,361	$21,717,677	($3,153,316)	($931,183)	
	$7,722,862	$9,034,656	($1,311,794)	($368,930)		$18,564,361	$21,717,677	($3,153,316)	($886,841)	
	$7,722,862	$9,034,656	($1,311,794)	($351,362)		$18,564,361	$21,717,677	($3,153,316)	($844,610)	
	$7,722,862	$9,034,656	($1,311,794)	($334,630)		$18,564,361	$21,717,677	($3,153,316)	($804,391)	
	$7,722,862	$9,034,656	($1,311,794)	($318,696)		$18,564,361	$21,717,677	($3,153,316)	($766,086)	
	$7,722,862	$9,034,656	($1,311,794)	($303,520)		$18,564,361	$21,717,677	($3,153,316)	($729,606)	
	$7,722,862	$9,034,656	($1,311,794)	($289,066)		$18,564,361	$21,717,677	($3,153,316)	($694,863)	
	$7,722,862	$9,034,656	($1,311,794)	($275,301)		$18,564,361	$21,717,677	($3,153,316)	($661,774)	
	$7,722,862	$9,034,656	($1,311,794)	($262,192)		$18,564,361	$21,717,677	($3,153,316)	($630,261)	
		$9,034,656	($9,034,656)	($1,719,790)		$18,564,361	$21,717,677	($3,153,316)	($600,249)	
		$9,034,656	($9,034,656)	($1,637,895)		$18,564,361	$21,717,677	($3,153,316)	($571,665)	
		$9,034,656	($9,034,656)	($1,559,900)		$18,564,361	$21,717,677	($3,153,316)	($544,443)	
		$9,034,656	($9,034,656)	($1,485,619)			$21,717,677	($21,717,677)	($3,571,160)	
			$0	$0			$21,717,677	($21,717,677)	($3,401,105)	
			$0	$0			$21,717,677	($21,717,677)	($3,239,147)	
							$21,717,677	($21,717,677)	($3,084,902)	
	$154,457,233	$180,693,117	($26,235,883)	$1,916,788		$371,287,226	$434,353,540	($63,066,314)	$3,980,228	

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APPENDIX H SAMPLE BREAKDOWN OF ANNUAL PAYMENTS WITH AND WITHOUT STATE PARTICIPATION FUNDING

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Texas Water Development Board
State Participation Funding Example

$10,000,000	Project Cost	Fee ($0.77 per $100 funded)	$77,000
34	State Part. Cap Recovery Period (years)		
20	City Cap Recovery Period (years)		
5.50%	Annual Percentage (interest) Rate		

Year	Unpaid Principal	Interest	Deferred Interest Percentage	Accrued Interest	Interest Paid	Principal Paid	Total Payment With State Participation	Total Payment Without State Participation
1	$10,000,000	$550,000	100%	$550,000	$0	$0	$0	$837,000
2	$10,000,000	$550,000	100%	$1,100,000	$0	$0	$0	$837,000
3	$10,000,000	$550,000	80%	$1,540,000	$110,000	$0	$110,000	$837,000
4	$10,000,000	$550,000	80%	$1,980,000	$110,000	$0	$110,000	$837,000
5	$10,000,000	$550,000	70%	$2,365,000	$165,000	$0	$165,000	$837,000
6	$10,000,000	$550,000	60%	$2,695,000	$220,000	$0	$220,000	$837,000
7	$10,000,000	$550,000	45%	$2,942,500	$302,500	$0	$302,500	$837,000
8	$10,000,000	$550,000	30%	$3,107,500	$385,000	$0	$385,000	$837,000
9	$10,000,000	$550,000	15%	$3,190,000	$467,500	$0	$467,500	$837,000
10	$10,000,000	$550,000	0%	$3,190,000	$550,000	$0	$550,000	$837,000
11	$10,000,000	$550,000	0%	$3,190,000	$550,000	$0	$550,000	$837,000
12	$10,000,000	$550,000	0%	$3,190,000	$550,000	$0	$550,000	$837,000
13	$10,000,000	$550,000	0%	$2,734,286	$1,005,714	$0	$1,005,714	$837,000
14	$10,000,000	$550,000	0%	$2,278,571	$1,005,714	$0	$1,005,714	$837,000
15	$10,000,000	$550,000	0%	$1,822,857	$1,005,714	$0	$1,005,714	$837,000
16	$10,000,000	$550,000	0%	$1,367,143	$1,005,714	$0	$1,005,714	$837,000
17	$10,000,000	$550,000	0%	$911,429	$1,005,714	$0	$1,005,714	$837,000
18	$10,000,000	$550,000	0%	$455,714	$1,005,714	$0	$1,005,714	$837,000
19	$10,000,000	$550,000	0%	$0	$1,005,714	$0	$1,005,714	$837,000
20	$10,000,000	$550,000	0%	$0	$550,000	$446,256	$996,256	$837,000
21	$9,553,744	$525,456	0%	$0	$525,456	$470,800	$996,256	$0
22	$9,082,944	$499,562	0%	$0	$499,562	$496,694	$996,256	$0
23	$8,586,250	$472,244	0%	$0	$472,244	$524,012	$996,256	$0
24	$8,062,238	$443,423	0%	$0	$443,423	$552,833	$996,256	$0
25	$7,509,405	$413,017	0%	$0	$413,017	$583,239	$996,256	$0
26	$6,926,166	$380,939	0%	$0	$380,939	$615,317	$996,256	$0
27	$6,310,849	$347,097	0%	$0	$347,097	$649,159	$996,256	$0
28	$5,661,690	$311,393	0%	$0	$311,393	$684,863	$996,256	$0
29	$4,976,827	$273,725	0%	$0	$273,725	$722,530	$996,256	$0
30	$4,254,296	$233,986	0%	$0	$233,986	$762,270	$996,256	$0
31	$3,492,027	$192,061	0%	$0	$192,061	$804,195	$996,256	$0
32	$2,687,832	$147,831	0%	$0	$147,831	$848,425	$996,256	$0
33	$1,839,407	$101,167	0%	$0	$101,167	$895,089	$996,256	$0
34	$944,318	$51,938	0%	$0	$51,938	$944,318	$996,256	$0
		$15,393,840			**$15,393,840**	**$10,000,000**	**$25,393,840**	**$16,740,000**

(orange)	No prinipal paid. Accrued interest payments ramped up to 100%
(green)	No principal paid. Annual accruing interest paid and all accumulated accrued interest paid in equal installments.
(yellow)	all principal and accruing interest paid.

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APPENDIX I GRAPHS OF ANNUAL COST BREAKDOWN AND PAYBACK POINT FOR EACH ALTERNATIVE

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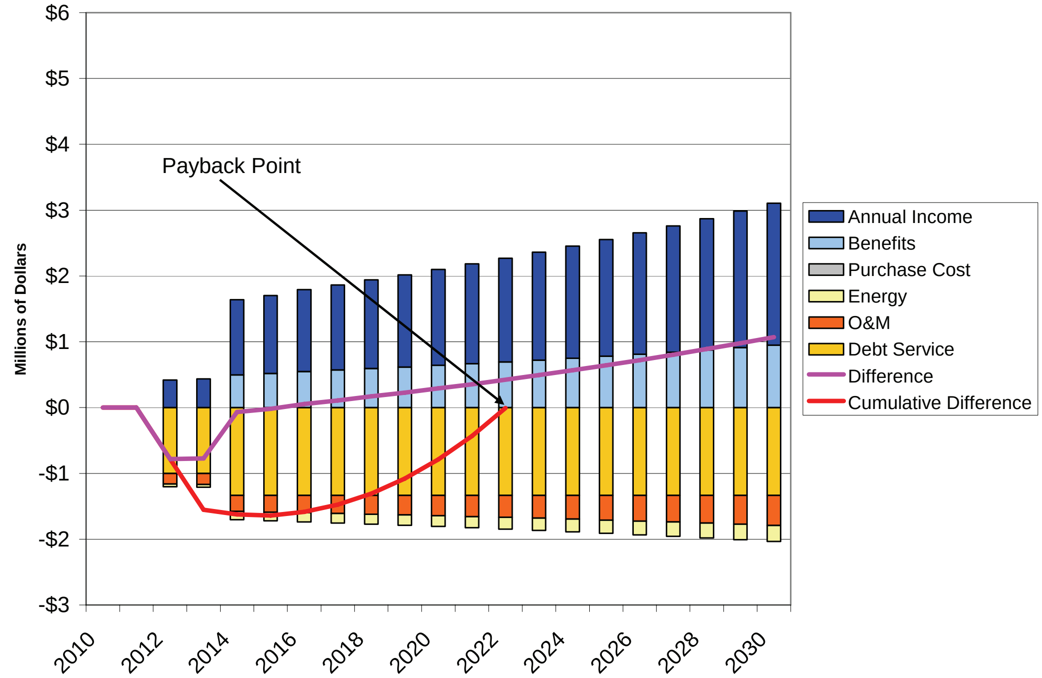

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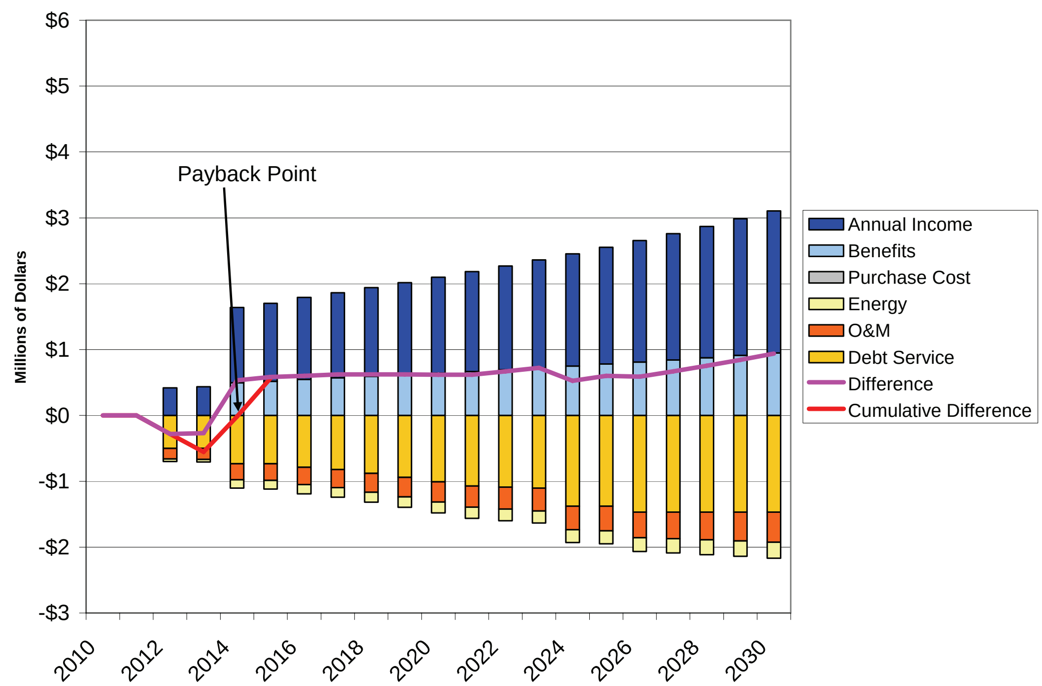

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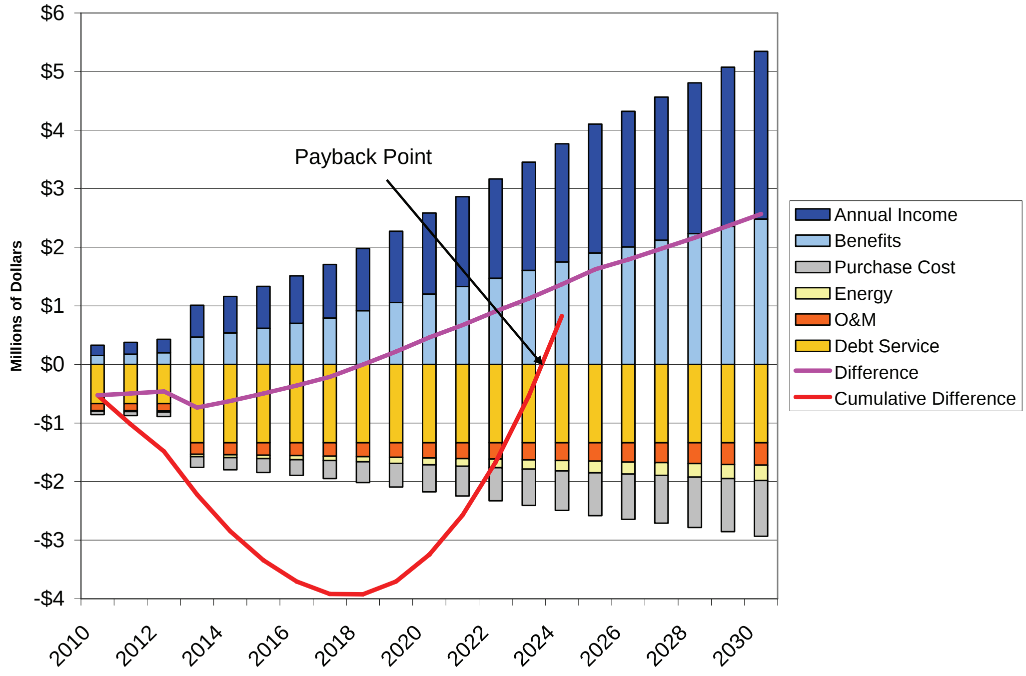
Alternative E1



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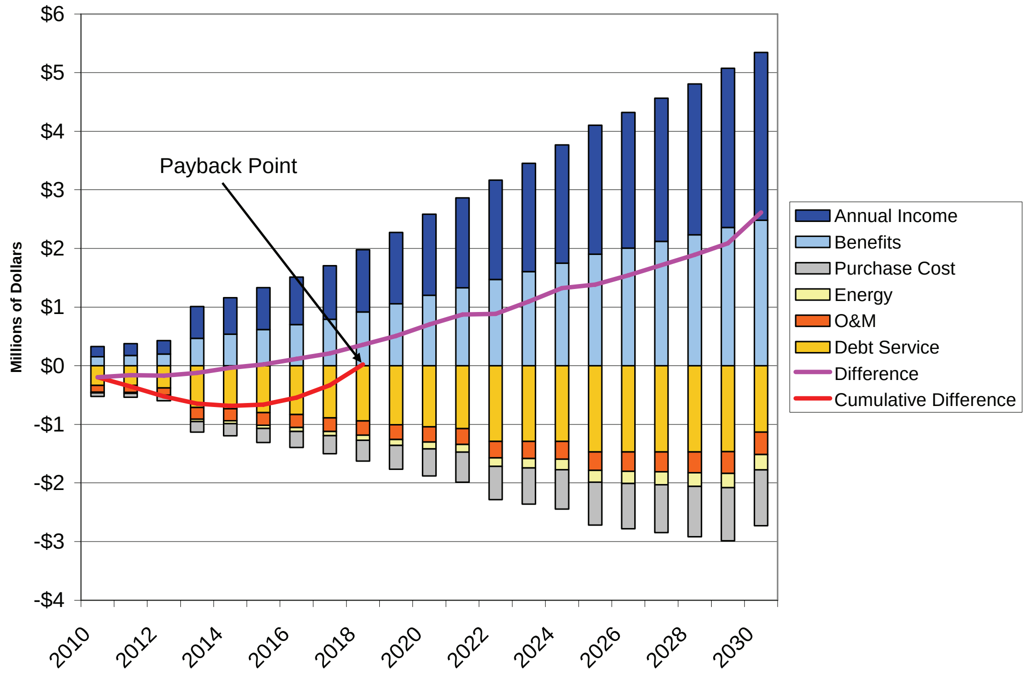

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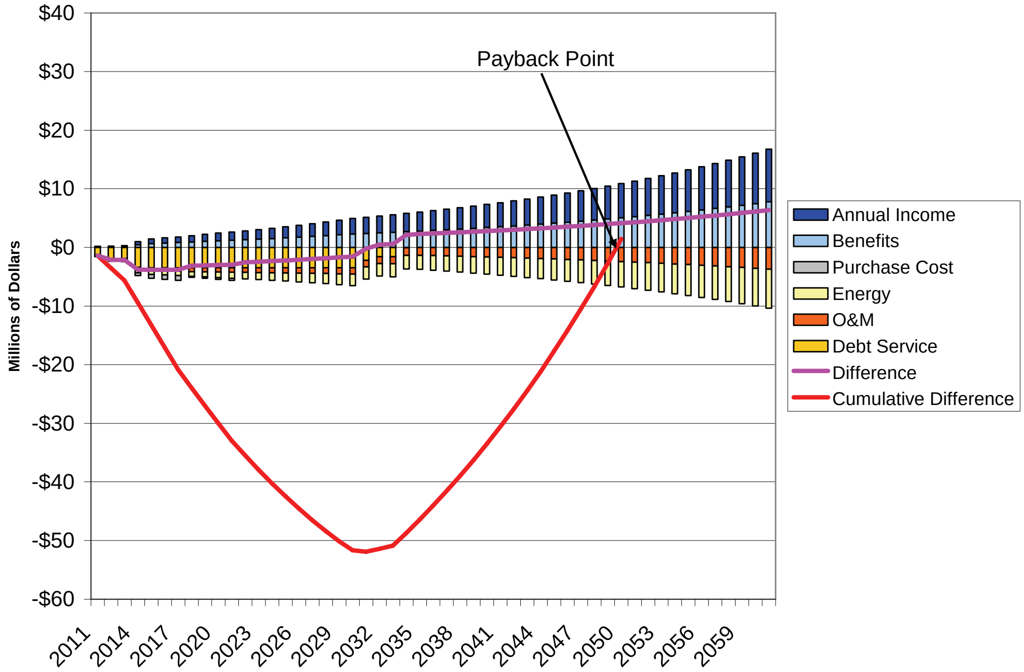

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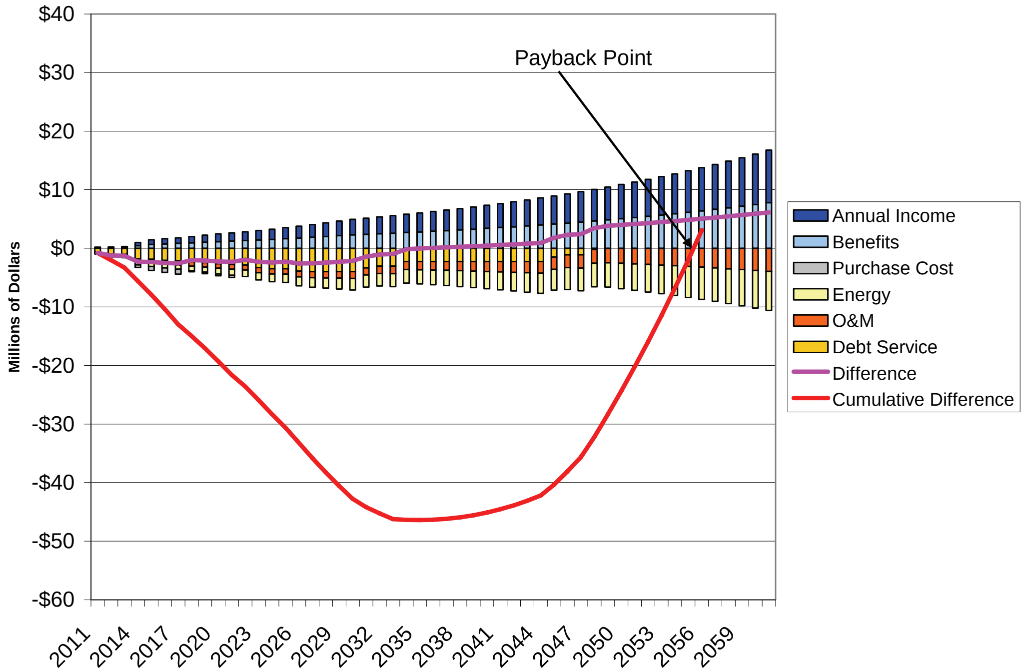
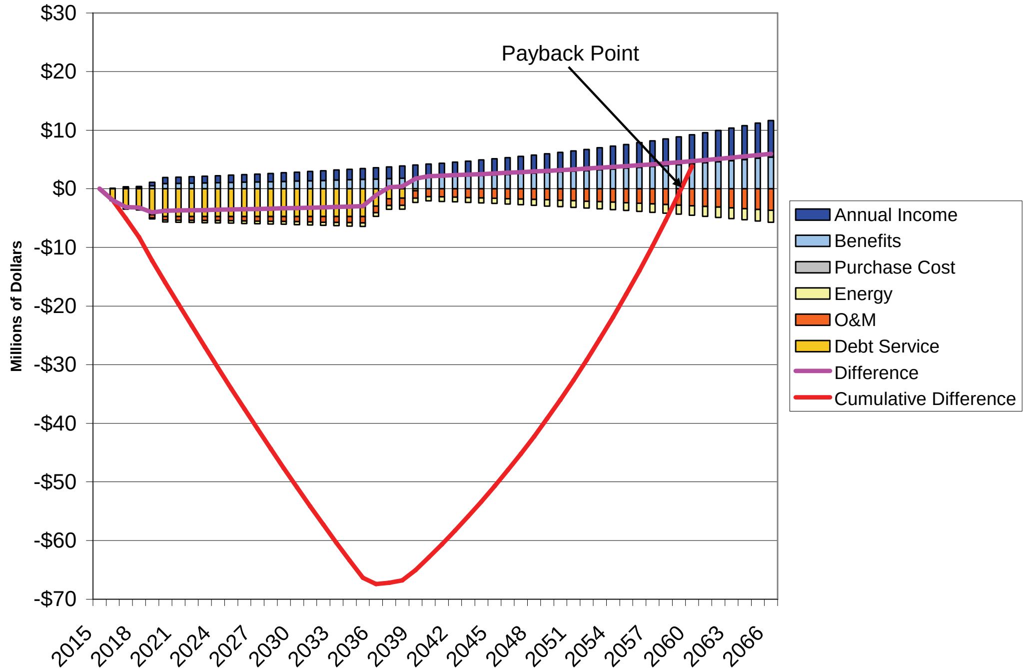


(b) State Participation Financing

Alternative W1



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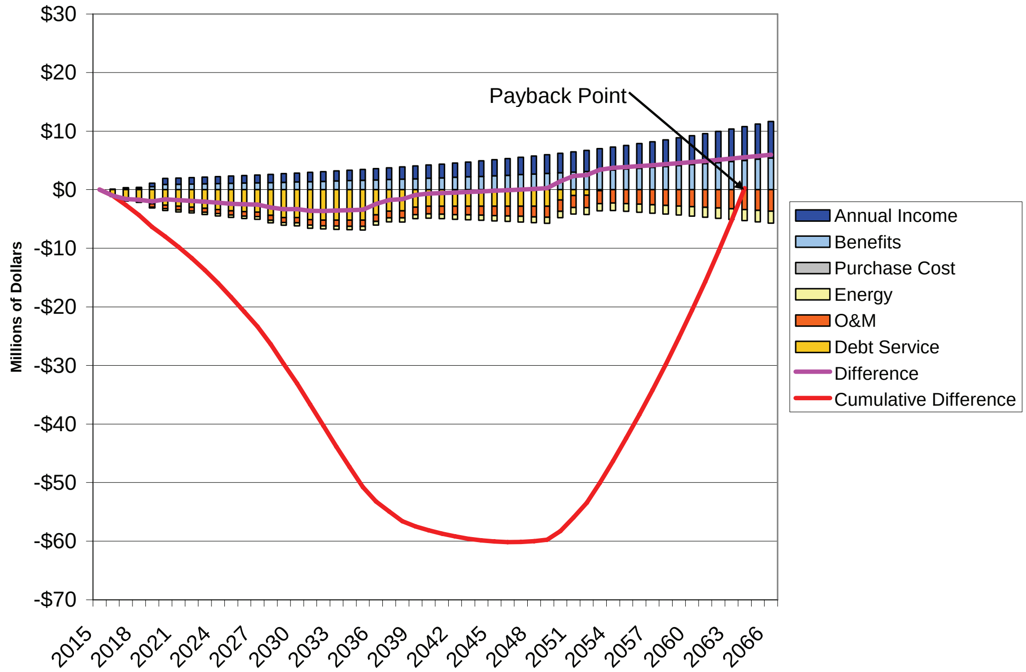

(b) State Participation Financing

Alternative CS2

APPENDIX J GLOSSARY OF TERMS RELATED TO WATER REUSE

- A -

***Advanced Treatment* –** wastewater treatment processes beyond conventional treatment including but not limited to such processes as ultrafiltration, microfiltration, nanofiltration, reverse osmosis, electrodialysis, ion exchange, carbon absorption (granular activated or powdered activated), chemical oxidation, nitrification, coagulation and flocculation, gravity filtration, nutrient removal (biological and/or chemical), air stripping, lime treatment). Also known as tertiary treatment. [NRC, 22-23; Dual, 81]

***Agricultural Reuse on Food Crops* –** irrigation of food crops which are intended for direct human consumption, often further classified as to whether the food crop is to be processed or consumed raw. [Review, 2]

***Agricultural Reuse on Nonfood Crops* –** irrigation of fodder, fiber, and seed crops, pasture land, commercial nurseries, and sod farms. [Review, 2]

***Augmentation of Potable Water Supplies* –** see indirect potable reuse.

- B -

***Backflow Prevention* –** means the installation of a device to prevent potential backflow of fluid or other contaminates into the potable water system and/or the reclaimed water system in the event that an inadvertent or illegal interconnection occurs with any nonpotable system. Accepted backflow prevention methods include: air gap, reduced pressure principle backflow assembly, double check value assembly. Other approved devices that may be used for additional protection of the potable water system and/or the quality and integrity of the reclaimed water system include: pressure vacuum breakers and atmospheric vacuum breakers as approved by the Foundation of Cross Connection Control and Hydraulic Research of the University of Southern California, as outlined in Section 10 of the most current issues of the "Manual of Cross Connection Control." [Guidelines, 52]

***Bed and Banks Authorization* –** authorization to convey treated wastewater in a stream or other state watercourse and then subsequently divert and reuse the water. [30 TAC § 297.16]

***Beneficial Use* –** an economic use of wastewater in accordance with the purposes, applicable requirements, and quality criteria of 30 TAC Chapter 210, and which takes the place of potable and/or raw water that could otherwise be needed from another source. The use of reclaimed water in a quantity either less than or the economically optimal amount may be considered a beneficial use as long as it does not constitutes a nuisance. [30 TAC §210.3]

***Blow-offs* –** even with sufficient disinfection, residual organics and bacteria may accumulate and/or grow at dead spots in the system. This may lead to odor and clogging problems. Blow-off valves and blow-off periodic maintenance of the system can significantly allay the problem. In most cases, the blow-off flow is directed into the sewage system and/or pervious areas such as parkways, easements, right-a-ways, parks and other managed receiving areas. [Guidelines, 53]

BOD $_5$ **–** biochemical oxygen demand. Used to assess the total amount of organics present. BOD is an index of the biodegradable organics, oil, and grease. It is a measure of the relative oxygen requirements of wastewaters, effluents, and polluted waters. [Dual, 81]

- C -

CBOD $_5$ **–** carbonaceous biochemical oxygen demand. $CBOD_5$ is the part of BOD due strictly to organic matter rather than ammonia. The BOD test is run with an inhibitor for nitrification. [Manual, 663]

CFU **–** colony forming units. Number of bacterial colonies formed on media inoculated with a water sample. Fecal coliform CFU standards are set for recycle water depending on the intended use of the water.

Conservation **–** those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses. [30 TAC §297.1]

Conventional Treatment – wastewater treatment typically including preliminary, primary, and secondary (biological) treatment processes.

Cross Connections **–** of unknown or unsafe quality, which may be capable of conveying contaminates to the public water supply as a result of backflow. Arrangements such as bypass, jumper connections, removable sections, swivel or changeable devices and other temporary or permanent devices through which or because of, backflow could occur or considered to be cross connections. [Manual, 664]

- D -

Direct Nonpotable Reuse **–** use of community wastewater treated to a sufficient degree that they are acceptable for a wide range of nonpotable uses and direct discharge into a nonpotable distribution system that provides service to customers who obtain their potable water from a separate system. [Dual, 81]

Direct Potable Reuse **–** immediate addition of reclaimed wastewater to the water distribution system. This practice has not been adopted by, or approved for, any water system in the United States. [NRC, 21]

Disinfection **–** the destruction of pathogenic organisms by chemical, physical, or biological means. [Dual, 81]

***Domestic Wastewater* –** waste and wastewater from humans or household operations that are discharged to a wastewater collection system or otherwise enters a treatment works. Also, this includes water borne human waste and waste from domestic activities such as washing, bathing, and food preparation, including greywater and blackwater, that is disposed in an on-site wastewater system as defined in 30 TAC Chapter 285. [30 TAC §210.3]

***Dual Water Systems* –** facilities that distribute two grades of water to the same service area – meeting all State and Federal requirements for human or animal ingestion and the other meeting State requirements for nonpotable applications. The quality, quantity, and pressure available from each system vary with the sources and intended uses for each grade of water. [Dual, 81]

- E -

***Endocrine Disrupters* –** a group of various environmental contaminants also known as "hormonally active agents" which are associated with adverse reproductive and developmental effects in wildlife, humans, and laboratory animals. The contaminants may mimic the effects of the female sex hormone estradiol or antagonize the action of natural hormones and include such compounds as PCBs, PCDFs, synthetic pesticides (e.g., DDT, DDE, lindane, methoxychlor), dioxin, phthalates, other synthetic organic compounds, alkylphenol ethoxylate (solvent/emulsifier/plasticizer), natural hormones, and synthetic hormones such as ethinylestradiol (birth control pill ingredient). It should be noted that the cause and effect relationships associated with this group of compounds is difficult to define and undergoing much evaluation at this time. [Safe, 1-3; Committee on HAA, 16-20; EPA, 2]

***Environmental Reuse* –** reclaimed water used to create man-made wetlands, enhance natural wetlands, and to sustain stream flows. [Review, 2]

***Epidemiological Studies* –** studies examining the relationship between contaminants in drinking water and health problems. [Issues, 11]

- F -

***Food Crop* –** any crops intended for direct human consumption. [30 TAC §210.3]

- G -

***Geometric Mean* –** the n^{th} root of the product of all measurements made in a particular period of time, for example in a month's time, where n equals the number of measurements made. In the alternative, the geometric mean can also be computed as the antilogarithm of the sum of the logarithm of each measurement made. Where any measurement using either computation method equals zero, it must be substituted with the value of one. [30 TAC §210.3]

Groundwater Recharge – replenishing groundwater potable water aquifers either through spreading the recycle water on the ground above the aquifers or directly injecting the recycle water into the aquifer. [Issues, 32]

- I -

Indirect Potable Water Reuse **–** abstraction, treatment, and distribution of water for drinking from a natural source water that is fed (augmented) in part by the discharge of wastewater effluent. [NRC, 20]

Industrial Reuse **–** reclaimed water used in industrial facilities primarily for cooling system makeup water, boiler-geed water, process water, and general washdown. [Review, 2]

Initial Holding Pond **–** an impoundment which first receives reclaimed water from a producer at the quality levels established by 30 TAC Chapter 210, not including subsequent holding ponds. [30 TAC §210.3]

Interruptible Source **–** water supply that can be limited to specific parts of the day or supply periods.

- L -

Landscape Impoundment – body of reclaimed water that is used for aesthetic enjoyment or which otherwise serves a function not intended to include contact recreation. [30 TAC §210.3]

Leak Detection System **–** a system or device designed, constructed, maintained, and operated with a pond that is capable of immediately detecting a release of leachate or reclaimed water that migrates through a liner. The system may typically include a leachate collection system along with either leak detection sensors or view ports. [30 TAC §210.3]

- M -

Membrane Treatment **–** advanced treatment processes including microfiltration, ultrafiltration, nanofiltration, reverse osmosis, and electrodialysis. Contaminants are removed from the liquid through straining at various synthetic membrane pore sizes.

Municipal Wastewater **–** waste or wastewater discharged into a publicly owned or a privately owned sewerage treatment works primarily consisting of domestic waste. [30 TAC §210.3]

- N -

Nonpotable Water **–** means not suitable for consumption by humans or animals and should not be used for the purposes of augmenting or filling of swimming pools where extended human contact time could result. [Dual, 81]

NTU* – *Nephelometric Turbidity Units. Units of measure used to denote turbidity in water.

Nuisance **–** any distribution, storage, or use of reclaimed water, in such concentration and of such duration that is or may tend to be injurious to or which adversely affects human health or welfare, animal life, vegetation, or property, or which interferes with the normal use and enjoyment of animal life, vegetation, or property.

- O -

On-channel Pond **–** an impoundment wholly or partially within a definite channel of a stream in which water flows within a defined bed and bans, originating from a definite source or sources. The water may flow continuously or intermittently, and if intermittently, with some degree of regularity, dependent on the characteristics of the source or sources. [30 TAC §210.3]

- P -

Pharmaceutically Active Compounds **–** a group of compounds including antibiotics, drugs, and synthetic hormones that have recently been shown to be present in the effluents from wastewater treatment plants. These compounds are of concern from both the environmental impact perspective and the potential impacts in water reuse projects. [Sedlak, 1]

Planned Indirect Potable Water Reuse **–** purposeful augmentation of a water supply source with reclaimed water derived from treated municipal wastewater. The water receives additional treatment prior to distribution. [NRC, 20]

Potable Water **–** water of high quality intended for drinking, cooking, and cleansing. This grade of water would conform to the drinking-water quality requirements of state and federal regulatory agencies. [Dual, 82]

Preliminary Treatment **–** includes initial screening of wastewater to remove rags and large objects, frequently followed by grit removal to separate sand and heavier solids from the wastewater. [Issues, 21]

Primary Drinking Water Standards **–** National Primary Drinking Water Regulations are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Microbial contaminants, disinfection byproducts, select disinfectants, inorganic contaminants (select metals, fluoride, asbestos, nitrite, and nitrate), select organic chemicals, and select radionuclides are included in the list of primary drinking water standards. [40 CFR Part 141, 30 TAC §290.104]

Primary Treatment **–** usually a physical settling process but may include chemical enhancement to remove slightly more than half of the suspended solids and about one-third of the biodegradable organic material as well as some nutrients, pathogenic organisms, trace elements, and potentially toxic organic compounds. [Issues, 21]

Producer **–** a person or entity that produces reclaimed water by treating domestic wastewater or municipal wastewater, in accordance with a permit or other authorization of the Agency, to meet the quality criteria established in 30 TAC Chapter 210. [30 TAC §210.3]

Provider **–** a person or entity that distributes reclaimed water to a user(s) of reclaimed water. For purposes of 30 TAC Chapter 210, the reclaimed water provider may also be a reclaimed water producer. [30 TAC §210.3]

- R -

Reclaimed Water **–** domestic or municipal wastewater which has been treated to a quality suitable for a beneficial use, pursuant to the provisions of 30 TAC Chapter 210 and other applicable rules and permits. [30 TAC §210.3]

Recycled Water **–** see reclaimed water.

Return Flow **–** discharge of treated wastewater into a receiving stream.

Restricted Landscaped Area **–** land that has vegetative cover to which public access is controlled in some manner. Access may be controlled by either legal means (e.g., state or city ordinance) or controlled by some type of physical barrier (e.g., fence or wall). Examples of such areas are: golf courses, cemeteries, roadway rights-of-way, and median dividers. [30 TAC §210.3]

Restricted Recreational Impoundment **–** body of reclaimed water in which recreation is limited to fishing, boating and other non-contact recreational activities. [30 TAC §210.3]

- S -

Secondary/Biological Treatment **–** treatment processes involving microorganisms that oxidize organic material to produce carbon dioxide and other end products. A portion of the organic material is used by the microorganisms for energy. Biological treatment and the subsequent solids separation process can remove up to 95 percent of the BOD and TSS entering the process along with significant amounts of heavy metals and certain organic compounds. [Issues, 21]

Secondary Drinking Water Standards **–** National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are nonenforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards. [40 CFR Part 143, 30 TAC §290.105]

***Single Grab Sample* –** an individual sample collected in less than 15 minutes. [30 TAC §210.3]

***Spray Irrigation* –** application of finely divided water droplets using artificial means. [30 TAC §210.3]

***Subsequent Holding Pond* –** a pond or impoundment that receives reclaimed water from an initial holding pond where the quality of the water changes after management in the initial holding pond. [30 TAC §210.3]

***Surface Water Augmentation* –** addition of reclaimed water into a drinking water reservoir to mix with the water supply source prior to the mix being treated at a conventional water treatment plant. [Storage, 3-2]

- T -

***Tertiary Treatment* –** see advanced wastewater treatment.

***Total Dissolved Solids* –** the material residue left in the glassware after filtered sample evaporation and drying in an oven at a defined temperature.

***Total Suspended Solids* –** the solid matter suspended in water or wastewater. Suspended solids are the portion of total solids retained by the filter during filtration of a sample. [Dual, 83]

***Total Solids* –** the material residue left in the glassware after sample evaporation and drying in an oven at a defined temperature. Includes both suspended and dissolved solids. [Dual. 83]

***Turbidity* –** the measure of the clarity of water. Turbidity refers to the presence of suspended materials in water that interfere with the passage of light through the water. Turbidity may be caused by inorganic or organic particulates or the presence of microorganisms. Turbidity is typically expresses in terms of nephelometric turbidity units or NTUs. [Chemistry, 331-332]

***Type I Reclaimed Water* –** use of reclaimed water where contact between humans and the reclaimed water is likely. [30 TAC §210.3]

***Type II Reclaimed Water* –** use of reclaimed water where contact between humans and the reclaimed water is unlikely. [30 TAC §210.3]

- U -

***Unplanned Indirect Potable Water Reuse* –** the unintentional addition of wastewater (treated or not) to a water supply that is subsequently used (usually by downstream communities) as a water source, with additional treatment prior to delivery. Many communities already unintentionally practice such unplanned indirect potable reuse. [NRC, 21]

Unrestricted Landscaped Area **–** land that has had its plant cover modified and access to which is uncontrolled. Examples of such areas are: parks, schoolyards, greenbelts, and residences. [30 TAC §210.3]

Unrestricted Recreational Reuse **–** an impoundment of water in which no limitations are imposed on body-contact water recreation activities. [Review, 2]

REFERENCES

American Water Works Association. *Manual of Water Supply Practices. Dual Water Systems.* AWWAM24. Denver, CO. AWWA. 1994 [Dual]

Code of Federal Regulations. [CFR]

Crook, James, Ph.D., P.E.; Ammerman, David K, P.E.; Okun, ScD, P.E.; and Matthews, Robert L., PE. *Guidelines for Water Reuse*. EPA/625/R-92/004. [Guidelines]

Crook, James; Okun, Daniel A., and Pincince, Albert B. *Water Reuse*. Alexandria, VA. Water Environment Research Foundation. 1994. [Reuse]

Environmental Protection Agency. *Removal of Endocrine Disruptor Chemicals Using Drinking Water Treatment Processes*. Cincinnati, OH. EPA/625/R-00/015. [EPA]

Miller, Gerald, Ph.D.; Bosch, Richard ten, P.E.; Horne, Alex, Ph.D; Lazenby, Andrew; Quinlan, Elizabeth; and Spangenberg, Carl, P.E. *Impact of Surface Storage on Reclaimed Water: Seasonal and Long Term*. Alexandria, VA. Water Environment Research Foundation. 2003. [Storage]

National Research Council. *Hormonally Active Agents in the Environment*. Executive Summary. Washington, D.C. National Academy Press. 1999 [Committee on HAA]

National Research Council. *Issues in Potable Reuse. The Viability of Augmenting Drinking Water Supplies with Reclaimed Water*. Washington, D.C. National Academy Press. 1998. [Issues]

Going, Victor, and Ammerman, David K. "*Review of Regulations and Guidelines for Water Reuse Across the United States.*" WateReuse Association. 2003 Symposium.

Safe, Stephen. H. "*Endocrine Disruptors and Human Health – Is There a Problem? An Update.*" Environmental Health Perspectives, Volume 108, Number 6, June 2000. [Safe]

Sedlak, David L. "*Should We Worry About Estrogenic Hormones and other Pharmaceutically Active Compounds in the Aquatic Environment?*" Encodrine Disruptors and Pharmaceutically Active Compounds in Drinking Water. Seminar co-sponsored by AWWARF, WERF, WateReuse Foundation. 2000. [Sedlak]

Texas Administrative Code. [TAC]

Texas Water Utilities Association. *Manual of Wastewater Treatment*. 4th Edition. Austin, TX. TWUA. 1991. [Manual]

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APPENDIX K FREQUENTLY ASKED QUESTIONS ABOUT WATER REUSE

1. What is reclaimed water used for?

   A. Planned uses generally include nonpotable water supply

      1. Parks Irrigation
      2. Schools Irrigation
      3. Golf Course Irrigation
      4. Commercial and Industrial Uses (i.e., cooling water)

   B. Unplanned uses include augmentation of potable supplies by discharging into reservoirs and/or streams with a downstream diversion for potable use.

2. Will reclaimed water harm the grasses or landscaping?

   A. Requires analyzing the quality of the water particularly with respect to "salt" content.

   B. There are numerous applications that have not harmed the grasses or landscaped areas.

3. Is the reclaimed water safe?

   Yes, regulations require advanced treatment levels for different uses (i.e., Type I and Type II)

4. Is the reclaimed water more economical than other water?

   A. Not generally more economical than ground water or raw surface water.

   B. It is more economical than potable water in many situations – requires site-specific analysis.

5. What are the major benefits of reclaimed water?

   A. More economical in some cases.

   B. Provides a dependable supply.

6. Can reclaimed water be used for potable supply?

   A. Not for direct use (e.g., from Wastewater Treatment Plant to Water Treatment Plant) due to uncertainties of constituents that may be in reclaimed water and public perception.

   B. Yes, for indirect use to augment a potable supply (e.g., discharge into a reservoir or stream with a downstream diversion) with multiple barriers provided (e.g., advanced wastewater treatment, blending with natural water, detention time).

7. Are permits or approvals required for use of reclaimed water?

   A. For direct use approval of a Chapter 210 Notification (e.g., describes the use of the water, quantity of water, provisions for compliance with rules) has to be obtained from TCEQ.

   B. For indirect use (e.g., discharge to state waterway) a water rights permit is required.

APPENDIX L DRAFT PUBLIC INFORMATION DOCUMENTS

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CITY OF FORT WORTH WATER DEPARTMENT

RECLAIMED WATER PROGRAM

Reclaimed water - do not drink

Agua no potable - no tomar

CITY OF FORT WORTH WATER DEPARTMENT

reh_2

RECLAIMED WATER PROGRAM

Reclaimed water - do not drink

Agua no potable - no tomar

RECLAIMED WATER
DO NOT DRINK

AGUA NO POTABLE
NO TOMAR

CITY OF FORT WORTH WATER DEPARTMENT
reh2o
RECLAIMED WATER PROGRAM

RECLAIMED WATER
DO NOT DRINK

AGUA NO POTABLE
NO TOMAR

CITY OF FORT WORTH WATER DEPARTMENT

reh2o

RECLAIMED WATER PROGRAM

Links on the City of Fort Worth Reuse Website

Overview

The City of Fort Worth and surrounding areas will experience significant growth in population over the next several decades. In order to help meet its future water supply needs, the City is pursuing opportunities that include conservation and the use of highly treated wastewater effluent (reclaimed water) to reduce demands for potable water.

The reuse or recycling of water is similar in concept to the recycling of paper, cans and glass. The idea is to reuse, rather than wastefully discard the water. Reclaimed water can be treated to a very high level, resulting in a product that is perfectly safe for many non-drinkable uses, including irrigation and some commercial and industrial uses.

Water reuse has been identified as a Best Management Practice for water conservation by the Water Conservation Implementation Task Force established by the 78th Texas Legislature. Therefore, in addition to other water conservation efforts, development of a reclaimed water program will provide for efficient use of the City's water resources, will preserve current water supplies, and will postpone the need to develop additional supplies to meet the needs of a growing Fort Worth.

FAQs

What is reclaimed water?

Reclaimed water is highly treated wastewater effluent that is ideal for irrigation and many commercial and industrial uses. Nitrogen and phosphorus in the reclaimed water provide excellent fertilizers for irrigation of turf grasses and ornamental plants. Reclaimed water can also be used as water for fracturing in the natural gas well drilling process, for cooling tower makeup water, and as makeup water for ornamental water features such as ponds or fountains. All of these applications reduce the amount of drinking water we use every day so that we can save that water for what it really was intended for…DRINKING!

Is reclaimed water safe?

Yes, reclaimed water is very safe. Extensive treatment and disinfection of reclaimed water ensure that public health and environmental quality are protected. Reclaimed water must meet strict standards of water quality established by the Texas Commission on Environmental Quality (TCEQ). Reclaimed water receives disinfection that destroys any harmful bacteria before it is used for irrigation or other purposes. The reclaimed water is monitored regularly to ensure that these standards are met. To see how wastewater is treated by the City of Fort Worth Village Creek Wastewater Treatment Plant, click here: (LINK to VCWWTP treatment process page- may want to put in process diagram eventually)

What are the benefits of using reclaimed water?

Every gallon of reclaimed water that is used for irrigation, industrial or commercial purposes, saves a gallon of our valuable drinking water supply. Use of reclaimed water will allow the City to reduce its need for additional drinking water supplies and treatment facilities. In addition, reclaimed water provides a very economical alternative to drinking water for irrigation, industrial and commercial uses, and is not restricted during times of drought.

Do other communities use reclaimed water?

Yes, reclaimed water has been used in some areas of the United States for up to 70 years. Major cities in Texas that have reclaimed water programs including El Paso, Odessa, Austin and San Antonio. Other states with reclaimed water programs include California, Arizona, Florida, Colorado and Hawaii.

How do I sign up to get reclaimed water?

First, view our Eligibility and Application link to learn more about the application process. Then, fill out and submit the application form. Water Department staff will review your application to determine whether you are eligible to receive reclaimed water.

Existing and Planned Projects

Existing Project

Waterchase Golf Course, located in east Fort Worth just north of I-30 and west of Eastchase Parkway, currently irrigates with reclaimed water from Village Creek Wastewater Treatment Plant, and has been doing so since 1999. (Provide pictures of Waterchase)

Planned Projects

The City of Fort Worth has prepared a plan to develop a number of reclaimed water projects, several of which are anticipated to begin construction within the next 5 years.

To see a map of the proposed reclaimed water service areas, click here: (LINK to MAP)

To download a copy of the Reclaimed Water Priority and Implementation Plan, click here: (LINK to REPORT- BY CHAPTER)

Regulations

State Regulations

The use and quality of reclaimed water is regulated by the Texas Commission on Environmental Quality (TCEQ) and Title 30, Chapter 210 of the Texas Administrative Code (LINK to 210 regs?). All reclaimed water applications must adhere to these state requirements.

City Regulations

Through a City ordinance (# XXXX- provide link?), the City of Fort Worth has established rules for its reclaimed water program. These rules cover a number of issues including application and approval procedures, design and construction requirements, and user responsibilities.

Reclaimed Water Treatment

Currently, the Village Creek Wastewater Treatment Plant (VCWWTP) is the only source of reclaimed water for the City of Ft. Worth. All water treated at VCWWTP meets the Texas Commission of Environmental Quality Type I standards for reclaimed water. Water treated to this quality is safe to use for irrigation in areas where public contact may occur, such as parks or athletic fields. (LINK to table with Type I standards). For a description of the treatment process at VCWWTP click here: (LINK to VCWWTP page).

Rates and Fees

(Show rates and fees here)

Application

(Describe application process here and provide link to application form. See Tuscon materials for example)

User Agreement

(Link to standard user agreement form)

Reclaimed Water Master Plan Report

The City has recently completed a Reclaimed Water Priority and Implementation Plan. As a part of this study, the Water Department met with potential customers to quantify their potential usage of reclaimed water. Based on this information, service areas were identified, and conceptual distribution systems have been developed to provide water to these service areas.

To see a map of the proposed reclaimed water service areas, click here: (LINK to MAP)

To download a copy of the Reclaimed Water Priority and Implementation Plan, click here: (LINK to REPORT- BY CHAPTER)

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APPENDIX M CITY OF FORT WORTH CHAPTER 210 REUSE AUTHORIZATION

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Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

August 28, 2006

Kathryn Henson, Attorney-At-Law
Regulator/Environmental Coordinator
City of Fort Worth
1000 Throckmorton
Fort Worth, Texas 76102

Re: Reclaimed Water Authorization
Village Creek Wastewater Treatment Plant
TPDES Permit No. WQ0010494013
CN600128862; RN102076924
Tarrant County, Texas

Dear Ms. Henson:

We have completed our review of information submitted on the above referenced projects. The project under review consists of using reclaimed water within the City of Fort Worth and the ETJ's. The project under review consists of the reuse of wastewater effluent from the Wastewater Treatment Plants referenced above. The treated effluent will be used for the Type I and Type II uses as define in 30 TAC §210.32 (Specific Uses of Reclaimed Water).

Our review showed that the material generally meets the applicable minimum standards as set forth in the Texas Natural Resource Conservation Commission's rules titled <u>Use of Reclaimed Water</u>. The project is approved. The attachment to this letter indicates the approved site and conditions that apply to this approval.

If you have any questions please contact me at (512) 239-4552.

Sincerely,

Louis C. Herrin, III, P.E.
Wastewater Permitting Section
Water Quality Division

Enclosure

cc: City of Fort Worth, w/attachments
TCEQ Region 4 Office, w/attachments
TCEQ Water Quality Division, Application Review and Processing Team (MC 148),w/attachments

Authorization No. R10494-013

This authorization supersedes
and replaces R10494-013
approved September 2, 1998.

AUTHORIZATION FOR RECLAIMED WATER

Producer: City of Fort Worth
P.O. Box 870
Fort Worth, Texas 76101

Producer: City of Fort Worth
P.O. Box 870
Fort Worth, Texas 76101

Users: Any user that the City of Fort Worth permits as a distributor or a bulk user of the reclaimed water

Location: The wastewater treatment plant is located southeast of the confluence of the West Fork Trinity River with Village Creek in Tarrant County, Texas.

Authorization: Reclaimed water from the City of Fort Worth Village Wastewater Treatment Plant (TPDES Permit No. WQ0010494013), to be used as defined in Title 30 Texas Administrative Code, (30 TAC) Chapter 210, *Use of Reclaimed Water*. See Attachment "A" for service area map.

This authorization contained the conditions that apply for the uses of the reclaimed water. The approval of a reclaimed water use project under Chapter 210 does not affect any existing water rights. If applicable, a reclaimed water use authorization in no way affects the need of a producer, provider and/or user to obtain a separate water right authorization from the commission.

Issued Date: August 28, 2006

L'Oreal Stepney, P.E., Director
Water Quality Division

Limitations: The authorization is subjected to the following requirements:

I. General Requirements.

(a) No wastewater treatment plant operator (producer) shall transfer to a user reclaimed water without first notifying the commission.

(b) Reuse of untreated wastewater is prohibited.

(c) Food crops that may be consumed raw by humans shall not be spray irrigated. Food crops including orchard crops that will be substantially processed prior to human consumption may be spray irrigated. Other types of irrigation that avoid contact of reclaimed water with edible portions of food crops are acceptable.

(d) There shall be no nuisance conditions resulting from the distribution, the use, and/or storage of reclaimed water.

(e) Reclaimed water shall not be utilized in a way that degrades ground water quality to a degree adversely affecting its actual or potential uses.

(f) Reclaimed water managed in ponds for storage must be prevented from discharge into waters in the state, except for discharges directly resulting from rainfall events or in accordance with a permit issued by the commission. All other discharges are unauthorized. If any unauthorized overflow of a holding pond occurs causing discharge into or adjacent to waters in the state, the user or provider, as appropriate, shall report any noncompliance A written submission of such information shall also be provided to the commission regional office and to the Austin Office, Water Enforcement Section (MC-149), within five (5) working days of becoming aware of the overflow. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the anticipated time it is expected to continue; and, steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

(g) The irrigation site must be maintained with a vegetative cover or be under cultivation during times when reclaimed water is being applied. The irrigation practices shall be designed so as to prevent incidental ponding or standing water except where local farming conditions and the accepted irrigation delivery systems and cropping patterns are such that, as an unavoidable consequence of such conditions, systems, and patterns, there will be standing water. Irrigation application rates and application times shall be developed so as to minimize "wet grass" conditions in unrestricted landscaped areas during the periods the area could be in use. Irrigation systems shall be designed so that the irrigation spray does not reach any privately-owned premises outside the designated irrigation area or reach public drinking fountains. There shall be no application of effluent when the ground is water saturated or frozen. Distribution systems must be designed to prevent operation by unauthorized personnel. Irrigation operations shall be managed in a manner to minimize the inadvertent contact of reclaimed water with humans Operational or tailwater controls shall be provided to preclude discharge of reclaimed water from irrigation sites.

(h) Signs in both English and Spanish shall be posted at storage areas, hose bibs and faucets reading "Reclaimed Water, Do Not Drink" or similar warnings. Alternately, the area may be secured to prevent access by the public.

(i) The reclaimed water user shall provide reasonable control of the application rates for reclaimed water applied to irrigation areas. These controls shall encourage the efficient use of reclaimed water and avoid excessive application of reclaimed water that results in surface runoff or excessive percolation below the root zone.

(j) The reclaimed water provider or user, as applicable shall determine and document typical irrigation demands for the proposed use based on type of vegetation and land area to be irrigated.

(k) The reclaimed water provider shall be responsible for conducting periodic audits of appropriate controls implemented by reclaimed water users.

(l) All hose bibs and faucets shall be painted purple and designed to prevent connection to a standard water hose. Hose bibs shall be located in locked, below grade vaults which shall be clearly labeled as being of non-potable quality. As an alternative to the use of locked, below grade vaults with standard hose bibs services, hose bibs may be placed in a non-lockable service box which can only be operated by a special tool so long as the hose bib is clearly labeled as non-potable water.

(m) One of the following requirements must be met by the user or provider, for any area where reclaimed water is stored or where there exist hose bibs or faucets:

(1) Signs having a minimum size of eight inches by eight inches shall be posted at all storage areas and on all hose bibs and faucets reading, in both English and Spanish, "Reclaimed Water, Do Not Drink" or similar warning.

(2) The area shall be secured to prevent access by the public.

(n) Where a reclaimed water line parallels a sewer line, the reclaimed water line shall be constructed in accordance with subsection (p) or (q) of this section. The horizontal separation distance shall be three feet (outside to outside) with the reclaimed water line at the level of or above the sewer line. Reclaimed water lines which parallel sewer lines may be placed in the same benched trench. Where a reclaimed water line crosses a sewer line, the requirements of Chapter290.44(e)(5)(B) (Location of Water Lines) shall be followed, with "reclaimed water line" substituted for "water line."

(o) Reclaimed water lines which transport reclaimed water under pressure shall be sized according to acceptable engineering practices for the needs of the reclaimed water users. The designer shall consider methods to prevent or maintain lines to mitigate the effect of the deposition of solids in such lines. Pipe specified for reclaimed water force mains shall be of a type having an expected life at least as long as that of the lift station and shall be suitable for the reclaimed water being pumped and operating pressure to which it will be subjected. All pipe shall be identified in the technical specifications with appropriate American Society for Testing and Materials, American National Standard Institute, or American Water Works Association (AWWA) standard numbers for both quality control (dimensions, tolerance, and installation such as bedding or backfill). All pipes and fittings shall have a minimum working pressure rating of 150 pounds per square inch. Final plans and specifications shall describe required pressure testing for all installed reclaimed water force mains. Minimum test pressure shall be 1.5 times the maximum design pressure. Allowable leakage rates shall be determined as described in Chapter 317 relating to Pressure Sewer Systems.

(p) Gravity flow reclaimed water lines shall meet the requirements of Chapter 317. The designer shall consider methods to prevent high velocity scour or maintain line fluid velocity to mitigate the effects of the deposition of solids in the gravity conveyance.

(q) All exposed piping and piping within a building shall be either purple pipe or painted purple. All buried piping installed after the effective date of these rules shall be one of the following: manufactured in purple, painted purple, taped with purple metallic tape, or bagged in purple. All exposed piping should be stenciled in white with a warning reading "NON-POTABLE WATER." All exposed or buried reclaimed water piping constructed at a wastewater treatment facility is exempt from the color coding requirements of this section.

(r) When applicable, in accordance with Chapter 317 the Design Criteria for Sewerage System, the design of distribution systems which will convey reclaimed water to a user shall be submitted to the executive director and must receive an approval. The design of the distribution systems must meet the requirements of Chapter 317. Where a municipality is the plan review authority for certain sewer systems which transport primarily domestic waste, in lieu of the commission, design submittal will not be subject to submittal to the commission and instead must be approved by the municipality. Materials shall be submitted for approval by the executive director in accordance with the Texas Engineering Practice Act (Article 3271a, Vernon's Annotated Texas Statutes).

(s) All ground level and elevated storage tanks shall be designed, installed, and constructed in accordance with current AWWA standards with reference to materials to be used and construction practices to be followed, except for health-based standards strictly related to potable water storage and contact practices, where appropriately less restrictive standards may be applied.

(t) The reclaimed water producer and user shall maintain on the sites a current operation and maintenance plan. The operation and maintenance plan which shall contain, as a minimum the following:
   (1) a copy of a signed contract between the user and producer and ;
   (2) a labeling and separation plan for the prevention of cross connections between reclaimed water distribution lines and potable water lines;
   (3) the measures that will be implemented to prevent unauthorized access to reclaimed water facilities (e.g , secured valves);
   (4) procedures for monitoring reclaimed water;
   (5) a plan for how reclaimed water use will be scheduled to minimize the risk of inadvertent human exposure;
   (6) schedules for routine maintenance;
   (7) a plan for worker training and safety; and
   (8) contingency plan for system failure or upsets.

(u) If effluent is to be used for irrigation within the Edwards Aquifer recharge zone, plans and specifications for the disposal system must be submitted to the executive director for review and approval prior to construction of the facility in accordance with Chapter 213 (Edwards Aquifer Rules).

II Storage Requirements for Reclaimed Water

(a) All initial holding ponds containing Type II effluent, located in a vulnerable area as defined by a rating of 110 or greater on the statewide "*Ground-Water Pollution Potential - General, Municipal, and Industrial Sources*" (DRASTIC) map, shall conform to the following requirements:
   (1) The ponds, whether constructed of earthen or other impervious material, shall be designed and constructed so as to prevent groundwater contamination;

(2) Soils used for pond lining shall be free from foreign material such as paper, brush, trees, and large rocks;

(3) All soil liners must be of compacted material, at least 24 inches thick, compacted in lifts no greater than 6 inches thick and compacted to 95% of Standard Proctor Density. In-situ clay soil's meeting the soils liner requirements shall be excavated and re-compacted a minimum of 6 inches below planned grade to assure a uniformly compacted finished surface.;

(4) Soil liners must meet the following particle size gradation and Atterberg limits:
   (A) 30% or more passing a number 200 mesh sieve; and
   (B) a liquid limit of 30% or greater; and a plasticity index of 15 or greater and have a permeability less than or equal to 1 X 10^{-7} cm/sec;

(5) Synthetic membrane linings shall have a minimum thickness of 40 mils with a leak detection system. In situ liners at least 24 inches thick meeting a permeability less than or equal to 1 X 10^{-7} cm/sec are acceptable alternatives;

(6) Certification shall be furnished by a Texas Registered Professional Engineer that the pond lining meets the appropriate criteria prior to utilization of the facilities; and

(7) Soil embankment walls shall have a top width of at least five feet. The interior and exterior slopes of soil embankment walls shall be no steeper than one foot vertical to three feet horizontal unless alternate methods of slope stabilization are utilized. All soil embankment walls shall be protected by a vegetative cover or other stabilizing material to prevent erosion. Erosion stops and water seals shall be installed on all piping penetrating the embankments.

(b) All initial holding ponds designed to contain Type I and Type II effluent, located in areas in the state not identified in subsection (a) of this section shall conform to the following requirements:

(1) The ponds, whether constructed of earthen or other impervious materials, shall be designed and constructed so as to prevent groundwater contamination;

(2) Soils used for pond lining shall be free from foreign material such as paper, brush, trees, and large rocks;

(3) All soil liners must be of compacted material having a permeability less than or equal to 1 x 10^{-4} cm/sec, at least 24 inches thick, compacted in lifts no greater than 6 inches each;

(4) Synthetic membrane linings shall have a minimum thickness of 40 mils. In situ liners at least 24 inches thick meeting a permeability less than or equal to 1 X 10^{-4} cm/sec are acceptable alternatives;

(5) Certification shall be furnished by a Texas Registered Professional Engineer that the pond lining meets the appropriate criteria prior to utilization of the facilities; and

(6) Soil embankment walls shall have a top width of at least five feet. The interior and exterior slopes of soil embankment walls shall be no steeper than one foot vertical to three feet horizontal unless alternate methods of slope stabilization are utilized. All soil embankment walls shall be protected by a vegetative cover or other stabilizing material to prevent erosion. Erosion stops and water seals shall be installed on all piping penetrating the embankments.

(7) An alternative method of pond lining which provides equivalent or better water quality protection than provided under this section may be utilized with the prior approval of the executive director

(8) A specific exemption may be obtained from the executive director if, after the review of data submitted by the reclaimed water provider or user, as appropriate, the executive director determines containment of the reclaimed water is not necessary, considering:

(A) soil and geologic data, and ground water data, including its quality, uses, quantity and yield; and

(B) adequate demonstration that impairment of ground water for its actual or potential use will be prevented.

(c) Reclaimed water may be stored in leak-proof, fabricated tanks

III. Specific Uses and Quality Standards for Reclaimed Water

Numerical parameter limits pertaining to specific reclaimed water use categories are contained in this section. These limits apply to reclaimed water before discharge to initial holding ponds or a reclaimed water distribution system. It shall be the responsibility of the reclaimed water producer to establish that the reclaimed water meets the quality limits at the sample point for the intended use in accordance with the monitoring requirements identified in Section IV relating to Sampling and Analysis.

(a) Type I Reclaimed water Use. This type of use includes irrigation or other uses in areas where the public may be present during the time when irrigation takes place or other uses where the public may come in contact with the reclaimed water.

(b) The following conditions apply to Type I of uses of reclaimed water. At a minimum, the reclaimed water producer shall only transfer reclaimed water of the following quality for Type I reclaimed water uses, reclaimed water on a 30-day average shall have a quality of:

$CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU/100 ml*
Fecal Coliform (not to exceed)	75 CFU/100 ml**

(c) Type II Reclaimed Water Use. The type of use where the public would not come in contact with the reclaimed water.

(d) The following conditions apply to this type of use of reclaimed water. At a minimum, the reclaimed water producer shall only transfer reclaimed water of the following quality as described for Type II reclaimed water use, reclaimed water on a 30-day average shall have a quality of:

$CBOD_5$	15 mg/l
Fecal Coliform	200 CFU/100 ml*
Fecal Coliform (not to exceed)	800 CFU/100 ml**

* geometric mean

** single grab sample

(e) In the event a reclaimed water provider or user proposes to design, construct, or operate a reclaimed water system or to utilize reclaimed water in a manner other than permitted in this authorization, the provisions of Chapter 210 Subchapter D shall apply.

IV. Sampling and Analysis

The reclaimed water producer shall sample the reclaimed water prior to distribution to user to assure that the water quality is in accord with the intended contracted use. Analytical methods shall be in accord with those specified in Chapter 319 (relating to Monitoring and Reporting). The minimum sampling and analysis frequency for Type I reclaimed water is twice per week and for Type II reclaimed water is once per week

The monitoring shall be done after the final treatment unit. These records shall be maintained on a monthly basis and be available at the plant site for inspection by authorized representatives of the Commission for at least five years.

V. Record Keeping and Reporting.

(a) The reclaimed water provider and user shall maintain records on site for a period of five years.

(1) Records to be maintained by the provider include:

(A) copies of notifications made to the commission concerning reclaimed water projects.

(B) as applicable, copies of contracts made with each reclaimed water user (this requirement does not include reclaimed water users at residences that have separate distribution lines for potable water).

(C) records of volume of water delivered to each reclaimed water user per delivery (this requirement does not apply to reclaimed water users at residences that have separate distribution lines for potable water).

(D) reclaimed water quality analyses.

(2) The reclaimed water producer shall report to the commission on a monthly basis the following information on forms furnished by the executive director Such reports are due to the commission by the 20th day of the month following the reporting period

(A) volume of reclaimed water delivered to provider.

(B) quality of reclaimed water delivered to a user or provider reported as a monthly average for each quality criteria except those listed as "not to exceed" which shall be reported as individual analyses

VI Transfer of Reclaimed Water.

Reclaimed water transferred from a provider to a user shall be done on a demand only basis. This means that the reclaimed water user may refuse delivery of such water at any time. All reclaimed water transferred to a user must be of at least the treatment quality specified in Section IV Transfer shall be accomplished via pipes or tank trucks.

VII. General Prohibitions.

Except for on-channel ponds, storage facilities for retaining reclaimed water prior to use shall not be located within the floodway and shall be protected from the 100-year flood.

VIII. Restrictions.

This authorization does not convey any property right and does not grant any exclusive privilege.

IX. Responsibilities and Contracts.

(a) The producer of reclaimed water will not be liable for misapplication of reclaimed water by users, except as provided in this section. Both the reclaimed water provider and user have, but are not limited to, the following responsibilities:
- (1) The reclaimed water producer shall:
  - (A) transfer reclaimed water of at least the minimum quality required by this chapter at the point of delivery to the user for the specified use;
  - (B) sample and analyze the reclaimed water and report such analyses in accordance with Sections IV and V relating to Sampling and Analysis and Record keeping and Reporting, respectively; and
  - (C) notify the executive director in writing within five (5) days of obtaining knowledge of reclaimed water use not authorized by the executive director's reclaimed water use approval.
- (2) The reclaimed water provider shall:
  - (A) assure construction of reclaimed water distribution lines/systems in accordance with 30 TAC Chapter 317 and in accordance with approved plans and specifications;
  - (B) transfer reclaimed water of at least the minimum quality required by this chapter at the point of delivery to the user for the specified use;
  - (C) notify the executive director in writing within five (5) days of obtaining knowledge of reclaimed water use not authorized by the executive director's reclaimed water use approval; and
  - (D) not be found in violation of this chapter for the misuse of the reclaimed water by the user if transfer of such water is shut off promptly upon knowledge of misuse regardless of contract provisions.
- (3) The reclaimed water user shall:
  - (A) use the reclaimed water in accordance with this authorization; and
  - (B) maintain and provide records as required by Section III relating to Record Keeping and Reporting.

X. Enforcement.

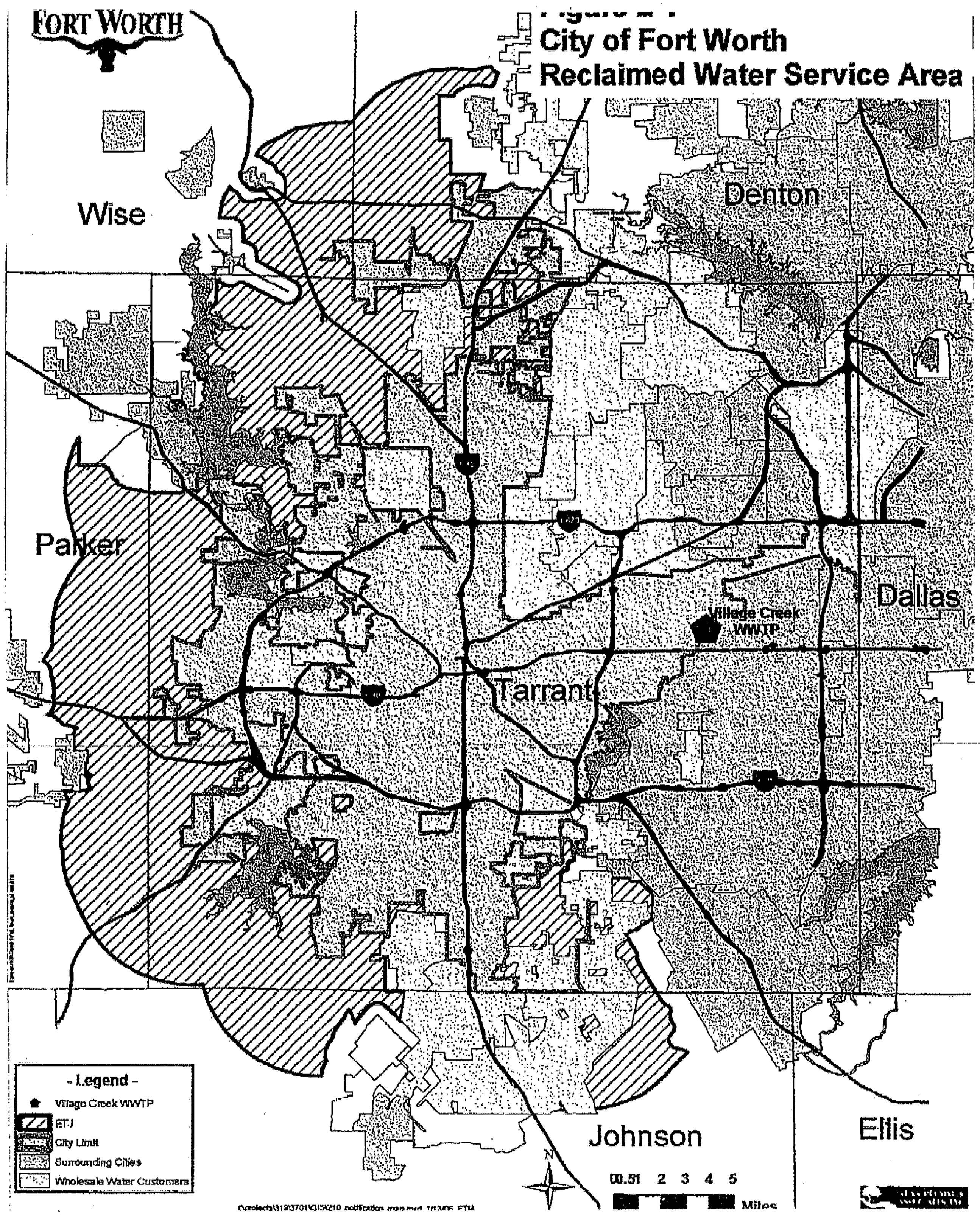
If the producer, provider and/or user fails to comply with the terms of this authorization, the executive director may take enforcement action provided by the Texas Water Code, §§26.019 and 26.136.

XI. STANDARD PROVISIONS:

(a) This authorization is granted in accordance with the Texas Water Code and the rules and other Orders of the Commission and the laws of the State of Texas.

(b) Acceptance of this authorization constitutes an acknowledgment and agreement that the provider and user will comply with all the terms, provisions, conditions, limitations and restrictions embodied in this authorization and with the rules and other Orders of the Commission and the laws of the State of Texas. Agreement is a condition precedent to the granting of this authorization.

Attachment "A"



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APPENDIX N DRAFT RECLAIMED WATER ORDINANCE

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DRAFT

This Document is a working document and is ONLY a draft ordinance.
Please do not disseminate.
January 9, 2007

CODE
CITY OF FORT WORTH, TEXAS
CHAPTER 35
WATER AND SEWERS

ARTICLE VII: RECLAIMED WATER

Division I. General Provisions

Sec. 35-154. Purpose.

The purpose of this Article is to define the terms and conditions for which reclaimed water may be provided to users within the City's reclaimed water service area.

Sec. 35-155. Definitions.

In this Article:

APPROVED USE means an application or beneficial use of reclaimed water authorized by a reclaimed water agreement.

APPROVED USE AREA means a site designated in a reclaimed water agreement to receive reclaimed water for an approved use.

CHAPTER 210 means Chapter 210 of Title 30 of the Texas Administrative Code, titled "Use of Reclaimed Water," as it may be amended from time to time.

COMMINGLE means the mixing of reclaimed water with one or more liquids in the same container unit.

COMMISSION means the Texas Commission on Environmental Quality and its successor agencies.

COMMUNITY FACILITIES AGREEMENT (CFA) is an agreement between the developer and the City to ensure new development is constructed to City standards and for improvements that will eventually be dedicated to the public and maintained by the City.

CONTAINER UNIT means any container that is used to hold reclaimed water during transport from a wastewater treatment facility to an approved use area.

CROSS CONNECTION means any physical arrangement where a potable water supply is actually or potentially connected with any non-potable water system, used water system or auxiliary water supply, sewer, drain conduit, swimming pool, storage reservoir, plumbing fixture, swamp cooler, air conditioning unit, fire protection system, or any other assembly which contains, or may contain, contaminated water, domestic sewage, or other liquid of unknown or unsafe quality which may be capable of imparting contamination to the public water system as a result of backflow. Bypass arrangements, jumper connections, removable sections, swivel or change over assemblies, or other temporary or permanent assemblies through which, or because of which, backflow may occur are considered to be cross connections.

DIRECTOR means the Director of the Fort Worth Water Department, or the Director's authorized representative.

DRAWINGS mean plans, working drawings, detail drawings, profiles, typical cross sections, or reproductions that show locations, character, dimensions, or details of work related to a reclaimed water system and its components.

.

OFFSITE FACILITIES means any reclaimed water distribution, storage, or delivery facilities upstream of the Point of Connection to an approved use area.

ONSITE FACILITIES means any reclaimed water distribution, storage or delivery facilities downstream of the Point of Connection to an approved use area, i.e. on the customer's side of the reclaimed water meter.

POINT OF CONNECTION means a location where offsite facilities connect to onsite facilities and, unless otherwise set forth in the reclaimed water service agreement, is the point at the downstream end of the Water Department's reclaimed water service.

RECLAIMED WATER means reclaimed wastewater that is collected through a publicly owned treatment works and is under the direct control of the City wastewater treatment plants or a wastewater treatment plant with which the City contracts, and that has been treated to a quality that meets or exceeds Chapter 210 requirements.

RECLAIMED WATER DISTRIBUTION SYSTEM means that system of pipes and related facilities for the distribution, use and sale of reclaimed water at various points of connection, that may be designed and constructed, or otherwise acquired, and thereafter operated by the City, all in its sole discretion.

RECLAIMED WATER SERVICE means the furnishing of reclaimed water to a user, through a metered connection, to onsite facilities.

RECLAIMED WATER SERVICE AGREEMENT means a contractual agreement between a user and the City that establishes the conditions and terms for delivery and use of reclaimed water.

RECLAIMED WATER SERVICE AREA means the territory within the City and within its extraterritorial jurisdiction.

RECLAIMED WATER TRANSPORTATION means the transport of reclaimed water by vehicles to an approved use area.

STORAGE FACILITY means an impoundment or structural tank that receives reclaimed water.

USER means a party to a reclaimed water agreement with the City.

WATER DEPARTMENT means the City of Fort Worth Water Department.

UTILITY STANDARD means a design criterion of the City, American Water Works Association, or the Commission.

Division 2. Reclaimed Water Service

Sec. 35-156. Availability of Reclaimed Water Service.

(A) The Director may make reclaimed water available to properties within the reclaimed water service area in compliance with this Article.

(B) The Director shall prescribe design requirements for reclaimed water facilities, the manner of construction, the method of operation, and conditions of service. These requirements shall be available_________________________.

(C) In no event shall the City be obligated to proceed with the construction, maintenance or operation of the reclaimed water system, or any part thereof, unless there are sufficient funds available, or if in the opinion of the Director, the extensions of the reclaimed water distribution system or reclaimed water operation is not in the public interest or disrupts or threatens to disrupt the health and safety of the public.

(D) The decision of the Director shall be final in the determination of line size, approval of plans and specifications, the decision to enter into a reclaimed water contract with a customer and the availability of funds for construction and/or reimbursement for construction of oversize lines.

Sec. 35-157. Reclaimed Water Service Application.

A person may submit an application for reclaimed water service for a subdivision plat, building permit, site plan, water service extension, or water connection within the reclaimed water service area.

Sec. 35-158. Reclaimed Water Service Application Review.

(A) The Director shall review an application for reclaimed water service and make such investigation as is necessary to make a decision to provide such service. The investigation may include a site visit with the applicant.

(B) The Director shall determine whether the application meets the requirements of this article and of the Commission.

(C) Upon approval of the application, the Director shall recommend that the City enter into a reclaimed water service agreement with the User to the City Manager.

Sec. 35-159. Approval Required for System Design and Operation.

(A) Upon receipt of approval from the Director, a user must submit the following to the Director for approval before the user may construct or retrofit an onsite facility that will use or receive reclaimed water:

(1) design drawings and specifications in compliance with the City's policies and regulations,.

(2) drawings of the final installed onsite facility and the entire approved use area before beginning operation. **Are 1&2 the same?**

(3) proof as requested by the Director, that the user has complied with Chapter 12.5, Division 3 *Cross Connection Control* and has the required backflow prevention assembly on the reclaimed water service line.

(4) proof as requested by the Director that the user has sufficient storage facilities for the storage of reclaimed water in compliance with TAC Section 210.23.

(B) The user shall request a final inspection in writing after completion of construction work and upon the receipt of the City's approval of system design and operation as specified in section 35-159 (A). The inspection shall include a cross-connection and an operational test.

(C) The Director may grant the user final approval for reclaimed water service if:

(1) the Director approves the system design and operation;

(2) the system passes inspection, cross connection control and operational tests.

Sec. 35-162. Reclaimed Water Agreement.

(A) Upon approval of the Director that the user has complied with Section 35-160 and Section 35-161, the User shall execute a reclaimed water service agreement with a the City.

(B) A reclaimed water service agreement shall incorporate the requirements of this article, Chapter 210 and any additional utility standards and other terms and conditions prescribed by the Director.

(C) The user must sign the reclaimed water agreement acknowledging that the user is responsible for onsite facilities and related activities, that the user shall comply with all applicable laws and regulations, including but not limited to Chapter 210, and must agree to hold the City harmless from claims related to the reclaimed water once it has passed through the point of connection, including any claims related to the operation and maintenance of the onsite facilities and related activities.

Sec. 35-163. Discontinuance of Service.

(A) The City may discontinue reclaimed water service to a user if the user:

(1) violates the terms of the reclaimed water service agreement or this article;

(2) fails to pay any and all fees assessed on the user's water bill;

(3) tampers with any facilities related to the service, including the meter;

(4) cross-connects with a potable water source;

(5) refuses to permit an authorized city representative to enter its premises to inspect the user's reclaimed water system; or

(6) performs an act that the Director determines, in his or her sole discretion, may be detrimental to the water, wastewater, and/or reclaimed water system or the health and safety of the public.

(B) A user who seeks to discontinue service must pay for the reclaimed water used until the service is disconnected.

(C) If a user reconnects a discontinued service without the Water Department director's approval, the Water Department may remove the service and charge an additional fee.

(D) A user may apply for reinstatement of service after paying the fees or charges authorized by this article.

(E) A user may not reconnect a discontinued service without the Director's approval.

(F) The Director shall charge a fee for service reinstatement.

Sec. 35-164. City's Responsibilities.

(A) The City and its authorized agents, employees, or contractors are responsible for the operation, management, and control of the offsite facilities and the oversight of reclaimed water.

(B) The City shall:

(1) obtain necessary Commission authorizations for the offsite use of reclaimed water under Chapter 210;

(2) conduct reclaimed water quality assessments to comply with regulatory requirements applicable to the reclaimed water that it delivers at the point of connection;

(3) pursuant to section 35-167 and reasonably promptly after receipt of the user's written request pursuant thereto, perform an initial inspection of the user's onsite facilities and their operations for conformance with this article, including the location and proper operation of backflow prevention

assemblies;

(4) In addition, the City shall have the right to take any action at such times that it deems proper to safeguard the public health and safety.

Sec. 35-165. User Responsibilities.

(A) The user shall:

(1) be responsible for constructing an onsite service line to an established point of connection;

(2) provide supervision of onsite facilities to assure compliance with this Article and Chapter 12.5, Article V, Division 3 (*Cross Connection Control*) of the City Code;

(3) provide access to on-site facilities at reasonable times for inspections by theCity;

(4) train all onsite facilities operations personnel consistent with the worker training and safety plan approved by the Commission, pursuant to Chapter 210.4 (a)(4)(F), as it may be amended from time to time; and

(5) conduct all operations related to reclaimed water service in compliance with this Article.

Sec. 35-166. Use of Reclaimed Water.

(A) A user may use reclaimed water for the following purposes:

(1) turf and general landscape irrigation;

(2) non-food processing industrial processes;

(3) non-residential toilet and urinal flushing;

(4) construction activities;

(5) vehicle washing;

(6) air conditioning cooling towers; and

(7) other lawful uses as authorized by the Director.

(B) A user may use reclaimed water only in specific locations authorized by the Director, as designated in the User's reclaimed water service agreement.

(C) Each of the uses authorized by, or actions taken pursuant to this section are subject to the prohibitions set forth in Section 35-169 and must comply with Chapter 210.

(D) A user who uses reclaimed water for cooling or processing must discharge the water to a sanitary sewer, in compliance with all applicable permits and laws governing such discharges, or obtain written approval from the Director for any other proposed use, disposal or discharge of such water.

Sec. 35-167. Inspection of Reclaimed Water System.

(A) The Director may inspect, devices installed by the user to control reclaimed water and may remove, or secure such devices if installed in violation of this Article or the terms of the reclaimed water service agreement.

(B) Director may inspect any offsite or onsite facilities, as well as use areas and adjoining property, during normal business hours and shall be granted access, without prior notice to the user.

(1) The Director may make periodic unannounced inspections of the onsite reclaimed water system.

(2) The user and its operations personnel shall cooperate with inspectors and assist in performing operational tests.

Sec. 35-168. Identification of Reclaimed Water Facilities.

A user must identify reclaimed water facilities with signs having a minimum size of eight inches by eight inches posted at all storage areas and on all hose bibs and faucets reading, in both English and Spanish, with the words "Reclaimed Water, Do Not Drink" or similar warning in accordance with Section 210.25 of Title 30 of the TAC.

Sec. 35-169. Violations; Prohibited Uses.
A person commits an offense if a person:

(1) uses reclaimed water for a purpose not approved in the reclaimed water agreement;

(2) uses or applies reclaimed water for any purpose, including approved uses, by direct application or by windblown spray, to an area other than that approved in the reclaimed water agreement;

(3) uses hose bibs or faucets on an onsite reclaimed water system unless they are designed and installed to prevent connection to a standard water hose, as defined in Section 210.25 ofof Title 30 of the TAC;

(4) allows any obstruction to impede access to meter boxes or other onsite or offsite facilities;

(5) gives, sells, trades, or transfers reclaimed water to another area without the prior written approval of the Director;

(6) discharges airborne or surface reclaimed water from the user's property, other than to a wastewater treatment system or wastewater collection system, without notifying the City of its intent to obtain a permit from the Commission and actually being granted a permit authorizing the discharge;

(7) interrupts reclaimed water service in a portion of the City's system without the prior written approval of the Director.

(8) stores or applies reclaimed water in such a way as to cause runoff or ponding. If such conditions occur, in addition to any other corrective action taken or required by law, the user shall immediately alter its method of application to prevent any further runoff or ponding.

Sec. 35-170. Rates and Charges.

(A) The Water Department shall charge the following fees as established by the City Council:

(1) application fee;

(2) reclaimed water volume charge;

(2) tap fee;

(3) meter set charges;

(4) engineering or other professional services or inspection fees;

(5) reconnection fee; and

(6) service reinstatement fee.

(B) A user of reclaimed water service must pay an additional fee set by City Council for discharge as allowable by City rules and regulations, of reclaimed water to the sanitary sewer.

Sec. 35-171. Inaccurate Meter Readings.

If a reclaimed water meter fails to register or registers inaccurately, the City may charge an average daily consumption rate based on a reading of the meter when in use and registering accurately during the same season or as close to the same season as is reasonably possible.

Sec. 35-172. Billing.

(A) The User shall be billed for services on their monthly water bills, according to the rates established by the City Council.
(B) The User shall be responsible for the payment of the fees incurred for services under this Article.

(C) When an account becomes delinquent, the Director may send the User a second notice. If the account is not brought current within ten (10) days of the date of the second notice, the city may suspend services until payment is made in full or arrangements have been made to satisfy the account that are agreeable to the City.

Sec. 35-173. No Grant or Transfer of Water Right or Ownership Interest.

The delivery of reclaimed water by the City and the acceptance and use of the reclaimed water by the user is not a transfer or an acquisition by the user of a water right or an ownership interest in any of the offsite facilities.

Sec. 35-174. Offenses.

(A) A person commits an offense if the person violates any provision of this Article.

(B) An offense under this subsection is a Class C misdemeanor punishable by a fine not to exceed $500.

(C) Each instance of a violation of this Article is a separate offense.

Division 3. Transportation of Reclaimed Water.

Sec. 35-175. Reclaimed Water Transportation.

(A) The City may make reclaimed water from its wastewater treatment facilities available for transportation by vehicle to approved use area.

(B) Reclaimed water shall be made available only under the terms and conditions provided herein and only to such persons as are duly permitted by the City as distributors as provided in Section 35-176.

(C) The City shall not be obligated to provide such reclaimed water to distributors and may discontinue such service at any time, to limit the volume and to establish or alter loading procedures and/or locations as deemed necessary by the Director.

Sec. 35-176. Reclaimed Water Transportation Permit Required.

(A) A reclaimed water transportation permit is required to transport reclaimed water from a City facility to an approved point of use.

(B) No reclaimed water transportation permit shall be issued except upon application filed with the Water Department.

Sec. 35-177. Reclaimed Water Transportation Permit Application Procedures.

At a minimum the application shall include every person who uses a vehicle to transport reclaimed water from a designated City facility shall make an application for such use with the Director and shall do the following:

(A) Complete and file a permit application on a form prescribed by the Water Department Director.

(B) Submit with the application a photocopy of the applicant’s driver’s license and photocopies of the driver’s license of every proposed driver of the reclaimed water transportation vehicles.

(C) Submit to the Director proof that applicant’s vehicles, which will be registered under the permit, are insured in at least the minimum amounts as required by state law, or are self-insured as provided by state law to secure payment of all lawful and proper claims arising out of the operation of each vehicle. A written statement from an authorized agent of the applicant's insurance carrier verifying the issuance of such insurance shall be filed with the Director before a permit is issued. All such verifications of insurance shall provide for a thirty (30) day cancellation notice to the Director.

(D) Provide any additional information requested by the Director.

Sec. 35-178. Inspection of Vehicles and Containers.

(A) Before a permit is issued, each vehicle must satisfactorily pass inspection and shall meet the following requirements:

(1) The business name, telephone number and address of applicant shall be permanently displayed on both sides of the vehicle in letters of a minimum height of three (3) inches, in a color contrasting to their background. An address is sufficient if it states city and state. If applicant's business is not within municipality, the name of the county and state will be sufficient.

(2) The vehicle shall display current state vehicle registration tags and inspection certificate.

(3) The vehicle shall be clean and odor free.

(G) Before a permit is issued, each container unit the applicant proposes to use shall meet the following requirements:
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(1) Container units or tanks shall have a minimum capacity of one thousand (1000) gallons, shall be capable of being closed water tight and shall be so closed during transport of reclaimed water; and shall be maintained in a leak-proof condition. Special permits may be issued for container units with a capacity of less than one thousand (1000) gallons upon the determination by the Director that all other container unit specifications herein required have been met and that the particular container unit does not create an increased risk to the public health and safety.

(2) Container units shall be identified by labels or signs such as "CAUTION – RECLAIMED WATER DO NOT DRINK" in English and Spanish. Labels or signs shall be placed so that they can be seen readily by all operations personnel using the vehicle and container unit.

Sec. 35-179. Issuance and Display of Reclaimed Water Transportation Permit.

(A) Upon the filing of the required application, and payment of the permit fee specified herein for each container unit, the Director shall upon his determination that the applicant and vehicles and container units are in compliance with all applicable provisions of this article, issue a permit for each container unit.

(1) The permit shall identify the particular container unit for which it is issued and shall be displayed in a prominent place upon the container unit.

(2) Each container unit shall be separately permitted.

(B) A permit shall be valid for one year from the date of its issuance, unless suspended or revoked.

(C) A permit shall not be transferable.

(D) The City Council shall set a base annual fee for a permit, which shall include one container unit. For each additional container unit, there shall be an additional fee as set by the City Council.

Sec. 35-180. Grounds for Reclaimed Water Transportation Permit Denial.

(A) The Director may deny the issuance of a permit if:

(1) The applicant, a partner of the applicant, a principal in the applicant's business, or applicant's manager or operator has:

(a) within the five (5) years preceding the date of the application been convicted of a misdemeanor that is punishable by confinement and/or by a fine exceeding $500.00, and which relates directly to the duty or responsibility of transporting reclaimed water or liquid waste.

(b) been convicted of a felony which relates directly to the duty or responsibility of transporting reclaimed water or liquid waste.

(2) The applicant fails to provide evidence of liability insurance or self insurance as required by this Article;

(3) The applicant had a permit, that was issued under this Article, suspended or revoked within the twelve (12) months preceding the date of the application;

(4) The application contains a false statement of a material fact;

(5) The application or all required other information is incomplete;

(6) The applicant's vehicles or container units submitted for inspection do not meet the criteria of Section 35-177;

(7) The applicant has not shown proof that the applicant and the applicant's drivers are qualified under Section 35-177(E); or

(8) The applicant has violated a provision of this Article within the preceding twelve (12) months.

(B) An applicant whose permit is denied will be notified by the Director, in writing, of the denial and the grounds therefore. Such notice will be sent certified mail, return receipt requested, to the mailing address listed on the application.

(C) An applicant whose permit is denied may request a reconsideration within (10) days after service of the notice of denial, in accordance with XXX.

Sec. 35-181. Reclaimed Water Transportation Permit Conditions.

A person who has been issued a permit by the Director shall comply with the following:

(A) A permit holder shall immediately notify the Director of any management changes in the business during the time the permit is in effect, and shall provide the Director with a photocopy of the new manager's or chief operating officer's driver's license;

(B) A transporter shall deliver reclaimed water only to users that have been approved by the Director and that have a reclaimed water service agreement on file with the City;

(C) The permit holder shall maintain insurance required by Section 35-177(C) and immediately notify the Director of any changes in its insurance carrier or policy, and insured status or self-insured status;

(D) The permit holder shall maintain all vehicles and container units registered under the permit in compliance with the requirements of Section 35-177(F) and 35-177(G);

(E) The permit holder shall immediately notify the Director when it sells or otherwise disposes of a vehicle or container unit registered under the permit;

(F) A permit holder shall ensure that all of the permit holder's employees collecting and transporting reclaimed water in vehicles and container units registered under the permit remain sufficiently knowledgeable of such vehicles and container units, and of the reclaimed water user locations they service, so that they are able to collect and transport reclaimed water in a safe and competent manner; and

(G) The permit holder shall ensure that none of the vehicles registered under a permit exceed state weight limits while transporting reclaimed water.

Sec. 35-181. Reclaimed Water Transportation Permit Modification.

(A) The permit holder may request a modification to the permit during the permit year to register additional vehicles or container units.

(B) A request to register additional vehicles or container units shall be made to the Director in a manner determined by the Director.

(C) Additional vehicles and container units shall be submitted to the Director for inspection, and shall meet the requirements of Section 35-177(F) and 35-177(G).

(D) The permit holder shall provide to the Director proof of liability insurance or self insurance for such additional vehicles in accordance with Section 35-177(C).

(E) Before the Director modifies the permit, the permit holder shall remit a permit fee for each additional container unit in an amount set by the City Council.

(F) All additional vehicles and container units are subject to the requirements of this Article.

(G) A permit modification shall not extend the term of the permit.

Sec. 35-182. Transporter Responsibilities.

(A) Before accepting a load of reclaimed water, a transporter shall determine whether the transporter's equipment is sufficient to properly handle the transportation without spillage or leaks.

(B) A transporter shall not operate for the transportation of reclaimed water a vehicle or use container units that fail to meet the requirements of Sections 35-177(F) and 35-177(G).

(C) A transporter shall deliver reclaimed water only to users that have been approved by the Director and that have a reclaimed water service agreement on file with the City.

(D) A transporter shall not commingle reclaimed water with any other liquid or waste, including other sources of nonpotable water.

(E) A transporter shall not use container units used to transport any other liquid or waste, including other sources of nonpotable water, to transport reclaimed water until decontamination as approved by XXX has occurred.

(F) A transporter shall not use container units used to transport reclaimed water to transport potable water until decontamination as approved by XXX has occurred.

(G) A transporter shall insure that reclaimed water is delivered to the approved user immediately but not later than 12 hours following receipt of the reclaimed water from the City.

(H) A transporter shall not discharge reclaimed water into the municipal separate storm sewer system, or into any ponds, streams or rivers.

(I) Any excess reclaimed water shall be disposed of by discharging to a wastewater treatment system or wastewater collection system in compliance with all applicable permits or laws for such treatment or collection systems.

(J) A transporter shall allow the Director and any peace officer to inspect vehicles and container units registered under a permit, upon their request.

(K) A transporter shall allow the Director and any peace officer to obtain samples of reclaimed water from the transporter's container units, upon their request.

(L) A transporter operating under a City permit shall use a manifest system book consisting of four-part trip tickets, purchased from the Director for a fee established by the City Council, in the following manner;

(1) Each manifest system book shall be used exclusively for a single vehicle.

(2) A transporter will complete one (1) trip ticket for each individual delivery.

(3) The transporter shall sign the original part of a trip ticket and request the wastewater treatment plant supervisor, or his designee, to do the same at the time of

reclaimed water collection. The transporter shall leave the first copy (yellow) of the trip ticket with the wastewater treatment plant supervisor.

(4) The transporter shall have the user sign the original part of the trip ticket at the time the reclaimed water is delivered, and shall leave the second copy (pink) of the trip ticket with the user.

(5) The transporter shall retain the third copy (green) of the trip ticket for the transporter's own records.

(6) The transporter shall deliver to the Director all completed original trip tickets no later than the tenth (10^{th}) day of the month following the month in which they were completed.

(7) The transporter shall retain its copies of all trip tickets for a period of five (5) years, and shall make such copies available to the Director, upon request, for inspection at all reasonable times.

Sec. 35-183. Offenses

(A) A person commits an offense if the person engages in the transportation of reclaimed water and fails to comply with any provision of Section 35-182.

(B) A person commits an offense if the person operates or causes to be operated a vehicle transporting reclaimed water in container units not registered under a City reclaimed water transportation permit.

(C) A person commits an offense if the person operates or causes to be operated a vehicle transporting reclaimed water and fails to display to the Director or any peace officer upon demand, a copy of a valid City permit.

(D) A person commits an offense if the person operates or allows to be operated a vehicle and/or containers which allows for the leakage or spillage of reclaimed water.

Sec. 35-184. Suspension or Revocation of Reclaimed Water Transportation Permit.

After notice and hearing NEED TO FLESH OUT THIS PROCEDURE the Director may suspend for up to six (6) months or may revoke a permit if the Director determines that:

(A) The permit holder, a partner of the permit holder, a principal in the permit holder's business, permit holder's manager or operator, or an officer of permit holder:

(1) has within the five (5) years preceding the date of the hearing been convicted of a misdemeanor that is punishable by confinement and/or by a fine exceeding $500.00, and which relates directly to the duty or responsibility in operating a reclaimed water transportation business; or

(2) has been convicted of a felony which relates directly to the duty or responsibility in operating a reclaimed water transportation business;

(B) The permit holder failed to comply with any of the permit conditions stated in Section 35-180;

(C) The permit holder or any agent or employee thereof failed to use the manifest system book in compliance with this Article, or to maintain manifests for five years, or to allow the Director to inspect the manifests;

(D) The permit holder or any agent or employee thereof improperly disposed of reclaimed water;

(E) The permit holder or any agent or employee thereof commingled reclaimed water with any other liquid or waste, including other sources of nonpotable water, in a City-permitted container unit;

(F) The permit holder or any agent or employee thereof refused or failed to allow the Director or a peace officer to inspect a reclaimed water transportation vehicle or container unit or obtain reclaimed water samples from a container unit; or

(G) The permit holder or any agent or employee thereof, within the twelve months preceding the hearing, was convicted of violating this Article.

Sec. 35-185. Reclaimed Water Transportation User Responsibilities.

(A) A user of reclaimed water delivered by vehicle shall submit a reclaimed water service application and obtain approval for reclaimed water service, per the requirements of this Article.

(B) A user of reclaimed water delivered by vehicle shall comply with all applicable user responsibilities of this Article.

(C) A user of reclaimed water delivered by vehicle shall sign the original of a City of Fort Worth trip ticket prepared by a transporter operating under a City permit for all reclaimed water received on the user's premises from such transporter.

(D) The user shall note any significant discrepancies on each copy of the trip ticket.

(1) Trip ticket discrepancies are differences between the quantity of reclaimed water on the trip ticket and the quantity of reclaimed water a user actually received.

(2) A significant discrepancy in quantity is any variation greater than fifteen percent (15%), measured in gallons.

Sec. 35-186. Additional Reclaimed Water Transportation Permit Holder Responsibilities.

(A) A permit holder shall immediately notify the Director in writing when the reclaimed water transportation business is sold or ceases to operate.

(B) In addition to the written notification required in subsection (A), the permit holder shall immediately deliver to the Director:

(1) All completed original trip tickets in permit holder's possession;

(2) All unused trip tickets in permit holder's possession; and

(3) Permit holder's permit(s).

(C) A permit holder commits an offense if the permit holder fails to provide notice to the Director as required by this Section.

(D) A permit for the transportation of reclaimed water shall be invalid upon the sale or cessation of operation of a reclaimed water transportation business.

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APPENDIX O DRAFT RECLAIMED WATER SERVICE AGREEMENTS

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CITY OF FORT WORTH WATER DEPARTMENT
RECLAIMED WATER SERVICE AGREEMENT
FOR METERED CONNECTION USERS

Effective Date:__________________________ Contract No. ____________________

PROVIDER:
City of Fort Worth Water Department (FWWD)
Address 1
Address 2
Address 3

USER:

For the consideration provided herein, FWWD agrees to supply and User agrees to accept, store and use reclaimed water in accordance with the terms and conditions of this Reclaimed Water Service Agreement (the "Agreement"). This Agreement incorporates and is subject to all of the terms and conditions set out herein as well as all of the following:

- All applicable Attachments and Appendices attached hereto;
- City of Fort Worth Water and Wastewater Installation Policy;
- City of Fort Worth Policies and Procedures for Processing Water and Wastewater Projects for Design and Construction Manual;
- City of Fort Worth Cross Connection and Backflow Prevention Program (REFERENCE ORDINANCE?)
- All applicable local, state, and federal statutes, ordinances, and regulations, as they may be amended, now or hereafter in effect ("Applicable Laws"), including without limitation, Chapter 210 of Title 30 of the Texas Administrative Code and Article VII of Chapter 35 of the City of Fort Worth Code (the "City Code").

1. Use

a. General.

User shall use reclaimed water supplied by FWWD under this Agreement (the "Reclaimed Water") only as authorized by Applicable Laws, including, without limitation, Sections 210.22 (General Requirements), 210.24 (Irrigation Using Reclaimed Water), and 210.32 (Specific Uses of Reclaimed Water) of Title 30 of the Texas Administrative Code, and Article VII of Chapter 35 of the City Code. FWWD in no way represents that the Reclaimed Water provided under this Agreement is suitable for User's purposes.

b. Specific

User agrees to use the Reclaimed Water only for the purpose(s) and in the location(s) described in Attachment A hereto. User agrees to obtain FWWD's written consent prior to using the Reclaimed Water for a purpose or at a location not described in Attachment A. Any changes to the purpose and location of use of the Reclaimed Water must be reflected in a substitute Attachment A and attached hereto. User agrees to take steps to minimize the risk of inadvertent human exposure to the Reclaimed Water. FWWD may terminate this Agreement immediately, in its sole discretion, if FWWD determines that User has failed to use the Reclaimed Water in accordance with Applicable Laws, this Agreement, and/or Attachment A.

c. Prohibited Uses:

User hereby covenants and agrees to the following:

i. The Reclaimed Water shall not be used for drinking, food preparation, domestic purposes or any type of human consumption, but Reclaimed Water may be used for toilet or urinal flush water in commercial applications, if noted as a purpose in Attachment A, hereto.

ii. The Reclaimed Water shall not be sold or supplied to any other person for any purposes whatsoever.
iii. Except as User may otherwise be expressly authorized by the TCEQ, Reclaimed Water may not be discharged into or adjacent to the waters in the State.
iv. There shall be no nuisance conditions resulting from the distribution, use and/or storage of the Reclaimed Water.

2. <u>Quantity</u>

a. <u>Annual Amount</u>

FWWD agrees to convey and transfer to User and User agrees to take from FWWD, Reclaimed Water up to the maximum quantity set forth in Attachment B per contract year (the "Annual Amount"), and in the monthly volumes set forth in Attachment B. User further agrees to take at least 75 percent of the Annual Amount in each 12 month period (the "Minimum Amount").

b. <u>Rate of Delivery</u>

FWWD will deliver Reclaimed Water on a continuous basis during each twenty-four hour period at a rate consistent with User's anticipated monthly and/or annual utilization of Reclaimed Water as set forth in Attachment B hereto.

c. <u>Adjustment of Annual Amount</u>

If User fails to take the Minimum Amount for any two consecutive 12 month periods, for reasons other than rainfall or default or nonperformance by FWWD, FWWD may reduce the Annual Amount to an amount that reflects the User's actual historical usage over the previous 12 months or as mutually agreed upon by the parties. FWWD may in its discretion increase the Annual Amount, if requested in writing by the User, based on availability and other factors related to the provision of Reclaimed Water. All adjustments to the Annual Amount must be reflected in a substitute Attachment B and attached hereto.

3. Delivery

a. <u>Point of Delivery</u>

The FWWD shall deliver Reclaimed Water from a meter or meters owned and maintained by the FWWD. The approximate location of the Reclaimed Water meter(s) is shown on Attachment A. Title to the Reclaimed Water shall pass from the FWWD to User at the meter connections on User's premises ("Points of Delivery"). The amount of Reclaimed Water received by User shall be determined by and based upon monthly meter readings performed by the FWWD.

b. <u>Service Pressure</u>

The FWWD does not guarantee to deliver Reclaimed Water to User at any specific operating pressure. User shall supply, install and maintain at User's sole expense all equipment to obtain User's desired pressure if the pressure provided by FWWD is not adequate for User's purposes.

4. Quality

a. <u>State Standards</u>
FWWD agrees to transfer to User, at the designated Points of Delivery, Reclaimed Water of at least the minimum quality required by State standards for Type I usage as set forth in Section 210.33 of Title 30 of the Texas Administrative Code, as such may be amended or superceded from time to time. Pursuant to

Section 210.33(1), the minimum Reclaimed Water quality for Type I water initially will be equal to or less than:

BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU/100 ml*
Fecal Coliform	75 CFU/100 ml**

* geometric mean
** single grab sample (not to exceed)

b. Warranties

User understands and agrees that the quality of the Reclaimed Water is different from that of User's normal potable water supply. User understands and agrees that the FWWD makes no warranties as to the quality of the Reclaimed Water beyond those contained in Section 4a. All other warranties whether express or implied, including, without limitation, the implied warranty for fitness for a particular purpose or the implied warranty of merchantability are hereby excluded.

5. Reclaimed Water Use Requirements

a. General

The use of Reclaimed Water is regulated by the Texas Commission on Environmental Quality ("TCEQ") and Article VII of Chapter 35 of the City Code. A copy of Article VII of Chapter 35 is included as Attachment C. User shall fully inform itself of applicable requirements for the use of Reclaimed Water and abide by all Applicable Laws. Delivery of Reclaimed Water may, at FWWD's sole discretion, be terminated for violation of the provisions of any Applicable Laws.

b. Reclaimed Water Supervisor

i. User shall designate an individual as User's Reclaimed Water Supervisor. The Reclaimed Water Supervisor shall be User's coordinator and the direct contact person between FWWD and the User. The User agrees that the Reclaimed Water Supervisor shall be responsible for the proper operation of User's Reclaimed Water system, implementing the requirements of this Agreement relative to the onsite use of reclaimed water, monitoring of User's Reclaimed Water system for prevention of potential hazards, and coordination with the FWWD and other regulatory agencies. The FWWD will assist in the training of User's Reclaimed Water Supervisor as time and resources permit; however, it shall be the non-delegable responsibility of User to assure its Reclaimed Water Supervisor is trained in the use and handling of Reclaimed Water in accordance with all Applicable Laws.

ii. User shall inform the FWWD in writing of the name, position and daytime and nighttime telephone numbers of User's Reclaimed Water Supervisor and shall promptly inform the FWWD in writing of any changes of designee and/or phone numbers during the term of this Agreement.

c. Onsite Facilities

i. If modifications are necessary to User's onsite facilities to conform to Reclaimed Water use requirements, User shall submit its plans and specifications for such modifications to the FWWD which shall approve same before construction commences and which approval shall not unreasonably be withheld. All modifications required in User's onsite facilities shall be the sole cost and responsibility of the User. The FWWD shall assist the User in identifying the modifications and/or changes required in User's onsite facilities. It shall be the User's responsibility to construct the modifications in accordance with the approved plans and specifications, and with all Applicable Laws.

ii. The FWWD shall install and maintain Reclaimed Water meter(s) on the User's site, as required to monitor the Reclaimed Water deliveries made to User. User shall provide FWWD with any easements necessary for delivery of Reclaimed Water to User's premises at a mutually agreeable location.

d. Notifications

i. User shall provide proper notification to User's employees and to the public that Reclaimed Water is being used on the Site in accordance with all Applicable Laws.

ii. Prior to User's commencement of the use of Reclaimed Water under this Agreement, the FWWD will notify the Executive Director of the TCEQ and obtain approval for such use in accordance with Section 210.4 of Chapter 210 of Title 30 of the Texas Administrative Code.

iii. Upon completion of all onsite modifications and changes to User's Reclaimed Water and potable water systems, User shall provide the FWWD with as-built drawings of User's completed Reclaimed Water system and potable water system on User's site. The drawings shall show at a minimum, the locations of all pipelines, controllers, valves, buildings, structures, property boundaries, and any other features important to the onsite use of Reclaimed Water.

iv. User agrees to notify FWWD by telephone or fax of any Reclaimed Water use not authorized by this Agreement, including, but not limited to, spills, leaks, discharges, or releases of a material volume of Reclaimed Water into or adjacent to the waters of the State. The only exception is when the discharge or spill is caused by rainfall events or in accordance with a permit issued by the TCEQ.

Telephone or faxed notice must be given to FWWD within 24 hours of obtaining knowledge of any such spill, leak, discharge, or release. FWWD personnel will then assist in (1) assessing the extent of the unauthorized discharge and (2) aid in determining what reports, if any, need to be made as well as assist in making the reports. FWWD will then provide written notice to TCEQ within 5 working days of obtaining knowledge of any such spill, leak, discharge or release. Notification contacts are as follows:

Fort Worth Water Department
Address 1
Address 2
Phone Number:
Fax Number:

iii.

7. Price and Payment for Use of Reclaimed Water

a. Rates and Fees

User shall pay the FWWD for Reclaimed Water and all applicable fees in accordance with Chapter XX, Article XX of the City Code, as such may be amended.

b. Payment

Each month User shall make a payment to FWWD based on the applicable rate for the amounts of Reclaimed Water received by User for the preceding month ("Monthly Payments"). Monthly Payments are due as provided in Article XX, Chapter XX of the City Code, as such may be amended. A penalty for late payment may be assessed in accordance with Article XX, Chapter XX of the City Code, as such may be amended.

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8. Permission to Enter

User hereby grants to the FWWD and regulatory agencies, acting through their duly authorized employees, agents, or contractors, access at all reasonable times to enter the Site for the purpose of observing construction or modification of reclaimed water facilities, for maintaining and repairing FWWD-installed facilities, for meter reading, and for observing and verifying that User is properly operating is reclaimed water facilities in accordance with the terms and conditions of this Agreement, and Applicable Laws. When entering User's premises, the FWWD or the regulatory agencies shall not unreasonably interfere with User's operations and its use of the premises.

9. Interruption of Service

FWWD may interrupt Reclaimed Water service at any time if FWWD determines that User is in breach of any provision in this Agreement. If FWWD interrupts service pursuant to this subsection, User shall have 30 days to cure the breach to the satisfaction of FWWD. If User fails to cure the breach to the satisfaction of FWWD in the period provided, FWWD shall have the right to immediately terminate the Agreement. The provisions of this Section are not intended to limit the rights of FWWD contained in Section 10 of this Agreement.

10. Termination

a. <u>With Notice</u>

Except as otherwise provided herein, either party may terminate this Agreement by giving the other party 180 days written notice of intent to terminate.

b. <u>Unauthorized Use</u>

Notwithstanding any provision in this Agreement to the contrary, FWWD may terminate this Agreement immediately if FWWD determines that the use of the Reclaimed Water is not in strict compliance with this Agreement or Applicable Laws, as each may be amended.

c. <u>Onsite System</u>

Notwithstanding any provision in this Agreement to the contrary, FWWD may terminate this Agreement immediately if FWWD determines that the Onsite System is not in strict compliance with this Agreement or Applicable Laws, as each may be amended.

d. <u>Nonpayment</u>

In the event User fails to timely pay for Reclaimed Water in accordance with this Agreement, FWWD may interrupt service and terminate this Agreement as authorized by Chapter XX of the City Code. Service will not be interrupted for failure to pay an amount contested in good faith by User and in accordance with FWWD's established procedures, so long as User timely pays all other charges due and not in dispute. All billing inquiries, disputes and decisions to terminate Reclaimed Water service for nonpayment shall be resolved in accordance with FWWD's established policies as such policies may be amended from time to time.

e. <u>Conveyance of Premises</u>

FWWD may terminate this Agreement immediately if User leases, sells, or conveys to another entity ownership, control or possession of all or parts of the land on which all or part of the Onsite System is located; provided, however, that FWWD may, in its discretion and on conditions it may require, permit this Agreement to be assigned to such other entity if the entity will use the Annual Amount of Reclaimed Water for the same purposes and in the same locations as established in the applicable Attachments hereto, all in accordance with this Agreement.

11. Liability, Indemnification and Force Majeure

a. User's Liability

User shall be solely responsible for any and all claims, damages, deaths, losses, injury, fines, penalties, suits and liability of every kind, including environmental liability, arising from the use, distribution or discharge of the Reclaimed Water, whether such us is intended or accidental, or authorized by this Agreement and Applicable Laws or otherwise. User shall be solely responsible for any and all claims, damages, deaths, losses, injury, fines, penalties, suits and liability of every kind arising from or relating to the design, installation, construction, connection, maintenance, operation and modification of the Onsite System, regardless as to whether the Onsite System was released for service by FWWD.

b. Indemnification

To the extent permitted by Applicable Law, User agres to indemnify and hold harmless the City of Fort Worth, and their employees, officers, agents and representatives from and against any and all claims, losses, damages, fines, penalties, causes of action, suits, and liability of every kind, including environmental liability, all expenses of litigation, court costs, and attorneys' fees, for injury to or death of any person, or for damage to any property, arising out of or in connection with User's distribution, use and/or storage of the Reclaimed Water provided hereunder, and/or the design, installation, construction, connection, maintenance, modification or operation of User's Onsite System, including when caused, in whole or part, by User, third parties, or by the contributory negligence of City representatives. It is the expressed intent of the parties hereto that the indemnity provided for in this paragraph is an indemnity by User to indemnify and protect City representative from the negligent acts of the User, third parties, and City representatives, except when caused by the sole negligence of City representatives.

c. Force Majeure

If by reason of Force Majeure, the FWWD shall be rendered unable wholly or in part to carry out its obligations under this Agreement to deliver Reclaimed Water, it shall not be required to deliver Reclaimed Water, and its failure to deliver Reclaimed Water in accordance with the terms and conditions of this Agreement, shall not be considered a breach of this Agreement. The term "Force Majeure" as used in this Agreement shall mean acts of God, strikes, lock-outs, or other industrial disturbances, acts of the public enemy, orders of any kind of the federal or state government or any civil or military authority, insurrection, riots, epidemics, landslides, lightning, earthquakes, fires, hurricanes, storms, floods, washouts, droughts, power failures, arrests, restraint of government and people, civil disturbances, explosions, breakage or accidents to machinery, pipelines or canals, the partial or entire failure of the Fort Worth Water System, unsuitable Reclaimed Water quality, or other causes. Nothing herein shall be construed to enlarge the duty or liability of the FWWD beyond that imposed by law.

12. General Conditions

a. This agreement shall be construed and interpreted in accordance with the laws of the State of Texas, and venue of any litigation hereunder shall be in a court competent jurisdiction sitting in Tarrant County, Texas.

b. This Agreement and the attachments thereto contain all the agreements of the parties with regard to this Agreement and cannot be enlarged, modified or changed in any respect except by written agreement between the parties.

c. The unenforceability, invalidity or illegality of any provisions of this Agreement shall not render the other provisions unenforceable, invalid or illegal, but the parties shall negotiate as to the effect of said unenforceability, invalidity or illegality on the rights and obligations of the parties.

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d. The FWWD and User will each use their best efforts to fully cooperate with one another as may be necessary to diligently obtain and maintain in effect any required permits and all other approvals and records required by regulatory requirements that may be necessary for the FWWD and User to perform under, or take advantage of, the terms and conditions of this Agreement.

e. The captions, titles and headings in this Agreement are merely for the convenience of the parties and shall neither limit nor amplify the provisions of the Agreement itself.

f. Notices to be given by either party to the other relative to this Agreement shall be in writing. Both parties agree that any such notice shall be effective when personally delivered or deposited, postage paid, in the U.S. Mail addressed by certified mail, return receipt request, as follows:

FWWD:	**User:**
Reclaimed Water Supervisor	______________________________
Fort Worth Water Department	______________________________
Address 1	______________________________
Address 2	______________________________
Address 3	______________________________

g. This Agreement is for the sole and exclusive benefit of the parties hereto and shall not be construed to confer any rights upon any third party. Nothing herein shall be construed to confer standing upon any third party who did not otherwise have such standing.

IN WITNESS WHEREOF, the FWWD and User have executed this Agreement as of the date and year first written above.

SIGNATURE BLOCK HERE

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ATTACHMENT A

PURPOSE AND LOCATION OF USE

Contract No. ______________ Effective Date of this Attachment:__________________

1. General category of reclaimed water use(s). Mark all that are applicable.

☐ Commercial ☐ Irrigation

☐ Industrial ☐ Other (specify)__________________

2. Describe specific purpose of reclaimed water use(s)

____

____

____

3. Describe the boundaries within which the reclaimed water will be used. Attach a map showing approximate meter and location of reclaimed water use.

____

____

____

Does this Attachment A supercede a previous Attachment A? Yes ☐ No☐

If yes, what is the Effective Date of superceded Attachment A? _________________________

If yes, execution by authorized FWWD representative is required.

____ _______________________

Fort Worth Water Department Representative Date

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ATTACHMENT B

ANNUAL AMOUNT AND MONTHLY VOLUMES

1. User's total maximum annual quantity of reclaimed water ("Annual Amount"):

_______________ acre feet/year

2. Peak usage required _____________ gallons per minute

3. Monthly volumes

MONTH	**Approximate Usage (1000 gallons/month)**
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Does this Attachment B supercede a previous Attachment B? Yes ☐ No☐

If yes, what is the Effective Date of superceded Attachment B? ________________________

If yes, execution by authorized FWWD representative is required.

____ ______________________

Fort Worth Water Department Representative Date

ATTACHMENT C

FORT WORTH CITY CODE
CHAPTER 35
ARTICLE VII

DRAFT

CITY OF FORT WORTH WATER DEPARTMENT
RECLAIMED WATER SERVICE AGREEMENT
FOR CUSTOMERS RECEIVING RECLAIMED WATER BY VEHICLE

Effective Date:__________________________ Contract No. ____________________

<u>PROVIDER</u>: **<u>USER:</u>**

City of Fort Worth Water Department (FWWD)
Address 1
Address 2
Address 3

For the consideration provided herein, FWWD agrees to supply and User agrees to accept, store and use reclaimed water in accordance with the terms and conditions of this Reclaimed Water Service Agreement (the "Agreement"). This Agreement incorporates and is subject to all of the terms and conditions set out herein as well as all of the following:

- All applicable Attachments and Appendices attached hereto;
- City of Fort Worth Water and Wastewater Installation Policy;
- City of Fort Worth Policies and Procedures for Processing Water and Wastewater Projects for Design and Construction Manual;
- City of Fort Worth Cross Connection and Backflow Prevention Program (REFERENCE ORDINANCE?)
- All applicable local, state, and federal statutes, ordinances, and regulations, as they may be amended, now or hereafter in effect ("Applicable Laws"), including without limitation, Chapter 210 of Title 30 of the Texas Administrative Code and Article VII of Chapter 35 of the City of Fort Worth Code (the "City Code").

1. <u>Use</u>

a. <u>General.</u>

User shall use reclaimed water supplied by FWWD under this Agreement (the "Reclaimed Water") only as authorized by Applicable Laws, including, without limitation, Sections 210.22 (General Requirements), 210.24 (Irrigation Using Reclaimed Water), and 210.32 (Specific Uses of Reclaimed Water) of Title 30 of the Texas Administrative Code, and Article VII of Chapter 35 of the City Code. FWWD in no way represents that the Reclaimed Water provided under this Agreement is suitable for User's purposes.

b. <u>Specific</u>

User agrees to use the Reclaimed Water only for the purpose(s) and in the location(s) described in Attachment A hereto. User agrees to obtain FWWD's written consent prior to using the Reclaimed Water for a purpose or at a location not described in Attachment A. Any changes to the purpose and location of use of the Reclaimed Water must be reflected in a substitute Attachment A and attached hereto. User agrees to take steps to minimize the risk of inadvertent human exposure to the Reclaimed Water. FWWD may terminate this Agreement immediately, in its sole discretion, if FWWD determines that User has failed to use the Reclaimed Water in accordance with Applicable Laws, this Agreement, and/or Attachment A.

c. <u>Prohibited Uses:</u>

User hereby covenants and agrees to the following:

i. The Reclaimed Water shall not be used for drinking, food preparation, domestic purposes or any type of human consumption, but Reclaimed Water may be used for toilet or urinal flush water in commercial applications, if noted as a purpose in Attachment A, hereto.

ii. The Reclaimed Water shall not be sold or supplied to any other person for any purposes whatsoever.
iii. Except as User may otherwise be expressly authorized by the TCEQ, Reclaimed Water may not be discharged into or adjacent to the waters in the State.
iv. There shall be no nuisance conditions resulting from the distribution, use and/or storage of the Reclaimed Water.

2. Quantity

a. Annual Amount

3. Delivery

a. Reclaimed Water Transportation

It is the User's sole responsibility to contract with and arrange for delivery of reclaimed water by vehicle to the location(s) identified in Attachment A. All vehicles and container units used to transport reclaimed water must have a current Reclaimed Water Transportation Permit issued by FWWD and must comply with all applicable requirements of Chapter 35, Article VII of the City Code.

4. Quality

a. State Standards
FWWD agrees to transfer to User, at the time of delivery to the container unit, Reclaimed Water of at least the minimum quality required by State standards for Type I usage as set forth in Section 210.33 of Title 30 of the Texas Administrative Code, as such may be amended or superceded from time to time. Pursuant to Section 210.33(1), the minimum Reclaimed Water quality for Type I water initially will be equal to or less than:

BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU/100 ml*
Fecal Coliform	75 CFU/100 ml**

* geometric mean
** single grab sample (not to exceed)

b. Warranties

User understands and agrees that the quality of the Reclaimed Water is different from that of User's normal potable water supply. User understands and agrees that the FWWD makes no warranties as to the quality of the Reclaimed Water beyond those contained in Section 4a. All other warranties whether express or implied, including, without limitation, the implied warranty for fitness for a particular purpose or the implied warranty of merchantability are hereby excluded.

5. Reclaimed Water Use Requirements

a. General

The use of Reclaimed Water is regulated by the Texas Commission on Environmental Quality ("TCEQ") and Article VII of Chapter 35 of the City Code. A copy of Article VII of Chapter 35 is included as Attachment C. User shall fully inform itself of applicable requirements for the use of Reclaimed Water and abide by all Applicable Laws. Delivery of Reclaimed Water may, at FWWD's sole discretion, be terminated for violation of the provisions of any Applicable Laws.

b. Reclaimed Water Supervisor

i. User shall designate an individual as User's Reclaimed Water Supervisor. The Reclaimed Water Supervisor shall be User's coordinator and the direct contact person between FWWD and the User. The User agrees that the Reclaimed Water Supervisor shall be responsible for the proper operation of User's Reclaimed Water system, implementing the requirements of this Agreement relative to the onsite use of reclaimed water, monitoring of User's Reclaimed Water system for prevention of potential hazards, and coordination with the FWWD and other regulatory agencies. The FWWD will assist in the training of User's Reclaimed Water Supervisor as time and resources permit; however, it shall be the non-delegable responsibility of User to assure its Reclaimed Water Supervisor is trained in the use and handling of Reclaimed Water in accordance with all Applicable Laws.

ii. User shall inform the FWWD in writing of the name, position and daytime and nighttime telephone numbers of User's Reclaimed Water Supervisor and shall promptly inform the FWWD in writing of any changes of designee and/or phone numbers during the term of this Agreement.

c. Onsite Facilities

i. If modifications are necessary to User's onsite facilities to conform to Reclaimed Water use requirements, User shall submit its plans and specifications for such modifications to the FWWD which shall approve same before construction commences and which approval shall not unreasonably be withheld. All modifications required in User's onsite facilities shall be the sole cost and responsibility of the User. The FWWD shall assist the User in identifying the modifications and/or changes required in User's onsite facilities. It shall be the User's responsibility to construct the modifications in accordance with the approved plans and specifications, and with all Applicable Laws.

d. Notifications

i. User shall provide proper notification to User's employees and to the public that Reclaimed Water is being used on the Site in accordance with all Applicable Laws.

ii. Prior to User's commencement of the use of Reclaimed Water under this Agreement, the FWWD will notify the Executive Director of the TCEQ and obtain approval for such use in accordance with Section 210.4 of Chapter 210 of Title 30 of the Texas Administrative Code.

iii. Upon completion of all onsite modifications and changes to User's Reclaimed Water and potable water systems, User shall provide the FWWD with as-built drawings of User's completed Reclaimed Water system and potable water system on User's site. The drawings shall show at a minimum, the locations of all pipelines, controllers, valves, buildings, structures, property boundaries, and any other features important to the onsite use of Reclaimed Water.

iv. User agrees to notify FWWD by telephone or fax of any Reclaimed Water use not authorized by this Agreement, including, but not limited to, spills, leaks, discharges, or releases of a material volume of Reclaimed Water into or adjacent to the waters of the State. The only exception is when the discharge or spill is caused by rainfall events or in accordance with a permit issued by the TCEQ.

Telephone or faxed notice must be given to FWWD within 24 hours of obtaining knowledge of any such spill, leak, discharge, or release. FWWD personnel will then assist in (1) assessing the extent of the unauthorized discharge and (2) aid in determining what reports, if any, need to be made as well as assist in making the reports. FWWD will then provide written notice to TCEQ within 5 working days of obtaining knowledge of any such spill, leak, discharge or release. Notification contacts are as follows:

Fort Worth Water Department
Address 1
Address 2
Phone Number:
Fax Number:

ii.

7. Price and Payment for Use of Reclaimed Water

a. Rates and Fees

User shall pay the FWWD for Reclaimed Water and all applicable fees in accordance with Chapter XX, Article XX of the City Code, as such may be amended.

b. Payment

Each month User shall make a payment to FWWD based on the applicable rate for the amounts of Reclaimed Water received by User for the preceding month ("Monthly Payments"). Monthly Payments are due as provided in Article XX, Chapter XX of the City Code, as such may be amended. A penalty for late payment may be assessed in accordance with Article XX, Chapter XX of the City Code, as such may be amended.

8. Permission to Enter

User hereby grants to the FWWD and regulatory agencies, acting through their duly authorized employees, agents, or contractors, access at all reasonable times to enter the Site for the purpose of observing construction or modification of reclaimed water facilities, for maintaining and repairing FWWD-installed facilities, for meter reading, and for observing and verifying that User is properly operating is reclaimed water facilities in accordance with the terms and conditions of this Agreement, and Applicable Laws. When entering User's premises, the FWWD or the regulatory agencies shall not unreasonably interfere with User's operations and its use of the premises.

9. Interruption of Service

FWWD may interrupt Reclaimed Water service at any time if FWWD determines that User is in breach of any provision in this Agreement. If FWWD interrupts service pursuant to this subsection, User shall have 30 days to cure the breach to the satisfaction of FWWD. If User fails to cure the breach to the satisfaction of FWWD in the period provided, FWWD shall have the right to immediately terminate the Agreement. The provisions of this Section are not intended to limit the rights of FWWD contained in Section 10 of this Agreement.

10. Termination

a. With Notice

Except as otherwise provided herein, either party may terminate this Agreement by giving the other party 180 days written notice of intent to terminate.

b. Unauthorized Use

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Notwithstanding any provision in this Agreement to the contrary, FWWD may terminate this Agreement immediately if FWWD determines that the use of the Reclaimed Water is not in strict compliance with this Agreement or Applicable Laws, as each may be amended.

c. Onsite System

Notwithstanding any provision in this Agreement to the contrary, FWWD may terminate this Agreement immediately if FWWD determines that the Onsite System is not in strict compliance with this Agreement or Applicable Laws, as each may be amended.

d. Nonpayment

In the event User fails to timely pay for Reclaimed Water in accordance with this Agreement, FWWD may interrupt service and terminate this Agreement as authorized by Chapter XX of the City Code. Service will not be interrupted for failure to pay an amount contested in good faith by User and in accordance with FWWD's established procedures, so long as User timely pays all other charges due and not in dispute. All billing inquiries, disputes and decisions to terminate Reclaimed Water service for nonpayment shall be resolved in accordance with FWWD's established policies as such policies may be amended from time to time.

e. Conveyance of Premises

FWWD may terminate this Agreement immediately if User leases, sells, or conveys to another entity ownership, control or possession of all or parts of the land on which all or part of the Onsite System is located; provided, however, that FWWD may, in its discretion and on conditions it may require, permit this Agreement to be assigned to such other entity if the entity will use the Annual Amount of Reclaimed Water for the same purposes and in the same locations as established in the applicable Attachments hereto, all in accordance with this Agreement.

11. Liability, Indemnification and Force Majeure

a. User's Liability

User shall be solely responsible for any and all claims, damages, deaths, losses, injury, fines, penalties, suits and liability of every kind, including environmental liability, arising from the use, distribution or discharge of the Reclaimed Water, whether such us is intended or accidental, or authorized by this Agreement and Applicable Laws or otherwise. User shall be solely responsible for any and all claims, damages, deaths, losses, injury, fines, penalties, suits and liability of every kind arising from or relating to the design, installation, construction, connection, maintenance, operation and modification of the Onsite System, regardless as to whether the Onsite System was released for service by FWWD.

b. Indemnification

To the extent permitted by Applicable Law, User agres to indemnify and hold harmless the City of Fort Worth, and their employees, officers, agents and representatives from and against any and all claims, losses, damages, fines, penalties, causes of action, suits, and liability of every kind, including environmental liability, all expenses of litigation, court costs, and attorneys' fees, for injury to or death of any person, or for damage to any property, arising out of or in connection with User's distribution, use and/or storage of the Reclaimed Water provided hereunder, and/or the design, installation, construction, connection, maintenance, modification or operation of User's Onsite System, including when caused, in whole or part, by User, third parties, or by the contributory negligence of City representatives. It is the expressed intent of the parties hereto that the indemnity provided for in this paragraph is an indemnity by User to indemnify and protect City representative from the negligent acts of the User, third parties, and City representatives, except when caused by the sole negligence of City representatives.

c. Force Majeure

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If by reason of Force Majeure, the FWWD shall be rendered unable wholly or in part to carry out its obligations under this Agreement to deliver Reclaimed Water, it shall not be required to deliver Reclaimed Water, and its failure to deliver Reclaimed Water in accordance with the terms and conditions of this Agreement, shall not be considered a breach of this Agreement. The term “Force Majeure” as used in this Agreement shall mean acts of God, strikes, lock-outs, or other industrial disturbances, acts of the public enemy, orders of any kind of the federal or state government or any civil or military authority, insurrection, riots, epidemics, landslides, lightning, earthquakes, fires, hurricanes, storms, floods, washouts, droughts, power failures, arrests, restraint of government and people, civil disturbances, explosions, breakage or accidents to machinery, pipelines or canals, the partial or entire failure of the Fort Worth Water System, unsuitable Reclaimed Water quality, or other causes. Nothing herein shall be construed to enlarge the duty or liability of the FWWD beyond that imposed by law.

12. General Conditions

a. This agreement shall be construed and interpreted in accordance with the laws of the State of Texas, and venue of any litigation hereunder shall be in a court competent jurisdiction sitting in Tarrant County, Texas.

b. This Agreement and the attachments thereto contain all the agreements of the parties with regard to this Agreement and cannot be enlarged, modified or changed in any respect except by written agreement between the parties.

c. The unenforceability, invalidity or illegality of any provisions of this Agreement shall not render the other provisions unenforceable, invalid or illegal, but the parties shall negotiate as to the effect of said unenforceability, invalidity or illegality on the rights and obligations of the parties.

d. The FWWD and User will each use their best efforts to fully cooperate with one another as may be necessary to diligently obtain and maintain in effect any required permits and all other approvals and records required by regulatory requirements that may be necessary for the FWWD and User to perform under, or take advantage of, the terms and conditions of this Agreement.

e. The captions, titles and headings in this Agreement are merely for the convenience of the parties and shall neither limit nor amplify the provisions of the Agreement itself.

f. Notices to be given by either party to the other relative to this Agreement shall be in writing. Both parties agree that any such notice shall be effective when personally delivered or deposited, postage paid, in the U.S. Mail addressed by certified mail, return receipt request, as follows:

FWWD:	**User:**
Reclaimed Water Supervisor	________________________________
Fort Worth Water Department	________________________________
Address 1	________________________________
Address 2	________________________________
Address 3	________________________________

g. This Agreement is for the sole and exclusive benefit of the parties hereto and shall not be construed to confer any rights upon any third party. Nothing herein shall be construed to confer standing upon any third party who did not otherwise have such standing.

DRAFT

IN WITNESS WHEREOF, the FWWD and User have executed this Agreement as of the date and year first written above.

SIGNATURE BLOCK HERE

DRAFT

ATTACHMENT A

PURPOSE AND LOCATION OF USE

Contract No. _____________ Effective Date of this Attachment:_________________

1. General category of reclaimed water use(s). Mark all that are applicable.

☐ Commercial ☐ Irrigation

☐ Industrial ☐ Other (specify)_________________

2. Describe specific purpose of reclaimed water use(s)

____

____

____

3. Describe the boundaries within which the reclaimed water will be used. Attach a map showing approximate meter and location of reclaimed water use.

____

____

____

Does this Attachment A supercede a previous Attachment A? Yes ☐ No☐

If yes, what is the Effective Date of superceded Attachment A? ________________________

If yes, execution by authorized FWWD representative is required.

____ ______________________

Fort Worth Water Department Representative Date

DRAFT

ATTACHMENT B

ANNUAL AMOUNT AND MONTHLY VOLUMES

1. User's total maximum annual quantity of reclaimed water ("Annual Amount"):

_______________ acre feet/year

2. Peak usage required _____________ gallons per minute

3. Monthly volumes

MONTH	**Approximate Usage (1000 gallons/month)**
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Does this Attachment B supercede a previous Attachment B? Yes ☐ No☐

If yes, what is the Effective Date of superceded Attachment B? ________________________

If yes, execution by authorized FWWD representative is required.

____ ______________________

Fort Worth Water Department Representative Date

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ATTACHMENT C

FORT WORTH CITY CODE
CHAPTER 35
ARTICLE VII

APPENDIX P TWDB COMMENTS AND RESPONSE TO COMMENTS- DRAFT FINAL REPORT

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Attachment I

Draft Final Report Comments
City of Fort Worth
Reclaimed Water Priority and Implementation Plan
TWDB Contract No. 2005483548

The draft report was well written and has met all the contractual requirements.

The following comments are provided for your information:

On page ES-19 and pages 7-10 of the draft report, please be aware that the Drinking Water State Revolving Fund is intended for water improvements to address health and compliance issues in existing water utilities and is not normally used for wastewater reuse projects. The project would have to demonstrate a purpose to be eligible. The fund that is normally used for reuse and wastewater projects is the Clean Water State Revolving Fund.

Also, on Table ES 8 there is a detailed schedule that does not appear to include the necessary environmental approvals needed for the project. All environmental approvals must be completed before going to our Board for a commitment of state participation funding.

RESPONSE TO TWDB COMMENTS- DRAFT FINAL REPORT

1. The wording on pages ES-19 and 7-10 was modified to better define the differences between the Drinking Water State Revolving Fund and the Clean Water State Revolving fund.

2. Environmental permitting was added as an implementation step to Table ES-8 (and Table 9-2).