

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

<i>Year</i>	<i>TWDB</i>	<i>NCTCOG</i>	<i>MP</i>
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.

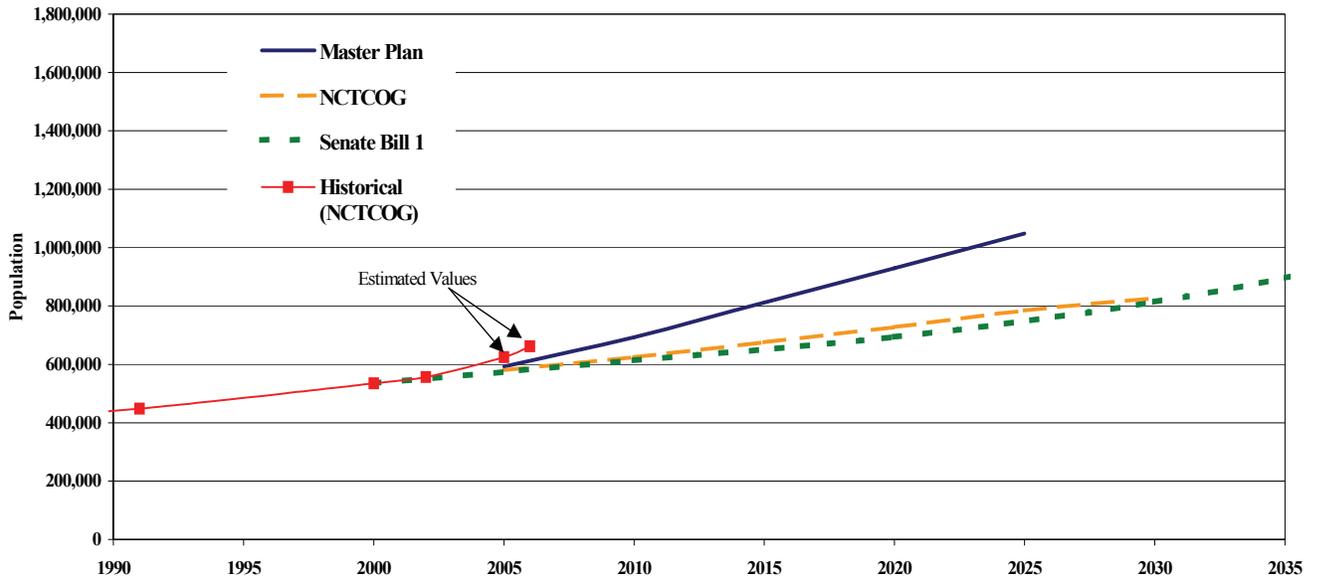


Figure 3-1: Comparison of Population Projections for Fort Worth

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*

<i>Source (ac-ft/yr)</i>	<i>Year</i>					
	<i>2010</i>	<i>2020</i>	<i>2030</i>	<i>2040</i>	<i>2050</i>	<i>2060</i>
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	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.

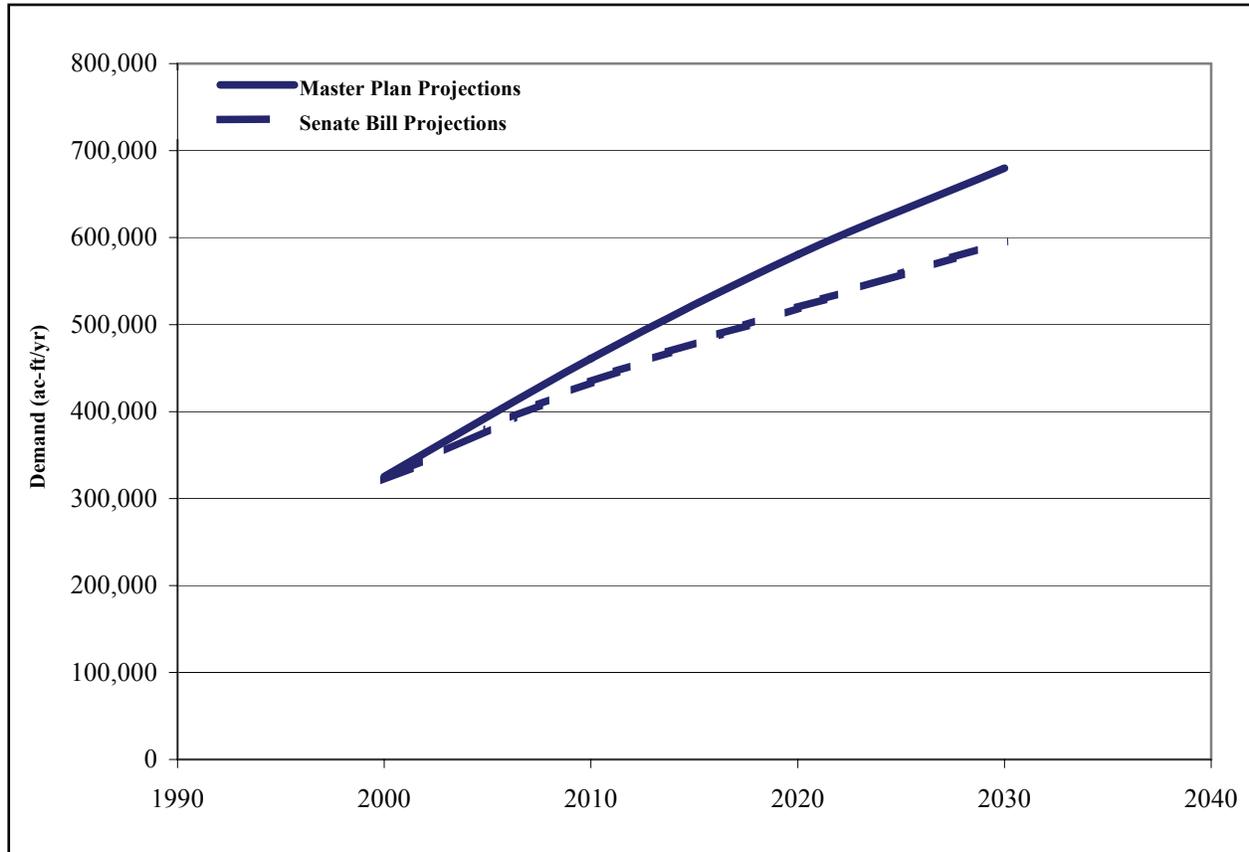


Figure 3-2: Comparison of Senate Bill 1 and Master Plan Projections for Water Demand

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

<i>Total Water Demands for City of Fort Worth</i>				
<i>Year</i>	<i>Average Day (MGD)</i>	<i>Maximum Day (MGD)</i>	<i>Average Day (ac-ft/yr)</i>	<i>Maximum Day (ac-ft/yr)</i>
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*

<i>Year</i>	<i>Wastewater Flow (MGD)</i>		
	<i>Annual Average</i>	<i>Maximum Month</i>	<i>Peak 2-hour</i>
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.

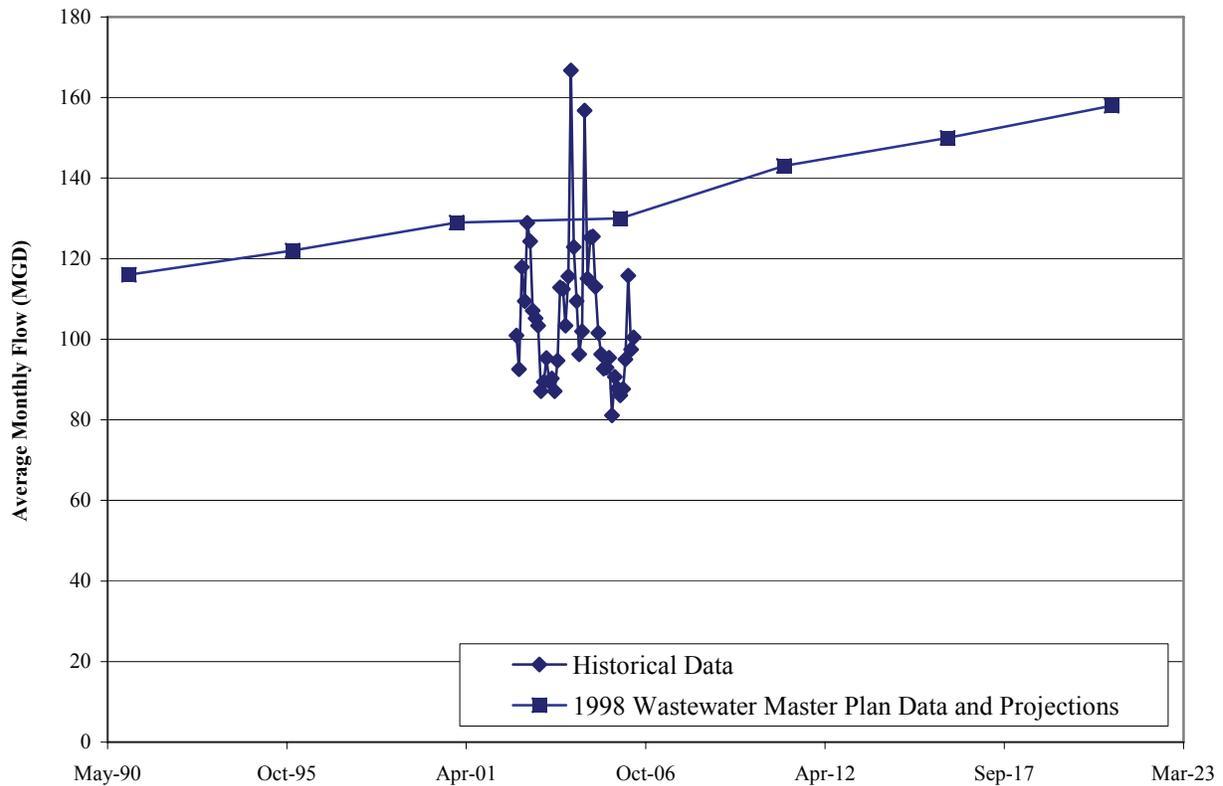


Figure 3-3: Comparison of Wastewater Master Plan Data and Projections to Recent Flow Measurements, Village Creek WWTP

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

<i>Year</i>	<i>Average Daily Flow (ADF)</i>	<i>Average Dry Daily Flow (ADDF)</i>	<i>Min Month</i>
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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