OVERTON REGIONAL WATER SUPPLY PLAN

RABBIT CREEK RESERVOIR

FUNDED BY:

CITY OF OVERTON
LIBERTY CITY WSC
JACKSON WSC
TEXAS WATER DEVELOPMENT BOARD

STATE OF TEXAS
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OVERTON REGIONAL WATER SUPPLY PLAN

I. INTRODUCTION

A. AUTHORIZATION AND ORGANIZATION

The City of Overton retained Burton & Elledge, Inc., R.J. Brandes Company, Horizon Environmental Services, Inc. and Hilliard Governmental Consultants to perform a Regional Water Supply Study including the feasibility of constructing a water supply reservoir on Rabbit Creek. Jackson Water Supply Corporation (WSC) and Liberty City WSC assisted the city of Overton in funding 50% of the study. The other 50% of the cost were provided by the Texas Water Development Board from its Research and Planning grant funds. The study area includes the water service areas of the three participating entities and the following five entities: West Gregg WSC, Leveretts Chapel WSC, City of New London, Wright City WSC, and City of Arp. The study area was selected based on the geographic proximity of the eight service areas to each other and to the proposed reservoir location. Exhibit 1 shows the location of all entities in this study.

B. SCOPE AND OBJECTIVES OF STUDY

The three participants recognized the need to plan for the future water demand for each of their service areas. Due to concerns about local ground water quality and quantity from individual wells, these communities do not feel secure with the reliability of groundwater only to meet future demand.

The scope and objective of this study was to investigate the most technically feasible alternative to provide a reliable water supply for the service area to meet increasing future demand in the most economical manner. This involved the evaluation of using surface water versus the existing and future water wells in the Carrizo and Wilcox aquifers. The different sources of water that have been considered are as follows:

1. The construction of a reservoir on Rabbit Creek and a water treatment plant to supply treated water to the region.

2. The procurement of treated water from the City of Tyler, Texas.

3. The construction of additional wells and, if needed, ground water treatment facilities.

C. CONTENTS OF REPORT

The contents of this report have been prepared by Burton & Elledge, Inc., Environmental/Civil Engineers in conjunction with other consultants. The consultants and the Sections involved are as follows:

1. R.J. Brandes Company

   Section IV - Identification of Potential Reservoir Sites and Water Treatment Plant Sites Including Yields and Downstream Flows.

   Section VI - Hydrologic Evaluation of Reservoir Structure and Spillway

2. Horizon Environmental Services, Inc.

   Section V - Environmental Considerations.

3. Hilliard Governmental Consultants (Partial)

   Section IX - Institutional and Legal Considerations and Financial Plan.

II. EXISTING CONDITIONS

A. DESCRIPTION OF STUDY AREA

1. GEOGRAPHY

The proposed Rabbit Creek Reservoir and study area are located in Northeast Texas within the Gulf Coastal Plain Region. Hilly and Rolling features with a heavy cover of soft (pine) and hardwoods are predominant in this area. The proposed reservoir would be located one mile north west of the City of Overton, as shown on Exhibit 1.

2. CLIMATOLOGY

The study area has a warm, humid, subtropical climate and heavy rains. The change in Winter, Spring, Summer, and Fall season is gradual with a mild winter. Based on records from 1950-1979 of the Climatic Atlas of Texas, the average annual temperature is 64° F, with mean temperatures ranging from 36°F - 59°F in December and 71°F - 94°F in July. The annual average precipitation is approximately 44 inches. The prevailing wind direction is from the south and southeast, occurring almost 40 percent of the time[1].

3. HYDROLOGY

The normal annual average runoff is approximately 10 inches per year[1] or 550 acre-feet per square mile of basin drained. The annual average gross lake surface evaporation rate from 1950 - 1979 was approximately 50 inches, and the monthly average equaled or exceeded rainfall 6 months out of the year as presented in Exhibit 2. The major aquifers are the Carrizo and Wilcox as shown in Exhibit 3. The Queen City is a minor aquifer underlying the region. Groundwater recharge is from the infiltration of rainfall and runoff on the outcrop areas and direct charging from the streams and lakes. The groundwater is discharged naturally and artificially. Natural processes include springs, seeps, evaporation or movement of perched (shallow) ground water, and transpiration by trees and plants whose roots reach the water table. Artificial processes include pumping from water wells. The artificial processes are usually several times the natural processes. The surrounding lakes are Lake Tyler, Lake Tyler East and Lake Cherokee as shown in Exhibit 4.

B. LAND USE PATTERNS

1. HISTORICAL TRENDS

The land use for the study area consists of developed and undeveloped areas. The developed areas are primarily low density residential, with some light commercial and light industrial. Land use in the undeveloped areas includes agriculture (improved pasture), forestry, and oil and gas production. The developed areas are both within and outside of the incorporated areas (cities).

Historical development and land use trends have been influenced almost exclusively by the oil and gas industry. Recent economic development efforts by the local communities sought to achieve more diversification of the region's economy.

2. PLANNING FOR FUTURE GROWTH

Each of the three participating entities have recently completed planning documents which have identified additional water supply needs. The Liberty City WSC planning document recommended construction of a fourth water well with a 500 gallon per minute (gpm) capacity.[8] This well was completed in March 1998, but with only a 400 gpm capacity. The City of Overton recently constructed treatment facilities to make use of a 300 gpm water well that had been previously abandoned due to excessive iron concentrations. Its planning document indicated still more water supply capacity is needed just to meet short-term needs. The capacity of the well has since dropped to less than 60 gpm. The City of Overton has recently lowered pump settings in its other two active wells to increase their production capacities and is actively pursuing additional water supply at this time. The Jackson WSC planning document included recommendations to extend the distribution system to meet increasing demand on its system.[20] Several miles of water main are currently under construction, and a new 300 gpm well has recently been completed.

Economic development efforts in Tyler, Kilgore, Longview, and Henderson are impacting growth patterns within the region. The most significant development with potential long term impact on water demands is a $700 million print mill facility proposed to be constructed near the intersection of State Highway 31 and Interstate 20 in the Liberty City WSC service area.

C. FRESHWATER SOURCES

1. QUANTITY & QUALITY OF EXISTING SOURCES

a. GROUND WATER

i. The major aquifers supplying all the public water for the study area are the Carrizo Formation and the Wilcox Group as shown on Exhibit 3 Even though they are separate aquifers, they are hydrologically interrelated. Therefore, they are often considered as one aquifer referred to as the Carrizo-Wilcox. The Carrizo aquifer overlies the Wilcox aquifer. Exhibit 6 shows the saturated thickness of each of the aquifers within the study areas. Well logs from within the region show the Carrizo sand at depths of 300-400 feet and the Wilcox sands at depths of 700-1,000 feet below ground.

ii. Studies performed by the Texas Water Development Board showed that under the same hydraulic gradient, these two aquifers transmit more water than minor aquifers like the Queen City Sand or Reklaw Formation. Exhibit 8 shows that the public water supply wells in the study area produce from 60 to 400 gpm, with an average capacity per well of 186 gpm. In addition to these ground water supplies, Liberty City WSC is under contract to take a minimum of 2 million gallons per month and a maximum of 18 million gallons per month from the City of Kilgore, which has both ground and surface water supplies.

iii. Ground water quality data for existing wells in the study area are presented in Exhibit 9. Primary and Secondary Drinking Water Quality Standards as published by the TNRCC are presented in Exhibit 10. No violations of primary standards have been reported for the region. The following secondary standards have been violated:

Constituent	Maximum Regulatory Level	Level Reported	Entity
Color	15 color units	25-30	Liberty City WSC, Overton
Hydrogen Sulfide	0.05 mg/l	Unknown	Liberty City WSC, Jackson WSC, New London
Iron	0.3 mg/l	3.0 mg/l	Overton
pH	7.0 minimum	5.6	Overton
Total Dissolved Solids	1,000 mg/l	1,200	Arp, Liberty City WSC

Although the presence of these secondary constituents at these levels present no health hazards, they are objectionable and unacceptable to the consumer. Iron will precipitate after exposure to air at concentrations in excess of 0.1 mg/l.[16] This results in stained plumbing fixtures, laundry, and cooking utensils. Objectionable tastes and odors are also associated with iron.

iv. The City of Overton has a pressure filtration system to remove iron from the ground water from its downtown well. This well can pump up to 300 gpm from the Carrizo aquifer at a depth of 350 feet. The City of Overton also removes H_2S by aeration. In addition, Liberty City WSC treats for color using chlorine and is planning to use ozone for color removal at its new well. Also, many surrounding water providers use polyphosphate to sequester iron at concentrations below 0.5 mg/l.

b. SURFACE WATER

Some of the larger cities near the study region currently use surface water. Only the City of Longview in Gregg County uses surface water exclusively. The others use a combination of surface and ground water.

i. City of Kilgore. The City of Kilgore recently completed construction of a water treatment plant to treat surface water from the Sabine River at a rate not to exceed 5.39 Million Gallons per Day (MGD)[9]. The water treatment plant is rated for 5.52 MGD [9]. The City also has 9 water wells with rated capacities as follows:

Well #	Flowrate (GPM)
1	460
2	320
3	570
4	350
5	270
6	290
7	410
8	460
9	420
Total	3450

The City of Kilgore is under contract with Liberty City WSC to supply a minimum of 2.0 MG per month and a maximum of 18 MG per month.

ii. City of Longview. The City of Longview supplies treated surface water from the Sabine River and from Lake Cherokee to its customers. There are approximately 25,338 connections for the Retail sector and 6,497 connections for the Wholesale. In 1996, the City of Longview contracted with the Northeast Texas Municipal Water District to purchase raw water from Lake O' Pines. The City's Sabine River plant had to be taken out of service, and a water rationing program was mandated in 1996 due to taste and odor problems. Plans are being prepared for a raw water main and new surface water treatment plant for the Lake O' Pines water.

iii. City of Tyler. The City of Tyler supplies treated surface water from Lake Tyler and Lake Tyler East to its customers. The available yield is 36 MGD. However, the practical yield of the two-lake system is 15 MGD with the drawdown limited due to recreational uses. The City of Tyler also has 12 water wells with a total available capacity of approximately 9 MGD. In addition, the City has water rights in Lake Palestine of 67,200 acre-feet per year (60 MGD). Plans are underway for construction of a 20 MGD water treatment facility to treat Lake Palestine water.

iv. Sabine River Authority (SRA). SRA has a joint use permit for Lake Fork and Lake Tawakoni for a total permitted water supply of 426,760 ac-ft/yr. The City of Dallas is SRA's largest single customer under contract for this water. The City of Longview, T. U. Electric Company, the City of Greenville, and the City of Terrell are also major customers. Many other entities near the study region are also either under contract with or have purchased options from SRA for use of this water. Current commitments are tabulated in Exhibit 5.

Only149,000 gpd is currently available from SRA's joint use permit "free and clear". However, the City of Dallas has 11,860 ac-ft/yr (10.6 MGD) which must remain in the Sabine Basin for which no price is yet established. Also, options of eight entities which total 11.932 MGD (13,365 ac-ft/yr) must be exercised by December 31, 1999 or terminated.

One of these eight entities is the city of Henderson with an option for 4.5 MGD. The City of Henderson is constructing a raw water main from the river to a new water treatment plant currently being designed. Excess capacity for long-term supply to the study region is not available according to Henderson City Officials. The intake structure is owned by SRA and delivers raw water to both the Kilgore and Henderson plants. The river authority has indicated that raw water could also be supplied to the study area by installing additional pumping capacity at the same intake structure.

2. IMPACTS OF GROWTH ON GROUND & SURFACE WATER SOURCES

The region appears to be poised for significant growth. The growth projections presented in Exhibit 11 are based primarily on historical trends which were driven by an exclusively oil and gas economy. The future economy of the region will be more diversified.

Southland Newsprint has applied for a diversion permit to use 10 MGD from the Sabine River downstream of the Kilgore-Henderson diversion point for industrial process and fire protection uses. New correctional facilities in the Liberty City WSC and Overton service areas are placing increased demand on those two systems. The majority of Liberty City WSC's inquiries and requests for new service in the past two years have been for nonstandard service, including apartment complexes, hotels, and residential subdivisions. The same is true for the Jackson WSC, with the majority of its new customers resulting from jobs being created in and around Tyler.

This growth will tend to deplete the excess well capacities in the study area. As presented in Exhibit 7 and 8, Jackson WSC, Liberty City WSC, West Gregg WSC, and Overton are in need of additional water supply based on the projected growth. This additional supply could be from additional wells or from surface water sources. The Cities of Tyler and Kilgore have recently completed water rate studies with recommendations to increase their rates. The City of Tyler has begun preparation of engineering plans for construction of a new water treatment facility to begin supplying water from Lake Palestine.

3. REGULATORY COMPLIANCE

Compliance deficiencies within the study area cited by the TNRCC have been limited to:

- Well capacities less than the required minimum of 0.6 gpm per connection
- Violations of some secondary water quality constituents
- Minor operation and maintenance deficiencies

Exhibit 8 presents a comparison of the well capacities within the study area to the State minimum required supply capacities based on current and projected future number of connections. Recent studies by Jackson WSC, Overton, and Liberty City WSC more fully addressed regulatory compliance issues for these individual systems.

The City of Overton has recently lost 250 gpm of its existing supply capacity due to problems with its Well No. 4. This places Overton with less than 60 percent of its minimum required capacity until this well is repaired or replaced and represents the most severe noncompliance in the study area.

D. WATER TREATMENT FACILITIES

1. CONDITIONS & PROJECTED LIFE OF EXISTING FACILITIES

a. CITY OF OVERTON IRON REMOVAL SYSTEM

The City of Overton completed construction of a pressure filter system for iron removal and pH adjustment for its No. 4 Carrizo well with a design capacity of 300 gpm in 1997. This plant uses aeration of ground water to oxidize the soluble iron, which is then removed by the pressure filter system. Caustic soda is used to raise the pH from 5.7 to 8.5. The design life of the plant is expected to be 30 years.

b. CITY OF TYLER WTP

The City of Tyler's Golden Road Water Treatment Plant was constructed in 1951. It was expanded and renovated in 1965 and again in 1970[10]. The City of Tyler is currently designing a new 20 MGD plant to treat Lake Palestine water. Construction is scheduled to begin in 1999. The Golden Road WTP is expected to maintain its present capacity through the year 2040 and even after the construction and operation of the Lake Palestine WTP.

c. CITY OF KILGORE WTP

The City of Kilgore completed construction of a new surface water treatment plant in 1995, with plans to expand capacity in 2002. The newest of its nine wells is 27 years old, and its oldest well is 46 years old.[21] All of its facilities are reported to be in good condition.

d. WATER WELLS

The City of Overton's newest well is 20 years old, and its oldest well is 43 years old. Many of its facilities are in need of repair or maintenance due to poor O & M practices.[7]

The City of New London's newest well is 12 years old, and its oldest well is 48 years old. All of its facilities are reported to be in good condition.[21]

Liberty City WSC's newest well was just completed. Its second newest well is 12 years old, and its oldest well is 35 years old. All of its facilities are reported to be in good condition. [21]

The oldest active wells in the region are approximately 60 years old, having been constructed during the 1930's oil boom. Many wells have been abandoned for various reasons. The life expectancy of these wells is dependent upon how well they are maintained and constructed. Overpumping a well can result in its rapid deterioration. The test pumping results for the recently completed Liberty City WSC well indicated that drawdown ceased and the water table stabilized at a pumping rate of 465 gpm. However, the hydrologist's report only recommended a continuous capacity of 350 gpm due to concerns over seasonal fluctuations in aquifer recharge potential. This raises concerns that capacities reported for some wells may be overly optimistic, or that over-reliance on an individual well could lead to its premature failure.

2. EXPANSION POTENTIAL (BASED ON REVIEW OF EXISTING REPORTS)

a. LAKE PALESTINE UTILIZATION STUDY, 1990, CITY OF TYLER

The City of Tyler has substantial expansion potential with 67,200 acre-feet per year (60 MGD) of unused water available in Lake Palestine. It has little expansion potential at the existing Golden Road WTP which treats water from Lake Tyler and Lake Tyler East. In 1990, the City's average annual water use from groundwater pumpage was 2.3 MGD, with a maximum ground water supply capacity of 8 MGD. The average daily surface water pumpage was 15 MGD from Lake Tyler and Lake Tyler East, as compared to Golden Road Water Treatment Plant maximum capacity of 30 MGD. The City of Tyler currently has a combined total capacity of 38 MGD from both of their water sources. The total maximum surface water yield available to the City of Tyler is 92 MGD, with 32 MGD from Lake Tyler/Lake Tyler East and 60 MGD from Lake Palestine. The water supply will meet the demand of the City through the year 2040.

b. CITY OF KILGORE REPORT[9]

The current capacity of the City of Kilgore's water system is 3.5 MGD from its surface water plant and 5.5 MGD from its nine wells, for a total capacity of 9.0 MGD. The system peak demand was recorded on October 17, 1996 at 5.939 million gallons which represents 60 percent of the system's capacity. The average daily pumpage was 3.145 MGD for the twelve months ended September 30, 1996, for a system peak to average day ratio of 1.89.

E. WATER DISTRIBUTION SYSTEMS

1. SERVICE AREA

The current service areas of the eight entities included in the study area are shown in Exhibit 1. Portions of Smith, Rusk, and Gregg Counties are included.

2. EXISTING STORAGE/DISTRIBUTION SYSTEMS

The distribution systems including the locations of the water storage tanks and line sizes are presented in Exhibits 12, 13, and 14, respectively. The system capacities which include the well capacity, total storage capacity, elevated storage capacity, and service pump capacity for each of the eight entities are individually presented in Exhibit 8.

III. POPULATION AND FLOW PROJECTIONS

A. SUBDIVIDING THE STUDY AREA

1. SERVICE AREA BOUNDARIES

The Certificate of Convenience and Necessity (CCN) service area boundaries as shown in Exhibit 1 served to divide the study area into eight subareas. These boundaries are likely to change as growth occurs in and around the region. For example, the WSC service areas may be reduced, and the city limits may increase as a result of annexations. Likewise, the WSC service areas may increase as development takes place in the unincorporated areas. Changes in these boundaries, however, were not considered as relevant for the purpose of this study.

2. DISTRIBUTION SYSTEM PATTERNS

Each of the eight systems generally developed in the same manner, with line locations and sizes being determined based on development trends rather than vice versa. Typically, cities will have larger line sizes and better pressure distribution (i.e., looped lines) than the WSCs because of the obligation of cities to provide fire protection. The WSCs typically will have "hub-type" systems, with their largest lines near the wells and progressively smaller line sizes emanating from them. Therefore, it would be unusual to have larger than a 2-inch line near any two service area boundaries. Therefore, when evaluating regional supply alternatives, the new transmission lines were assumed to extend to the storage tank locations well within the service area boundaries. The Liberty City WSC is an exception because it was once an incorporated city.

The current distribution systems do not have the capacity to support large scale industrial use. The largest line size in any of the existing systems is 12-inches.

Water losses in rural systems such as these can be substantial because leaks can go undetected for extended periods of time. Also, because of the many dead end lines in the WSC systems, a properly maintained system can lose a lot of water due to flushing. On the other hand, lawn watering tends not to be as prevalent in this region as in the larger metropolitan areas. This is also due to the abundance of rain water.

For these reasons, per capita demands may not follow Statewide trends. There is also not much opportunity for conservation efforts to significantly reduce per capita usage rates. In the flow projections which follow, per capita usage rates were therefore based on the historic usage rates within each of the service areas.

B. POPULATION PROJECTIONS

1. PROJECTING TOTAL POPULATIONS - EVALUATE PREVIOUS ESTIMATES

The population of the study area includes the populations served by the Cities of Arp, New London and Overton, and those who are served by the Water Supply Corporations (WSCs) of Jackson, Liberty City, West Gregg, Leveretts Chapel and Wright City. The State Data Center has estimated the populations served for the years 1990-1996 by the three cities and by the Liberty City WSC, including populations inside and outside the city limits. This information is presented in Exhibit 26. One correction to this data is needed for the City of Overton to reflect the 500-bed correctional facility added as an outside city connection in 1995. This single connection supplies approximately 50,000 gpd and is therefore equivalent to 167 "normal" connections, assuming 300 gpd per connection.

The Texas Water Development Board (TWDB) has prepared population projections in 10-year increments for the three cities and for the three counties in the study area. The TWDB projections for cities do not include people outside the city who are served by the city water systems. The TWDB projections also are not divided among the service areas of the WSCs.

Additional information on population growth for the incorporated and unincorporated areas for Gregg County, Smith County, and Rusk County was obtained from the East Texas Council of Governments (ETCOG). The ETCOG information is based on a 1993 report prepared by Perryman Consultants, Inc.

2. PROJECTING POPULATION BY SERVICE AREA

It should be noted that population projections is this study are only to be used as a tool in predicting future water demand for the study area as a whole. They are not intended to be an accurate projection of the individual service area populations for any other purpose.

Since the TWDB only prepares population projections for cities and counties, and since all three cities in the study area serve connections outside their city limits, populations served had to be estimated for all eight entities.

For the people within the city limits, the TWDB projections were used. These projections are included in Exhibit 26. The TWDB projection for Overton was adjusted as described in Section III. B. 1. For populations served by cities but outside the city limits and for populations served by the WSCs, the populations were estimated by multiplying the number of service connections-equivalents by 3.0 persons per connection. The number of connections were assumed to increase form 1990 to 2030 at the same rate as the total municipal populations of the respective county as projected by TWDB.

The Liberty City WSC, however, was treated differently due to the accelerated growth being experienced in its service area. This current growth is illustrated by the following three developments:

- 80-bed correctional facility under construction; 8,000 gpd = 27 connection-equivalents added in 1998
- Southland Newsprint industrial facility; 30,000 gpd = 100 connection equivalents added in 2000
- Shallow Creek Subdivision; 48,000 gpd = 160 connection-equivalents added in 1999

Since Liberty City was once a municipal corporation, the TWDB projected its population in 1996 Consensus Texas Water Plan. These projections are included in Exhibit 26. The projected increase in population for Liberty City was 91% from 1990 to 2030. This same rate of growth was used in our projections, but with 1990 population changed to 3,600 to agree with the more accurate data provided by the State Data Center.

The population projections for each of the eight service areas and the region as a whole are tabulated and presented graphically in Exhibit 11. The individual entity growth rate ranges from 0.1% as projected in the City of Overton to 91 % in Liberty City WSC. The population growth within each service area has been summarized below.

	POPULATION		
SERVICE AREA	**1996**	**2030**	**GROWTH IN PERCENTAGE**
Arp	1,049	1,618	54
Jackson WSC	2,811	3,288	17
Wright City WSC	2,340	2,973	27
Leveretts Chapel WSC	495	771	56
New London	1,979	2,663	35
Overton	2,813	2,816	0.1
Liberty City WSC	4,020	6,873	71
W. Gregg WSC	3,717	5,955	60
Regional Total	**19,224**	**26,957**	**40**

C. PROJECTING WATER DEMAND

1. METHODOLOGY

a. Records of the past water usage were used in conjunction with the estimated populations to determine historic usage per capita. These usage records for each entity were compiled by the TWDB based on information submitted by the entities.

b. The reported annual water usage was divided by the estimated service populations in 1990-1996 to determine the average annual per capita water use for each entity for each of these seven years. These seven values were then averaged for the purpose of projecting future demands for each of the eight service areas. In other words, the future per capita demand for each entity was assumed to be equal to the average per capita demand of the entity over the past seven years.

As discussed in Section III. A. 2., average per capita usage rates in this region of the State are not expected to change significantly over the next 30 years. The per capita usage rates are already well under State averages due to the rural nature and high rainfall of the area. They range from 63 gpcd in West Gregg WSC to 178 gpcd in New London. Overton experienced a rate of 240 gpcd in 1996, but this was due to a large leak in its main transmission line which could not be located for several months.

c. The demand projections for the individual service areas were added to obtain the demand projections for the study area. The individual and regional projections are presented in Exhibit 11 and are summarized as follows:

SERVICE AREA	ANNUAL WATER DEMAND (AC-FT)		PERCENT INCREASE
	1996	**2030**	
Arp	165	312	89
Jackson WSC	262	307	17
Wright City WSC	251	343	37
Leveretts Chapel WSC	60	77	28
New London	414	533	29
Overton*	756	528	-30
Liberty City WSC	446	770	73
W. Gregg WSC	433	694	60
Regional Total	**2,787**	**3,564**	**28**

*The reduction in demand for the City of Overton is caused by an unusually high demand in 1996 due to a large system leak.

2. FUTURE DEMAND vs. CURRENT SUPPLY CAPACITIES

a. Current supply capacities based on reported pumping rates of current water wells are presented in Exhibit 8. Future demands in 2030 based on historical usage rates are presented in Exhibit 11. Future demands based on the State's minimum requirement for public water supplies of 0.6 gpm per connection are presented in Exhibit 7. A comparison of these three parameters is presented below for the study area.

Service Area	Population in 2030	No. Connections in 2030	2030 Water Demand (gpm)			Current Supply Capacity (gpm)
			Annual Average	Maximum Month	State Req'd Minimum Capacity (0.6 gpm per conn.)	
Arp	1,512	697	193	243	418	500
Jackson WSC	3,288	1,096	190	224	658	582
Wright City WSC	2,973	991	213	278	595	612
Leveretts Chapel WSC	771	257	48	58	154	200
New London	2,663	968	331	457	581	960
Overton	2,816	1,173	331	467	704	650
Liberty City WSC	6,873	2,291	477	711	1,375	670
West Gregg WSC	5,955	1,985	430	581	1,191	670
Region Total	**26,957**	**9,458**	**2,213**	**3,019**	**5,675**	**4,844**

b. It is apparent from the above table that some of the entities have adequate long-term water supply capacity and some will need to secure additional capacity. The region as a whole appears to have sufficient water based on historical usage data. However, an additional 831 gpm supply capacity will be needed by 2030 in order to meet State minimum requirements.

c. Current supply capacity for the region is approximately 4,844 gpm or 7 MGD, which far exceeds current annual average demand of approximately 1,700 gpm or 2.5 MGD. The projected annual average demand of approximately 2,200 gpm or 3.2 MGD for 2030 is still less than half of total reported capacity.

d. Current supply capacity of 4,844 gpm or 7 MGD also far exceeds the current maximum month reported demand of 2,367 gpm or 3.4 MGD for the region. The projected maximum month demand of 3,019 gpm or 4.4 MGD for 2030 is still less than the current supply capacity.

e. Although supply capacities appear adequate for current needs, many of the regional entities experience difficulty in meeting peak demands during drought periods. However, this is probably due more to deficiencies in storage and distribution facilities rather than supply deficiencies. Also, lack of redundancy in system facilities (i.e. only one pump per well) to handle emergencies such as fire-fighting and equipment failure can result in sudden supply deficiencies during peak demand times. Overpumping a water well can then lead to its premature failure with little advanced warning.

f. Assessment of supply capacity based on annual average and maximum month demand values is appropriate for surface water sources. This is because reservoir yields are based on annual rainfall and runoff during drought years, and water treatment plants are designed to meet maximum month demands with redundancy and excess capacity to meet maximum day demands.

g. However, ground water sources (i.e. water wells) with sufficient capacity to meet maximum month demands may be inadequate for meeting maximum day demands. For this reason the State requires that all public water supplies have a minimum supply capacity of 0.6 gpm per connection. This required minimum capacity for the region is projected to be 8.2 MGD for 2030. (This is equivalent to a per capita demand of 300 gpcd.) Therefore, the region is in need of only an additional 1.2 MGD supply capacity to meet projected State requirements, which are considered sufficient to meet maximum day demands. This additional supply capacity of only 831 gpm could be met with two or three additional high production wells. However, as mentioned in Section II, the public water supply wells in the study area produce from 60 to 400 gpm, with an average capacity per well of 186 gpm. Therefore, a more realistic scenario is presented in Exhibit 24, where wells with capacities more typical of the region are placed to increase the supply capacities of those four entities which would otherwise have water supply deficiencies.

IV. IDENTIFICATION OF POTENTIAL RESERVOIR SITES AND WATER TREATMENT PLANT SITES INCLUDING YIELDS AND DOWNSTREAM FLOWS

Topographic maps were examined and previous reports were collected and researched to identify potential reservoir sites feasible to serve the study area. Previous studies evaluated other dam locations on the same stream segment.[11,12] These previously studied locations were as follows:

Ref. No.	Dam Location Studied	Conservation Pool				Yield (ac-ft/year)
		Drainage Area (sq. mi.)	Elevation	Surface Area (acres)	Storage Volume (ac-ft)	
11	South of FM 850	1.39	456.0	89	1,332	300
12	Just West of FM 3053 / East of Smith-Rusk County Line	14.72	406.0	866	16,900	5,825
12	1,000' East of FM 3053	20.64	399.0	1,203	22,420	7,842

The first location was eliminated because its yield was too small for further consideration as a regional water supply. The third location was eliminated because its yield was too large based on preliminary demand projections for the region. Also, the additional expense of having to relocate FM 3053 made it much more expensive. The second of the above locations was the preferred site. However, significant opposition to this location by the Bruce McMillan Jr. Foundation was voiced at the beginning of this study because it would inundate a large amount of Foundation property of considerable agricultural and historical value. Therefore, a fourth dam location was selected for this planning investigation. Although it would also be on McMillan Foundation property, no serious opposition has been communicated.

Both of these previously studied locations from Reference 12 are worthy of further consideration should circumstances and regional water needs change significantly in the future. Another reservoir site on Wilds Creek north of Rabbit Creek near the intersection of the Smith, Rusk, and Gregg County lines is also worthy of further consideration for this region. It would be similar in storage volume and yield to the 866-acre reservoir above.

A. PROPOSED RABBIT CREEK RESERVOIR SITE

For purposes of this planning investigation, a single reservoir site has been examined with regard to its potential for developing a firm surface water supply for the entities within the planning area. The proposed Rabbit Creek Reservoir site is located in Smith County approximately two miles northwest of the City of Overton and approximately 18 miles east southeast of the City of Tyler. The general location map in Exhibit 1 identifies the proposed reservoir site and the City of Overton.

Rabbit Creek is a small tributary of the Sabine River. Its watershed is generally undeveloped consisting primarily of farm and ranch land and forest. Rabbit Creek flows into the Sabine River about 15.5 miles northeast of the proposed reservoir site at a point approximately six miles northeast of the City of Kilgore.

The drainage area upstream of the proposed reservoir site covers approximately 7,500 acres (11.72 square miles). At the confluence of Rabbit Creek with the Sabine River, the drainage area controlled by the proposed reservoir represents approximately 0.4 percent of the entire drainage area of the Sabine River, and at the mouth of the Sabine River, it represents approximately 0.1 percent of the total drainage area.

The watershed above the proposed reservoir site is about equally divided between pasture land or forest. A small portion of the watershed (~ 2.6 %) lies within the City of Overton. The only major road through the watershed is State Highway 850, which extends generally west-northwestward from Overton.

B. HISTORICAL RABBIT CREEK STREAMFLOWS

On the U. S. Geological Survey (USGS) topographic maps covering the area upstream of the proposed dam site, i. e., *HOPE POND, TEX.* (1966) and *KILGORE SW, TEX.* (1971), Rabbit Creek generally is indicated to be characterized by intermittent streamflows. While there are no historical streamflow records available for Rabbit Creek at the proposed dam site, there are records from a USGS streamflow gage located downstream on Rabbit Creek that was in operation during the period October 1963 through January 1977. At the location of this gage, the drainage area of Rabbit Creek covers approximately 75.8 square miles. The watershed upstream of the proposed dam site encompasses approximately 15.5 percent of the gauged drainage area.

Examination of the historical daily streamflow records for Rabbit Creek indicates that, indeed, the flow in the watercourse is intermittent. Extended periods of zero flow occur in the records during 1963, 1964, 1967 and 1972. Streamflows less than one cubic feet per second (cfs) are indicated almost every year the gage was in operation. It should be noted that during the time the USGS gage was in operation, the effluent from the City of Overton's wastewater treatment plant was discharged into a tributary of Rabbit Creek located upstream of the USGS gage. The average flow rate for this discharge was less than 0.5 cfs; however, the quantity of effluent that actually passed the gage probably was substantially less because of seepage, evapotranspiration and other channel losses.

In order to effectively determine the potential water supply yield that the proposed Rabbit Creek Reservoir could develop over a broad range of hydrologic conditions, it is necessary to estimate the actual streamflow at the proposed dam site for an extended historical period. Normally such periods should cover 40 to 50 years of historical hydrologic conditions. Typically, this length of historical record would include one or more extended droughts. For purposes of such reservoir yield analyses, it is assumed that the historical hydrologic trace, adjusted for any significant watershed runoff or streamflow changes that may have occurred in the recent past or are expected to occur in the future, is a reasonable representation of future streamflow conditions.

For the proposed Rabbit Reservoir, the development of an appropriate record of daily streamflows at the dam site has been accomplished through the following steps:

Step 1 The monthly streamflows measured at the Rabbit Creek gage for the period 1964-1976 were correlated with corresponding monthly rainfall amounts as measured at Overton and at Longview, i.e., the National Weather Service rainfall stations closest to the proposed reservoir site with long-term records. For this purpose, the Overton monthly rainfall amount was weighted two thirds and the Longview monthly rainfall amount was weighted one-third because of the relative distances of these stations from the proposed reservoir site. Correlations and corresponding regression equations were developed for four monthly periods, i. e., January through May, June, July through October, and November and December. These correlations are plotted in Figures IV-1 through IV-4 in Exhibit 15, and the corresponding regression equations are specified.

Step 2 Flow duration analyses were performed for the two sets of monthly streamflows, i. e., the gauged streamflows and the regression streamflows, for the 1964-1976 period. In these analyses, both sets of the monthly streamflows corresponding to the gage site location were adjusted to represent streamflow conditions at the proposed reservoir site location using the drainage area ratio method, i. e., 0.155 drainage area ratio. Adjustment factors were calculated based on the deviation of the monthly regression streamflows from the corresponding monthly gauged streamflows for specific flow ranges, i. e., probabilities of occurrence, for each month of the year. This matrix of adjustment factors then was applied to the monthly regression streamflows for the 1964-1976 period to correct them so as to more accurately reflect the monthly gauged streamflows. The resulting distributions of the probabilities of occurrence of these two sets of monthly streamflows are plotted on Figure IV-5 in Exhibit 15. The agreement between these probability distributions is considered to be acceptable for purposes of estimating the monthly streamflows at the proposed reservoir site based on historical monthly rainfall amounts.

Step 3 The four monthly streamflow versus monthly rainfall regression equations developed in Step 1 and the matrix of adjustment factors developed in Step 2 then were applied to long-term monthly rainfall amounts measured at the Overton and Longview stations. The period of record used for this analysis extended from 1940 through 1994. The result of this analysis was a set of monthly streamflows at the proposed reservoir site for the period 1940 through 1994. This set of monthly streamflows is plotted on Figure IV-6 in Exhibit 15.

Step 4 The final step in the streamflow development process was the distribution of the monthly streamflows for the 1940-1994 period as derived in Step 3 to average daily flow values. For this purpose, the historical distribution of mean daily streamflows as measured at the USGS gage on Big Sandy Creek near the town of Big Sandy was used. Big Sandy Creek also is a tributary of the Sabine River, and its confluence is located about 20 miles north of the proposed Rabbit Creek Reservoir site. Records of mean daily streamflow from the Big Sandy Creek gage for the 1940-1994 period were analyzed to determine daily fractions of the measured monthly flow amounts. These fractions then were applied to the monthly flows developed in Step 3 for Rabbit Creek at the proposed reservoir site to derive values of average daily streamflows at the reservoir site for the entire 1940-1994 period. The probability distribution for this long-term set of average daily streamflows is plotted on Figure IV-7 in Exhibit 15 along with the daily streamflow probability distributions for the 1964-1976 period from the gage records and from the monthly regression equations, and the agreement among these curves is considered to be acceptable for purposes of this reservoir yield investigation.

The result of this four-step process is the entire set of estimated average daily streamflows for Rabbit Creek at the site of the proposed reservoir (or dam) for the period 1940 through 1994. This set of daily streamflows represents the estimated inflows to the proposed reservoir that would have occurred historically had the reservoir been in place. As illustrated by the average daily flow probability curve in Figure IV-7 of Exhibit 15, the estimated historical streamflows at the proposed reservoir site range from less than 0.1 cfs about six percent of the time up to a maximum of about 1,000 cfs. The estimated median value of streamflow, which is exceeded 50 percent of the time, is about 3.5 cfs. About 25 percent of the time, the estimated streamflow is less than 1.0 cfs and about 75 percent of the time it is less than 8.9 cfs. The estimated overall average daily flow for the entire 1940-1994 period is 7.9 cfs.

Based on the size of the drainage area upstream of the proposed reservoir site (11.72 square miles) and the estimated overall average daily flow for the 1940-1994 period of 7.9 cfs at the proposed dam site, the estimated historical average annual unit runoff for the watershed is 489 acre-feet per square mile per year. By comparison, the measured historical average annual unit runoff for Big Sandy Creek near the town of Big Sandy (231 square miles of drainage area) was 585 acre-feet per square mile per year based on 1940-1994 records, and the corresponding figure for Little Cypress Creek near Jefferson (675 square miles of drainage area) was 572 acre-feet per square mile per year based on 1947-1994 records. Both of these streams are located generally in the same climatic region as Rabbit Creek and both have generally similar watersheds with respect to land use and runoff characteristics. Based on these higher measured unit runoff values for similar watersheds, it is possible that the estimated historical streamflows at the proposed Rabbit Creek Reservoir site may be conservatively understated by as much as 15 to 20 percent.

One reason for the potentially-understated streamflows at the proposed reservoir site may be the nature of the stream channel and floodplain along Rabbit Creek between the proposed reservoir site and the downstream gage site. This reach is characterized by relatively flat ground slopes and terrain and relatively permeable alluvial-type soils, with numerous small ponds and lakes that capture and store runoff, and possibly even Rabbit Creek flows, during wet periods. These conditions would tend to cause streamflows in Rabbit Creek at the gage site to be lower than otherwise might occur farther upstream in the vicinity of the proposed reservoir site. Hence, the estimated streamflows at the proposed reservoir site, which are based on the measured gauged streamflows, may be somewhat lower than those that actually result from the runoff and watershed conditions upstream of the proposed reservoir site. For purposes of this planning investigation of the proposed Rabbit Creek Reservoir; however, no further adjustments in the estimated streamflows at the proposed dam site have been made, and whatever degree of conservatism is inherent in the potentially-understated inflows to the proposed reservoir is also reflected in the water supply yield estimates developed in this study.

C. PROJECTED RABBIT CREEK RESERVOIR INFLOWS

No significant future changes in the runoff characteristics of the watershed upstream of the proposed Rabbit Creek Reservoir are known or anticipated. It is expected that the watershed will remain generally in a rural state, with pasture land and forests being the predominant future land uses over the next 40 to 50 years. While the City of Overton may grow and expand further into the watershed of the proposed reservoir, such development is not likely to significantly affect the quantity of runoff at the proposed dam site. Additionally, there are no existing water rights located upstream of the proposed reservoir site within the Rabbit Creek basin. Hence, there should not be any future impoundment or diversion of surface water upstream of the proposed reservoir that would have any significant effect on future reservoir inflows.

For these reasons, the estimated historical daily streamflows derived through the four step process described above are considered to be representative of future inflows to the proposed reservoir, and they have been used directly in this investigation of reservoir yield.

D. ENVIRONMENTAL INSTREAM FLOW REQUIREMENTS

Historically, the construction and operation of major reservoirs in Texas has resulted in reductions in streamflows downstream of such impoundments. Such streamflow reductions potentially can have detrimental effects on existing downstream aquatic life and habitat. To insure that such impacts are minimized, the Texas Natural Resource Conservation Commission (TNRCC), the regulatory water authority for the State, has issued rules and regulations that, in effect, require certain minimum levels of streamflow as may be necessary to sustain and support existing fish and wildlife resources downstream of water supply development projects.

Through the State Consensus Water Planning Process, the Texas Water Development Board (TWDB), together with the Texas Parks and Wildlife Department and the TNRCC, has developed certain desktop procedures for quantifying the amount of streamflow required to effectively sustain and support the existing fish and wildlife resources along a particular stream reach without the need to conduct extensive field investigations. For this planning study of the proposed Rabbit Creek Reservoir, the TWDB has stipulated that these desktop procedures are to be used to estimate minimum levels of streamflow that must be released from the proposed reservoir for satisfying downstream environmental instream uses, to the extent that such quantities of flow are available from the reservoir inflows during corresponding time periods.

For a stream reach downstream of a proposed reservoir, the TWDB environmental flow criteria require that inflows to the reservoir be passed through to meet certain target minimum streamflow levels downstream. The magnitude of the minimum streamflow levels is dependent upon the amount of water stored in the reservoir as follows:

RESERVOIR ZONE	RESERVOIR STORAGE	MINIMUM STREAMFLOW
1	Storage > 80% Full*	Median Flow
2	80% Full > Storage > 50% Full	25th Percentile Flow
3	Storage < 50% Full	7Q2 or Water Quality Flow

*In this case, the term "Full" refers to the conservation pool of a reservoir.

The specified minimum streamflows are derived through statistical analyses of the mean daily flows for the period of record. For the proposed Rabbit Creek Reservoir, this data set corresponds to the 1940-1994 estimated daily streamflows as described above. For Zones 1 and 2, values of the median flow and the 25th percentile flow are required for each month of the year. For Rabbit Creek Reservoir, these flows are summarized in Table IV-1 in Exhibit 15. In Zone 3, the 7Q2 flow is defined as the seven-day average low flow with a two-year recurrence interval, i. e., the seven-day average low flow value for which there is a 50% chance that the seven-day average low flow in any given year will be equal to or less than. The "water quality flow" is defined as the magnitude of low flow required for the State's water quality standards to be satisfied under existing permitted wastewater discharge loadings. In Zone 3, the greater of either the 7Q2 or the water quality flow is to be used. For purposes of this planning investigation, the 7Q2 flow has been used. The results of statistical analyses of the seven-day average low flows for Rabbit Creek at the proposed reservoir site based on the 1940-1994 estimated daily flow data set are summarized on Figure IV-8 in Exhibit 15, and, as indicated, the resulting 7Q2 value at the 50-percent probability of occurrence is 0.06 cfs.

It is important to remember that the TWDB environmental instream flow procedures require that releases be made from a reservoir to satisfy the specified minimum downstream flow requirements only to the extent that such flows are available from reservoir inflows for the corresponding time period.

E. DOWNSTREAM WATER RIGHTS FLOW REQUIREMENTS

Based on TNRCC records, there are no existing water rights located along Rabbit Creek downstream of the proposed Rabbit Creek Reservoir. There are, however, several existing water rights located on the Sabine River downstream of the Rabbit Creek confluence that potentially could be impacted by the construction and operation of the proposed reservoir. If the storage of streamflows in the proposed reservoir on Rabbit Creek actually caused the quantity of water available to the downstream water rights to be reduced such that their authorized diversions or storage amounts could not be fully satisfied, then, according to TNRCC rules and regulation, inflows to the proposed reservoir would have to be passed through the impoundment in sufficient quantities to avoid any impairment of the downstream water rights.

For purposes of this planning investigation, it has been assumed that the proposed Rabbit Creek Reservoir would cause no impairment of downstream water rights and that inflow pass-throughs for satisfying downstream water rights would not be necessary. This assumption is supported by the fact that historical streamflows in Rabbit Creek as indicated by the flows measured at the gage downstream of the proposed reservoir site regularly are very low and, at times, are zero; hence, the contribution of flows from Rabbit Creek to the flow of the Sabine River at the locations of downstream water rights during low flow periods must be very minimal or nonexistent altogether. Furthermore, based on the extremely small size of the drainage area controlled by the proposed reservoir compared to that of the Sabine River at the existing downstream water rights locations, the amount of runoff (streamflow) that might be contributed from the watershed above the proposed reservoir to the flow of the Sabine River to satisfy the downstream water rights also must be extremely small, i. e., less than 0.4 percent. For these reasons, it seems very unlikely that any pass-throughs of inflows at the proposed reservoir, other than those required for downstream environmental purposes, would be necessary to satisfy downstream water rights.

F. RABBIT CREEK RESERVOIR OPERATIONS MODEL

One of the standard measures of the ability of a reservoir to provide a certain amount of water supply is referred to as the firm annual yield. The firm annual yield is defined as the quantity of water that can be withdrawn from a reservoir continuously throughout each year during the occurrence of the critical drought of record without causing the reservoir to go dry. The determination of the firm annual yield generally involves hydrologic routing of inflows through a reservoir using a long-term sequence of historical flows that is believed to include a severe drought condition, with a prescribed water demand imposed on the reservoir along with appropriate evaporation losses. Often, these analyses are performed using a computer program specifically designed to simulate reservoir operations.

For the Rabbit Creek Reservoir firm annual yield analyses, the SIMYLD-IID reservoir systems daily operations computer program has been employed. This program is a modification of the original SIMYLD-II program that was formulated and coded by the TWDB in the early 1970's as part of that agency's overall mathematical simulation capabilities for analyzing water resources systems. The SIMYLD-IID program modifications were made by R. J. Brandes Company through previous reservoir operation studies and projects.

Both the SIMYLD-II program and the SIMYLD-IID program can be applied to provide a multi-reservoir simulation model capable of describing the movement and storage of water through a system of river reaches, canals, reservoirs and non-storage river junctions. The fundamental difference between the SIMYLD-IID program used in this investigation and the original SIMYLD-II model is that a daily time step is used instead of a monthly time step. The use of a daily time step is necessary for describing streamflow variations and reservoir behavior when applying the TWDB's environmental instream flow procedures.

The SIMYLD-IID program simulates the operation of a single reservoir or a system of reservoirs subject to a specified sequence of demands and hydrologic conditions. The model simulates the movement of water among reservoirs, rivers and conduits on a daily basis while striving to meet a set of specified demands in a given order of priority. If shortages occur during the operation, i. e., not all demands can be met for a particular time period, the shortages are spatially located at the lowest-priority demand nodes.

The SIMYLD-IID program also is designed to provide flexibility in selecting operating rules for each reservoir in the system being simulated. The operating rules are formulated as the percentage of each reservoir's capacity (either total or conservation) that is desired to be held in storage at the end of each computational time step (each day). In addition, a priority ranking, used to determine the allocation of water between meeting demands and maintaining storage, is assigned to each storage and demand node. The operating rules provide flexibility by allowing the desired reservoir storage levels and the priorities for allocating water between satisfying demands and maintaining storage in the reservoirs to be varied by month during the year. Furthermore, these priorities can be changed during a simulation according to the hydrologic state of the system being modeled, i. e., dry, normal or wet conditions based on system storage.

The fundamental concept in applying the SIMYLD-IID program is that the physical reservoir system has to be transformed into a capacitated network flow problem. In making this transformation, the real system's physical elements are represented as a combination of two possible network components -- nodes and links. Given the proper parametric description of these two network components, it becomes a straightforward task to develop the necessary network. Once properly developed, the network system can be analyzed as a direct analog of the real system.

As the nomenclature implies, a node is a connection and/or branching point within the network. Therefore, a node is analogous to a reservoir or a non-storage junction, e. g., a canal junction, major river confluence, etc., in the physical system. Additionally, a node is a network component which is considered to have the capacity to store a finite and bounded amount of the water moving within the network. In the case of SIMYLD-IID, reservoirs are represented by nodes which have storage capacity as well as the ability to serve as branching points. A non-storage capacitated junction is handled similarly to a capacitated junction (reservoir) except that its storage capacity is always zero. Demands placed on the system must be located at nodal points. Also, any water entering the system, such as might occur naturally from upstream river inflows or artificially by import, must be introduced at nodal points.

The transfer of water among the various network nodes is accomplished by transfer components called links. Typically, a link is a river reach, canal or closed conduit with a specified direction of flow and a fixed maximum and minimum capacity. The physical system and its basic time step operation, in this case one day, is formulated as the network flow problem. The set of solutions to this network flow problem provides the sequential operation of the system with the set of daily operations becoming the operation of the system over the entire length of the desired hydrologic sequence.

For the firm annual yield analyses of the proposed Rabbit Creek Reservoir, two nodes have been used with a single link connection. Node 1 represents the reservoir itself, and Node 2 represents the downstream demand node for the minimum environmental instream flows. The water supply demand on the reservoir for determining its firm annual yield is specified at Node 1, while the downstream environmental water demands are specified at Node 2. The Node 2 environmental water demands are assigned a higher priority than either the Node 1 water demands or the storage of water in the Node 1 reservoir. Hence, to the extent that inflows to the reservoir are available, the Node 2 environmental water demands are satisfied first in the model operations. Coding changes in the SIMYLD-IID program have been made to incorporate the three-zone criteria of the TWDB's environmental instream flow procedures.

Fundamental to operation of the SIMYLD-IID model is a description of the physical characteristics of the proposed Rabbit Creek Reservoir. This consists of specifications of corresponding sets of stage, surface area and storage volume for the reservoir such that its entire contents are described from zero storage up to a specified level of conservation storage. For developing these relationships, the USGS topographic maps covering the reservoir area have been analyzed. The resulting relationships are plotted on Figure IV-9 in Exhibit 15. Discrete sets of reservoir stage, surface area and storage values have been included in the input data file for the SIMYLD-IID model of the proposed Rabbit Creek Reservoir.

Another important input variable required for the reservoir operation simulations is evaporation. For the Rabbit Creek Reservoir analyses, monthly values of historical reservoir net evaporation rates as compiled by the TWDB have been used for describing evaporation conditions at the reservoir site. These values have been compiled from data developed and provided by the TWDB, and they include monthly evaporation rates for the entire 1940-1994 analysis period. For the specific Rabbit Creek Reservoir site, monthly net reservoir evaporation data for Quadrangles 512 and 513 have been averaged, and then distributed to daily values based on the number of days in each calendar month.

G. RABBIT CREEK RESERVOIR FIRM ANNUAL YIELD ANALYSES

Using the SIMYLD-IID model of the proposed Rabbit Creek Reservoir as described above with the 1940-1994 daily inflow and evaporation data sets, simulations have been made to determine the firm annual yield of the reservoir for a range of assumed maximum conservation storage levels. These results are presented in Figure IV-10 in Exhibit 15. As indicated, the firm annual yield varies from about 2,920 acre-feet per year up to about 3,770 acre-feet per year for conservation pool levels ranging from 400 feet msl (Mean Sea Level) up to 410 feet msl. This range in firm annual yield corresponds to a dependable water supply of about 2.6 to 3.4 MGD (million gallons per day).

The selection of the optimum conservation pool level and the final recommended conservation pool storage capacity are discussed in Section VI of this report.

A.0 RESERVOIR AREA

A.1 WATER QUALITY

This section of the report deals with surface water quality issues associated with the development of a reservoir. The issues are those which affect the quality of water as a drinking source, for recreational purposes, and for the support of the aquatic resources of the reservoir.

Water quality in a reservoir depends upon a number of things ranging from the natural runoff quality including seepage from springs, to the size, number, and type of upstream wastewater discharges, upstream land uses, shoreline and recreational use in the reservoir, the morphometry of the reservoir, and stratification.

The geology and soils of the drainage area provide the baseline water quality in the runoff water. However, depending upon the level of urban or agricultural development in the drainage area upstream, the water quality can be significantly altered from the natural condition. Very little of the area within the reservoir footprint (including the flood pool area) has been cleared. The remainder of the Rabbit Creek Reservoir contributing watershed is largely undeveloped forested land or pastureland for beef cattle. The footprint of the reservoir below the flood stage elevation is almost entirely forested and non forested wetland. Less than 10% of the reservoir's drainage area is affected by runoff from a developed portion of the City of Overton. A portion of the drainage area has a number of oil or gas wells. The TDWB (1980) notes that along the entirety of Rabbit Creek above the gage at Highway 31 there are several small diversions for oilfield operation, and that low flow is partly sustained from effluents from these operations.

Given the largely undeveloped contributing watershed the potential for good water quality in the reservoir is high. The quality of the water should be superior to that of the groundwater currently in use by the City of Overton. According to the grant applications prepared for the City of Overton (July 1996), the City has been plagued with water quality problems in the groundwater since the late 1940s. High iron, carbon dioxide, and sulfide concentrations, coupled with low pH have necessitated above average maintenance costs and created taste and odor problems. Given proper drainage area protection and proper reservoir operation, none of the above listed factors should effect the water supply from Rabbit Creek Reservoir. For instance, the water quality of the reservoir could be negatively affected if dairy farming with its intense land use by cattle were established in the watershed. Any concentrated urban development in the watershed, especially any adjacent to the reservoir should be required to control the quality of its runoff, especially with regards to fertilizers, herbicides, and pesticides. Such area should be required to insure that leakage or drainage from sewers or septic systems does not enter the reservoir.

Water depth of the reservoir is another factor which can influence the quality of water and aesthetic qualities of the reservoir. The maximum depth of the reservoir will be approximately 36 feet. Estimations of water depth distribution planimetered from the USGS 7.5 minute quadrangle map yields the following results.

Normal Pool Level Water Depth (ft)	% of Total
0 - 6	22.60
7 - 16	34.80
17 - 26	18.40
27 - 36	24.20
TOTAL	100.00

The above values compare favorably with other local reservoirs (Young, 1988). According to Young, stratification is likely to occur in any reservoir with depths greater than 10 feet.

Water withdrawn from the hypolimnion may contain higher amounts of dissolved minerals than surface waters which would require additional water treatment processes and increased cost of chemical additions. The minimize the need for these additional treatment processes, intake structures can be designed to selectively withdraw water from depths with the most desirable water quality during different seasons of the year.

Shallow areas of a lake or reservoir are susceptible to growth of aquatic weeds and filamentous algae. While often a nuisance problem for swimmers, boaters, and fishermen, abundant growth can possibly negatively affect the taste and odor of the water. However, other lakes in the area such as Lake Hawkins and Lake Holbrook, which have similar distributions of shallow versus deeper areas, have experienced no nuisance aquatic growths. Even Lake Gladewater which has roughly twice the percentage of shallow acreage than Rabbit Creek, Hawkins or Holbrook has experienced no nuisance growths (Young, 1988).

A.2 PHYSICAL SETTING

The proposed Rabbit Creek Reservoir lies within the upper drainage basin of Rabbit Creek in Smith County (Figure V-1). The proposed reservoir would have a contributing drainage area of approximately 12-square miles. The reservoir would encompass approximately 516 acres at normal pool elevation of 406 ft MSL and 875 acres at flood stage height (420 ft MSL) within three major tributary branches of the Rabbit Creek headwaters. Topography in the area is hilly to gently rolling with well

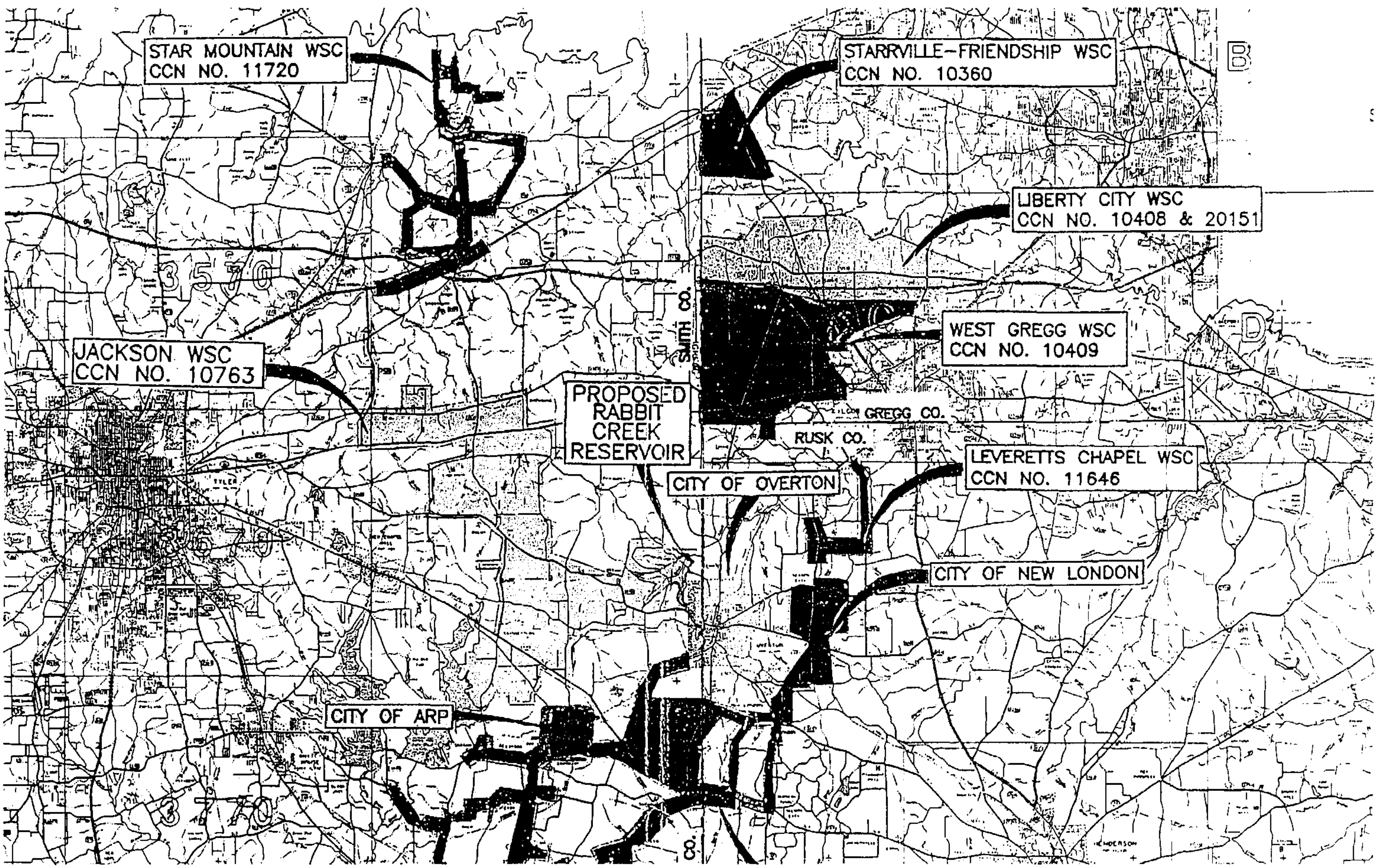


FIGURE V-1

VICINITY MAP
RABBIT CREEK RESERVIOR
SMITH CO., TEXAS

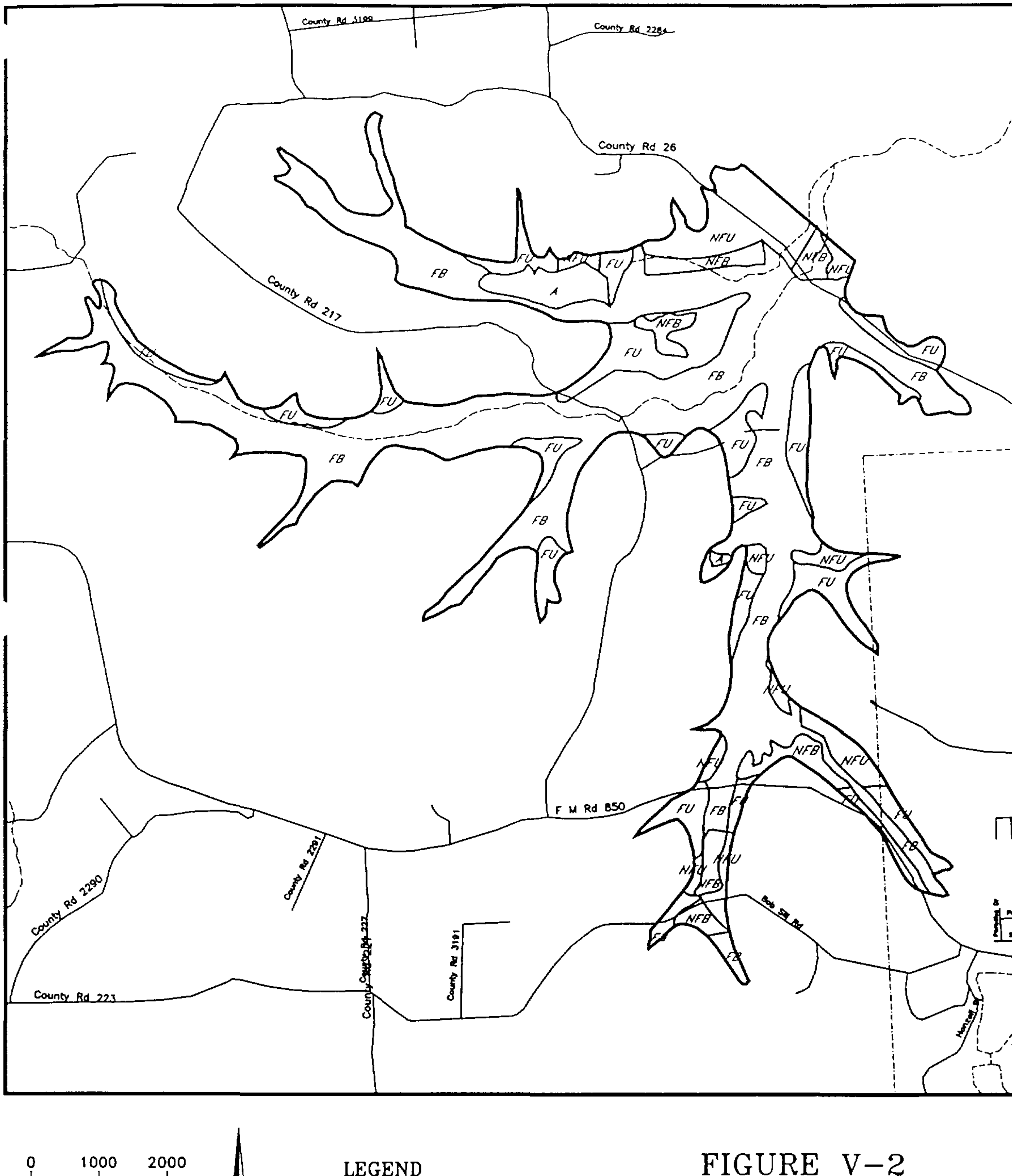
Horizon
ENVIRONMENTAL SERVICES, INC.

incised drainages. Elevations in the upper drainage basin range from about 590 ft MSL to 365 ft MSL at the proposed dam site. Rabbit Creek and its larger tributaries typically exhibit wide flood plains, often with braided flow channels. Soils of the surrounding hills are generally permeable sands to sandy loams that act as recharge areas for shallow groundwater zones. Groundwater seeps out of the bases of the hills at the edges of the flood plains and contributes to the base flow of the streams. Numerous smaller lakes and ponds are present within the upper drainage basin of Rabbit Creek, including Overton Lake, a small water supply reservoir near Overton.

A.3 TERRESTRIAL ECOLOGY

A.3.1 Vegetation And Wetlands

The Rabbit Creek bottomland within the proposed reservoir pool area is largely wooded, much of which is relatively mature hardwood forest (Figure V-2). A majority of these bottomland hardwood forest areas are considered jurisdictional wetlands according to the technical criteria utilized by the US Army Corps of Engineers to delineate wetlands (EL, 1987). Additional areas within the bottomland which have been logged or cleared for grazing pasture are also considered jurisdictional wetlands. Table V-1 provides approximate acreages of vegetational types and areas subject to jurisdiction under Section 404 of the Clean Water Act (wetlands) within the proposed flood pool at elevation 420 ft MSL.



0 1000 2000

SCALE IN FEET

N

LEGEND

FB Forested Bottomland
NFB Non-forested Bottomland
FU Forested Upland
NFU Non-forested Upland
A Aquatic

FIGURE V-2

LAND COVER TYPES
RABBIT CREEK RESERVOIR
SMITH COUNTY, TEXAS

Horizon

ENVIRONMENTAL SERVICES INC

TABLE V-1

AERIAL EXTENT OF VEGETATION TYPES

AND

404 JURISDICTIONAL AREAS

WITHIN FLOOD POOL (ELEV. 420 FT MSL)

TYPE		APPROXIMATE ACREAGE
Forested Bottomland		713.7
Non-forested Bottomland		46.3
Forested Upland		7.5
Non-forested Upland		85.1
Aquatic		22.3
	TOTAL	874.9
404 Jurisdiction (Approx. 85% of bottomland and aquatic habitats)		665

Wetland areas exhibit hydric characteristics for three requisite parameters: vegetation, soils and hydrology. Common trees in jurisdictional bottomland forests include black willow, river birch, sweetgum, green ash, red maple, ironwood, cherrybark oak and overcup oak. Herbaceous species common to the understory of jurisdictional bottomland forests or cleared areas include rushes, sedges, spikerushes, honeysuckle and fall panicum. All dominant species in these areas are wetland indicators.

Some areas of bottomland forest and pastures did not exhibit prevalent hydric vegetation. Common trees in the non-hydric forested areas included water oak, American holly, blackgum, southern red oak, sweetgum, eastern redcedar and hackberry. Common grassland species included bermudagrass, dallisgrass, dewberry, goldenrod, ragweed and various wildflowers and other forbs.

Soils within the bottomlands are predominantly Mantachie loam with lesser degrees of Owentown loamy fine sand. The Mantachie is frequently flooded and is considered a hydric soil. Observed characteristics of this soil included wet, saturated or inundated conditions, and soil color of 10YR4/1, with extensive 10YR4/6 mottles. These characteristics confirm the hydric nature of this soil. The Owentown loamy fine sand is not considered uniformly hydric, but contains hydric inclusions. Non-hydric areas of this soil were observed to exhibit colors of 10YR4/6 with no mottles and were generally moist to dry. The hydric inclusion areas exhibited wet or saturated conditions and colors of 10YR4/2 with 10YR6/1 and 10YR4/6 mottles and 10YR2/2 organic streaks. All areas of Mantachie soil and the hydric inclusions within the Owentown corresponded with a dominance of hydric vegetation.

Hydrology of the bottomlands is influenced by three principal factors: overbanking of the creek and tributaries as evidenced by flood debris distribution; ponding resulting from typical undulating topography and/or beaver activity; and groundwater seepage along the bases of adjacent hills.

Areas determined to be jurisdictional within the bottomlands exhibited at least one of the hydrologic indicators as well as a predominance of hydric vegetation species and hydric soil characteristics. Areas determined not to be jurisdictional were lacking in at least one of the primary criteria.

The determination of Section 404 jurisdiction is a general estimate at this time for planning and constraints analysis purposes based on a cursory field evaluation, analysis of aerial photography and information from existing maps such as USGS topo maps, county soils maps and National Wetlands Inventory maps. At such time as a Section 404 permit is to be sought from the Corps of Engineers, a more detailed wetland delineation will need to be conducted.

A.3.2 Wildlife

The proposed Rabbit Creek Reservoir is situated in the Austroriparian Biotic Province described by Blair (1950). This province extends from the Atlantic coastal plain westward into eastern Texas and as far north as southern Virginia. Climax vegetation of the Austroriparian province is hardwood forest, but most of the upland areas in the province are covered by subclimax pine forest (Dice, 1943). In Texas, the Austroriparian province corresponds to the Pineywoods vegetational area described by Gould (1975). The Pineywoods ecoregion encompasses approximately 15,000,000 acres of gently rolling to hilly forested land in Texas. Common forest species include shortleaf pine, loblolly pine, southern red oak, water oak, overcup oak, sweetgum, red maple, and mockernut hickory, among others. The vertebrate fauna of the Pineywoods region is similar to that of the Austroriparian province as a whole, supporting at least 47 species of mammals, 29 snakes, 10 lizards, 2 land turtles, 17 anurans, and 18 urodeles (Blair, 1950).

The forested habitats of the proposed Rabbit Creek Reservoir comprise approximately 82% of the flood pool. Bottomland hardwood forest is the most extensive forest type in the proposed reservoir area and is an important habitat for wildlife due to the available cover, water, vegetation diversity, and mast production. Typical wildlife species include the Pileated Woodpecker (*Dryocopus pileatus*), Wood Duck (*Aix sponsa*), White-eyed Vireo (*Vireo griseus*), gray squirrel (*Sciurus* *carolinensis*), swamp rabbit (*Sylvilagus aquaticus*), white-tailed deer (*Odocoileus virginianus*), and numerous herpetofauna species.

The forested upland habitat is only represented by 7.5 acres of habitat within the project area. Although this cover type is typically an important wildlife habitat, the small areal extent of the upland hardwood forest within the project area limits its importance to wildlife.

Non-forested cover types at the proposed reservoir comprise 15% of the flood pool. This habitat is composed primarily of improved grasses and is either grazed or used for hay. Improved pastures typically have limited values to wildlife due to the lack of diversity. These habitats are important to bird species such as the Eastern Meadowlark (*Sturnella magna*), Dickcissel (*Spiza americana*), and Cattle Egret (*Bubulcus ibis*). Fossorial species such as the plains pocket gopher (*Geomys bursarius*) utilize this habitat frequently and eastern cottontails (*Sylvilagus floridanus*) and white-tailed deer occasionally may be seen near the edges of these habitats.

The marsh and aquatic habitats of the project area are important to numerous wildlife species. Both of these wetland habitats are vital to virtually all amphibians of the project area and to many of the reptile species as well. Additionally, many of the recreationally or commercially important species in the area are associated with these habitats. Included within this category are the Mallard (*Anas platyrhynchos*) and Wood Duck, and furbearers such as the mink (*Mustela vison*), raccoon (*Procyon lotor*), and beaver. Many non-game species are also attracted to this habitat and include wading birds such as the Great Egret (*Casmerodius albus*), Great Blue Heron (*Ardea herodius*), and the Belted Kingfisher (*Ceryle alcyon*). Numerous herpetofauna species inhabit aquatic and marsh habitats and include such species as the red-eared slider (*Pseudemys scripta elegans*), common snapping turtle (*Chelydra *serpentina serpentina*), diamondback water snake (*Nerodia rhombifera rhombifera*), and bullfrog (*Rana catesbiana*). The aquatic and associated wetland habitats are the most productive and diverse non-forested habitats of the project area.

The inundation of the proposed Rabbit Creek Reservoir will result in the loss of 516 acres of terrestrial wildlife habitat within the normal pool for the life of the project. An additional 300 acres of habitat within the flood pool will be temporarily flooded in response to large inflow events. This will result in the displacement of the more mobile species of wildlife which currently reside within the boundaries of the project. These mobile species will most likely emigrate to surrounding areas which have suitable habitat. If surrounding area are already at carrying capacity, then they will not be able to sustain higher wildlife populations without a degradation in habitat. Wildlife species which are not highly mobile will be most negatively affected by inundation.

Indirect effects on wildlife from the existence of the proposed reservoir will result from development of private lands around its shores and also from the development of public recreational facilities. Additionally, new roads will be needed to gain access to these development and will result in an additional loss of habitat as well as some auto related wildlife mortalities.

A.3.3 Threatened or Endangered Species

A.3.3.1 Federally-listed species

Records of state and federally-listed threatened or endangered species were reviewed at the Texas Biological and Conservation Data System (TXBCD) to determine the potential for the occurrence of any threatened or endangered species.

According to TXBCD records, seven federally-listed and eleven state-listed wildlife species are of potential occurrence in Smith County. No federally-listed fish species or plants are known to occur in Smith County. Seven plant species of possible occurrence in Smith County are indicated as "Species of Concern" by the US Fish and Wildlife Service. Species of Concern are those which are presently under study or review for possible future listing, but sufficient biological information to support a proposal for listing is not yet available. These species have no official status or protection and are not discussed any further in this text at this time. Table V-2 provides a listing of the species which are of possible occurrence in Smith County.

Of the seven federally-listed species, all but the bald eagle are transients or migrants in east Texas and are not likely to be adversely affected by the proposed reservoir project. In fact, reservoirs in East Texas are frequently attractors for many of the transient or migrant species.

The bald eagle is known to nest in parts of East Texas and is a casual resident, although generally migratory. Bald eagles in East Texas are most common around large reservoirs or along major waterways. Suitable nesting habitat does not occur within the proposed reservoir pool area. The eagle's occurrence, other than a possible transitory fly-over or rest stop, is not likely. The occurrence of any of the other federally-listed species are also not likely.

A.3.3.2 State-listed species

Six of the state-listed species are the same as the federally-listed species discussed above. Five additional species, the white-faced ibis, scarlet snake, timber rattlesnake, alligator snapping turtle and Texas horned lizard are listed by the State as threatened. With the exception of the Texas horned lizard, the four other species may

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TABLE V-2

TEXAS PARKS AND WILDLIFE DEPARTMENT
ENDANGERED RESOURCES BRANCH
SPECIAL SPECIES LIST
SMITH COUNTY

Scientific Name	Common Name	Federal Status	State Status
*** BIRDS			
FALCO PEREGRINUS	PEREGRINE FALCON	LE/LT/SA	
FALCO PEREGRINUS ANATUM	AMERICAN PEREGRINE FALCON	LE	E
FALCO PEREGRINUS TUNDRIUS	ARCTIC PEREGRINE FALCON	T/SA	T
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	LT	T
LANIUS LUDOVICIANUS MIGRANS	MIGRANT LOGGERHEAD SHRIKE	SOC	
PELECANUS OCCIDENTALIS	BROWN PELICAN	LE	E
PLEGADIS CHIHI	WHITE-FACED IBIS	SOC	T
*** MAMMALS			
URSUS AMERICANUS	BLACK BEAR	T/SA	T
URSUS AMERICANUS LUTEOLUS	LOUISIANA BLACK BEAR	LT	T
*** REPTILES			
CEMOPHORA COCCINEA	SCARLET SNAKE		T
CROTALUS HORRIDUS	TIMBER RATTLESNAKE		T
MACROCLEMYS TEMMINCKII	ALLIGATOR SNAPPING TURTLE	SOC	T
PHRYNOSOMA CORNUTUM	TEXAS HORNED LIZARD	SOC	T
*** VASCULAR PLANTS			
ASTER PUNICEUS SSP ELLIOTTII VAR SCABRICAULIS	ROUGH-STEM ASTER	SOC	
COREOPSIS INTERMEDIA	GOLDEN WAVE TICKSEED	SOC	
CRATAEGUS WARNERI	WARNER'S HAWTHORN	SOC	
CYPERUS GRAYIOIDES	MOHLENBROCK'S UMBRELLA-SEDGE	SOC	
MIRABILIS COLLINA	SANDHILL FOUR-O'CLOCK	SOC	
TALINUM RUGOSPERMUM	ROUGHSEED FLAMEFLOWER	SOC	
TRILLIUM PUSILLUM VAR TEXANUM	TEXAS TRILLIUM	SOC	

Codes:

LE, LT	-	Federally Listed Endangered/Threatened
PE, PT	-	Federally Proposed Endangered/Threatened
T/SA	-	Federally Threatened due to Similarity of Appearance
C1	-	Federal Candidate, Category 1; information supports proposing to list as endangered/threatened
SOC	-	Federal Species of Concern
DL, PDL	-	Federally Delisted/Proposed Delisted
E, T	-	State Endangered/Threatened

potentially occur within the proposed reservoir pool area. However, state-listed species are only protected from direct intentional injury or death and would not be subject to regulatory action for construction of the reservoir. Construction workers should be briefed on these species and instructed not to kill or capture any if they are encountered.

Regarding state-listed fish species, no state endangered species occur in the project area. The paddlefish (*Polyodon spathula*) has not been reported in the Sabine River system upstream from Toledo Bend Reservoir since its impoundment in 1968 (Pitman, 1991). Therefore, the Rabbit Creek Reservoir project will not directly impact the paddlefish or its habitat.

The state threatened creek chubsucker (*Erimyzon oblongus*) has been recorded as occurring in Rusk County but no records exist for Smith County. It is possible that the creek chubsucker could occur throughout Rabbit Creek based upon life history and habitat preference data reviewed below.

Hubbs (1957) notes that the creek chubsucker range in Texas corresponds to the Austroriparian Biotic Province. The range of the creek chubsucker includes Atlantic slope streams from Maine through central Georgia and Gulf slope streams from western Florida to the San Jacinto River of Texas. Also the Mississippi Valley states of Louisiana, Arkansas, southeast Oklahoma, Missouri, Mississippi, western Tennessee, western Kentucky, Illinois, Indiana, and west-central Ohio are included in the species range as are the southern drainages to Lakes Michigan, Erie, and Ontario (Lee, et. al., 1980).

In Texas, Lee, et. al., (1980) show the distribution as including the Cypress Creek, Red River, southern Sabine River, San Jacinto River, Trinity River, and

Neches River Basins. The only upper Sabine River records are those by EH&A (1981, Rusk Co.), CDM (1990, Panola Co.), and Wood County (TNHP, 1991).

The creek chubsucker is a widely distributed species but is not abundant within its habitat (Lee, et. al., 1980; Boschung, et. al., 1983; Pflieger, 1975). The literature concerning the creek chubsucker contains some disparities regarding habitat preferences. Lee, et. al., (1980) indicate that the creek chubsucker occupies small rivers and creeks over a wide range of gradients, substrates, and vegetation. Pflieger (1975), Douglas (1974), and Smith (1979) indicate that the creek chubsucker is generally found in low gradient streams and often in pool or backwater areas. They do, however, spawn over gravelly shoals or riffles (Pflieger, 1975). Smith-Vaniz (1968) and Miller and Robinson (1973) both indicate the creek chubsucker is found in small creeks of at least moderate gradient and generally over sandy substrates. Pflieger (1975) and Smith (1979) note that the substrate is usually soft, contains debris, and often submerged vegetation. Lee, et. al., (1980) note that the young often occur in headwater rivulets and Smith (1979) and Evans and Noble (1979) observe that the young are among the first fish to ascend headwaters or previously dry stream courses. Evans and Noble (1979) indicate that creek chubsuckers are distributed by age class with younger fish more upstream than older individuals. Lee, et. al., (1980) note that the species is not found in spring areas, but may inhabit spring-fed creeks. Douglas (1974) and Lee, et. al., (1980) indicate that creek chubsuckers are seldom found in impoundments.

The creek chubsucker is apparently not tolerant of silty conditions (Lee, et. al., 1980; Boschung, et. al., 1983; Miller and Robinson, 1973). However, Pflieger (1975) writes that the preferred substrate may be a bottom of sand or silt mixed with debris. Both Smith (1979) and Miller and Robinson (1973) indicate that the creek chubsucker feeds on small benthic invertebrates. This would support the conclusion that silty conditions would not be well tolerated, as such conditions would tend to minimize the benthic organisms utilized as food.

As a result, the reservoir located in the most upstream portions of Rabbit Creek will probably preclude its use of that area; however, the entire downstream reach will remain as habitat.

Blue sucker (*Cycleptus elongatus*)

The blue sucker (*Cycleptus elongatus*) is listed as a state threatened species by TPWD and as a C2 candidate by the USFWS. According to TNHP records, it has not been confirmed from the counties examined in this study. Furthermore, it is not listed as a possible species of occurrence in those counties. However, Lee, et. al., (1980) reports the distribution and habitat of the blue sucker as limited to the largest rivers and lower parts of their major tributaries, from the Rio Grande River, as far west as New Mexico; eastward to Mobile Bay, Alabama; and north in the Mississippi River basin through the Missouri and Ohio River drainages. Randy Moss (TPWD, pers. comm.) indicated that the blue sucker is a possible species in most major Texas rivers. They are relatively abundant in the Red River below Lake Texoma and have been collected as far as Clay County but not common in that area. They are also relatively abundant in the Colorado River from Austin to Eagle Lake. Given suitable substrate, Dr. Moss indicated they could occur throughout the length of the major rivers. The fish is seldom common even in preferred habitat which is generally exposed bedrock sometimes in common with hard clay, sand, or gravel (Lee, et. al., 1980). Douglas (1974) and Moss (TPWD, pers. comm.) note that the species may be more wide ranging than collections would indicate due to difficulty in sampling the preferred habitat.

As is the case in Texas (Lee, et. al., 1980), the blue sucker is widely distributed in most of the major river of Louisiana, but is nowhere common (Douglas, 1974). Smith (1979) notes that blue sucker is strongly migratory and will occasionally ascend medium-sized tributaries of major rivers. The blue sucker migrates into riffle areas of small tributaries to spawn. The species is intolerant of turbidity unless sufficient current is present to prevent siltations (Pflieger, 1975). Dr. Moss (TPWD, pers. comm.) indicated they would most likely be restricted to larger rivers as opposed to smaller tributaries. They do, for instance, spawn in the channel areas of the Colorado River in Texas as opposed to migrating into tributary streams. Dam construction, which results in lower stream flow and increased siltation, presents unfavorable conditions for blue sucker habitation (Lee, et. al., 1980).

Given the above presented information, it is possible that the blue sucker would occur in the Sabine River near the confluence with Rabbit Creek. However, given that the Rabbit Creek habitat and generally turbid water are not preferred by the blue sucker, it is very unlikely that the Rabbit Creek Reservoir will have any impact on the species.

Western sand darter (*Etheostoma clarum*)

The western sand darter (*Etheostoma clarum*) is not a state- or federally-listed species, but is considered a threatened species by TOES (Texas Organization for Endangered Species). In Texas, the species has been collected from the Red, Sabine, and Neches River drainages. Based upon the literature, the species is a possible inhabitant of Smith County. The possibility of the species occurring in Gregg and Rusk counties is reasonable. Douglas (1974) notes that the species enters eastern Texas but indicates a rather narrow north-south area of habitat with Texas as a peripheral area. Harlan and Speaker (1956) indicate that the species prefers primarily large rivers with deep channels containing coarse sand or fine gravel substrates. Miller and Robinson (1973) generally agree, but add that the fish may spend much of its time buried in the sand in moderate current areas. Pflieger (1975) indicates that the species avoids strong currents and prefers quiet margins of the stream channels or backwater areas, but notes the species is intolerant of excessive siltation or turbidity. Obviously some disparity as to preferred habitat exists in the literature, but overall the species is probably ruled out of the reservoir area due to inappropriate habitat type and an intolerance to turbidity. If it did occur in downstream areas or in the Sabine River, those areas would not be impacted by Rabbit Creek Reservoir and therefore, the project should not affect this species.

2.4 AQUATIC RESOURCES

A review of Lee, et. al. (1980) and Hubbs, et. al. (1991) indicates that the geographic range of approximately 84 fish species includes the project areas. Table V-3 presents the list of those species with an estimate of abundance for each species for the project area (Upper Rabbit Creek) and the adjacent downstream Rabbit Creek area through its confluence with the Sabine River (Lower Rabbit Creek). The abundance estimate is not an absolute abundance estimate (e.g. number per unit area) but is rather an estimate of the relative abundance likely for each species given the habitat available. The abundance rankings range from abundant through common, uncommon, unlikely, and none. Table V-4 presents a summary of the ranking results by number of species and percentage of the total possible species per each rank category.

Based upon the habitat observed throughout the Rabbit Creek watershed by Horizon personnel, the potential for species to occur changes primarily on the size of the wetted creek area and the relative permanence of such areas. Rabbit Creek

TABLE V-3

FISH SPECIES WHOSE RANGE INCLUDES THE RABBIT CREEK AND ADJACENT PORTIONS OF THE SABINE RIVER WATERSHED

Common Name	Scientific Name	Lower Rabbit Creek	Upper Rabbit Creek
chestnut lamprey	*Ichthyomyzon castaneus*	UC	UL
southern brook lamprey	*Ichthyomyzon gagei*	UL	NO
spotted gar	*Lepisosteus oculatus*	UC	UC
longnose gar	*Lepisosteus osseus*	UC	NO
shortnose gar	*Lepisosteus platostomus*	UL	NO
alligator gar	*Lepisosteus spatula*	UL	NO
bowfin	*Amia calva*	UC	NO
gizzard shad	*Dorosoma cepedianum*	UL	NO
threadfin shad	*Dorosoma petenense*	UC	NO
goldfish	*Carassius auratus*	UL	UL
red shiner	*Cyprinella lutrensis*	A	C
blacktail shiner	*Cyprinella venusta*	C	UL
common carp	*Cyprinus carpio*	C	UL
Mississippi silvery minnow	*Hybognathus nuchalis*	UC	NO
ribbon shiner	*Lythrurus fumeus*	C	A
redfin shiner	*Lythrurus umbratilis*	C	C
speckled chub	*Macrohybopsis aestivalis*	UL	NO
golden shiner	*Notemigonus crysoleucas*	C	UC
pallid shiner	*Notropis amnis*	UC	UL
emerald shiner	*Notropis atherinoides*	A	C
blackspot shiner	*Notropis atrocaudalis*	C	C
ghost shiner	*Notropis buchanani*	C	UC
Sabine shiner	*Notropis sabinae*	UC	UL
weed shiner	*Notropis texanus*	C	UC

A = Abundant; C = Common; UC = Uncommon; UL = Unlikely; NO = Will not occur in project area

Common Name	Scientific Name	Lower Rabbit Creek	Upper Rabbit Creek
mimic shiner	*Notropis volucellus*	UC	UL
pugnose minnow	*Opsopoeodus emiliae*	UL	UL
bullhead minnow	*Pimephales vigilax*	A	C
creek chub	*Semotilus atromaculatus*	UL	UL
river carpsucker	*Carpiodes carpio*	UC	UL
blue sucker	*Cycleptus elongatus*	UL	NO
creek chubsucker	*Erimyzon oblongus*	UC	UC
lake chubsucker	*Erimyzon sucetta*	UL	UL
smallmouth buffalo	*Ictiobus bubalus*	UL	NO
big mouth buffalo	*Ictiobus cyprinellus*	NO	NO
black buffalo	*Ictiobus niger*	UL	NO
spotted sucker	*Minytrema melanops*	UC	UC
blacktail redhorse	*Moxostoma poecilurum*	NO	NO
black bullhead	*Amieurus melas*	UC	NO
yellow bullhead	*Amieurus natalis*	UC	NO
blue catfish	*Ictalurus furcatus*	NO	NO
channel catfish	*Ictalurus punctatus*	C	UC
tadpole madtom	*Noturus gyrinus*	UC	UC
freckled madtom	*Noturus nocturnus*	UC	UC
flathead catfish	*Pylodictis olivaris*	UC	NO
redfin pickerel	*Esox americanus vermiculatus*	C	UC
pirate perch	*Aphredoderus sayanus*	C	C
golden topminnow	*Fundulus chrysotus*	NO	NO
Starhead topminnow	*Fundulus dispar blairae*	UC	UC
blackstripe topminnow	*Fundulus notatus*	A	A
blackspotted topminnow	*Fundulus olivaceus*	A	A
western mosquito fish	*Gambusia affinis*	C	A

A = Abundant; C = Common; UC = Uncommon; UL = Unlikely; NO = Will not occur in project area

Common Name	Scientific Name	Lower Rabbit Creek	Upper Rabbit Creek
brook silverside	*Labidesthes sicculus*	UC	UC
inland silverside	*Menidia beryllina*	C	C
white bass	*Morone chrysops*	UC	NO
yellow bass	*Morone mississippiensis*	UC	NO
flier	*Centrarchus macropterus*	NO	NO
banded pygmy sunfish	*Elassoma zonatum*	NO	NO
redbreast sunfish	*Lepomis auritus*	UC	UL
green sunfish	*Lepomis cyanellus*	UC	UC
warmouth	*Lepomis gulosus*	C	C
orangespotted sunfish	*Lepomis humilis*	C	C
bluegill	*Lepomis macrochirus*	C	C
dollar sunfish	*Lepomis marginatus*	C	C
longear sunfish	*Lepomis megalotis*	UC	UC
redear sunfish	*Lepomis microlophus*	C	C
spotted sunfish	*Lepomis punctatus*	C	C
bantam sunfish	*Lepomis symmetricus*	UL	UL
spotted bass	*Micropterus punctulatus*	C	UC
largemouth bass	*Micropterus salmoides*	C	UC
white crappie	*Pomoxis annularis*	C	UC
black crappie	*Pomoxis nigromaculatus*	UC	NO
eastern redfin darter	*Etheostoma artesiae*	NO	NO
mud darter	*Etheostoma asprigene*	UC	UC
bluntnose darter	*Etheostoma chlorosomum*	C	C
western sand darter	*Etheostoma clarum*	UL	UL
slough darter	*Etheostoma gracile*	C	C
harlequin darter	*Etheostoma histrio*	NO	NO
goldstripe darter	*Etheostoma parvipinne*	C	C

A = Abundant; C = Common; UC = Uncommon; UL = Unlikely; NO = Will not occur in project area

Common Name	Scientific Name	Lower Rabbit Creek	Upper Rabbit Creek
cypress darter	*Etheostoma proeliare*	C	C
scaly sand darter	*Etheostoma vivax*	UC	UC
bigscale logperch	*Percina macrolepida*	UL	NO
dusky darter	*Percina sciera*	UL	NO
river darter	*Percina shumardi*	NO	NO
freshwater drum	*Alpodinotus grunniens*	NO	NO

A = Abundant; C = Common; UC = Uncommon; UL = Unlikely; NO = Will not occur in project area

TABLE V-4
NUMBER OF SPECIES IN EACH
RELATIVE SPECIES ABUNDANCE CATEGORY

	Lower Rabbit Creek		Upper Rabbit Creek	
Abundant	5	5.9%	4	4.8%
Common	26	31.0%	17	20.2%
Uncommon	28	33.3%	20	23.8%
Unlikely	15	17.9%	13	15.5%
No	10	11.9%	30	35.7%
	84	100.0%	84	100.0%

appears to increase in width, depth, amount of cover, and relative permanence relatively consistently from upstream to downstream areas. The sandy substrate seems consistent throughout. Therefore, the changes in fish species composition and abundance changes gradually as well progressing downstream.

Most East Texas creeks of similar size to Rabbit Creek will have only three to eight abundant species depending upon habitat quality. Rabbit Creek has good water quality but does not possess great habitat diversity. It does, however, historically display monthly median flows reasonably supportive of fish populations. Therefore, the actual numbers of individuals present for abundant and common species could be reasonably high (e.g. toward the high end of the range for each category).

The most notable difference in Table V-4 when comparing the upstream project area and the downstream reaches of Rabbit Creek is that fewer species in each abundance category are likely to be present upstream. Indeed roughly 36% (30 of 84 species) whose range includes the area will not be found in the upstream project area;

however, primarily due to deeper, wider, and more permanent habitat downstream at least 20 additional species could occur in the downstream reach.

Recall that the abundance ranking distributes the species which could potentially occur in the area according to the habitat quality which exists for each in the area.

Generally, if present, an abundant or common species listed in Table V-3 will be the only species present at concentrations of more than 1 or 2 specimens per unit of the area sampled. Therefore, typically one could expect 20 to 30 species to be collected during a baseline survey analysis of the creek. Generally, 2 to 5 species will comprise 75 to 90% of the total catch with the rest being represented by single individuals.

Not surprisingly, Horizon's assessment of the potential fishery (Table V-3) includes minnows, topminnows, and mosquitofish among the abundant species. Those species considered common would be additional minnow species, pirateperch, silversides, sunfish species, and darters. While the foregoing are largely prey or forage species, a few predatory species such as the channel catfish, redfin pickerel, and largemouth bass will be present.

The inundation of the Rabbit Creek will alter the biological community substantially over what exists at present. Stream species will largely be replaced by species which prefer reservoir habitat. The majority of the benthic species which occur in riffle areas and several minnow species will not inhabit the reservoir; however, many of the existing fish and benthic species will be found in much greater concentrations in the reservoir than in the creek.

Rabbit Creek is, at present, subject to large swings in available habitat and large stable populations cannot establish, whereas, the reservoir will provide roughly 575 acres of available habitat on a consistent basis.

A substantial recreational fishery, which does not exist in the creek, will be created. Species such as sunfish, crappie, bass, and channel and yellow catfish will all thrive in the reservoir. Topminnows, mosquitofish, shad, and numerous minnow species will provide the forage species. Carp and spotted gar are also likely inhabitants of the proposed reservoir.

The creek fishery lost in the reservoir area will be more than replaced by the reservoir fishery. It is doubtful that significant use of Rabbit Creek is currently made by migratory species such as white or yellow bass, due to restricted habitat or unpredictable flow. Therefore, it is doubtful that seasonal use for spawning is a factor in the upper portion of Rabbit Creek.

A.5 CULTURAL RESOURCES

A.5.1 Known Archeological and Historical Resources

A records and literature search was performed at the Texas Archeological Research Laboratory, Pickle Research Campus, University of Texas at Austin in December 1996. Examination of the Hope Pond and Kilgore SW 7.5' USGS quadrangles revealed that there are no <u>significant</u> recorded historic or prehistoric cultural resources sites on or within 3 miles of the subject property. From the records it appears that there have been no formal cultural resources surveys conducted within or adjacent to the area of the proposed Rabbit Creek Reservoir.

Further review of modern and historic USGS quadrangle maps revealed no evidence of structures within the pool of the proposed reservoir. A small formal cemetery and one isolated historic grave site are noted on the maps as near, but outside, what will be the flood pool shoreline near the proposed dam site.

While there was some early Spanish and French exploration and settlement in the region there is no indication of such activities near the project area. There is some documentation that historic period immigrant tribes may have been in the area.

Anglo-American settlement began circa the 1830s in this region of Texas, but was mostly along major trails and waterways. The main thrust of settlement near Overton came with the founding of the town in conjunction with the building of the railroad in 1873. The next large period of growth was during the 1920s and 1930s during the oil boom. It is expected that most potential historic sites in the project area will date from the late 1800's to 1930's.

A.5.2 Nearby Recorded Archeological Sites and Surveys

The closest recorded site to the proposed reservoir is 41RK228, which is within 2 miles and was recorded during a 1988 cultural resources survey for Rayburn Electric Co-op by Espey, Huston and Associates. The site was an early 20th Century historic dump site, but was not judged as significant because of its thin deposits that were mixed with later 20th Century trash. Sites 41RK70 and 41SM47 are other nearby recorded resources which are within 6.5 miles of the project boundaries. 41RK70 is evidently a multi-component site containing Paleoindian projectile points (*Folsom and San Patrice*) and potsherds. Site 41SM47 is a small prehistoric scatter of lithic artifacts.

In 1977, 9 to 14 miles to the south of the Proposed Rabbit Creek Reservoir Area, the Archeology Research Program of Southern Methodist University conducted a 2,500 acre sampling survey within what would become the Exxon Coal Troup Lignite Mine (Scott, McCarthy and Grady, 1978). Seventeen sites were located during the survey, ranging from historic standing structures to Late Prehistoric and Archaic sites. Further investigation in the form of a cultural resources survey and testing program on another 33,000 acres was performed by Environment Consultants, Inc. in 1980 and 1981. Two hundred forty-eight sites were located, including 108 historic sites and 46 prehistoric sites. The historic sites span the period 1850 to mid-1900s, and the prehistoric sites include Archaic, Sanders Focus and Frankston Focus components.

A.5.3 Possible Cultural Resources Noted in Literature

Many archeological sites in Northeast Texas have yielded artifacts, primarily dart points, suggestive of Paleoindian (9000-6000 BC) and Archaic (6000-300 BC) occupations. As noted in the section above, Paleoindian and Archaic sites are found in the region of the proposed reservoir, as are Ceramic period (AD 400-1760) sites.

The proposed reservoir lies outside the boundaries of the Hasinai and Kaddohadacho Confederacies. However, it is certainly within the Caddo sphere of influence.

In, *Archeology in the Eastern Planning Region, Texas: A Planning Document*, produced by the Texas Historical Commission, the general region surrounding the proposed Rabbit Creek reservoir is identified as a Critical Resource Zone (CRZ) for archeological information and possible sites associated with "Immigrant

Indian" tribes, such as the Cherokee, Choctaw, Kickapoo, and Shawnee (Kenmotsu and Perttula, editors, 1993). This is because the area was populated during the late 1700s, early 1800s by tribes moving into Texas and the Smith/Rusk County region which was part of an area designated by the Mexican government for the Cherokee Tribe. Immigrant tribes were present until 1839 when the Republic of Texas did not ratify the Cherokee Treaty and the Cherokees and associated tribes were forced out of Texas by military force. The archeology of these immigrant Native American groups is not well known, and thus any sites that can be associated with them, even those with limited integrity, have the potential to provide information valuable to interpreting the past.

There is documentation that a Cherokee village was located on Rabbit Creek 15 miles northwest of Henderson (Woldert, 1938). This would place it very close to the proposed project.

A.5.4 Field Observations

On 6 and 7 February 1997 a field visit to the proposed project area was conducted by Horizon staff archeologist Bert Rader accompanied by Horizon Principal Lee Sherrod. This included a windshield survey of the general area along existing paved and unimproved roads with frequent spot checks of locales to inspect for obvious cultural resources and likely settings for sites, plus a limited non-systematic pedestrian examination of select areas along drainages and upland areas including the proposed dam site.

During the course of the investigation no historic standing structures were observed. The cemetery near El Bethel Church and the isolated grave site of John Barber were located. Both have interments from the late 1800s.

Prehistoric materials were not observed within the project area during the limited pedestrian reconnaissance with the exception of a single piece of quartzite lithic debris and a partial quartzite biface which were observed eroding at mid-slope on the side of the hill where the south side of the proposed dam will tie in. This area has experienced considerable soil disturbance due to past clearing of the area for pasturage, and much of the sandy soils on the slope have eroded.

During transects along the upper branches of Rabbit Creek it was noted that recent alluvium from deposition in historic times may be as deep as 1 meter in places.

Generally, one would not expect to find many prehistoric sites near the origin of a small drainage. Most sites occur on sandy well-drained soils near creeks and rivers, often at confluences, but usually farther downstream. However, sites have been found in this region in contexts similar to those found in the proposed flood pool of Rabbit Creek Reservoir. In the absence of more definitive settlement data for the area, no further predictive statements can be made.

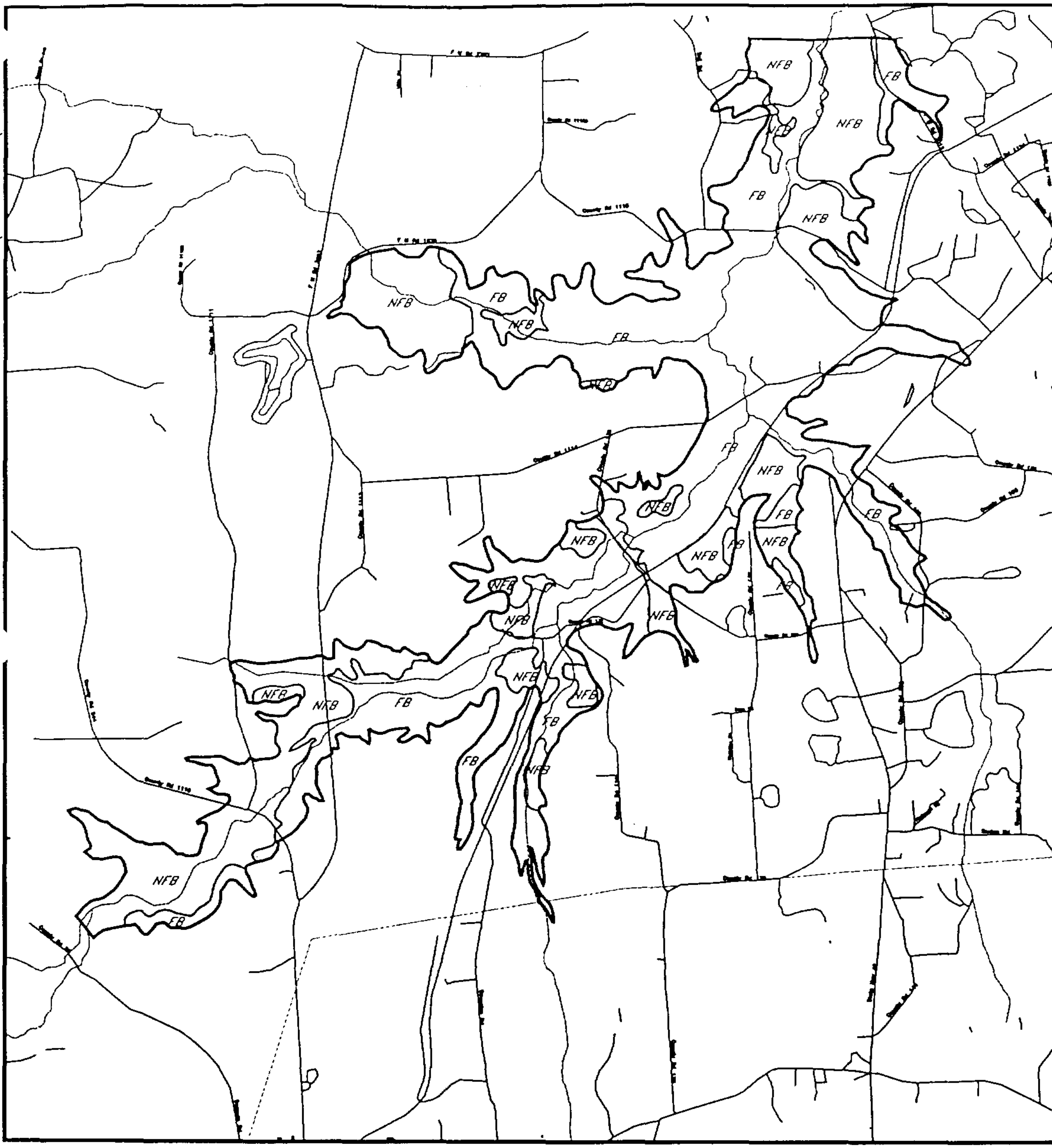
B.0 DOWNSTREAM SEGMENT

B.1 PHYSICAL SETTING

Rabbit Creek flows northeastward through Kilgore to its confluence with the Sabine River approximately 20 miles downstream of the proposed dam site. The downstream flood plain below the proposed dam is generally wide and flat with a braided or multiple flow channel along much of its reach. Numerous intersecting tributaries contribute base flow to Rabbit Creek as well as seepage from the bases of slopes adjacent to the flood plain. Major named tributaries include Little Rabbit, Star, Wilds, Helton, Sandot, Big Caney, Turkey and Peavine Creeks. Two of the larger tributaries, Little Rabbit and Wilds Creeks, intersect Rabbit Creek at approximately 3 and 5 miles downstream, respectively. No significant impoundments are present on Rabbit Creek or its major tributaries below the proposed reservoir.

B.2 TERRESTRIAL ECOLOGY

The flood plain of Rabbit Creek and its major tributaries exhibit a general mix of forested and non-forested land cover characteristics along the reach from the proposed dam to the Rush/Gregg Counties line (approximately 10 miles) (Figure V-3). The majority of forested areas within the flood plain are generally mature hardwood forests. Some areas of mixed pine and hardwood are present, primarily along the edges of the flood plain and on elevated areas. Non-forested areas include grazing pastures, disturbed areas and shrubby habitats. Based on visual reconnaissance efforts of this downstream reach from various road crossings, and analysis of aerial photography, much of the bottomlands are judged to be jurisdictional wetlands.



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LEGEND

FB	Forested Bottomland
NFB	Non-forested Bottomland
FU	Forested Upland
NFU	Non-forested Upland
A	Aquatic

FIGURE V-3
LAND COVER TYPES
DOWNSTREAM CORRIDOR
RABBIT CREEK RESERVOIR
SMITH COUNTY, TEXAS

Horizon
ENVIRONMENTAL SERVICES INC

B.3 INSTREAM FLOW RELEASES AND DOWNSTREAM ECOLOGY

The minimum flow release program for Rabbit Creek Reservoir was developed based upon the most recent TNRCC guidance by the RJ Brandes Co. Those results are presented in Section IV of this report. Table V-5 presents the median monthly flows to be released depending upon the reservoir storage at the time of release. Note that the proposed flows releases will be made on to the extent that such flows are available from reservoir inflows for the corresponding time period. No releases from storage are required by the minimum flow release program to meet a given median, 25th percentile or 7 day, 2 year low flow monthly flow requirement.

The release program displayed in Table V-5 is projected to supply the required yield throughout the planning period.

Additionally, since the reservoir releases will essentially mimic the Rabbit Creek reservoir inflows over time, downstream impacts of water impoundment should be minimized. Furthermore, major contributing creeks to Rabbit Creek begin entering Rabbit Creek within a few miles of the dam. Since approximately 85% of the Rabbit Creek drainage is below the dam, downstream flushes or pulses, while somewhat reduced in the most upstream area should in general mimic naturalized flows in Rabbit Creek (e.g. those flows which would have occurred in the watershed if the dam had not been built) throughout the majority of Rabbit Creek.

Therefore, no serious impact to the downstream fishery or benthic ecology of Rabbit Creek is expected due to reservoir development.

TABLE V-5

PROPOSED RABBIT CREEK RESERVOIR INSTREAM FLOW RELEASES

MONTH	CONCENSUS WATER PLANNING CRITERIA		
	ZONE 1	ZONE 2	ZONE 3
	MONTHLY MEDIAN FLOW cfs	MONTHLY 25^{TH} PERCENTILE FLOW cfs	ANNUAL 7-DAY, 2-YEAR LOW FLOW cfs
January	7.1	4.3	0.06
February	8.5	4.6	0.06
March	8.3	5.2	0.06
April	5.8	3.1	0.06
May	7.1	2.9	0.06
June	3.1	1.7	0.06
July	0.7	0.3	0.06
August	0.5	0.2	0.06
September	0.6	0.2	0.06
October	1.4	0.3	0.06
November	4.2	1.6	0.06
December	3.0	1.3	0.06
ANNUAL	3.5	1.0	0.06

Source: Table IV-1, RJ Brandes Co.

C.0 REGULATORY CONSIDERATIONS

C.1 TNRCC WATER RIGHTS

The impoundment and utilization of the water for Rabbit Creek Reservoir will require a TNRCC permit to appropriate state water (Water Rights Permit). Water rights permits have numerous conditions to protect the rights of other water right holders, the public, and the environment. Provisions to protect other than environmental considerations are discussed elsewhere in the planning report. Water rights permits contain conditions which describe the volume and timing of a continuous downstream release to protect the downstream ecology. Secondly, permit conditions are included regarding the acquisition and maintenance of mitigation lands to offset the ecological impact of reservoir construction. The amount of land and general location will be defined by the permit conditions which stipulate that the Texas Parks and Wildlife Department (TPWD) will review and comment on lands acceptability in fulfilling the requirements.

The above are two major conditions which must be negotiated with the TNRCC, and TPWD for this permit. Similar conditions will be contained in the Section 404 permit with regards to mitigation acreage.

TPWD as part of their review and comments will also require the submittal of a reservoir cleaning plan, development of a public recreation plan for the reservoir, and definition of shoreline access and utilization conditions.

C.2 CORPS OF ENGINEERS SECTION 404 PERMIT

Construction of the dam, impoundment of water and mechanical land clearing within jurisdictional areas will require an individual permit from the US Corps of Engineers (COE). In previous reservoir permitting actions, the COE has requested that a 404 permit application not be filed until the TNRCC water rights procedure is near completion. The 404 permit process may require six or more months to finish from the date a complete application is submitted to the COE. The 404 permit application should detail all relevant aspects of the construction and operation of the proposed reservoir. Any ancillary facilities or activities to the reservoir, such as recreational facilities; water supply intake and treatment facilities; pipeline, transmission line or roadway relocations; and borrow areas for dam fill must be described as part of the project. A large amount of supporting documentation such as engineering and hydrology studies, environmental characterization of the reservoir area and downstream segment, detailed wetland delineation, cultural resources investigation report and other materials is needed to accompany the permit application. Most of the information will have been developed as part of the TNRCC water rights permit process. Other integral pieces of information needed with the permit application include a wetland mitigation plan, an instream flow or minimum release calculation and supporting data and a reservoir clearing plan. Again, much of this information may be developed during the TNRCC water rights permit process. However, the federal permit process opens those aspects to further agency scrutiny as well as public comment. The development of a wetland mitigation plan may become quite involved, perhaps requiring some form of computer aided mathematical evaluation process may take several months to complete. The results of the analyses will indicate the approximate acreage of mitigation required for the project.

Mitigation for reservoir projects usually involves acquisition enhancement, and management of existing bottomland areas for wildlife habitat. The acreage requirement for mitigation may be equal or greater than the amount of impacts of the reservoir. Such areas could be acquired upstream, downstream or in adjacent drainages. Enhancements might involve tree plantings, hydrologic modifications (to make it wetter) or other management techniques to increase wetland habitat values. Since the majority of impacts of the reservoir are going to occur to forested bottomlands, the mitigation will focus on acquisition, enhancement and management of similar habitats. Once the mitigation requirement is determined and the potential mitigation tract or tracts identified, they must be presented along with the application for review. Again, these procedures can and should be addressed during the TNRCC permit process.

The COE cannot issue a permit if any potentially significant cultural resources sites might be adversely impacted. Through Section 106 consultation with the Texas Historical Commission (described below) the COE will determine the requirements for cultural resources testing and mitigation for the project. This will result in a Memorandum of Agreement (MOA) between the COE and Texas Historical Commission. The necessary investigations and development of the MOA can require considerable time to accomplish (many months to a year or more).

C.3 SECTION 106 COMPLIANCE

An intensive pedestrian survey will be required by the Corps of Engineers and the Texas Historical Commission in compliance with the Section 106 of the National Historic Preservation Act and the Antiquities Code of the State of Texas (Texas Natural Resource Code, Title 9, Chapter 191). The areas that will require survey include the flood pool, the area adjacent to the flood pool, all areas to be altered during the project, and all areas permitted for associated development or construction use.

Standard pedestrian survey techniques and limited shovel testing will probably be sufficient for the uplands. Many places are so eroded that the subsoil is exposed on slopes and shovel testing will not be necessary. Vegetative cover is intense over much of the area and the ground is obscured. Surveying should be performed during the winter for best results. Because the recent alluvium in the bottoms is deep, older surfaces may be beyond the reach of shovel tests, and backhoe testing may be necessary. Consideration should be given to conducting backhoe survey and geomorphological analysis in a sampling strategy prior to the pedestrian survey in case certain areas can be eliminated from intensive survey and savings realized.

Examination of land deeds and records in the General Land Office will probably be the most effective way of determining the presence of potential historic sites.

While no existing sites of particular importance have been identified in the projection area, the results of the 100% survey are necessary before one can speculate as to what level of effort might be required during the testing and mitigation phases to resolve any cultural resources questions or concerns.

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VI. SURFACE WATER TREATMENT ALTERNATIVES

A. INTRODUCTION

1. SELECTION OF DEVELOPMENT SCENARIOS

As discussed in Section IV, only one reservoir site was evaluated as a potential source for the planning area. Development of the reservoir in phases would not be economically attractive for such a small project. However, a phased approach to construction of a water treatment plant or the distribution lines is worthy of consideration.

For this planning investigation, only the ultimate developed condition was examined. However, sufficient detailed information is provided to enable subsequent investigation of other development scenarios. Alternate surface water sources are also presented for possible consideration.

2. RESERVOIR SITE

Reservoir sites are typically selected based on the following criteria:

- proximity to water demand location
- potential tributary drainage area
- close proximity of two elevated land masses on each side of the waterway
- minimal obstacles to development (pipelines, utilities, roadways, structures, etc.)

Each of these criteria prove favorable for the proposed location, which is approximately 1.5 miles northeast of the City of Overton as shown on Exhibit 17.

3. TREATMENT ALTERNATIVES

The raw water quality in the proposed reservoir is expected to be typical of East Texas surface water, with the following characteristics:

- low alkalinity
- low hardness
- neutral pH
- variable turbidity (depending on rainfall)
- susceptible to seasonal "turnover" and stratification
- potential for presence of iron and manganese
- organic color due to decaying detritus
- presence of trihalomethane precursors
- potential for tastes and odors

Water softening treatment should not be necessary. Lime and/or caustic addition will be required for alkalinity addition and pH-adjustment. The intake structure should include provisions for varying the intake level to assist in treatment for turbidity, manganese, tastes, and odors. Chemical addition should also be provided at the intake for taste and odor control and to aid in coagulation. Color, turbidity, and iron can be effectively removed with alum as the primary treatment chemical. Short detention time for sedimentation should be avoided due to raw water quality variability. Manganese can be effectively removed by pH-adjustment ahead of dual media filters. Activated carbon should be available for seasonal use to treat for taste and odor. Trihalomethane formation can be avoided by chloramine disinfection. Emerging technologies such as ozonation and membrane filtration should be investigated for possible long-term cost savings. Provisions for disposal of residuals and filter backwash water must be included. Demineralization processes such as reverse osmosis or ion exchange will not be required. A "conventional" surface water treatment plant with alum coagulation, and flocculation, 6-hour detention time sedimentation, dual media filtration, and sufficient clearwell storage to meet disinfectant contact time requirements was selected as the preferred treatment alternative.

B. METHODOLOGY

1. DETERMINING WATER DEMANDS

a. SERVICE AREA DELINEATION

The service area will include the service areas of the eight regional entities as shown on Exhibit 1 and described in Section III.

b. DEMAND PROJECTIONS

As discussed in Section III, the projected demand for the planning area will be 5,675 gpm in 2030, which equates to 8.2 MGD and 9,160 acre-feet per year. Therefore, the proposed reservoir, with a firm annual yield of 3,500 acre-feet per year or 3.1 MGD will serve only to supplement the current ground water sources.

2. HYDROLOGIC EVALUATION OF RESERVOIR STRUCTURE AND SPILLWAY

The selection of the optimum size and height of the structure for the proposed Rabbit Creek Reservoir involves consideration of the optimum size of the conservation pool and the potential for flooding of adjacent properties, as well as the cost of the structure.

The relationship between the quantity of inflows to the reservoir and the maximum available storage volume, particularly with regard to the frequency of flood spills, is of particular importance. If the reservoir storage volume is too great, then flood spills may be too infrequent or entirely eliminated, and the reservoir would be considered to be oversized with respect to the available quantity of inflows. Normally, spills from a reservoir through its primary service outlet structure or principal spillway, which typically has its overflow crest set at or slightly above the elevation of the top of the conservation pool, might be expected to occur about every five to ten years or so. Based on the results from the SIMYLD-IID reservoir operation simulations for the Rabbit Creek Reservoir, the average frequency of spills, expressed as the average number of years between spills, for the three conservation pool levels considered is summarized below:

CONSERVATION POOL LEVEL Feet MSL	AVERAGE NUMBER OF YEARS BETWEEN SPILLS
400.0	3.1
406.0	9.2
410.0	18.3

These results would suggest that the proposed Rabbit Creek Reservoir would appear to be about optimally sized with respect to typical reservoir water supply operations, i. e., it would spill on the average about once every five to ten years, with its conservation pool level set at Elevation 406.0 feet msl.

Another consideration in evaluating the optimum conservation storage capacity of a reservoir relates to the potential for flooding of properties adjacent to the reservoir. Normally, the primary outlet structure or principal spillway, with its crest set at or slightly above the top of the conservation pool, is sized and designed to pass the 100-year flood event. For the proposed Rabbit Creek Reservoir, it has been assumed that the principal spillway would be constructed within the embankment of the dam and would consist of a concrete ogee-type structure with a stilling basin at its downstream toe. Floodwater spills from the reservoir would pass over the crest of the principal spillway and down the ogee slope into the stilling basin. For safely passing floods larger than the 100-year event without overtopping the dam or embankment structure, an emergency spillway, with its crest set at about the maximum water surface elevation of the reservoir when passing the 100-year flood, typically is excavated into natural ground at the abutment of one end of the dam or embankment structure. A profile along the centerline of this type of typical dam structure, with its associated spillway facilities, is shown on Figure VI-1 in Exhibit 16.

The critical elevation that determines the maximum design height to which flood waters are allowed to rise in a reservoir during the occurrence of the maximum design flood typically is considered to be the lowest elevation of an existing critical structure that must not be flooded because of safety reasons or the potential for significant damage. In the case of the proposed Rabbit Creek Reservoir, the minimum slab elevation of an existing wastewater lift station located northwest of the City of Overton, at 422.25 feet msl, has been determined to be the critical elevation with regard to the hydraulic design of the principal and emergency spillways. Hence, the size (length) of these spillways must be adequate to allow passage of the maximum design flood through the reservoir without causing the water level of the reservoir to rise higher than 422.25 feet msl so as to avoid flooding of the lift station.

Establishing the length of the principal and emergency spillway crests and their respective elevations, as well as, the top of the dam structure or embankment involves performing hydrologic and hydraulic flood routing analyses of the reservoir for different design flood events. As indicated above, the 100-year flood event is the basic design flood for determining the size (length) of the principal spillway and the crest elevation of the emergency spillway. The discharge capacity of the emergency spillway is determined based on the design flood event stipulated in the Dam Safety rules of the TNRCC (Chapter 299, 30 TAC). These rules specify the minimum design flood hydrograph for dams as functions of the height of the dam structure, the volume of water stored in the impoundment created by the dam, and the level of risk associated with the loss of life and property damage downstream in the event of dam failure due to overtopping. Assuming that the top of the proposed Rabbit Creek Dam will be set about 15 to 20 feet above the top of the conservation pool, the total height of the structure then will be on the order of 50 to 60 feet, since the elevation of the existing stream channel at the site of the proposed dam is about 370 feet msl. For a dam with this height and with a reservoir storage capacity on the order of 10,000 acre-feet (see Figure IV-9 in Exhibit 15), the Size Classification of the proposed structure is "Intermediate" according to the TNRCC's rules. Based on development conditions downstream of the proposed dam site, i. e. for five miles or so, the appropriate TNRCC Hazard Potential Classification appears to be "Significant". The "Significant" Hazard Potential Classification category refers to dams that are usually located in "predominantly rural areas where failure would not be expected to cause loss of life, but may cause damage to isolated homes, secondary highways, minor railroads, or cause interruption of service or use (including the design purpose of the facility) of relatively important public utilities". According to the TNRCC rules, then, the minimum design flood event for the emergency spillway of the proposed Rabbit Creek Dam is between the one-half probable maximum flood and the full probable maximum flood for the subject watershed. By definition, the probable maximum flood is the flood magnitude that may be expected from the most critical combination of meteorologic and hydrologic conditions that are reasonably possible for a given watershed. For purposes of this planning investigation, the two-thirds probable maximum flood event has been adopted as the maximum design flood for sizing the emergency spillway of the proposed Rabbit Creek Dam.

For performing the necessary hydrologic and hydraulic flood routing analyses for determining and evaluating the required spillway designs, the Corps of Engineers' HEC-1 Flood Routing Package (September 1990) computer program has been utilized and applied to the Rabbit Creek Reservoir watershed and impoundment. As stated in the HEC-1 User's Manual, *The HEC-1 model is designed to simulate the surface runoff response of a river basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component models an aspect of the precipitation-runoff process within a portion of the basin, commonly referred to as a subbasin. A component may represent a surface runoff entity, a stream channel, or a reservoir. Representation of a component requires a set of parameters which specify the particular characteristics of the component and mathematical relations which describe the physical processes. The result of the modeling process is the computation of streamflow hydrographs at desired locations in the river basin.*

Standard procedures and methodologies have been employed in applying the HEC-1 rainfall-runoff model to the Rabbit Creek watershed upstream of and including the proposed Rabbit Creek Reservoir. The overall watershed, which encompasses approximately 11.72 square miles, has been represented in the model as a single runoff-producing subwatershed unit. Procedures and methods previously developed by the National Resource Conservation Service (NRCS), formerly the U. S. Department of Agriculture Soil Conservation Service (SCS), and outlined in Technical Release No. 55 ("Urban Hydrology for Small Watersheds"; June, 1986) have been applied to describe certain hydrologic processes and to estimate certain hydrologic parameters, including rainfall losses (Curve Number approach) and the subwatershed time of concentration. The NRCS synthetic unit hydrograph method has been used to construct runoff hydrographs for specified rainfall amounts corresponding to different magnitude storm events with specified rainfall distributions.

Soil types and land use conditions within the Rabbit Creek Reservoir watershed have been examined to establish an appropriate SCS curve number for describing rainfall losses, i. e., infiltration, surface retention, etc. For this purpose, the "Soil Survey of Smith County, Texas" (1993) has been used to establish specific soil types and their hydrologic group classifications. The SCS hydrologic group classifications provide an indication of the relative amount of runoff to be expected from a given amount of rainfall on a particular soil type. There are four hydrologic group classifications, i. e., A, B, C and D, with the A classification indicating a soil with a high rate of infiltration and low runoff potential and the D classification indicating a soil with a very slow rate of infiltration and high runoff potential. The general soil unit referred to as Lilbert-Darco-Tenaha covers practically the entire Rabbit Creek watershed upstream of the proposed reservoir site. These are generally sandy soils with a loamy subsoil that occur on gently sloping to moderately steep terrain. The Lilbert soils, with a B hydrologic group classification, occur primarily on broad interstream divides; the Darco soils, with an A hydrologic group classification, are found on the slightly higher convex ridges, and the Tenaha soils, also with a B hydrologic group classification, are located on side slopes above drainageways. Most of the land in the watershed is used for pasture, with some limited cropland, or is covered with hardwood and pine forests. Based on a detailed analysis of the specific acreages of individual soil types and land uses within the watershed, the area-weighted average

SCS curve number for the overall watershed has been determined to be 70. This value applies to average antecedent moisture conditions (AMC-II). For wet soil conditions (AMC-III), the corresponding curve number value is 85. The AMC-III curve number, which reflects more extreme hydrologic conditions, has been used for sizing both the principal and the emergency spillways.

The time of concentration for a given watershed is defined as the time required for a particle of water (runoff) to travel from the most remote point in the headwaters of the watershed to the discharge point of the watershed, i. e., to the proposed dam site for the Rabbit Creek Reservoir. The time of concentration is a fundamental input parameter for simulating the runoff behavior of a watershed, particularly as runoff varies with time in response to varying rainfall amounts during the occurrence of a storm event. For determining an appropriate value of the time of concentration for the Rabbit Creek watershed upstream of the proposed dam site, the SCS TR-55 procedures have been applied. The travel path has been divided into 300 feet of sheet flow, 2,100 feet of overland surface flow, and 23,000 feet of channelized flow, and the corresponding average value of the time of concentration has been determined to be 2.3 hours.

Statistical rainfall amounts for different storm magnitudes (frequencies of occurrence) and durations for the Rabbit Creek watershed have been determined based on information contained in the Texas Department of Transportation's "Hydraulics Manual" (Smith County regression equations) and the NOAA National Weather Service's "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian", Hydrometeorological Report No. 51 (all season 10 square-mile curves). A summary of these rainfall amounts is presented in the following table.

STORM MAGNITUDE	STORM DURATION Hours	RAINFALL AMOUNT Inches
100-Year Event	2	5.4
100-Year Event	3	6.1
100-Year Event	6	7.4
100-Year Event	12	9.0
100-Year Event	24	10.8
Probable Maximum	6	31.0
Probable Maximum	12	37.2
Probable Maximum	24	43.4
Probable Maximum	48	48.5
Probable Maximum	72	51.5

In accordance with TNRCC procedures for evaluating dam safety, the time distribution used in analyzing and sizing the proposed spillways corresponds to a standard distribution developed by the SCS as presented in Figure 2-6C of the SCS report titled "Earth Dams and Reservoirs" (1985). This distribution provides intense critical rainfall conditions that are important for conservatively determining the required capacity of spillway structures.

Based on previous reservoir operation simulations from the SIMYLD-IID model, the elevation of 406 feet msl has been used as the optimum level of the conservation pool for the Rabbit Creek Reservoir. With this normal non-flood maximum pool level set, the crest of the principal spillway also has been established at this same elevation. Using these fixed principal spillway crest conditions, the HEC-1 flood routing model has been operated to simulate the passage of the 100-year flood through the reservoir for three different lengths of principal spillway, i. e., 50 feet, 100 feet and 150 feet. These simulations have been made assuming a twelve-hour storm duration, which previously has been determined to be the critical storm duration for the Rabbit Creek Reservoir and watershed, i. e. it is the duration that produces the maximum stage in the reservoir for the 100-year storm event. The purpose of simulating the behavior of the reservoir for the three principal spillway lengths was to evaluate the sensitivity of the reservoir to principal spillway length and to provide a range of 100-year flood stage levels for establishing the crest elevation of the emergency spillway. The results of these simulations are plotted on Figure VI-2 in Exhibit 16. As shown, depending on the length of the principal spillway within the limits analyzed, the maximum stage of the reservoir for the 100-year flood ranges from about elevation 410.2 feet msl up to approximately 411.4 feet msl.

To investigate the potential flooding impacts of the proposed reservoir based on the adopted maximum design storm, i. e., the two-thirds probable maximum flood, additional flood routing simulations using the HEC-1 model have been made for the same three principal spillway crest lengths analyzed above. For these analyses, two different lengths of the crest of the emergency spillway have been assumed; simulations have been made for a 300-foot spillway and a 500-foot spillway. For these simulations, the elevation of the crest of the emergency spillway has been set equal to the maximum 100-year flood level of the reservoir corresponding to each of the three principal spillway lengths as simulated above and as plotted in Figure VI-2 of Exhibit 16. The resulting maximum flood levels of the reservoir from the HEC-1 simulations of the two-thirds probable maximum flood also are plotted on the graph in Exhibit 16 for both the 300-foot and the 500-foot emergency spillway lengths. As indicated on the plot, the critical flood level of the existing wastewater lift station located northwest of the City of Overton, at elevation 422.25 feet msl, is not threatened by flooding from the reservoir with either the 300-foot or the 500-foot long emergency spillway for any of the principal spillway lengths analyzed. Hence, the 300-foot long emergency spillway should be more than adequate for dam safety purposes. A 200-foot long spillway probably would be sufficient; however, the final selection of the spillway length should be made after more detailed investigations. Since a 300-foot long emergency spillway will be adequate, it was used for cost estimating purposes. The emergency spillway length will have little effect on overall reservoir cost.

The final selection of the lengths of the principal and emergency spillways should be made taking into consideration the relative construction costs of the various combinations that satisfy the basic flooding criteria. Generally, the length of the concrete ogee-type principal spillway within the embankment of the dam should be the minimum required to pass the 10-year flood with the emergency spillway of the corresponding required length to prevent overtopping during the design storm. For these purposes, the height of the embankment used to form the proposed dam structure should be assumed to be a minimum of three feet above the maximum water surface elevation of the reservoir as simulated with the HEC-1 model for the maximum design storm, i. e., the two-thirds maximum probable flood. For cost estimating purposes, a principal spillway length of 150 feet was assumed in order to include some conservation in the overall reservoir estimated cost. Likewise, as shown in Exhibit 17, the emergency spillway crest was assumed at 2 feet higher than necessary and the dam crest was assumed at approximately 10 feet higher than necessary, based on other curves in Exhibit 16, Figure VI-2.

3. EVALUATION AND SIZING OF TREATMENT PLANT AND SYSTEMS

a. TREATMENT PLANT

A conventional water treatment facility was used for the purpose of estimating costs for this planning investigation. The selected treatment process would produce water of adequate quality to meet current State and Federal drinking water quality goals. A design capacity equal to the safe yield of the reservoir was selected for planning purposes. The actual plant capacity will depend on subsequent analysis of the regional demands and the level of participation among the regional entities.

A schematic diagram of the 3.1 MGD treatment facility is presented in Exhibit 18. It would be a conventional type plant and would include the following:

- raw water intake pumping station
- static/rapid mix structure
- sedimentation basin(s)
- filtration structures and pipe gallery
- 0.5 MG clearwell
- filter backwash tank and pumps
- high service pump station
- wastewater ponds
- laboratory/administration/chemical building(s)

- chemical feed systems for alum, polymer, taste and odor control, chlorine, lime, caustic, activated carbon, and ammonia
- sitework
- electrical
- instrumentation and controls
- yard piping

b. DISTRIBUTION SYSTEM

Based on water demand projections, the full yield of the reservoir would not be needed unless existing ground waters supplies were relegated to standby service. However, for planning purposes, the regional distribution (transmission) lines were sized to carry the ultimate flow capacity of 3.1 MGD on a prorated basis to the various service areas. A peaking factor of 4.0 was used to size the various lines. Approximately 281,200 linear feet (53 miles) of pipeline of different sizes would be required for the planning area, as shown on Exhibit 19. Pipe would either be PVC conforming to AWWA C-900, Class 350 ductile iron, or concrete lined steel cylinder. Pipe sizes would range from 10" to 18" in diameter.

Pipeline routes were selected to coincide with public roadways to minimize the need for easement acquisition. The lines were extended to existing storage tank locations within each of the eight service areas so that upgrade of existing distribution lines within the service area would not be necessary.

4. ESTIMATING CAPITAL COST

Costs associated with construction of the proposed reservoir on Rabbit Creek, the raw and treated water pump stations, the 3.1 MGD water treatment facility, and the regional water distribution system are presented in detail in Exhibit 20. All costs are presented in 1998 dollars. These costs can be expected to increase at a rate of 3.5-4.0 percent per year.

a. The capital costs for the reservoir are estimated to be:

Dam & Spillway	$ 4,539,000
Raw Water Intake Structure	675,000
Clearing	100,000
Road Relocation	500,000
Contingencies	872,000
Land Acquisition & Mitigation	2,250,000
Professional Services	1,399,000
TOTAL RESERVOIR & INTAKE	**$10,335,000**

b. The capital costs for the water treatment facility are estimated to cost $1.66 per gpd of treatment capacity. This would include:

- raw water transmission line
- all treatment process components
- clearwell storage
- service pumps
- operations buildings
- professional services

The 3.1 MGD plant is estimated to cost $5,146.000.

c. The capital costs for the distribution system to deliver treated drinking water to the existing distribution systems of the eight regional entities are estimated to be:

Pipeline Construction (9 segments)	$ 8,472,000
2 MG Elevated Storage Tank	2,200,000
Contingencies	1,600,000
Professional Services	1,119,000
TOTAL DISTRIBUTION SYSTEM	**$13,391,000**

Land acquisition costs were not included.

C. ALTERNATE WATER SOURCE

1. CITY OF TYLER

The City of Tyler currently has surface water rights for 40,325 acre-feet per year (36 MGD) in Lake Tyler and Lake Tyler East. The City also has a contract to purchase up to 67,200 acre-feet per year (60 MGD) from the Upper Neches River Municipal Water Authority which owns Lake Palestine. In addition to its surface water sources, the City has 12 water wells with a total capacity of 11.1 MGD. These three sources amount to an available water supply capacity of 107.1 MGD or 119,957 acre-feet per year. The City's current use averages only 18 MGD, with peak demands of up to 36 MGD.

The possibility of delivering treated water at a rate of up to 3.1 MGD was discussed with City of Tyler staff. It was agreed that a pump station located at the Golden Road WTP in Tyler would be the best way to serve the planning region. Approximately 125,000 linear feet of 24" diameter pipeline would be required. The proposed pipeline route was selected along public rights-of-way, as shown in Exhibit 21.

Since this alternative appeared more likely than the other three described below due to the close proximity of the planning region to Lake Tyler East, cost opinions were developed for this alternative. The capital cost for this alternative is presented in Exhibit 22. Including pipeline construction, pump station, easement acquisition, and professional services, the cost would be approximately $11,000,000.

The City has recently completed a cost-of-service study which recommended a wholesale water rate structure. City officials have indicated a willingness and capability to make a long-term commitment to supply water to the planning area. City staff have stated that a rate of $1.50-2.00 per thousand gallons could be used for planning purposes, not including debt service and O&M costs for the delivery system. Capital costs for this alternative would be:

Tyler Delivery System	$ 11,000,000
Regional Distribution System	13,400,000
TOTAL	$ 24,400,000

Additional costs for this alternative are detailed in Exhibit 22.

2. SABINE RIVER AUTHORITY (SRA)

As discussed in Section II, the SRA currently owns a pumping station which delivers raw water from the Sabine River to the cities of Henderson and Kilgore. Authority staff has stated that a similar arrangement would be available to the planning region from the same pump station. The SRA only has ownership rights to 0.149 MGD of water available for sale above the planning region. However, it has the authority to sell water reserved for use by the City of Dallas as described below.

Costs were not developed for this alternative because the distance would be greater than from Tyler' Golden Road WTP, and a treatment plant and distribution system would still be required. The SRA currently charges a maximum rate of $0.20 per thousand gallons to its other raw water customers. A list of these customers for the portion of the basin above the planning region is included as Exhibit 5.

3. CITY OF HENDERSON

The City of Henderson is currently constructing a raw water supply main from the SRA pumping station north of Kilgore to a proposed surface water treatment plant east of Henderson. The Henderson city manager has stated that the City of Henderson was not in the position to make any long-term commitments to supply water to the planning area.

4. CITY OF KILGORE

The City of Kilgore has recently completed a cost of service study[9], which recommends a wholesale rate of $2.55 per thousand gallons for treated water.

The City has a new 3.5 MGD surface water treatment plant for treating Sabine River water. In addition, it has nine wells with total capacity of 5 MGD which are used to supply peak demands. The City's current average consumption is 2.5 MGD, and its peak demand is 5.3 MGD. The City has current obligations which prevent it from making a long-term commitment to supply treated water to the planning area.

5. CITY OF DALLAS

The City of Dallas has a purchase contract with the SRA for 131, 860 acre-feet per year (118 MGD) of water in Lake Fork, of which 11,860 acre-feet cannot be transferred out of the Sabine basin. A price for this water has not yet been established. Total yield of Lake Fork is 188,660 acre-feet per year. The City has ownership position in Lake Tawakoni but, according to SRA officials, no excess water is available from it. The contract between Dallas and SRA for Lake Fork water stipulates a 50-year renewable term. The first term will end in 2013. The SRA is the authorized agent to sell water from Lake Fork on behalf of the City of Dallas. For this service, SRA receives a 5% commission.

The City of Dallas performs a cost of service analysis every year which stipulates wholesale water rates. The most recent study recommended a "noninterruptable" rate of $0.4238 per thousand gallons. This rate is over twice the maximum rate that the SRA is currently charging to other raw water customers for water from the Sabine River. For this reason, costs were not developed for this alternative either.

6. UPPER NECHES RIVER MUNICIPAL WATER AUTHORITY (UNRMWA)

The UNRMWA owns and operates Lake Palestine. According to UNRMWA officials, sufficient water is available to supply the projected long-term needs of the planning area. Also, the Authority would be willing to finance, own, and/or operate the entire regional system A firm raw water cost was not available from the Authority, but $0.18-0.20 per thousand gallons could be expected. Due to the long distance of the lake from the planning area, costs were not developed for this alternative.

VII. GROUNDWATER TREATMENT ALTERNATIVES

A. GROUNDWATER AVAILABILITY

The availability of groundwater as a public drinking water source in and around the planning area has been studied extensively in the past.[3,4,5,6,23,24]

The two most recent reports contain the most relevant information to our planning area, which is in the northern portion of the study area of the 1991 report.[23]

These previous reports generally concluded that a sufficient quantity of water to meet projected needs is available from the Carrizo and Wilcox aquifers underlying the planning area. Also, the quality of groundwater is generally acceptable for drinking water purposes. Relatively high concentrations of dissolved iron, dissolved solids, sulfate, and chloride are occasionally encountered. Water quality data for the public wells in the planning area are summarized in Exhibit 9.

Problems with decline in well capacities are often due to the one or more of the following factors rather than to insufficient recharge capacity of the aquifers:

- too many wells in too small of an area (i.e., inadequate spacing)
- seasonal fluctuations in recharge rates
- improper construction methods which lead to premature failure of the well
- poor well and pump maintenance

Preston and Moore[23] concluded that "there are still large amounts of water available from the Carrizo-Wilcox aquifer throughout most of the area, in fact enough to supply most of the water for all projected uses."

A recent study for the Liberty City WSC[8] revealed that wells located near the Smith-Rusk County line in the planning area were susceptible to contamination by oil field brines. Depths to the aquifer tend to increase both east and west of the county line, and groundwater quality tends to improve. Well yields and water quality tend to be better to the west than to the east.

Existing well logs reveal that the Carrizo sand can be expected at depths of 300-400 feet, and the Wilcox sands are encountered at depths of 600-1,000 feet in the planning area. However, past test holes by the City of Overton failed to locate any suitable Wilcox sand up to 1,000 feet deep. This suggests that the better quality Wilcox aquifer may be present in "fingers" or isolated, linear beds under the planning area, making the need for test holes critical when attempting to locate a new well site. The Carrizo sand, however, appears to be consistently present in all well logs. These observations are consistent with the explanations of the area's geology reported in the literature.[23]

The City of Overton has one well completed in the Carrizo sand. Its quality is poor with high dissolved iron and low pH indicative of water from Queen City sands. The City is equipped to treat this well water for pH, iron, and sulfide. However, it is currently out of service due to an excess decline in capacity, and its continued use by the City is questionable. Its other two wells produce good quality water from the deeper Wilcox sands, but with occasional color and odor problems. Treatment is performed by overdosing with chlorine.

Jackson WSC treats two of its five wells for sulfide odor by overdosing with chlorine. Liberty City WSC treats for color and sulfide odor with excess chlorine. It is considering the use of ozone for color treatment of its new well. The new well also has high concentrations of bicarbonate and sodium. Dissolved solids concentrations are slightly in excess of 1,000 mg/l.

Well capacities in the planning area are presented in Exhibit 23. The extreme northern, southern, and central portions of the planning area appear to offer the worst well sites. The eastern wells should not be expected to produce more than 200 gpm, and the western wells should not be expected to produce more than 350 gpm. Due to the redundancy issues discussed in Section III C. 2. for meeting peak demands, consideration should be given to the construction of two smaller capacity wells instead of a single large capacity well.

B. SELECTION OF TREATMENT ALTERNATIVES

1. GENERAL

Treatment of groundwater in the planning area may be needed for individual wells. Treatment may be needed for removal of color, iron, and hydrogen sulfide and for pH adjustment. Treatment to lower dissolved solids may be feasible in the cities with sanitary sewage collection systems in which to dispose of brine water. However, it is not feasible for remote well locations due to the large amount of brine generated by demineralization processes. Any treatment required for a particular well location can be determined after completion of a test hole. Test hole costs can vary from $10 to $90 per foot of depth, depending on how much information is desired upon completion of the test hole.

2. COLOR

Color can be caused by the presence of dissolved metals such as iron and manganese which precipitate out of solution upon contact with air. However, color is often caused by contact of the groundwater with organic deposits within the formation, such as lignite. Organic color cannot be removed by filtration. The most common treatment for organic color is with a strong oxidant such as ozone. Liberty City WSC effectively treats for color with chlorine. However, a longer contact time is required than with ozone.

3. IRON

Iron removal can be achieved by preaeration, filtration, ion exchange, softening, chemical clarification and filtration, oxidation, and chlorination. Lower concentration of iron up to 0.5 mg/l can be effectively managed by use of a sequestering agent such as sodium tripolyphosphate. Careful feeding of a sequestering agent at proper dosages will keep the iron in solution and thus nonobjectionable. Higher concentrations of iron, however, must be removed. The most common method of iron removal is by preaeration/aeration followed by filtration since iron precipitates after exposure to air.[16] Iron exists in soluble Fe^{+2} or insoluble Fe^{+3} oxidation states. Soluble iron is in a reduced form and is the dominant state in groundwater because of the lack of oxygen.[17] Therefore by oxidizing the Fe^{+2} state to Fe^{+3}, the insoluble iron will be easily removed by filtration. The most commonly used oxidizing method is aeration. Aeration methods can be achieved by fine bubble, medium bubble, coarse bubble or mechanical aeration. Filtration of the insoluble Fe^{+3} can be achieved by gravity or pressure filters. A single sand filter is preferred over a dual media filter for iron removal because the full media depth should be utilized. Iron filters will not develop the large head loss common to turbidity filters. Hence, backwash based on time interval is usually preferred to backwash based on head loss. Much more frequent back washing is required for filters removing iron than for filters removing turbidity. Backwash wastewater will amount to 15-25% of treated water.

4. LOW pH

Most groundwater contains dissolved gases derived from natural sources. Those involved in the normal geochemical cycle of groundwater include the atmospheric gases: carbon dioxide (CO_2), oxygen (O_2), and nitrogen (N_2). Others derived from underground biochemical processes include the gases methane (CH4) and hydrogen sulfide (H_2S).[16] The presence of H_2S or CO_2 will react with groundwater to create an acidic water. Acidic water can be defined as having a pH of numerically less than 7. To increase the pH in water, caustic soda (NAOH) or lime ($Ca(OH)_2$) will have to be added. The chemical reactions are as follows:

$$H_2CO_3 + Ca(OH)_2 = CaCO_3 + 2H_2O$$
$$H_2CO_3 + 2Na(OH) = Na_2Co_3 + 2H_2O$$

5. HYDROGEN SULFIDE

Three methods of treating hydrogen sulfide are preaeration, oxidation, and chlorination. The most common method used is aeration. Feeding excess amounts of chlorine is also common, however, aerating should prove more economical in most cases. Hydrogen adsorption by powered or granular activated carbon has also been used to remove hydrogen sulfide. Ozone, if used for color removal, will also remove hydrogen sulfide.

C. ESTIMATING CAPITAL COSTS

1. WELL LOCATIONS

In order to meet projected demands, only four of the eight entities would need to construct additional wells. The locations would be selected based on the considerations of quality and quantity discussed above, after an exploratory test hole investigation. Additional wells would be recommended as follows:

Entity	Additional Wells
Jackson WSC	1 @ 100 gpm
City of Overton	1 @ 100 gpm
Liberty City WSC	2 @ 350 gpm
West Gregg WSC	2 @ 300 gpm

The locations were arbitrarily selected with consideration given to adequate spacing and proximity to the existing systems. The proposed wells are shown on Exhibit 23.

2. TREATMENT NEEDED

Based on the above discussions regarding water availability and quality issues, it was assumed that the Overton and Liberty City wells would require treatment. The other wells, however, were assumed to only be provided with disinfection as required for all wells in Texas.

3. DISTRIBUTION SYSTEM

Each new well will have to be connected to the existing system with a transmission line. The length and size of the line depends on the well location and the topographic elevations. In order to serve new customers from the transmission line, each new well was assumed to include a storage tank, pressure tank, and service pumps.

4. OPINION OF PROBABLE COST

Detailed cost opinions for the groundwater alternative based on the above assumptions are presented in Exhibit 24. The total annual cost associated with this alternative would be approximately $1,000,000 per year, including debt service, operation, and maintenance costs.

VIII. OVERALL EVALUATION AND RECOMMENDATIONS

A. EVALUATION OF ALTERNATIVE SCENARIOS

1. ALTERNATIVE A – Rabbit Creek Reservoir

This alternative would supply treated water to the eight regional entities by construction of the proposed reservoir on Rabbit Creek, a 3.1 MGD water treatment facility, and a regional distribution system. Proposed improvements are shown in Exhibits 17, 18, and 19 and associated costs are presented in Exhibit 20. A capacity of 3.1 MGD was selected for comparison of alternatives because (1) that is the safe yield of the proposed reservoir and (2) that is still less than future needs. Therefore, existing ground water supply, storage, and distribution facilities would need to remain in service to meet future needs.

The water provided would be in most cases of superior quality to the groundwater currently being supplied. The environment would be impacted to a greater degree than with the other alternatives, as discussed in Section V. The yield of the reservoir would be sufficient to meet the needs of the region well into the future and might serve to enhance the economic diversity being sought for the region. This alternative presents the greatest risk due to unforeseen cost factors associated with State and Federal permitting, environmental mitigation, cultural resources, land acquisition, and potential for litigation.

2. ALTERNATIVE B – Purchase Treated Water

This alternative would supply treated water to the eight regional entities by construction of a pump station and treated water main from the City of Tyler's Golden Road WTP to a regional storage facility near the proposed reservoir location. Proposed improvements are shown in Exhibit 21, and associated costs are presented in Exhibit 22.

The pump station and proposed 24-inch diameter transmission main were sized for 3.1 MGD average flow with a peaking factor of 4.0 MGD. If this assumed peaking factor were reduced to 2.0 MGD, the required pipe size could be reduced to 18-inch diameter. However, a capacity of 3.1 MGD was selected in order to achieve an equitable comparison with Alternative A.

As discussed in Section III, the region only needs an additional 1.2 MGD to meet 2030 demands projections. This minimum required future need is important when considering reserve capacity and minimum take requirements which would be addressed in any purchase contract with the City of Tyler.

With this alternative, a regional distribution system would still be required. The costs are presented in such a manner that the effect of removing one or more entities from the regional system can also be evaluated. However, all eight entities were assumed to be served so that an equitable comparison of the alternatives could be made. The regional needs would be easily met with superior quality water as in Alternative A. The environmental impact would be only that associated with construction of the pipelines. In addition to debt service and O&M costs, this alternative has the additional cost component of purchase price of treated water.

3. ALTERNATIVE C – Ground Water

This alternative would not require a regional approach. Each of the eight entities would continue to function as separate, autonomous entities. Future supply needs would be met by the construction of six additional wells, including treatment facilities, storage tanks, pump stations, and transmission lines. Proposed well locations are shown on Exhibit 23. These locations are completely arbitrary but are near the four systems where needs are projected. Associated costs are presented in Exhibit 24.

This alternative would eliminate the need for a regional distribution system, because the water is already distributed underground. There will be no significant improvement in water quality under this alternative. Economic development benefits would be minimal or nonexistent. Environmental impacts would also be minimal.

4. COST COMPARISONS OF ALTERNATIVES

Opinions of probable costs for the three alternatives, including capital, operation and maintenance components, are presented in Exhibits 20, 22, and 24. These costs for all three alternatives would be in addition to the current costs being experienced throughout the region. The existing water wells, tanks, pumping facilities, and distribution systems would still need to be operated and maintained. Although Alternative C is not a regional water supply alternative, its costs are presented for comparison of ground water with surface water supply sources.

A comparison of costs for the three alternatives would be summarized as follows:

	ALTERNATIVE		
	A	**B**	**C**
Capital Costs	$ 28,872,285	$ 24,399,234	$ 8,532,019
Annualized Cost of Improvements (Includes debt service at 6% and 20 years plus O&M costs.)	$ 3,228,487	$ 2,240,963	$ 1,076,655
Cost Per Thousand Gallons (Based on 3.1 MGD usage for Alternatives A & B and 2.16 MGD usage for Alternative C. *See notes.*)	$ 2.85	$ 1.98	$ 1.37
Purchase Price Per Thousand Gallons (*See notes.*)	N/A	$ 1.50 – 2.00	N/A
Total Cost Per Thousand Gallons	$ 2.85	$ 3.48 – 3.98	$ 1.37

Notes: 1. Only 2.16 MGD usage used for Alternative C because that is the maximum capacity of improvements for ground water supply.
2. N/A = not applicable.
3. Range of $1.50 – 2.00 per thousand gallons for treated water from City of Tyler for Alternative B.

The rates required to generate sufficient revenue to meet the annualized cost for the various alternatives would depend on actual water usage and to what extent existing well supplies were used. Curves are presented in Exhibit 25 for Alternatives A and B which enable estimation of the cost of water depending on how much of that water is actually produced. Obviously, the more water treated and sold, the lower the cost. At any usage rate, however, Alternative C represents the least cost alternative of the three.

For additional comparison purposes, the current rate structures of the three participating entities result in the following charges per thousand gallons based on usage of approximately 10,000 gallons of water per customer:

City of Overton	$ 3.40
Jackson WSC	$ 4.08
Liberty City WSC	$ 3.21

These existing rate structures will need to be increased for all three alternatives.

B. CONCLUSIONS

The least cost alternative for meeting the water supply needs of the region is the ground water alternative. This is true even if significant treatment of ground water is necessary to render it suitable for public use. The cost for developing and supplying additional ground water is less than half the cost of surface water. The main reason for the much lower cost for Alternative C is the $13.4 million savings for not having to construct a regional distribution system.

Even though the cost of Alternative A is higher than the cost for Alternative C, Alternative A does offer an additional benefit in that it provides a new water source, and the existing water wells could be used as an alternative source or emergency backup system. This would provide needed redundancy and reliability to the planning region. As discussed in Section III, surface supply systems are typically more reliable than ground water supply systems. Alternative A would also provide a more superior and consistent water source in quality than the existing groundwater sources for the City of Overton and Liberty City WSC.

If excess capacity for backup were provided by constructing redundant facilities, then the cost for Alternative C could be more comparable to the cost for Alternative A. However, it would still be less than the unit cost for Alternative A, even at maximum usage. Curves are presented in Exhibit 25 to show how the cost would increase for Alternatives A and B at usage rates less than 3.1 MGD.

Should a regional system be pursued, each of the eight entities should retain enough personnel and equipment to maintain their own distribution system, backup wells, tanks, pumps, and meters. A portion of the O&M could possibly be performed more economically by a single regional crew than by eight separate crews.

Should conditions change within the region or should the regional entities change, then either of the two surface water alternatives may prove more attractive. For example, purchasing treated water from the City of Tyler may be more economical than constructing additional water wells for Jackson WSC due to its closer proximity to the City of Tyler than the other seven entities. Also, industrial water needs and recreational uses may present opportunities for subsidizing the cost of Rabbit Creek Reservoir. For these reasons, issues regarding formation of a regional water supply system are presented in Section IX. Also, charts are presented in Exhibit 25 for evaluating the use of ad valorem tax revenue to reduce required water rates at various use rates.

C. RECOMMENDATIONS

For the purpose of domestic water supply to meet the population growth needs of the planning region, it is recommended that additional water wells be constructed even if treatment of the ground water is necessary. The Wilcox aquifer is the preferred ground water source due to its superior water quality. However, abundant supply is also available in the Carrizo aquifer. Ground water from the Carrizo and Wilcox aquifers can be accessed, treated if necessary, and distributed in the planning region more economically than surface water. The reliability of existing ground water supply systems should be improved by construction of redundant facilities such as standby wells, excess storage and pumping facilities, and treatment facilities.

IX. INSTITUTIONAL AND LEGAL CONSIDERATIONS AND FINANCIAL PLAN

A. INSTITUTIONAL AND LEGAL CONSIDERATIONS

1. RIGHT OF WAY AND LAND ACQUISITION

Right of Way and land required for the alternative projects can be acquired by all of the owner/operator options being considered. There are no jurisdictional conflicts with the reservoir site or pipeline routes into the project area. Land acquisition will pose no developmental problems for any of the alternatives.

2. WATER RIGHTS

There are no senior water right holders adversely affecting the proposed reservoir. There is no jurisdiction affecting ground water in the project area. Water provided by third parties may have trans basin (interbasin transfer) considerations or other legal impediments to providing service.

3. ISSUES RELATING TO OWNERSHIP AND MANAGEMENT OF THE REGIONAL SYSTEM INCLUDING THE RESERVOIR

A variety of entities including political subdivisions and non-profit corporations have been considered for utilization within the project area.

a. City
A City has all necessary authority to act as project sponsor and owner and to be a regional provider of treated and/or untreated water to project participants and other contracting entities. A sponsoring city should have a favorable bond rating and be in sound financial condition in order to minimize interest rates. If water is purchased from an existing surface supply, this option would offer fewer advantages when compared with the other options. Financing options would be more limited than found in option b. Other project participants would have limited input regarding project management.

b. Water District
A Water District created under Chapter 51 of the Texas Water Code and Article XVI, Section 59 of the Texas Constitution has all the powers and authority described in option a. above. This type of conservation and reclamation district has other broad authority to provide regional services. This type of district would have the most alternatives for financing of a project. This type of district could issue tax supported bonds and levy maintenance taxation with voter approval. Representation of the board of directors could be crafted to reflect equity of participating entities. This type of district would have the broadest authority available and could provide full service, operation and maintenance for all alternatives being considered in this study. The dormant Smith/Rusk WCID could be used as is or by amending its enabling legislation as desired.

c. Special Utility District (SUD)
A SUD created by converting an existing Water Supply Corporation (WSC) could be used as project sponsor and owner. A SUD's powers and authority are almost as broad as a WCID. The principal, and most significant, difference is that a SUD is prevented by law from levying ad valorem taxes or accepting revenue from other entities derived from taxation. A special district mirroring the powers and limitations of a SUD could be created by special legislation should one of the participating WSC's not choose to convert. The Canyon Regional district is an example of a legislatively created SUD-like district.

d. Water Supply Corporation
One of the existing Water Supply Corporations, or a newly organized WSC, could serve as project sponsor and owner. The powers, authority and financing options would be more limited than any of the options discussed above. A WSC is not a tax exempt entity and does not have access to some of the subsidized loan programs enjoyed by the cities and districts.

e. River Authority
With virtually all of the proposed service area being in the Sabine River basin the Sabine River Authority (SRA) could sponsor and own a regional project. Financing options would be more limited, and local control of the project might be jeopardized under this option. The SRA would be a feasible sponsor for the reservoir alternative only.

f. Other
Other cities and districts providing service, such as the City of Tyler or the Upper Neches River MWA, can also provide service, sponsor, and own a regional system. These two entities would not likely be interested in the reservoir alternative. Service from their existing projects would also require authorization for trans basin diversion. Local control would be sacrificed under this option. Financing options would also be more limited.

4. INTER-GOVERNMENTAL CONTRACTING METHODS

All of the owner/operator options presented above could be used for some or all of the alternatives being studied. There is no limitation of any of the project participants for contracting for the purchase of untreated or treated water. The most preferred contracting option is a water purchase agreement and contract pledging revenue for debt service and operation and maintenance of the project(s). A "take or pay" contract can fully finance a project with revenues derived from rate payers. There are few if any limitations for contracting on any of the project participants.

5. REGIONAL WATER SUPPLY IMPLICATIONS

The principal benefit to be realized by a regional project is the shared cost of development. Lower unit costs should be realized through regional development and supply. More favorable treatment by regulatory authorities is also likely. Financing options are greater, and more favorable terms may be available. The State of Texas encourages cities, districts, and other utilities to develop regional solutions whenever and wherever possible.

B. FINANCIAL PLAN

1. PROJECTED REVENUES

A review of revenues derived from "in-place" service rates will not service debt and provide operation and maintenance funding. All alternatives providing additional supply will require rate increases for all project participants.

2. FUNDING MECHANISMS

Depending on the ownership and management option selected, a regional project could be funded by long-term debt secured by customer water rates, ad valorem taxes, or a combination of the two sources. Revenues secured from the levy of a tax supporting a general obligation issue can have the least effect on water rates within the region.

If the Chapter 51 water district project owner and sponsor is selected, the participants will have available the passage of a general obligation bond issue or a combination general obligation/revenue issue. This will require voter approval but should result in the most favorable rating of bonds. Other funding programs, including those available through the Texas Water Development Board, for certain components of the preferred alternative may be available.

A pure revenue bond issue can be used to finance the project with or without participation by a third party (i.e. Texas Water Development Board or others). This option will result, most probably, in greater debt service cost to the participants. This option may be preferred if taxation, or the potential for taxation, is determined not to be viable.

Water purchase agreements with third party service providers can also finance a project without the issue of debt by the participants. Overall increase in cost and lack of control over water rates are issues of concern for this option.

3. COMPARISON OF PROJECT FUNDING ALTERNATIVES

In order to evaluate and compare funding alternatives using tax-supported revenue, estimates of taxable values within the region were made. The estimated taxable value in the proposed project area is $473,000,000.[25] Current mineral values and homestead exemptions are included in this estimate.

It should be noted that mineral values have been declining in recent years and are expected to continue this downward trend. Property values, on the other hand, have been increasing.

In order to achieve an equitable comparison of alternatives, a consistent annual average usage must be assumed. The usage will affect the O&M portion of project costs but will not affect the debt service portion. For Alternative A, debt service accounts for over 75% of project costs. For Alternative B, debt service accounts for over 90% of project costs, excluding the treated water purchase price. For Alternative C, debt service accounts for 60-70% of project costs.

Funding entirely by tax revenue is not realistic for water projects because of the need to collect for a portion of the costs on a usage-dependent basis. The debt service portion of costs, however, could reasonably be funded by either tax revenue or customer water rates. Since actual usage would initially be much less than the ultimate regional usage of 3.1 MGD, Exhibit 25 presents water rates required to meet the annualized costs for Alternative A and B at varying water usages. If water rates can be subsidized with ad valorem taxes, then the water rates required to meet debt service and O&M requirements will be reduced. Thus, Exhibit 25 also shows how required water rates will be affected by varying tax rates, and vise versa, for combined tax and revenue funding.

At one extreme, if the project were to be funded entirely by tax revenue, then the tax rate for each alternative based on the above estimated tax base would be as follows:

Alternative		Maximum Tax Rate (per $100 valuation)
A -	Rabbit Creek Reservoir (@ 3.1 MGD)	$0.68
B -	Purchase Treated Water (@ 3.1 MGD + $1.50–2.00 per thousand gallons)	$0.49
C -	Ground Water	N/A

Conversely, if the project were to be funded entirely by revenue from water sales, then water rates would have to be structured to generate the following additional revenues:

Alternative	Maximum Increase in Water Rate (per 1,000 gallons)
A - Rabbit Creek Reservoir (@ 3.1 MGD)	$2.85
B - Purchase Treated Water (@ 3.1 MGD)	$3.48 – 3.98
C - Ground Water (@ 2.16 MGD)	$1.18

X. WATER CONSERVATION PLANNING

A. PLAN ELEMENTS

1. EDUCATION AND INFORMATION

During summer time, the utility bills for both electric and water/sewer are typically high and can be of concern to the public in general. The water/sewer portion of the utility bill is often a small percentage of the total utility bill, consequently the attention is focused on the electric portion. Education and information on water conservation planning would increase the awareness of the public to the need for and financial impacts of water conservation.

Education methods consist of flyers, press releases in local newspaper, media release on evening news and radio talk shows, and water conservation presentation in junior high and high schools by environmental groups. The contents of the flyers should contain information on incremental water and sewer rates and water conservation. Guidelines for municipal water conservation and drought contingency planning and program developments are available from the TNRCC and TWDB.

Flyers should be mailed out six times the first year and twice in subsequent years. For the maximum impact the press release, media release, and water conservation presentation should coincide with the first mail out.

New customers should be made aware of the water conservation plans by providing them with a fact sheet and brochures similar to the mailouts.

2. WATER RATE STRUCTURES

a. CITY OF OVERTON

RESIDENTIAL RATE:

- Minimum monthly charge of $13.00 for first 3000 gallons.
- Overage billed at $3.00 per thousand gallons.

Cost of 10, 000 gallons = $34.00 Total.

b. JACKSON WATER SUPPLY CORPORATION

RESIDENTIAL RATE

- Monthly minimum for first 1000 gallons is $13.75/month.
- 2000 gallons - 5000 gallons is $2.75 per 1000 gallons.
- 5000 gallons - plus is $3.25 per 1000 gallons.

Cost per 10, 000 gallons = $40.82 Total.

c. LIBERTY CITY WATER SUPPLY CORPORATION

RESIDENTIAL RATES

- Monthly minimum for first 2000 gallons is $12.06/month.
- 2000 Gallons - 10, 000 gallons is $2.50 per 1000 gallons
- 10, 000 gallons - 20, 000 gallons is $2.50 per 1000 gallons
- 20, 000 gallons - plus is $3.00 per 1000 gallons.

Cost per 10, 000 gallons = $32.06 Total.

3. UNIVERSAL METERING

All the Cities and water supply corporations should meter all of their customers and have a program to conduct periodic testing of meters. State guidelines recommend yearly testing for 1" meters or larger, and every 10 years for smaller meters. If and when the need arises in the future due to water shortages, individual meters may be required and necessary in lieu of master meters for multiple users.

4. LEAK DETECTION AND REPAIR

Periodic water balance provides an indication of potential water loss in the distribution system. The amount of water purchased by each entity plus the estimated amount for fire protection and line flushing should be equal to the amount of water produced. The difference would be the potential amount of water loss.

Two methods of discovering leaks in the distribution system is by:

a. Complaints from customers that they are experiencing unusually low pressure.

b. Water appearing on the ground from a leaking water main.

Repairs should be performed in accordance with TNRCC Rules and Regulation for Public Water Systems as found in Chapter 31 TAC 290.46 (g), including disinfection.

5. IMPLEMENTATION AND ENFORCEMENT

a. EDUCATION AND INFORMATION

Should be implemented by utility personnel under supervision of the City or General Manager, with possible assistance from the utility's consulting engineer.

b. WATER RATE STRUCTURE

The City Council or Board of Directors will enact the ordinances or otherwise vote to establish the new water rate structure, providing for increasing block rates if needed in the future, and setting the appropriate rate schedules. Enforcement powers include termination of water services.

c. **UNIVERSAL METERING AND LEAK DETECTION**
Should be implemented and monitored by utility personnel under supervision of the City or General Manager. Leaks should be eliminated immediately upon detection.

d. **LEAK DETECTION**
This is an ongoing process which is the responsibility of all personnel, members, Board, Council, and Citizens. Assistance is available from the TWDB and private companies to locate hard-to-find leaks.

e. **PLUMBING CODES**
The governing authority will enact the necessary plumbing code revisions, with enforcement by the utility's plumbing inspector. Enforcement powers could include termination of water services.

6. REVIEW AND EVALUATION

The water conservation program should be reviewed annually or bi-annually to determine the effectiveness of the program. All of the five parameters mentioned in Section 5 should be examined and revised to meet the existing needs.

Any foreseeable changes in the supply or demand, and any changes in state regulations should also be considered as part of the review.

7. WATER CONSERVING LANDSCAPING

Because of the high rainfall in the study area there is no need for special landscaping requirements. If in the future when the need arises due to drought conditions, the customers may be made aware of lawn watering restrictions.

8. PRESSURE CONTROL

The elevation in Wright City WSC area is approximately 370 feet, compared to 500 feet near the City of Arp. The remaining areas are relative uniform in elevation, and there is not a need to divide the study area into more than one pressure plane.

9. RECYCLING AND REUSE

Recycling water is generally only feasible within the region for commercial users such as car washes.

Reuse of treated wastewater effluent is more acceptable in arid and semi arid areas. Domestic reuse of treated effluent is not encouraged because of the potential of cross-connections with potable water sources, hygiene concerns from potential pathogens, and the abundance of conventional supplies.

Reuse of filter backwash water should be considered, especially for iron removal filters. However, most existing water treatment plants in the vicinity do not reuse backwash water due to problems with chemical dosage control.

Irrigation is not considered feasible for treated effluent because of the extensive amount of land required, low soil permeability, and high annual rain fall. Much of the land is too hilly for irrigation to be practical without extensive terracing. Tailwater control is a problem due to high annual rainfall.

Potential users of treated effluent are golf courses and industrial users like electric utility companies which require a substantial amount of water for cooling. Any new construction of waste water treatment plants should include provisions for using treated effluent for wash down purposes, lawn irrigation and any other usage that does not require potable drinking water quality.

10. RETROFIT PROGRAM

Mandatory retrofit programs should be limited to the following instances to avoid any financial hardship on the customer:

i. Replacement of plumbing due to wear, damage, remodeling, or modernization.
ii. Displacement devices in toilets tanks (where practical).
iii. Low flow showerheads (where they can be readily installed).

11. PLUMBING CODES

Each entity should adopt a plumbing ordinance which includes water conservation measures. The population growth in this area is projected to increase by 40 percent. In addition many older homes may be abandoned or demolished within the planning period and will be replaced by new residential construction. Also many existing homes may undergo modernization or replacement of fixtures within design period. Therefore, conservation measures in new construction could save a fairly significant amount of water after 20 years.

B. ANNUAL REPORTING

Each entity should prepare and submit annual reports to the TWDB, TNRCC, and other interested parties in order to take advantage of technical and financial assistance available to public water utilities. Guidelines, requirements, and formats for reporting are available from TWDB.

XI. DROUGHT CONTINGENCY

A. TRIGGER CONDITIONS

1. GOAL OF POLICY

The Governing Authority for the Rabbit Creek Reservoir shall be the sole authority to notify the Cities and Water Supply Corporations of the need to implement their own drought contingency plans.

Guidelines must be created in advance to clearly define which drought condition is being experienced; Mild, Moderate or Severe.

2. FOCUS OF EMERGENCY MEASURES

In the event of a water supply emergency, one of the following goals shall be adopted:

a. Keeping existing supply and/or distribution systems operative.

b. Preventing further loss or contamination of water.

c. Controlling or restricting usage in order to conserve water.

d. Preventing public health problems which could result from a contaminated water supply.

e. Obtaining alternate sources of water.

3. BASIS FOR TRIGGER CONDITIONS-GENERAL

A systematic approach must be developed for the basis for trigger conditions. This could be due to quantitative reasons such as a drought condition or qualitative reasons such as contaminated water conditions.

4. SOURCES OF SUPPLY

Groundwater is the primary source of water supply for each entity and should be used as a secondary source of water during drought and emergency conditions, should one of the surface water alternatives be implemented.

5. STORAGE AND PRESSURE MAINTENANCE

A summary of storage facilities for each City and Water Supply Corporation is presented in Exhibit 8.

6. DISTRIBUTION

A single pump station at the Rabbit Creek Water Treatment Plant would be designed to distribute water to all entities through a pipe network. Each entity would then have its own system to store and distribute throughout its separate system.

7. STANDBY POWER

Standby generators should be included as a component of the raw water pump station and the Water Treatment Plant. All entities should have a backup power source, whether on ground water or surface water systems.

8. GENERAL CONSIDERATIONS

Other considerations that have to be considered which would disrupt service are as follows:

a. WATER SUPPLY
Contamination of surface water at the reservoir or contamination of the ground water aquifer.

b. WATER TRANSMISSION.
Transmission line breaks, between the service pumps and the entities.

c. STORAGE
Structural failure in the elevated and ground storage tanks.

d. SERVICE AND BOOSTER PUMPING
Equipment failure due to water hammer, poor O&M practices, or fatigue.

e. DISTRIBUTION SYSTEM
Major line breaks; heavy demands for fire fighting; contamination.

9. MILD CONDITIONS

Water demand is approaching the safe capacity of the system on a sustained basis.

10. MODERATE CONDITIONS

Water demand occasionally reaches safe limit of the system (two days within a 30 day period).

11. SEVERE CONDITIONS

Water demand is exceeding safe capacity on a regular basis (five consecutive days).

12. TERMINATION OF EMERGENCIES

Authorized Water Authority must use judgement as to whether to upgrade, continue, downgrade, or discontinue an emergency.

B. DROUGHT CONTINGENCIES MEASURES

1. MILD CONDITIONS

Authorized Water Authority must notify all entities of their forecast and projection of water supply that a low level emergency has been reached. Each entity should attempt to notify all the customers through all the methods described earlier in the water conservation planning.

2. MODERATE CONDITIONS

Authorized Water Authority must notify all entities of their forecast and projection of water supply that a mid level emergency has been reached. Each entity should attempt to notify all the customers through all the methods described earlier in the water conservation planning.

3. SEVERE CONDITIONS

Authorized Water Authority must notify all entities of their forecast and projection of water supply that a level of emergency has been reached. Each entity must notify all the customers through all the methods described earlier in the water conservation planning. Impose rationing if appropriate. In the case of contamination, warn customers to use bottled water for drinking and cooking (or to purify water before use), if appropriate.

C. INFORMATION AND EDUCATION

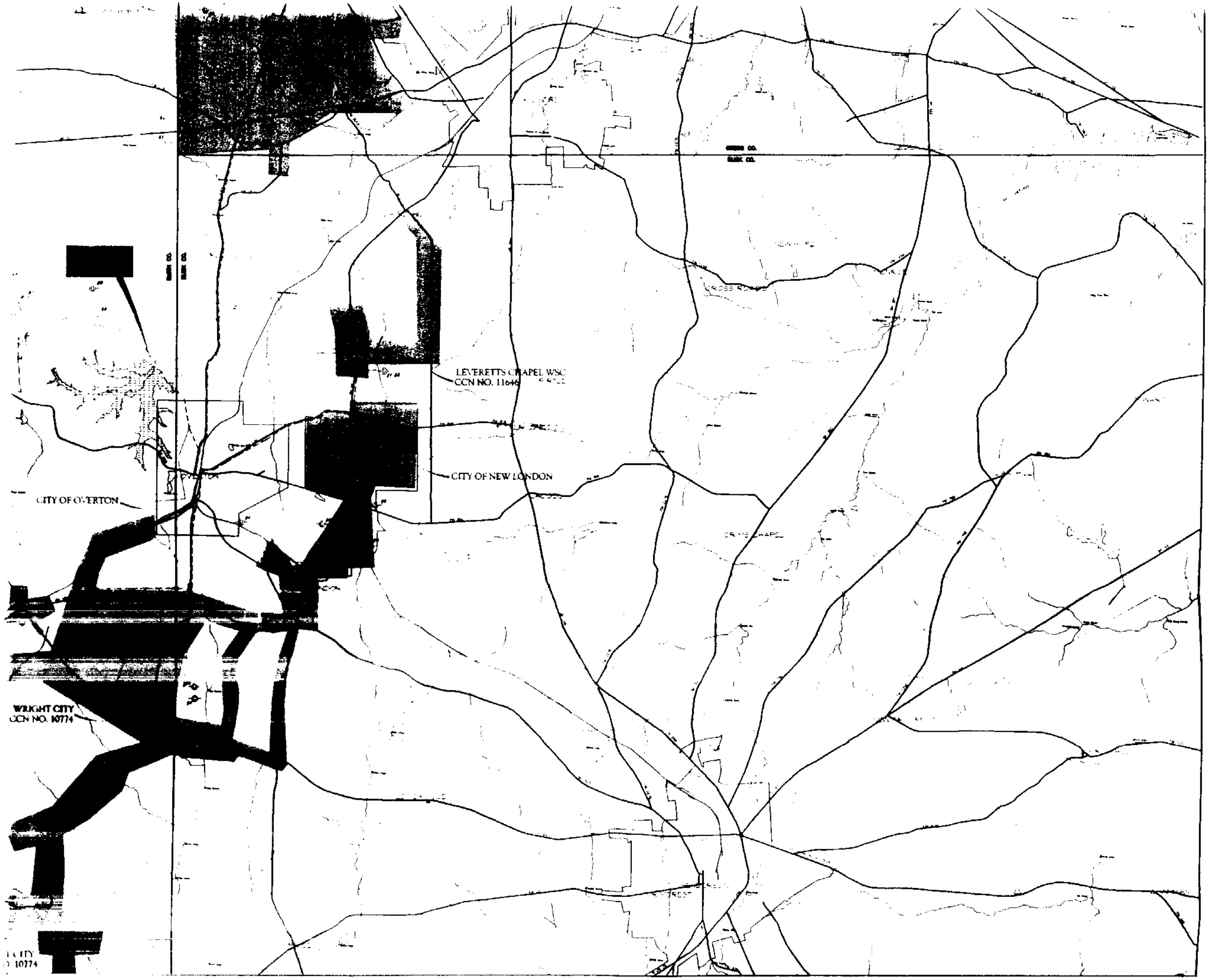
Authorized Water Authority should adopt similar approach for public education and information as described in detail in Water Conservation Plan.

D. INITIATION PROCEDURES

1. Responsibility for Monitoring
2. Authority for Action
3. Procedures for Implementation
4. Advance Planning

XII. LIST OF EXHIBITS

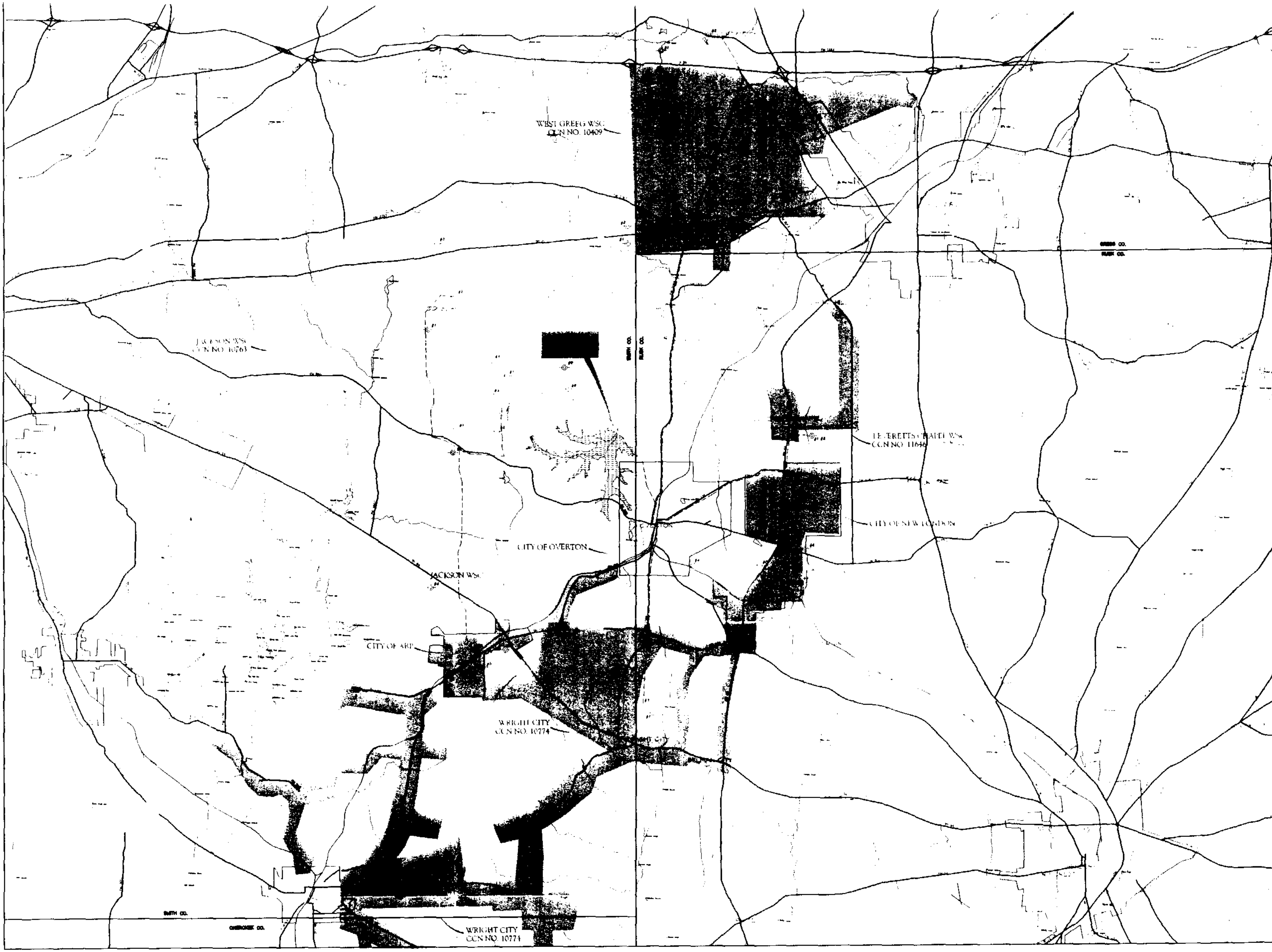
26	Population Estimates (1990 – 1996) by State Data Center Population and Consumptive Water Demand Forecast by TWDB
27	TWDB Executive Administrator's Comments



REGIONAL WATER STUDY
PLANNING AREA MAP/CCN'S AND WATER DISTRIBUTION SYSTEM

10000 5000 0 10000 20000

BURTON & ELLEDGE, INC.
Environmental/Civil Engineers


WEST GREGG WSC
CCN NO. 10409
JACKSON WSC
CCN NO. 10763
SMITH CO.
RUSK CO.
GREGG CO.
RUSK CO.
LEVERETTS CHAPEL WSC
CCN NO. 11646
CITY OF NEW LONDON
CITY OF OVERTON
JACKSON WSC
CITY OF ARP
WRIGHT CITY
CCN NO. 10774
SMITH CO.
CHEROKEE CO.
WRIGHT CITY
CCN NO. 10774

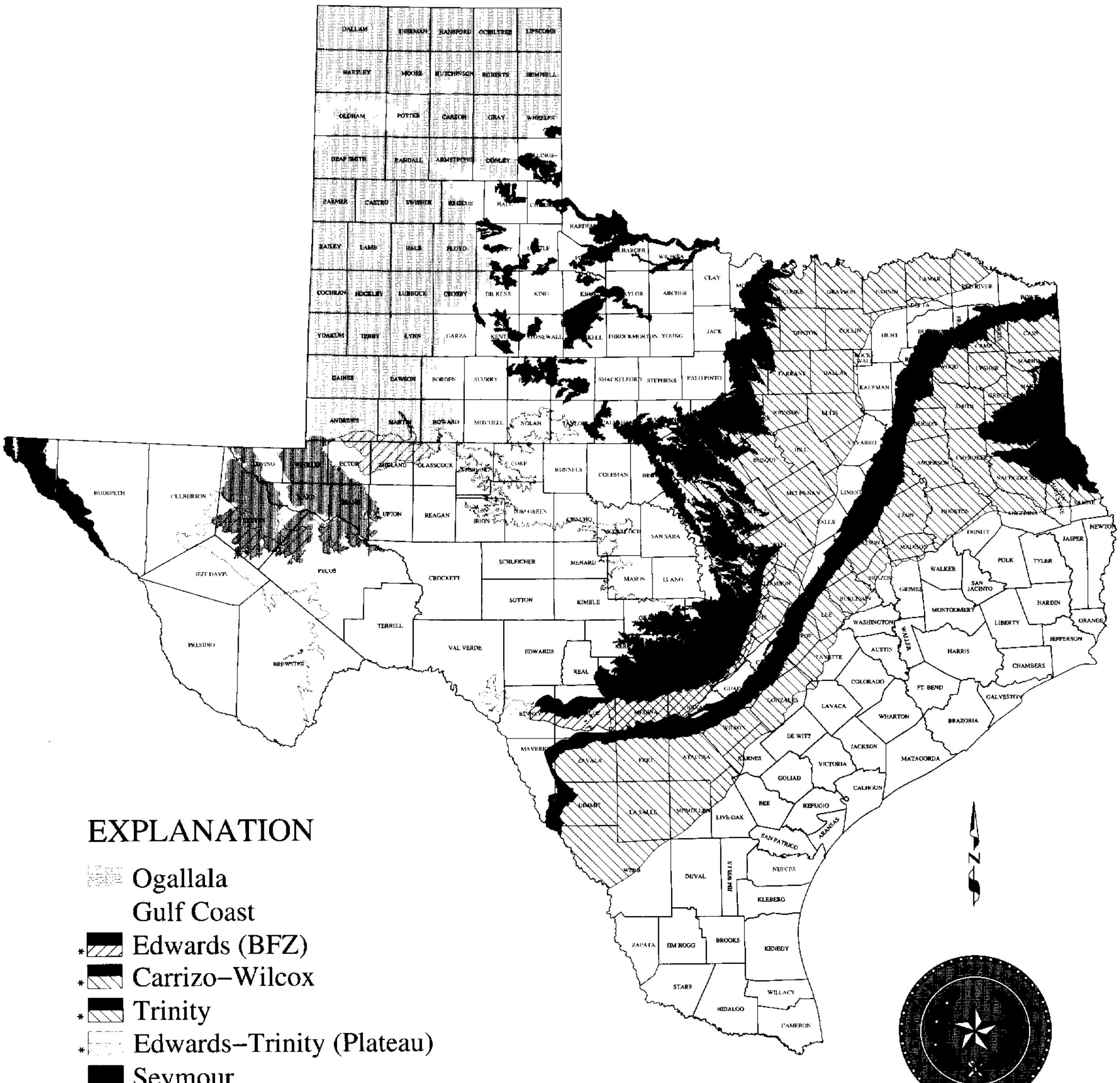
AVERAGE MONTHLY PRECIPITATION VS
AVERAGE MONTHLY GROSS LAKE SURFACE EVAPORATION RATE
1950-1979

EXHIBIT 2

MONTHS	PRECIPITATION (INCHES)	EVAPORATION (INCHES)
January	3.5	2
February	3.5	2.25
March	3.5	3
April	5	3.5
May	5	4.25
June	4	5.5
July	3	6.5
August	2	7.25
September	4	5.5
October	3	4.75
November	3.5	3.5
December	3.5	2.75

Source: Texas Department of Water Resources, "Climatic Atlas of Texas", December 1983.

MAJOR AQUIFERS OF TEXAS



EXPLANATION

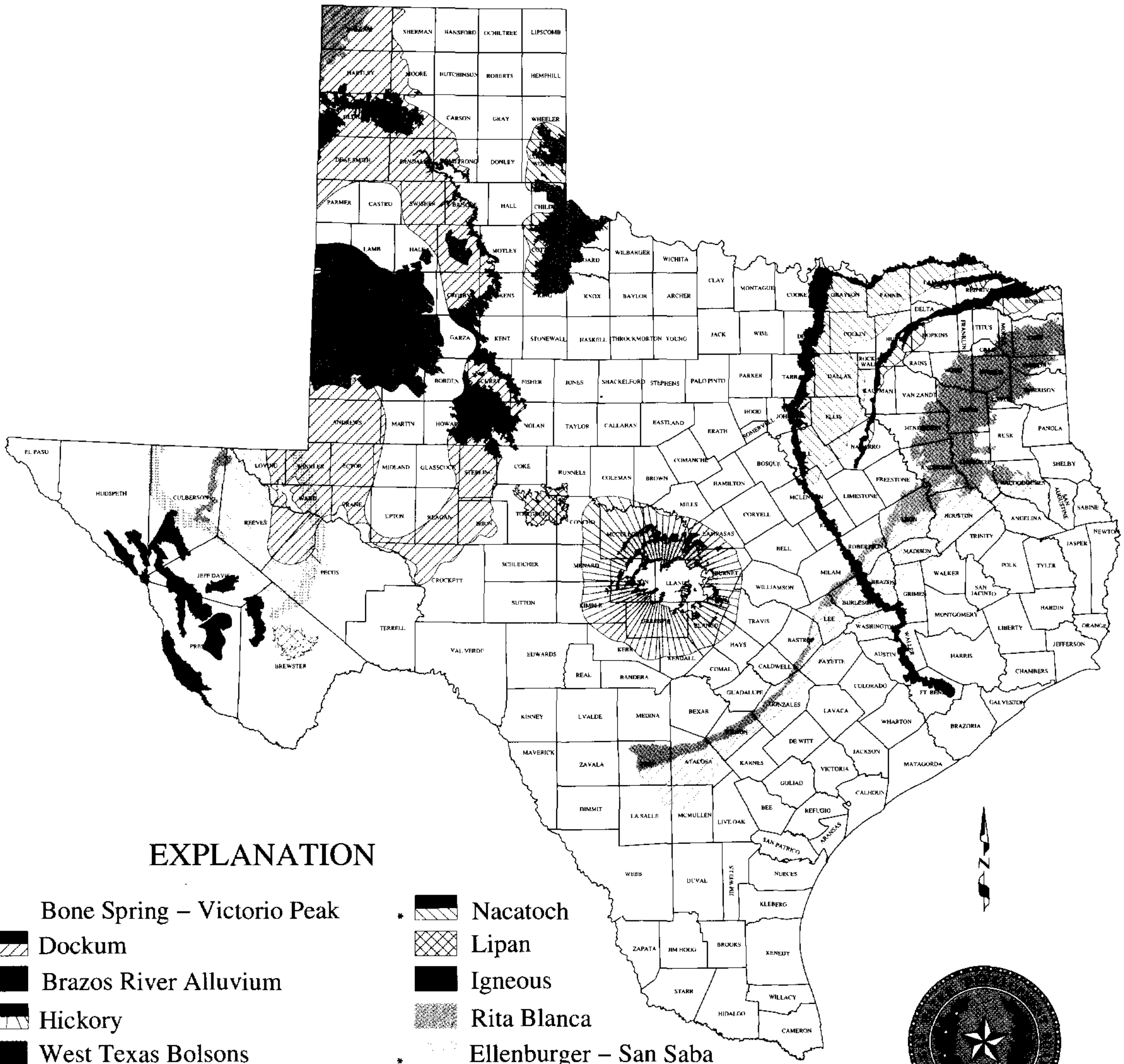
- Ogallala
- Gulf Coast
- * Edwards (BFZ)
- * Carrizo–Wilcox
- * Trinity
- * Edwards–Trinity (Plateau)
- Seymour
- Hueco–Mesilla Bolson
- Cenozoic Pecos Alluvium

OUTCROP (That part of a water-bearing rock layer which appears at the land surface.)

* DOWNDIP (That part of a water-bearing rock layer which dips below other rock layers.)

January 1994

MINOR AQUIFERS OF TEXAS



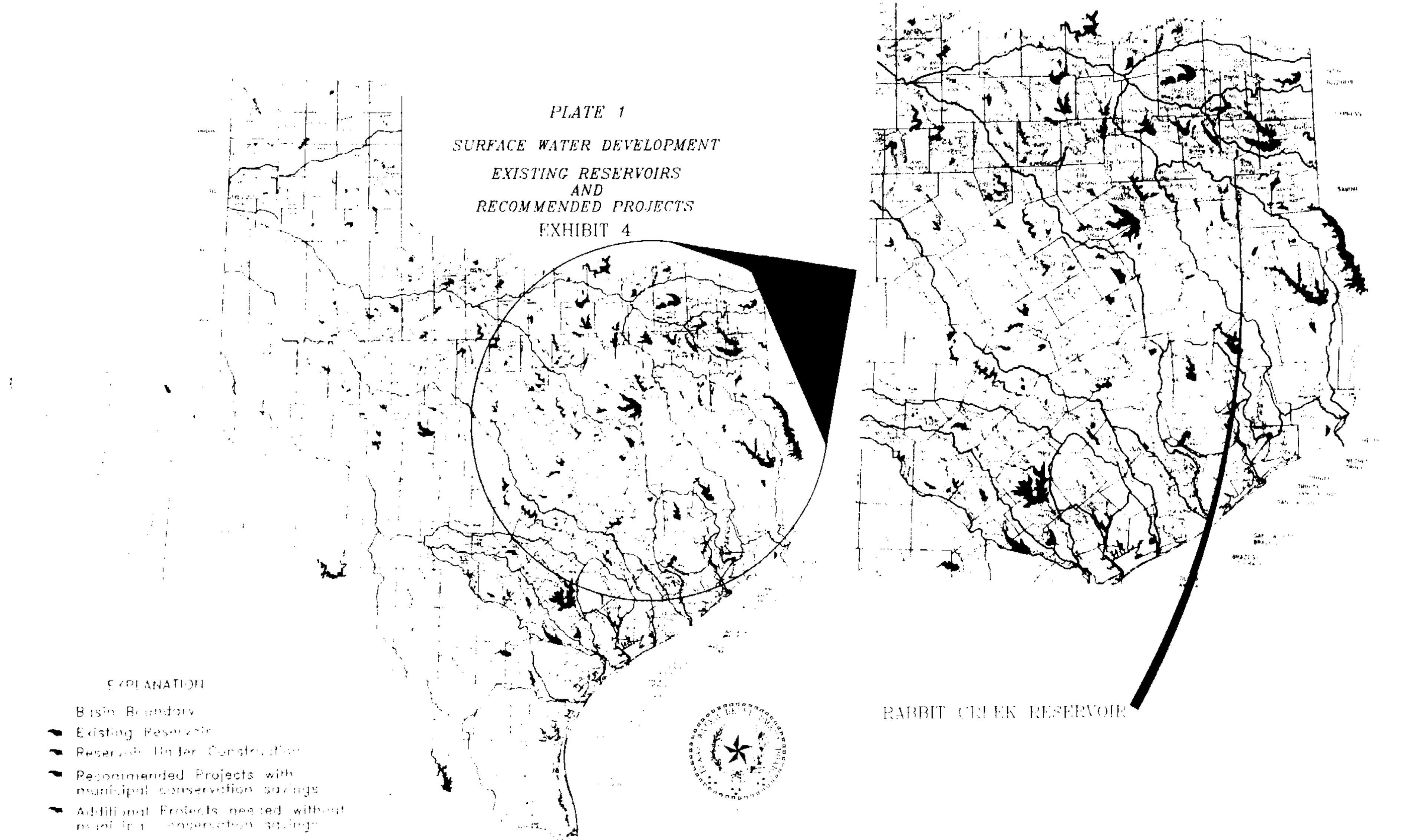
EXPLANATION

- Bone Spring – Victorio Peak
- * Dockum
- Brazos River Alluvium
- * Hickory
- West Texas Bolsons
- * Queen City
- * Woodbine
- Edwards – Trinity (High Plains)
- Blaine
- * Sparta
- * Nacatoch
- Lipan
- Igneous
- Rita Blanca
- * Ellenburger – San Saba
- * Blossom
- Marble Falls
- * Rustler
- Capitan Reef Complex
- Marathon

OUTCROP (That part of a water-bearing rock layer which appears at the land surface.)
* DOWNDIP (That part of a water-bearing rock layer which dips below other rock layers.)

Miles
0 25 50 75 100

January 1994



BURTON & ELLEDGE, INC

SURFACE WATER SUPPLY BY SABINE RIVER AUTHORITY ABOVE STUDY AREA

EXHIBIT 5

Lake Fork and Lake Tawakoni Joint Use Permit Information:

Amount Permitted	**Ac-Ft/Yr**	**MGD**
Lake Fork Permit	188,660.00	168.425
Lake Tawakoni Permit	238,100.00	212.562
Total Permitted Amount	**426,760.00**	**380.987**

Amount Committed	**Ac-Ft/Yr**	**MGD**
Lake Fork	188,190.599	168.006
Lake Tawakoni	238,401.937	212.832
Total Amount Committed	**426,592.536**	**380.838**
Net Available	**167.464**	**0.149**

Lake Fork Division:

Customer	**Effective Date**	**Expiration Date**	**Total Water Committed Ac-Ft/Yr *(MGD)***
Dallas	10/1/81	12/31/2013	131,860.000* *(117.717)*
Texas Utilities Electric Company	10/1/81	12/31/2013	12,000.000 *(10.713)*
Longview	3/5/75	1/1/2006	20,000.000 *(17.855)*
Eastman Chemical Company	1/1/94	12/31/2013	3,500.000 *(4.910)*
Quitman	1/1/94	12/31/2013	560.071 *(0.5)*
MacBee WSC	3/1/94	12/31/2013	560.071 *(0.5)*
Ables Springs WSC	9/1/94	12/31/2013	280.036 *(0.25)*
Kilgore	5/1/95	12/31/2013	3,920.499 *(3.50)*
Edgewood	9/1/96	12/31/2013	840.107 *(0.75)*
South Tawakoni WSC	9/1/97	12/31/2013	560.071 *(0.5)*
Combined Consumers WSC	9/1/97	12/31/2013	560.071 *(0.5)*
Tawakoni Plant Farms	9/1/97	12/31/2013	184.133 *(0.164)*
Total Water Contracts			**174,825.059 *(156.074)***

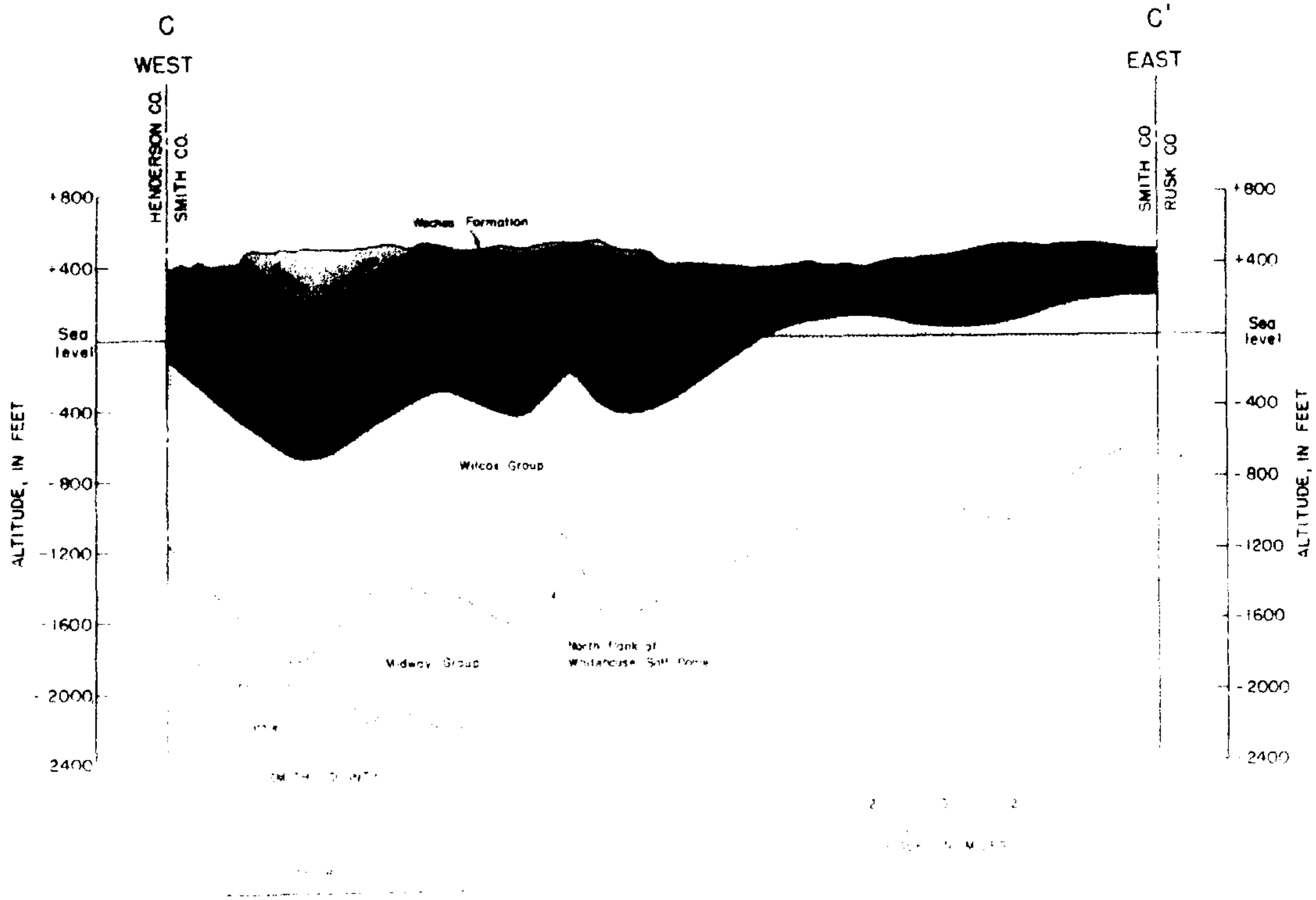
Lake Fork Division (cont'd):

Water Options	Effective Date	Expiration Date**	Total Water Committed Ac-Ft/Yr *(MGD)*
Quitman	12/1/82	12/31/99	560.071 *(0.5)*
Emory	12/14/82	12/31/99	896.114 *(0.8)*
Point	12/22/82	12/31/99	224.029 *(0.2)*
Ables Springs WSC	1/1/87	12/31/99	840.107 *(0.75)*
MacBee WSC	10/1/87	12/31/99	1,680.214 *(1.5)*
Kilgore	5/1/91	12/31/99	2,800.356 *(2.5)*
Henderson	8/1/91	12/31/99	5,040.641 *(4.5)*
Cash WSC	4/1/94	12/31/99	1,324.008 *(1.182)*
Total Water Options			**13,365.540** ***(11.932)***
Total Water Committed			**188,190.599** ***(166.842)***

*Only 120,000 is subject to interbasin transfer. The remaining 11,860 Ac-Ft/Yr (10.6 MGD) is for use in the Sabine Basin.
**After this date the Option must be exercised or terminated.

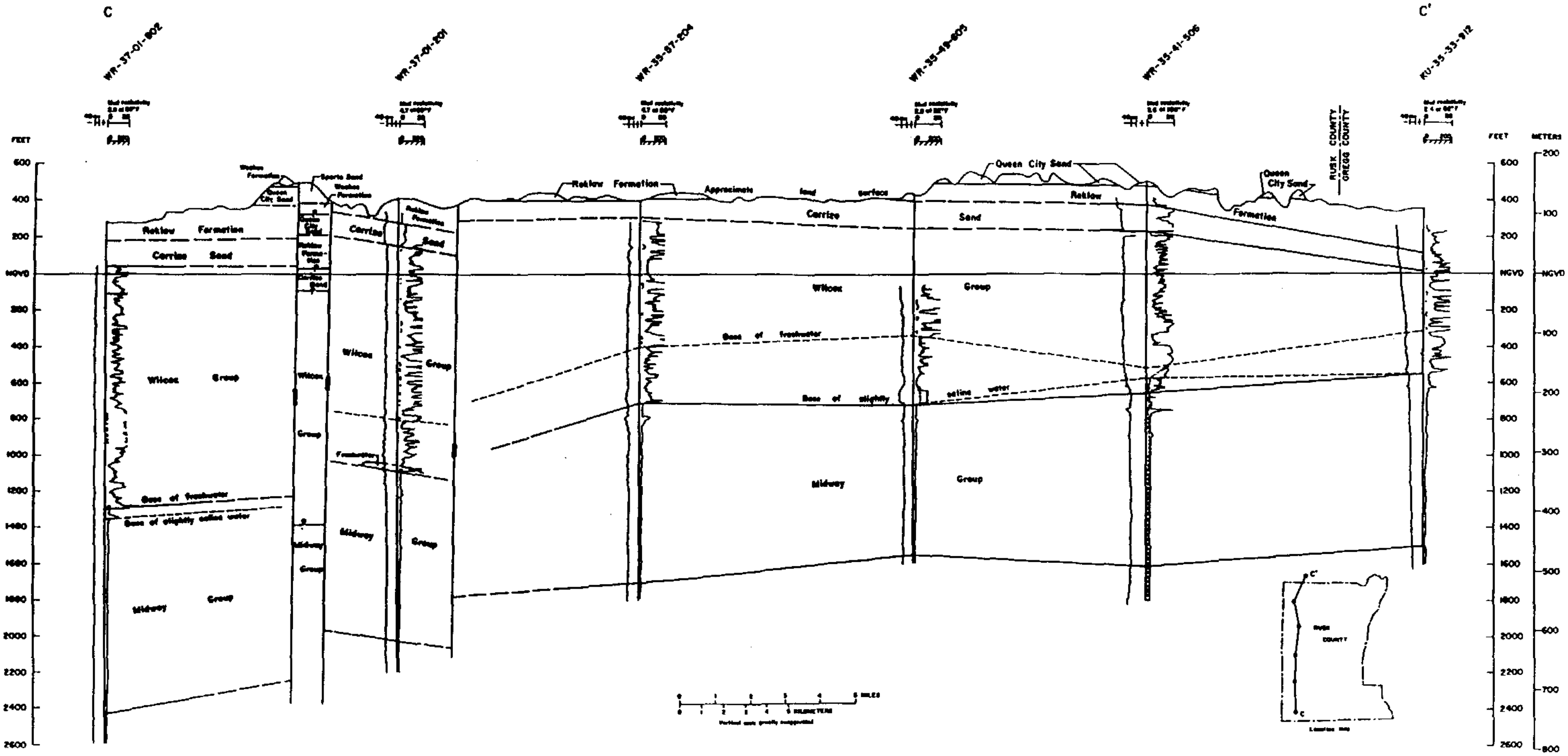
Iron Bridge Division:

Entity	Effective Date	Expiration Date	Total Water Committed Ac-Ft/Yr *(MGD)*
Cash WSC	6/1/76	5/31/2016	1,680.213 *(1.5)*
Commerce Water District	8/1/77	7/31/2027	8,401.069 *(7.5)*
Dallas	7/14/56	Perpetuity	190,480.000 *(170.05)*
Community Water Company	11/1/87	12/31/2013	91.852 *(0.082)*
Emory	1/1/73	12/31/2032	1,120.143 *(1.0)*
Greenville	7/15/76	6/30/2006	21,282.707 *(19.0)*
Point	7/9/85	8/31/2013	224.029 *(0.2)*
Combined Consumers WSC	10/1/87	12/31/2013	1,680.214 *(1.5)*
Terrell	1/1/76	12/31/2005	10,081.282 *(9.0)*
West Tawakoni	7/1/73	6/30/2008	1,120.143 *(1.0)*
Wills Point	7/1/96	12/31/2021	2,240.285 *(2.0)*
Iron Bridge Division Totals			**237,841.866** ***(212.332)***
Permitted Amount			**238,100.00** ***(212.562)***



SMITH COUNTY
EXHIBIT

RUPTON & ELLEDGE, INC



GEOLOGIC SECTIONS
of RUSK COUNTY
EXHIBIT 6

BURTON & ELLEDGE, INC.
Environmental/Civil Engineers
1121 ESE LOOP 323, SUITE 212
TYLER, TEXAS 75702
(903) 561 – 6993

Drawing File: EXHIBIT 6.DWG

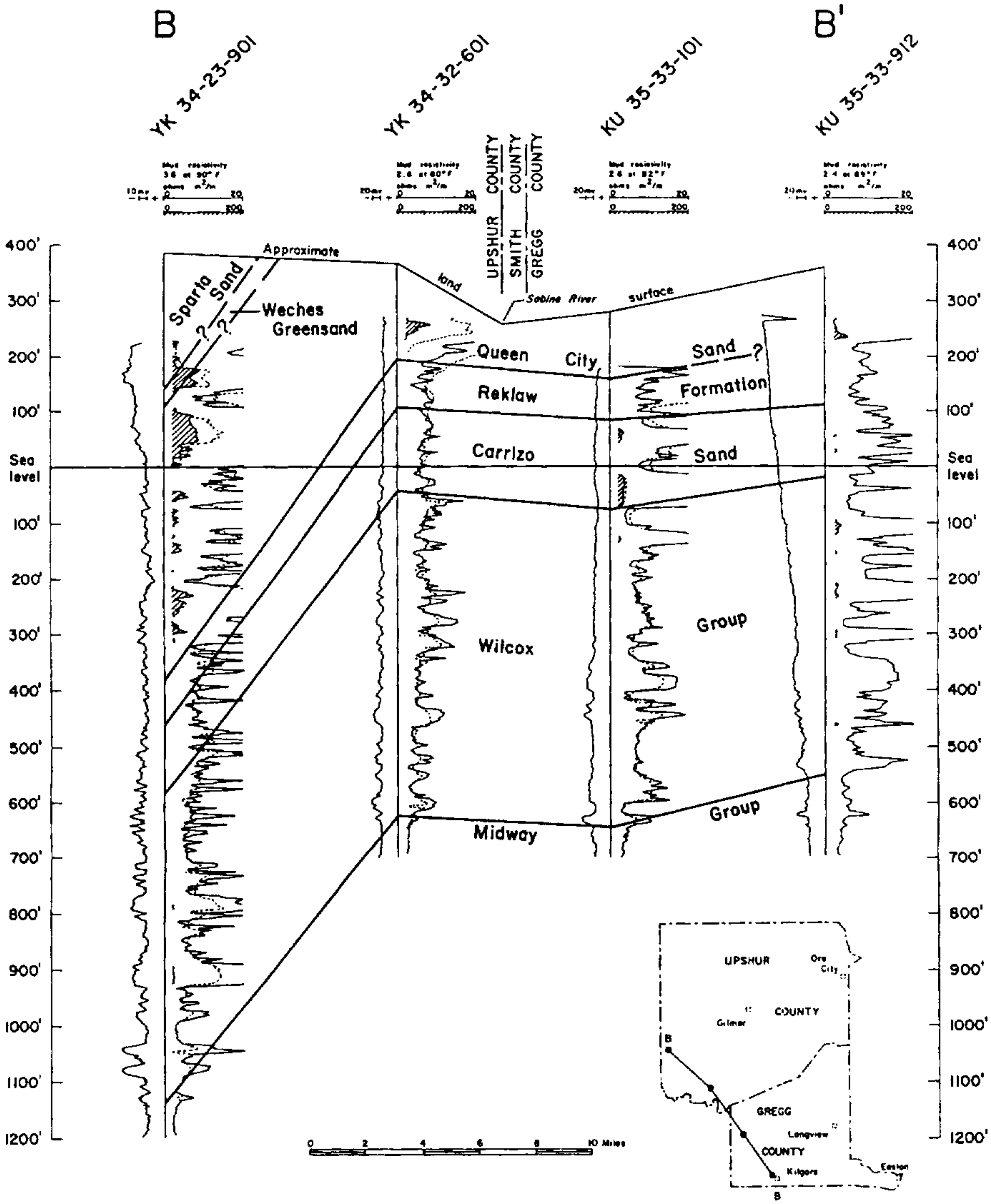


Figure 15
Geologic Section B-B'

GEOLOGIC SECTIONS
of GREGG–UPSHUR COUNTY
EXHIBIT 6

BURTON & ELLEDGE, INC.
Environmental/Civil Engineers
1121 ESE LOOP 323, SUITE 212
TYLER, TEXAS 75702
(903) 561 – 6993

Drawing File: EX-6 GEOLOGIC SECTIONS GREGG.DWG

REQUIRED WATER SUPPLY CAPACITY
PER STATE REGULATIONS

EXHIBIT 7

Region Summary

(A) Year	(B) Total Population	(C) Total Connections	(D) State Required Minimum Capacity (0.6 gpm/conn)
1990	16,857	6,086	3,652
1991	16,962	5,173	3,104
1992	17,343	6,212	3,727
1993	17,405	6,205	3,723
1994	17,861	6,474	3,884
1995	18,411	6,576	3,946
1996	19,224	6,805	4,083
2000	21,270	7,506	4,504
2010	23,806	8,374	5,025
2020	25,722	9,031	5,418
2030	26,957	9,459	5,675

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REQUIRED WATER SUPPLY CAPACITY
PER STATE REGULATIONS

EXHIBIT 7

City of Arp

(A) Year	(B) Total Population Served	(C) No. of Connections Inside City Limits	(D) No. of Connections Outside City Limits	(E) Total Connections	(F) State Required Minimum Capacity (0.6 gpm/conn)
1990	890	402	26	428	257
1991	879	403	26	429	257
1992	955	406	26	432	259
1993	988	406	31	437	262
1994	1,065	430	31	461	277
1995	1,029	423	31	454	272
1996	1,049	422	31	453	272
2000	1,208			521	312
2010	1,359			586	351
2020	1,497			645	387
2030	1,618			697	418

Liberty City

(A) Year	(B) Population Inside City Limits	(C) No. of Connections Inside City Limits	(D) No. of Connections Outside City Limits	(E) Total Connections	(F) State Required Minimum Capacity (0.6 gpm/conn)
1990	3,600	1,200	0	1,200	720
1991	3,600	1,200	0	1,200	720
1992	3,690	1,230	0	1,230	738
1993	3,705	1,235	0	1,235	741
1994	3,804	1,268	0	1,268	761
1995	3,912	1,304	0	1,304	782
1996	4,020	1,340	0	1,340	804
2000	4,860	1,620		1,620	972
2010	5,736	1,912		1,912	1,147
2020	6,423	2,141		2,141	1,285
2030	6,873	2,291		2,291	1,375

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REQUIRED WATER SUPPLY CAPACITY
PER STATE REGULATIONS

Wright City WSC

(A) Year	(B) Total Population Served	(C) Total Connections	(D) State Required Minimum Capacity (0.6 gpm/conn)
1990	2,208	736	442
1991	2,256	752	451
1992	2,244	748	449
1993	2,238	746	448
1994	2,280	760	456
1995	2,310	770	462
1996	2,340	780	468
2000	2,613	871	523
2010	2,868	956	574
2020	2,982	994	596
2030	2,973	991	595

Leveretts Chapel WSC

(A) Year	(B) Total Population Served	(C) Total Connections	(D) State Required Minimum Capacity (0.6 gpm/conn)
1990	510	170	102
1991	510	170	102
1992	510	170	102
1993	495	165	99
1994	495	165	99
1995	495	165	99
1996	495	165	99
2000	549	183	110
2010	594	198	119
2020	681	227	136
2030	771	257	154

REQUIRED WATER SUPPLY CAPACITY
PER STATE) GULATIONS

City of New London

(A) Year	(B) Total Population Served	(C) No. of Connections Inside City Limits	(D) No. of Connections Outside City Limits	(E) Total Connections	(F) State Required Minimum Capacity (0.6 gpm/conn)
1990	1,946	393	340	733	440
1991	1,966	390	350	740	444
1992	1,892	447	300	747	448
1993	1,858	431	289	720	432
1994	1,857	431	289	720	432
1995	2,043	367	353	720	432
1996	1,979	397	323	720	432
2000	2,137			777	466
2010	2,254			820	492
2020	2,438			887	532
2030	2,663			968	581

Overton

(A) Year	(B) Total Population Served	(C) No. of Connections Inside City Limits	(D) No. of Connections Outside City Limits	(E) Total Connections	(F) State Required Minimum Capacity (0.6 gpm/conn)
1990	2,141	953	12	965	579
1991	2,105	N/R	N/R	N/R	0
1992	2,259	922	32	954	572
1993	2,277	916	38	954	572
1994	2,252	1,032	32	1,064	638
1995	2,325	1,032	32	1,064	638
1996	2,813	972	199	1,171	703
2000	2,802			1,168	701
2010	2,856			1,190	714
2020	2,839			1,183	710
2030	2,816			1,173	704

REQUIRED WATER SUPPLY CAPACITY
PER STATE REGULATIONS

Jackson WSC

(A) Year	(B) Total Population Served	(C) Total Connections	(D) State Required Minimum Capacity (0.6 gpm/conn)
1990	2,442	814	488
1991	2,490	830	498
1992	2,523	841	505
1993	2,574	858	515
1994	2,637	879	527
1995	2,703	901	541
1996	2,811	937	562
2000	2,889	963	578
2010	3,171	1,057	634
2020	3,297	1,099	659
2030	3,288	1,096	658

W. Gregg WSC

(A) Year	(B) Population = Conn * 3	(C) Total Connections	(D) State Required Minimum Capacity (0.6 gpm/conn)
1990	3,120	1,040	624
1991	3,156	1,052	631
1992	3,270	1,090	654
1993	3,270	1,090	654
1994	3,471	1,157	694
1995	3,594	1,198	719
1996	3,717	1,239	743
2000	4,212	1,404	842
2010	4,968	1,656	994
2020	5,565	1,855	1,113
2030	5,955	1,985	1,191

SYSTEM CAPACITY
CITY OF ARP

EXHIBIT 8

1996 - Total Connections - 453			2030 - Total Connections - 697
SYSTEM COMPONENT	**EXISTING CONDITIONS**		**STATE MIN. REQUIREMENTS**
Well Capacity	Well #1 Well #2	250 gpm 250 gpm 500 gpm Total	697 conn. x 0.6 gpm/conn. = **418 gpm**
Total Storage Capacity	Ground	250,000 gal	697 conn x 200 gpm/conn. = **139,400 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	50,000 gal 75,000 gal 125,000 gal	697 conn. x 100 gal/conn = **69,700 gal.** or
	Pressure	0 gal	697 conn x 20 gal/conn. = **13,940 gal.**
Service Pump Capacity	Pump #1 Pump #2 Pump #3	250 gpm 250 gpm 500 gpm 1,000 gpm Total	697 conn. x 2 gpm/conn. = **1,394 gpm**

SYSTEM CAPACITY
LIBERTY CITY WATER SUPPLY CORPORATION

EXHIBIT 8

1996 - Total Connections - 1,340 | 2030 - Total Connections - 2,291

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #1 Well #2 Well #3 Well #4	110 gpm 80 gpm 80 gpm 400 gpm 670 gpm Total	2291 conn. x 0.6 gpm/conn. = **1375 gpm**
Total Storage Capacity	Ground	650,000 gal	2291 conn x 200 gpm/conn. = **458,200 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	200,000 gal	2291 conn. x 100 gal/conn = **229,100 gal.** or
	Pressure	20,000 gal	2291 conn x 20 gal/conn. = **45,820 gal.**
Service Pump Capacity	Plant #1 Plant #2	1050 gpm 1050 gpm 2,100 gpm Total	2291 conn. x 2 gpm/conn. = **4,582 gpm**

SYSTEM CAPACITY
CITY OF NEW LONDON

EXHIBIT 8

1996 - Total Connections - 720 | 2030 - Total Connections - 968

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #1	200 gpm	
	Well #2	400 gpm	
	Well #3	360 gpm	
		960 gpm Total	968 conn. x 0.6 gpm/conn. = **581 gpm**
Total Storage Capacity	Ground	247,000 gal	968 conn x 200 gpm/conn. = **193,600 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	100,000 gal	968 conn. x 100 gal/conn = **96,800 gal.**
			or
	Pressure	0 gal	968 conn x 20 gal/conn. = **19,360 gal.**
Service Pump Capacity	Pump #1	360 gpm	
	Pump #2	360 gpm	
	Pump #3	500 gpm	
	Pump #4	500 gpm	
		1,720 gpm Total	968 conn. x 2 gpm/conn. = **1,394 gpm**

SYSTEM CAPACITY
CITY OF OVERTON

EXHIBIT 8

1996 - Total Connections - 1,171 | 2030 - Total Connections - 1,173

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #4	250 gpm	
	Well #5	200 gpm	
	Well #6	<u>200 gpm</u>	1173 conn. x 0.6 gpm/conn.
		650 gpm Total	= **704 gpm**
Total Storage Capacity	Ground	762,000 gal	1173 conn x 200 gpm/conn. = **234,600 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	462,000 gal	1173 conn. x 100 gal/conn = **117,300 gal.**
			or
	Pressure	0 gal	1173 conn x 20 gal/conn. = **23,460 gal.**
Service Pump Capacity	Pump #1	500 gpm	
	Pump #2	500 gpm	
	Pump #3	<u>500 gpm</u>	1173 conn. x 2 gpm/conn.
		1500 gpm Total	= **2,346 gpm**

SYSTEM CAPACITY
WRIGHT CITY WATER SUPPLY CORPORATION

EXHIBIT 8

1996 - Total Connections - 468 | 2030 - Total Connections - 595

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #1	102 gpm	
	Well #2	175 gpm	
	Well #3	135 gpm	
	Well #4	200 gpm	595 conn. x 0.6 gpm/conn.
		612 gpm Total	= **357 gpm**
Total Storage Capacity	Ground	210,000 gal	595 conn x 200 gpm/conn. = **119,000 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	0 gal	595 conn. x 100 gal/conn = **59,500 gal.**
			or
	Pressure	11,400 gal	595 conn x 20 gal/conn. = **11,900 gal.**
Service Pump Capacity	Pump #1	480 gpm	
	Pump #2	480 gpm	
	Pump #3	300 gpm	
	Pump #4	300 gpm	
	Pump #5	500 gpm	595 conn. x 2 gpm/conn.
		2,060 gpm Total	= **1,190 gpm**

SYSTEM CAPACITY
LEVERETTS CHAPEL WATER SUPPLY CORPORATION

EXHIBIT 8

1996 - Total Connections - 165 | 2030 - Total Connections - 257

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #2	200 gpm	257 conn. x 0.6 gpm/conn. = **154 gpm**
Total Storage Capacity	Ground	55,000 gal	257 conn x 200 gpm/conn. = **51,400 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	25,000 gal	257 conn. x 100 gal/conn = **25,700 gal.** or
	Pressure	0 gal	257 conn x 20 gal/conn. = **5,140 gal.**
Service Pump Capacity	Plant #1 Plant #2	300 gpm 300 gpm 600 gpm Total	257 conn. x 2 gpm/conn. = **514 gpm**

SYSTEM CAPACITY
JACKSON WATER SUPPLY CORPORATION

EXHIBIT 8

1996 - Total Connections - 937 2030 - Total Connections - 1,096

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #1	110 gpm	
	Well #2	62 gpm	
	Well #3	210 gpm	
	Well #4	200 gpm	1096 conn. x 0.6 gpm/conn.
		582 gpm Total	= **658 gpm**
Total Storage Capacity	Ground	140,000 gal	
	Stand Pipe	169,000 gal	1096 conn x 200 gpm/conn.
		309,000 Total	= **219,200 gal.**
Elevated Storage or Pressure Tank Capacity			1096 conn. x 100 gal/conn
	Elevated	56,000 gal	= **109,600 gal.**
			or
			1096 conn x 20 gal/conn.
	Pressure	16,500 gal	= **21,920 gal.**
Service Pump Capacity	Plant #1	1100 gpm	
	Plant #2	600 gpm	1096 conn. x 2 gpm/conn.
		1,700 gpm Total	= **2,192 gpm**

SYSTEM CAPACITY
WEST GREGG WATER SUPPLY CORPORATION

EXHIBIT 8

1996 - Total Connections - 1,239 | 2030 - Total Connections - 1,985

SYSTEM COMPONENT	EXISTING CONDITIONS		STATE MIN. REQUIREMENTS
Well Capacity	Well #1	170 gpm	
	Well #2	120 gpm	
	Well #3	140 gpm	
	Well #4	100 gpm	
	Well #5	140 gpm	1985 conn. x 0.6 gpm/conn.
		670 gpm Total	= **1,191 gpm**
Total Storage Capacity	Ground (3)	330,000 gal	1985 conn x 200 gpm/conn. = **397,000 gal.**
Elevated Storage or Pressure Tank Capacity	Elevated	0 gal	1985 conn. x 100 gal/conn = **198,500 gal.**
			or
	Pressure	24,000 gal	1985 conn x 20 gal/conn. = **39,700 gal.**
Service Pump Capacity	Plant #1	1200 gpm	
	Plant #2	1050 gpm	
	Plant #3	1070 gpm	1985 conn. x 2 gpm/conn.
		3,320 gpm Total	= **3,970 gpm**

REGIONAL WATER SUPPLY STUDY
GROUND WATER QUALITY SAMPLES
TEXAS WATER DEVELOPMENT BOARD

EXHIBIT 9

Wellname	Latitude	Longitude	Grid	Topograhic Map	Aquifer	Well Depth	Date of Collection	pH	Silica (SIO2) mg/l	Calcium (Ca) mg/l	Magnesiu (Mg) mg/l	Sodium (Na) mg/l	Pottasiu (K) mg/l	Carbonate (CO3) mg/l	Bicarb. (HCO3) mg/l	Sulfate (SO4) mg/l	Chloride (Cl) mg/l	Flouride (F) mg/l	Nitrate (NO3) mg/l	Dissolve Solids mg/l	Spec. Cond. (microohms)	Hardness as CaCO3 mg/l	Percent Sodium	SAR	RSC
Smith County																									
City of Arp				Troup, West																					
1 (34-56-209)	32 13 35	95 03 40	I 15		124CRRZ	360	08/05/1936			48	23	97			140	242	40			518		214	49	2.9	
4 (34-56-201)	32 14 06	95 02 37	I 15		124CZW	1014	02/00/1950			3	2	131			256	65	11	0.7	0.9	339			94	14.4	3.9
5 (34-56-208)	32 13 28	95 03 33	I 15		124WLCX	967	07/14/1971	8.6		2	1	416		48	566	19	247	0.6	3	1014	1750	7	99	60	10.7
Jackson WSC				Hope Pond																					
1 (34-48-103)	32 21 46	95 06 42	N 14		124WLCX	860	10/14/1968	8.8	11	2	1	323		36	594	19	100	0.9	0.1	785	1375	9	98	46.6	10.8
					124WLCX	860	01/24/1975	8.7		2	<1	321		18	630	20	101	0.9	1	774	1419	6	98	46.3	10.6
					124WLCX	860	03/20/1976	8.7		2	<1	319		20	610	21	98	0.8	<0.4	762	1400	4	98	46	10.6
2 (34-48-104)	32 21 52	95 06 34	N 14		124WLCX	811	11/22/1976	8.5		2	1	345		33	621	0	136	1	0	823	1400	6	98	49.7	11.1
3 (34-48-105)	32 22 08	95 06 36	O 14		124WLCX	865	09/14/1982	8.8		1	2	353		22	637	7	145	0.9	<0.	844	1550	12	98	46.9	11
					124WLCX	865	09/16/1982	8.3		2	0	357		26	644	0	148	1	0	850	1400	5	99	69.5	11.3
					124WLCX	865	03/06/1987	8.7	12	1	1	330	1	20	645	6	112	0.9	0.1	801	1450	4	98	55.8	11.1
4 (34-48-803)	32 15 20	95 04 38	J 15		124WLCX	1062	10/15/92	8.7	15	1	<1	182	1	10	443	12	12	0.4	0	452	604	7	98	29.2	7.4
Wright City WSC																									
1 (35-49-404)	32 12 02	94 59 37	H 17	Price	124WLCX	720	04/21/1969	8.6		2	1	203		36	425	24	11	0.4	0.5	486	720	6	97	29.3	8
					124WLCX	720	08/01/1973	U																	
					124WLCX	720	06/20/1974	8		1	<1	185		0	438	26	5	0.4	0.4	434	750	2	98	31.3	7.1
					124WLCX	720	08/27/1975	8.8		1	<1	179		16	411	24	5	0.3	<.4	428	1008	4	98	30.3	7.1
					124WLCX	720	08/27/1976	8.8		2	<1	222		17	414	24	72	0.3	<.4	542	794	6	98	32	7.2
					124WLCX	720	10/13/1992	8.8	13	<1	<1	192	1	8	380	38	41	0.3	0	482	1500	6	98	32.5	6.4
2 (34-56-704)	32 08 49	95 06 14	F 13	Troup, East	124WLCX	1085	05/14/1975	8.3		2	1	401		49	672	0	175	1.1	0	959	1500	6	98	57.8	12.5
					124WLCX	1085	08/27/1976	U																	
					124WLCX	1085	04/09/1987	8.8	13	1	1	397	0	26	687	6	195	1.2	0	978	1822	3	99	67.2	12
					124WLCX	1085	10/13/1992	8.7	13	1	<1	402	2	17	697	6	199	1.2	0	984	1612	6	99	66.8	11.8
3 (35-49-405)	32 12 21	94 59 48	H 17	Price	124WLCX	903	04/01/1984	8.7		2	1	411		31	669	4	210	1.2	0	989	1500	7	98	59.3	11.8
					124WLCX	903	05/15/1984	U																	
4 (34-56-703)	32 09 35	95 05 22	F 13	Troup, East	124QNCT	35	07/01/1976	7.6	76	60	1	7		0	173	13	9	0.1	3.7	254	340	153	9	0.3	0
					124QNCT	35	11/11/1981	8.2	65	67	1	6	1	0	201	13	9	0.1	0.3	261	375	172	7	0.2	0
Rusk County																									
Leveretts Chappel WSC				Kilgore, SW																					
1 (35-41-501)	32 18 41	94 55 17	L 19																						
2 (35-41-502)	32 18 41	94 55 18	L 19		124WLCX	843	06/01/1979	8.7		1	<1	235		16	546	26	1	0.3	0.2	548		3	98	39.8	9.4
					124WLCX	843	09/17/1980	8.4		<1	<1	235		5	573	26	9	0.4	0.8	559	960	2	98	39.8	9.4
					124WLCX	843	06/20/1981	U																	
					124WLCX	843	07/05/1983	8.4		1	<1	233		10	561	24	9	0.4	<.1	554	992	3	98	39.4	9.4
					124WLCX	843	11/10/1986	8.6		1	<1	230		11	547	19	13	0.4	0.4	544		3	98	38.9	9.3

Wellname	Latitude	Longitude	Grid	Topograhic Map	Aqu	Spec. Cond. (microohms)	Hardness as CaCO3 mg/l	Percent Sodium	SAR	RSC
Smith County										
City of Arp				Troup, West						
1 (34-56-209)	32 13 35	95 03 40	I 15		124C		214	49	2.9	
4 (34-56-201)	32 14 06	95 02 37	I 15		124C			94	14.4	3.9
5 (34-56-208)	32 13 28	95 03 33	I 15		124W	1750	7	99	60	10.7
Jackson WSC				Hope Pond						
1 (34-48-103)	32 21 46	95 06 42	N 14		124W	1375	9	98	46.6	10.8
					124W	1419	6	98	46.3	10.6
					124W	1400	4	98	46	10.6
2 (34-48-104)	32 21 52	95 06 34	N 14		124W	1400	6	98	49.7	11.1
3 (34-48-105)	32 22 08	95 06 36	O 14		124W	1550	12	98	46.9	11
					124W	1400	5	99	69.5	11.3
					124W	1450	4	98	55.8	11.1
4 (34-48-803)	32 15 20	95 04 38	J 15		124W	604	7	98	29.2	7.4
Wright City WSC										
1 (35-49-404)	32 12 02	94 59 37	H 17	Price	124W	720	6	97	29.3	8
					124W					
					124W	750	2	98	31.3	7.1
					124W	1008	4	98	30.3	7.1
					124W	794	6	98	32	7.2
					124W	1500	6	98	32.5	6.4
2 (34-56-704)	32 08 49	95 06 14	F 13	Troup, East	124W	1500	6	98	57.8	12.5
					124W					
					124W	1822	3	99	67.2	12
					124W	1612	6	99	66.8	11.8
3 (35-49-405)	32 12 21	94 59 48	H 17	Price	124W	1500	7	98	59.3	11.8
					124W					
4 (34-56-703)	32 09 35	95 05 22	F 13	Troup, East	124Q	340	153	9	0.3	0
					124QI	375	172	7	0.2	0
Rusk County										
Leveretts Chappel WSC				Kilgore, SW						
1 (35-41-501)	32 18 41	94 55 17	L 19							
2 (35-41-502)	32 18 41	94 55 18	L 19		124W		3	98	39.8	9.4
					124W	960	2	98	39.8	9.4
					124W					
					124W	992	3	98	39.4	9.4
					124W		3	98	38.9	9.3

New London																									
1 (35-41-901)	32 16 50	94 54 53	K 19	Kilgore, SW	124WLCX	657	07/06/1961	8.1	13	1	0	154		0	366	21	8	0.2	2.2	379	607	1	99	42.4	5.9
					124WLCX	657	10/21/1965	8.7		2	<1	152		10	348	24	3	0.2	3	365	636	9	97	21.9	5.8
					124WLCX	657	07/20/1967	8.6		1	<1	138		6	314	30	6	0.2	4	340	604	6	97	23.4	5.2
					124WLCX	657	05/06/1972	8.8		2	<1	159		12	373	14	7	0.3	<0.4	379	670	6	97	22.9	6.3
					124WLCX	657	12/12/1972	8.5		<1	1	121		5	254	40	8	0.1	1	301	528	6	97	20.5	4.2
					124WLCX	657	10/08/1987	8.7		1	<1	157		8	366	22	9	0.2	0.2	378	675	3	98	26.6	6.2
2 (35-41-808)	32 15 07	94 55 54	J 19		124WLCX	591	12/12/1972	8.7		1	<1	153		11	355	22	5	0.2	<.4	368	650	6	98	25.9	6.1
					124WLCX	591	05/06/1976	8.7		2	<1	126		8	261	34	9	0.1	<.4	308	548	6	96	18.2	4.4
					124WLCX	591	10/08/1987	8.5		1	<1	138		4	315	30	7	0.2	1.3	337	600	3	97	23.4	5.2
					124WLCX	591	03/16/1993	8.5	14	1	0	130	2	5	283	36	7	0.2	<.0	333	518	2	99	37	4.8
3 (35-41-811)	32 15 14	94 55 37	J 19																						
Overton																									
4 (35-41-702)	32 16 27	94 58 29	J 18	Kilgore, SW	124WLCX	327	04/00/1955	6.7		15	4	42		0	49	64	28	0.2	0.4	177		54	62	2.5	0
					124WLCX	327	05/23/1956	8.5	18	2	0	332		30	605	20	112			811		6	99	64.7	10.8
					124WLCX	327	11/06/1967	6		7	4	31		0	26	51	19	0.2	<.4	125	245	35	66	2.3	0
5 (35-41-807)	32 16 14	94 56 10	J 19		124WLCX	815	04/18/1968	8.8	11	2	0	255		12	631	5	12			607	976	5	99	49.7	10.6
					124WLCX	815	05/24/1968	8.7	11	1	1	249		29	587	1	10			590	966	4	98	42.1	10.5
					124WLCX	815	10/29/1971	8.8		2	<1	233		23	570	7	8	0.6	<.4	555		8	98	33.6	10
					124WLCX	815	10/24/1972	8.7		1	1	234		17	570	7	10	0.6	<.4	551	980	9	98	39.6	9.9
6 (35-41-809)	32 16 37	94 55 32	K 19																						
Gregg County																									
Liberty City																									
1 (35-33-502)	32 26 40	94 57 15	Q 17	Kilgore, NW	124WLCX	622	08/04/1964	8.7	8	1	0	196		12	447	11	23			470	785	4	99	54	7.7
					124WLCX	622	12/08/1966	8.4	13	1	0	183	1		406	13	22	0.5	0.2	438	438	4	99	50.4	6.6
					124WLCX	622	07/16/1970	8.8		2	<1	170		14	390	14	19	0.4	<.4	412	412	8	97	24.5	6.7
					124WLCX	622	07/16/1971	8.6		2	1	170		6	399	15	19	0.4	<.4	409	409	10	97	24.5	6.6
					124WLCX	622	09/25/1972	8.8		1	1	178		14	389	14	23	0.4	<.4	423	423	7	98	30.1	6.7
					124WLCX	622	09/17/1974	8.8		1	1	229		14	389	17	94	0.6	.6	548	548	9	98	38.8	6.7
					124WLCX	622	08/20/1975	8.8		4	2	166		13	389	16	21	0.3	1	414	414			16.9	6.5
					124WLCX	622	07/19/1976	u																	
					124WLCX	622	05/13/1980	8.8		1	<1	177		14	394	18	21	0.4	<.1	426	426	2	98	30	6.8
					124WLCX	622	10/18/1983	8.4		<1	<1	177		3	414	15	20	0.4	<.1	421	421	3	98	30	6.8
					124WLCX	622	10/22/1987	8.8	9	1	1	179	1	14	394	15	20	0.4	0	434	434	4	98	30.3	6.8
					124WLCX	622	03/25/1993	8.7	13	1	<0	194	2	14	393	17	21	0.4	<.0	456	456	2	98	54.7	6.9
2 (35-33-505)	32 26 16	94 57 17	Q 17		124WLCX	615	04/16/1971	8.1		2	1	139		22	282	15	20	0.3	10	347	500	8	97	21.2	5.2
3 (35-33-506)	32 27 13	94 56 56	R 18		124WLCX	515	08/08/1987	8.6		1	1	186		22	384	30	21	0.4	0	450	700	6	98	31.5	6.9

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
WATER UTILITIES DIVISION
PRIMARY STANDARDS GOVERNING DRINKING WATER QUALITY

EXHIBIT 10

CONSTITUENT	MAXIMUM CONTAMINANT LEVEL, mg/L
Inorganic Chemicals	
Antimony	0.006
Arsenic	0.05
Asbestos	(7 million fibers/liter longer than 10 microns)
Barium	2.0
Beryllium	0.001
Cadmium	0.005
Copper	Treatment Technique*
Chromium	0.1
Cyanide	0.2
Fluoride	4.0
Lead	Treatment Technique*
Mercury	0.002
Nitrate (as Nitrogen)	10.0
Nitrite (as Nitrogen)	1.0
Nitrate + Nitrite (both as Nitrogen)	10.0
Selenium	0.05
Thallium	0.002
Organic Chemicals	
Acrylamide	Treatment Technique **
Alachlor	0.002
Aldicarb	0.003
Aldicarb sulfone	0.002

CONSTITUENT	MAXIMUM CONTAMINANT LEVEL, mg/L
Aldicarb sulfoxide	0.004
Atrazine	0.003
Benzene	0.005
Benzo (a) pyrene	0.0002
Carbofuran	0.04
Carbon Tetrachloride	0.005
Chlordane	0.002
2,4-D	0.07
Dalapon	0.2
Dibromochloropropane	0.0002
Di (2-ethylhexyl) adipate	0.5
Di (2-ethylhexy1) phthalate	0.006
o-Dichlorobenzene	0.6
P-Dichlorobenzene	0.075
1,2 Dichloroethane	0.005
1,1-Dichloroethylene	0.007
cis-1,2-Dichloroethylene	0.07
trans-1,2-Dichloroethylene	0.1
Dichloromethane (methylene chloride)	0.005
1,2-Dichloropropane	0.005
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Endrin	0.002
Epichlorohydrin	Treatment Technique ***
Ethylbenzene	0.7
Ethylene Dibromide (EDB)	0.00005
Glyphosphate	0.7
Heptachlor	0.0004

CONSTITUENT	MAXIMUM CONTAMINANT LEVEL, mg/L
Heptachlor Epoxide	0.0002
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Lindane	0.0002
Methoxychlor	0.04
Monochlorobenzene	0.1
Oxamyl (Vydate)	0.2
Pentachlorophenol	0.001
Pichloram	0.5
Polychlorinated Biphenyls (PCB's)	0.0005
Simazine	0.004
Styrene	0.1
2,3,7,8-TCDD (Dioxin)	0.00000003
Tetrachloroethylene	0.005
Toluene	1
Toxaphene	0.005
2,4,5-TP (Silvex)	0.05
1,2,4-Trichlorobenzene	0.07
1,1,1-Trichloroethane	0.2
1,1,2-Trichloroethane	0.005
Trichloroethylene	0.005
Total Trihalomethanes	0.1
Vinyl Chloride	0.002
Xylenes (total)	10
Radionuclides	
Beta-particle and photon emitters	4 mrem
Alpha emitters	15 pCi/L
Radium 226 + 228	5 pCi/L

CONSTITUENT	MAXIMUM CONTAMINANT LEVEL, mg/L
Microbiological	
Giardia lamblia	Treatment Technique****
Legionella	Treatment Technique****
Standard Plate Count	Treatment Technique****
Viruses	Treatment Technique****

Total Coliform Organisms

For systems collecting less than 40 samples per month, no more than one sample may be positive for coliform organisms. For systems analyzing at least 40 samples per month, no more than 5 per cent of the total monthly samples may be positive for total coliform organisms.

Turbidity

For conventional treatment plants, filtered water turbidity must at no time exceed 5 Nephelometric Turbidity Units (NTU) and must not exceed 0.5 NTU in 95 per cent of the measurements taken each month. Turbidity measurements must be made every 4 hours by grab sampling or by continuous monitoring.

* Lead and Copper

Corrosion Control if action levels exceeded.

** Acrylamide

Maximum allowable level of acrylamide in polymers is 0.5 per cent; maximum allowable dosage for these polymers is 1.0 mg/l.

***Epichlorohydrin

Maximum allowable level of epichlorohydrin in coagulant aids is 0.01 per cent; maximum allowable dosage is 20 mg/l.

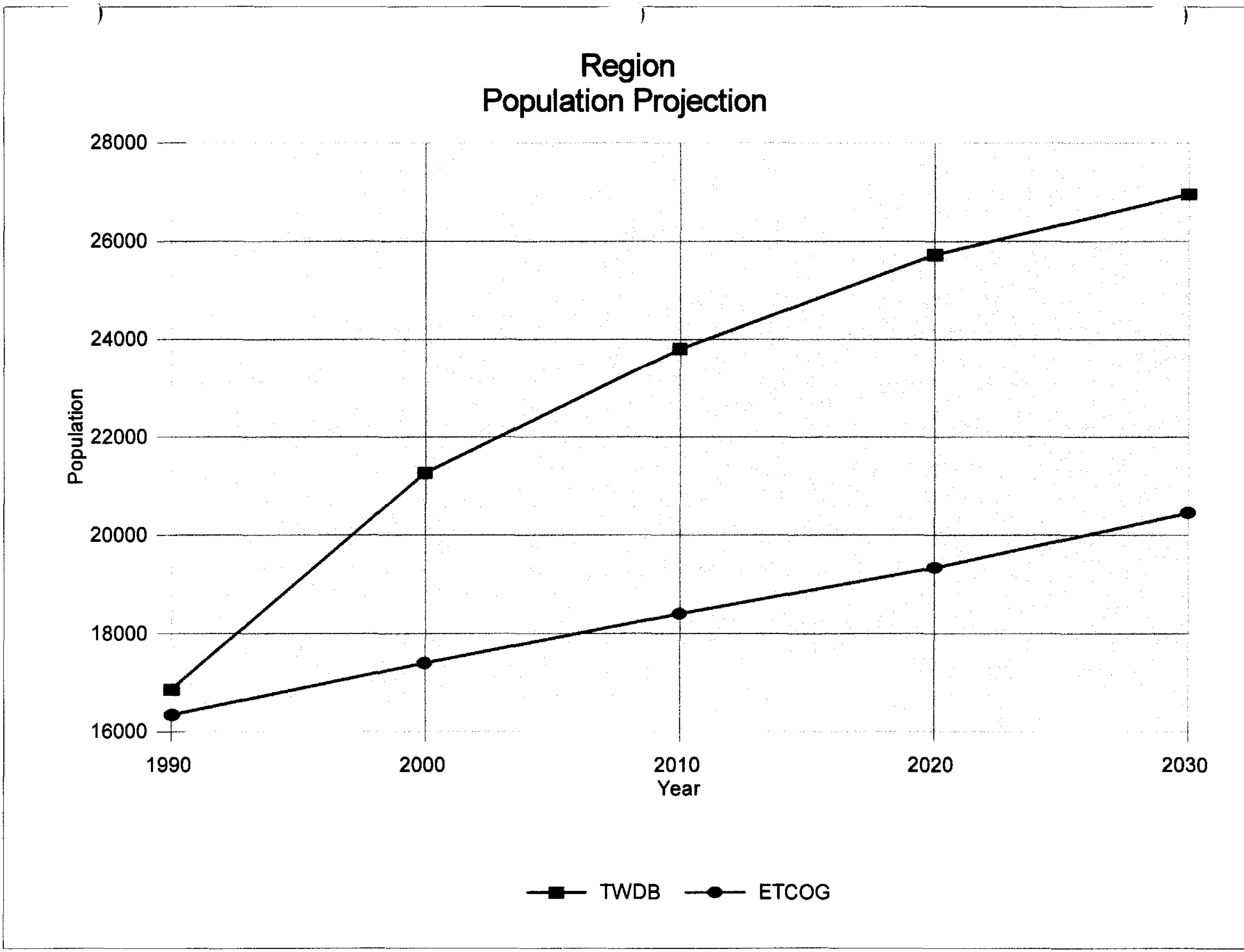
****Giardia lamblia, Legionella, Standard Plate Count, and Viruses

Treatment techniques required by Surface Water Treatment Rule.

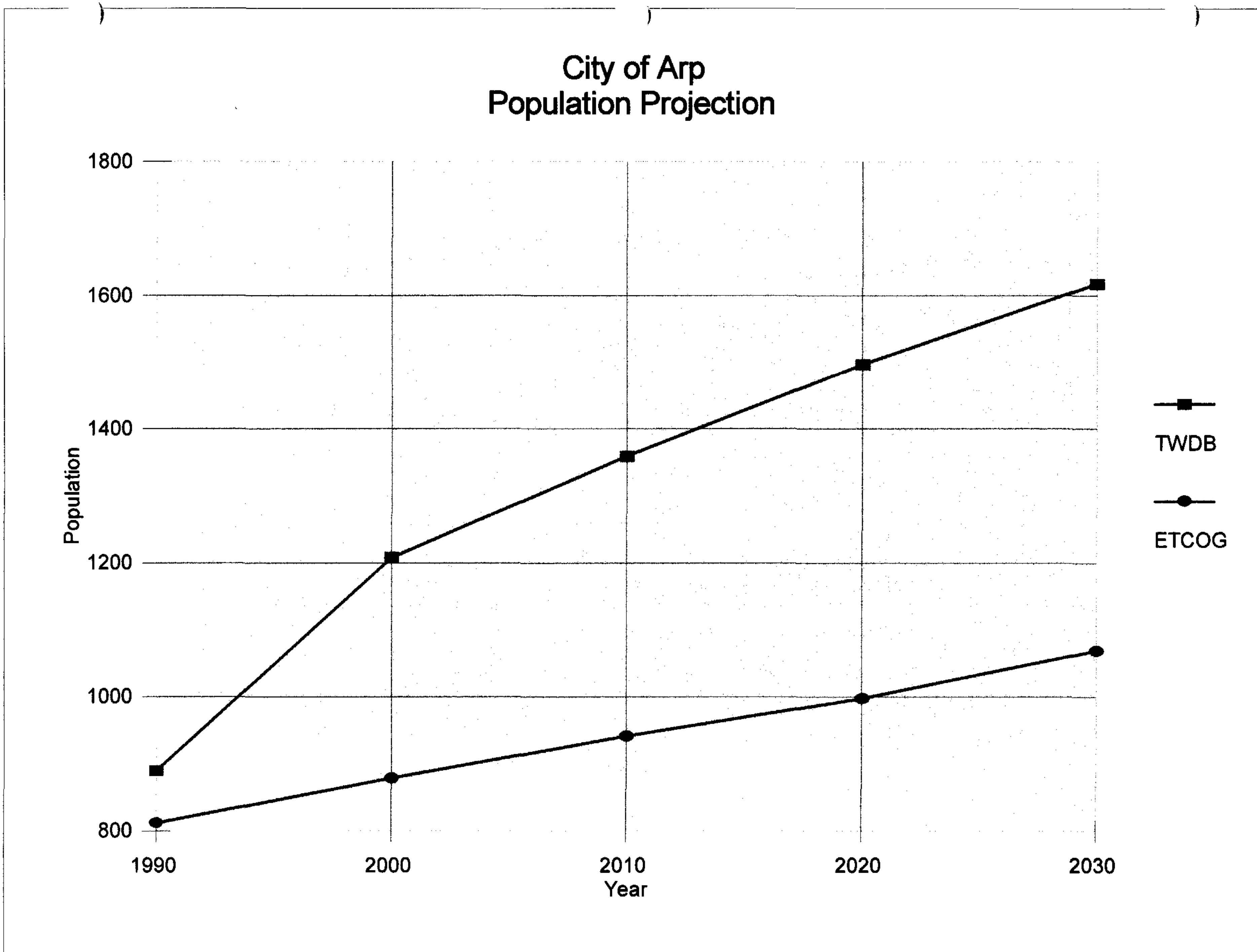
TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
WATER UTILITIES DIVISION
SECONDARY STANDARDS GOVERNING DRINKING WATER QUALITY

EXHIBIT 10

Constituent	Level
Aluminum	0.05-0.2 mg/l
Chloride	300 mg/l
Color	15 color units
Copper	1.0 mg/l
Corrosivity	non-corrosive
Fluoride	2.0 mg/l
Foaming agents	0.5 mg/l
Hydrogen Sulfide	0.05 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 Threshold Odor No.
pH	7.0 minimum
Silver	0.1 mg/l
Sulfate	300 mg/l
Total Dissolved Solids	1,000 mg/l
Zinc	5.0 mg/l



Region
Population Projection
28000
26000
24000
22000
20000
18000
16000
Population
1990
2000
2010
2020
2030
Year
TWDB
ETCOG



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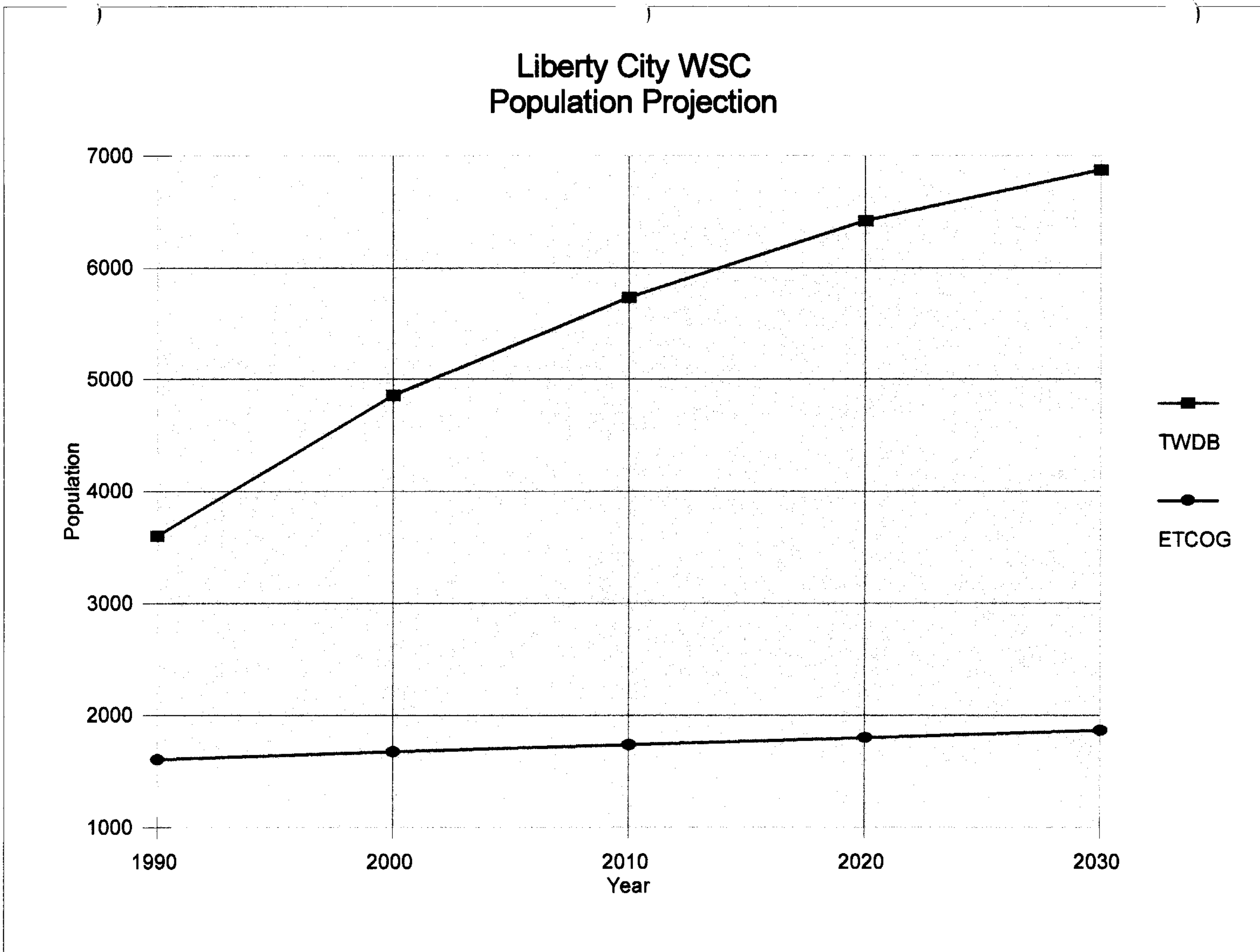

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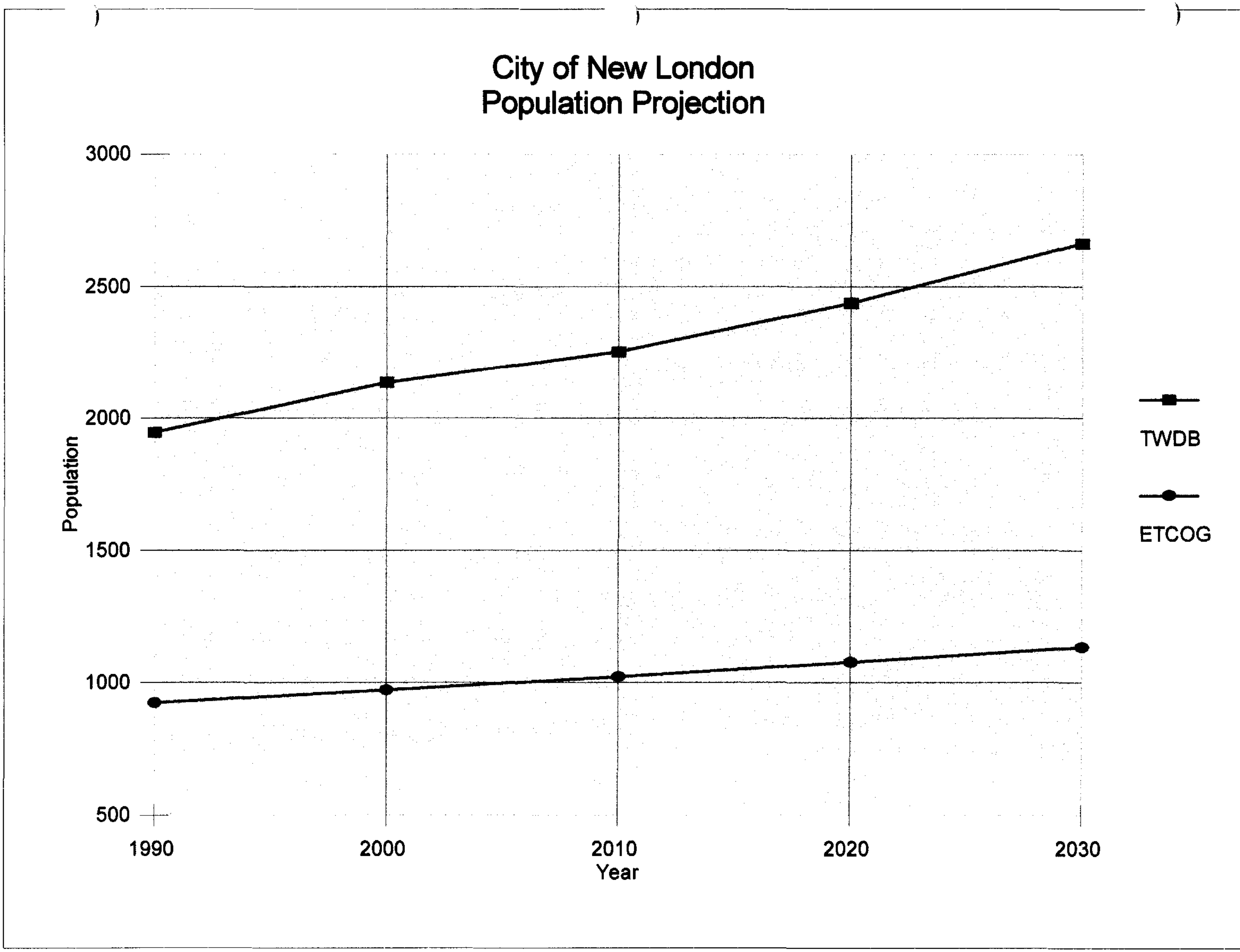
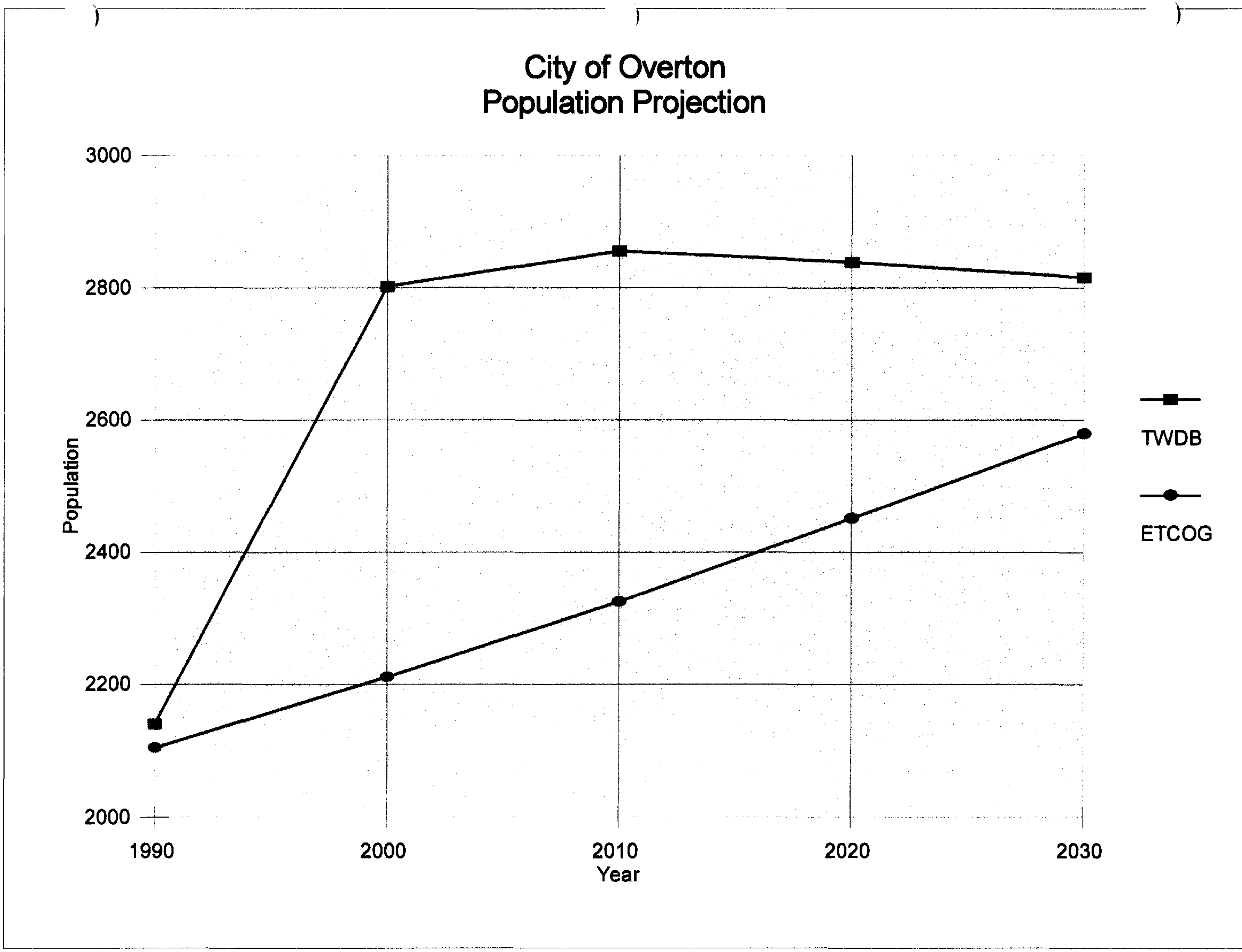
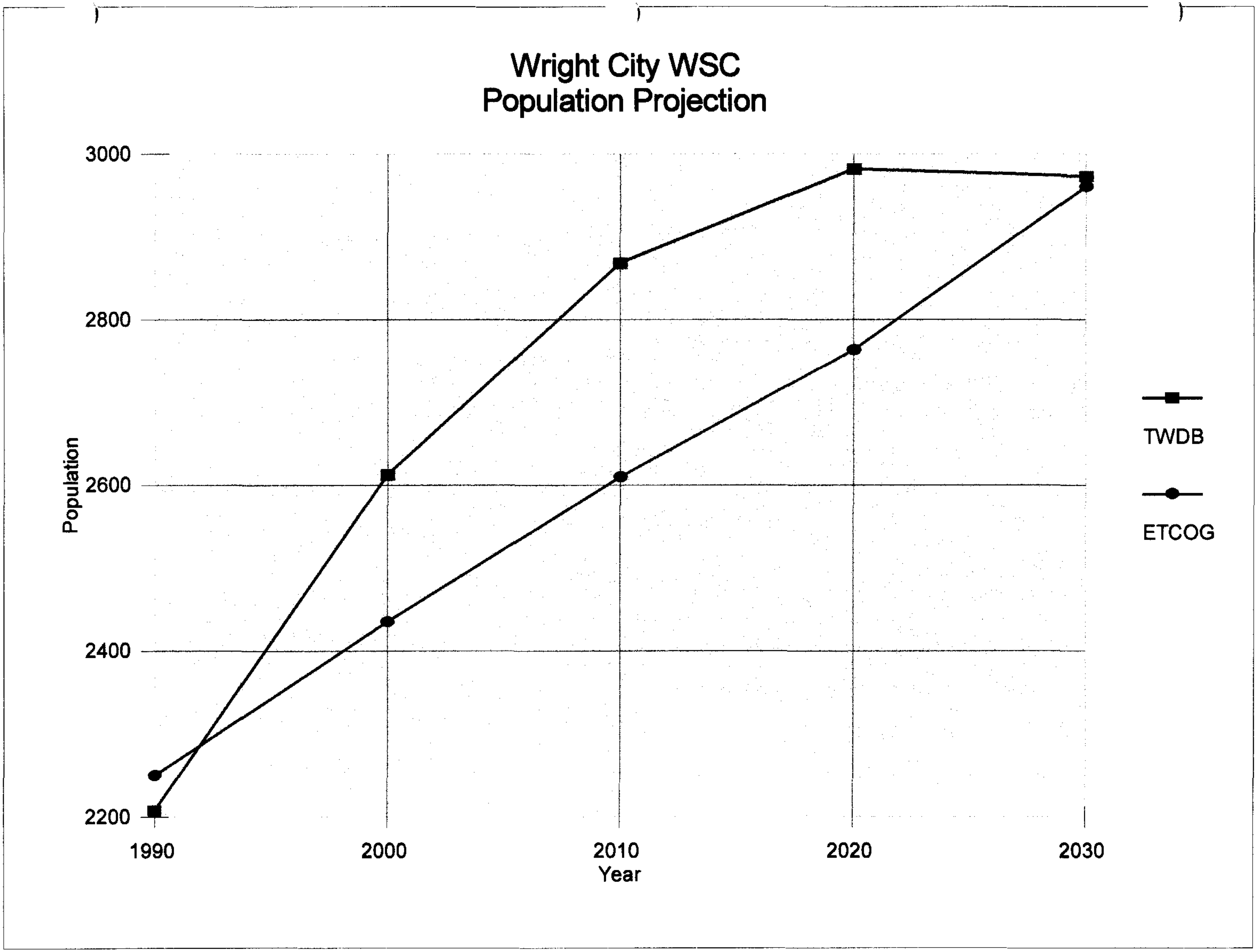

City of New London
Population Projection
3000
2500
2000
1500
1000
500
Population
1990
2000
2010
2020
2030
Year
TWDB
ETCOG



City of Overton
Population Projection
3000
2800
2600
2400
2200
2000
Population
1990
2000
2010
2020
2030
Year
TWDB
ETCOG



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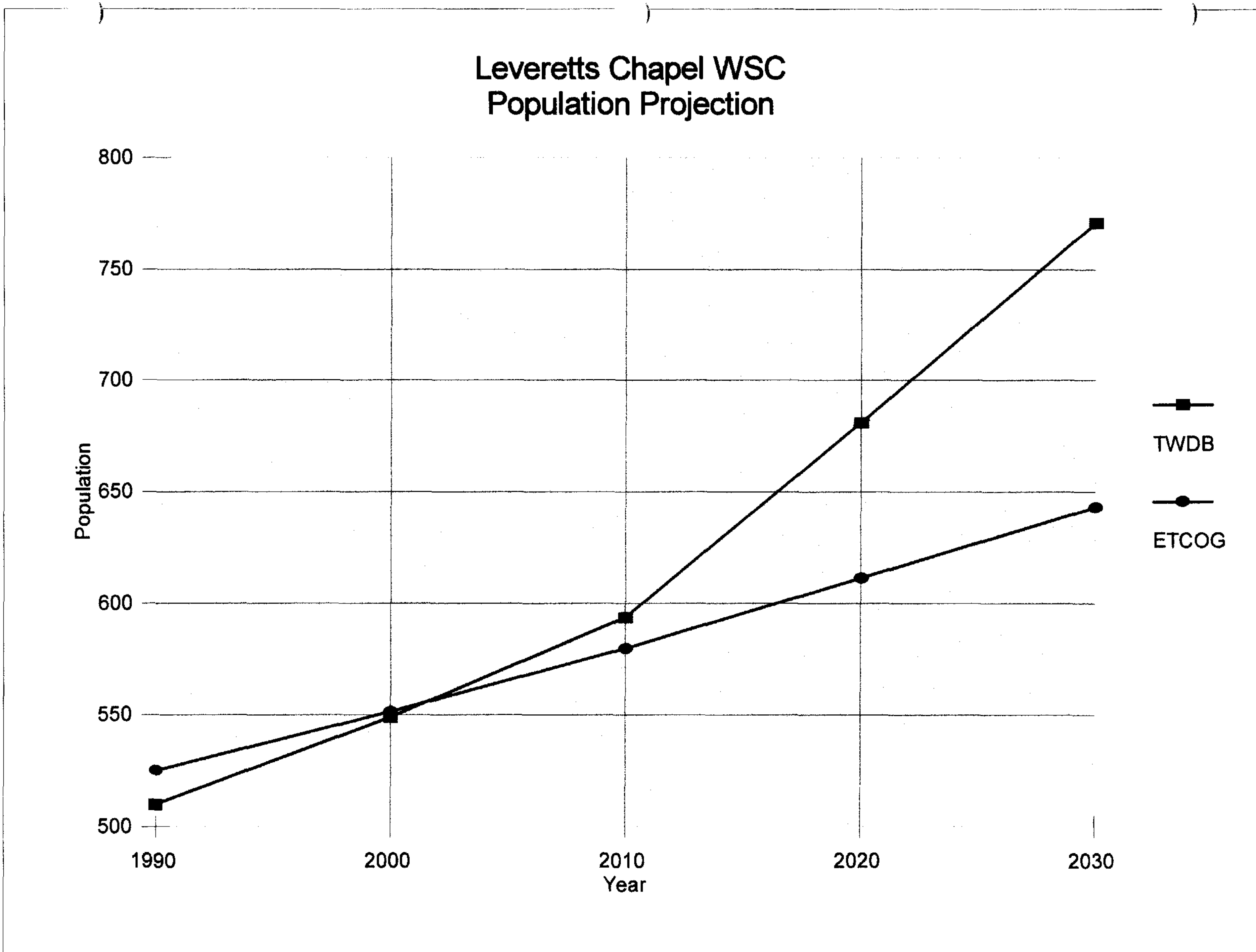

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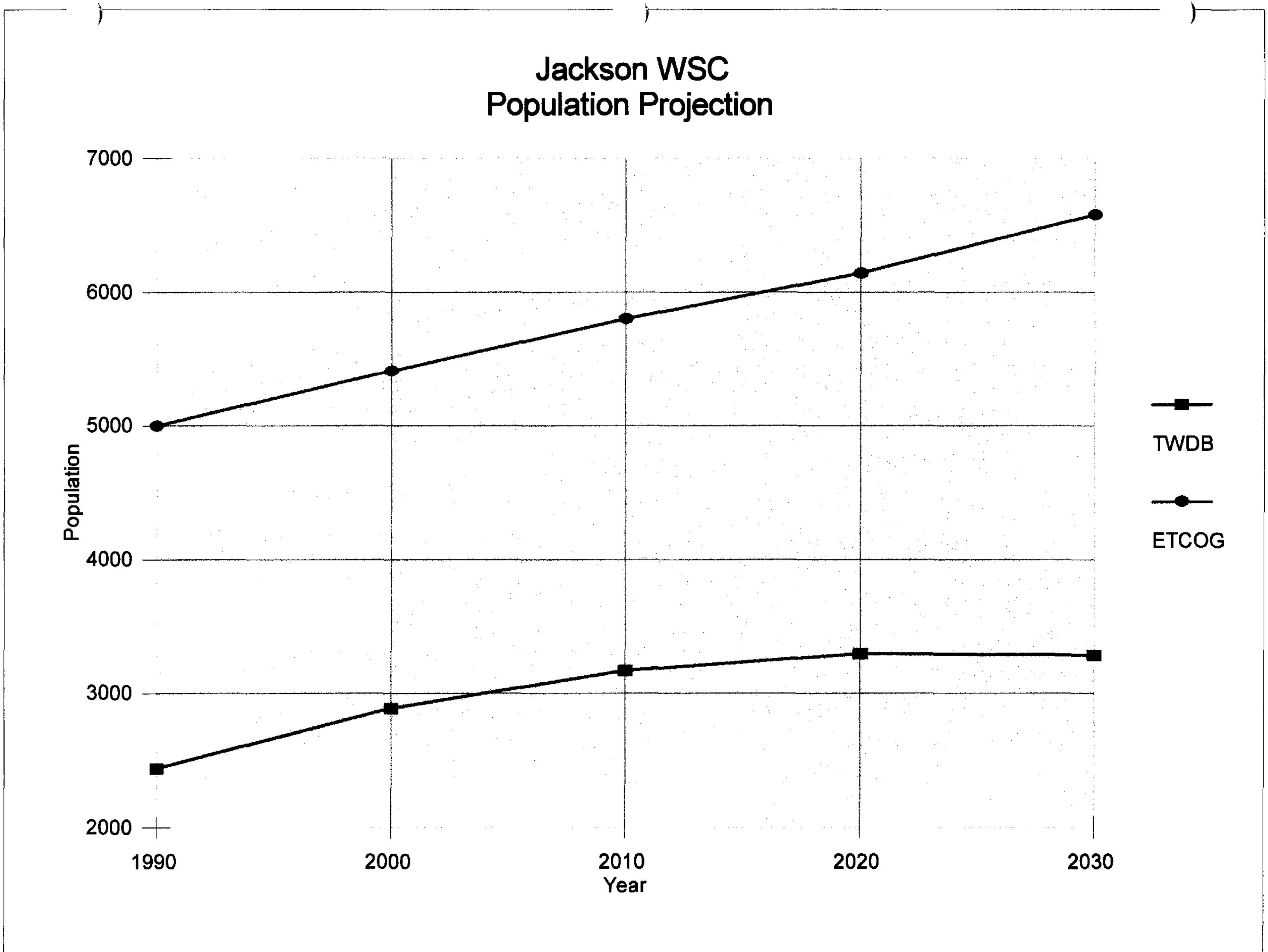

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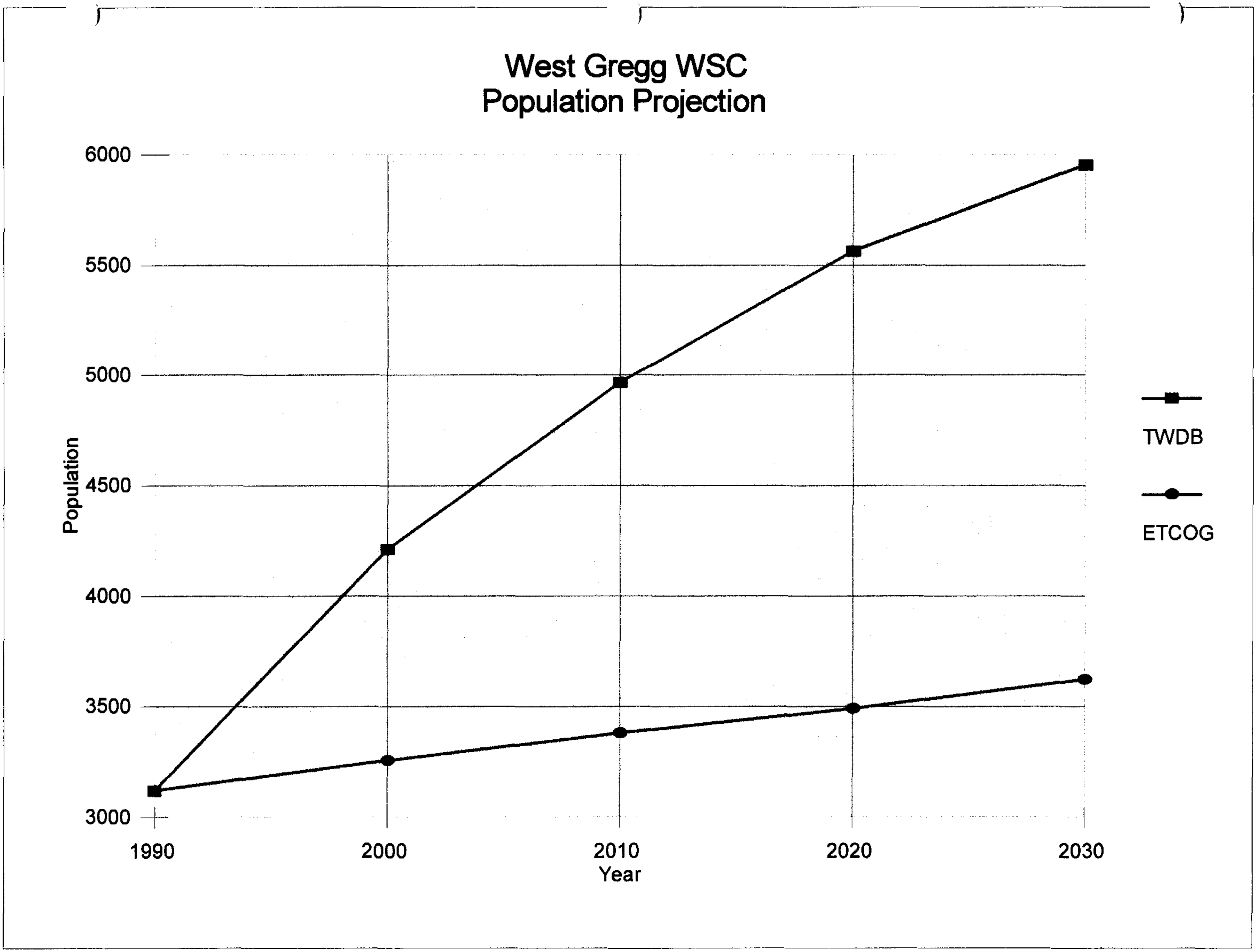

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HISTORICAL WATER DEMANDS AND FUTURE POPULATION AND WATER DEMAND PROJECTIONS
EXHIBIT 11

Region Summary

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Year	No. of Connections	Population	Annual Water Use				Maximum Month Water Use			Max/Avg Ratio
			(1000 gal)	(ac-ft/yr)	(gpm)	(gpcd)	(gpm)	(1000 gal)	(gpcd)	
1990	6,086	16,857	701,576	2,153	1,335	114	N/A	N/A	N/A	N/A
1991	5,173	16,962	731,580	2,245	1,392	118	N/A	N/A	N/A	N/A
1992	6,212	17,343	729,833	2,240	1,389	115	2,020	81,609	157	1.34
1993	6,205	17,405	740,722	2,273	1,409	117	2,370	92,667	177	1.50
1994	6,474	17,861	738,469	2,266	1,405	113	2,149	84,061	157	1.37
1995	6,576	18,411	865,763	2,657	1,647	129	2,402	97,802	177	1.36
1996	6,805	19,224	908,042	2,787	1,728	129	2,367	56,123	97	0.74
2000	4,017	21,270	960,185	2,947	1,827	124	2,521	108,817	171	1.36
2010	4,498	23,806	1,048,893	3,219	1,996	121	2,761	118,938	167	1.36
2020	4,870	25,722	1,112,245	3,413	2,116	118	2,929	126,191	164	1.36
2030	5,088	26,957	1,160,542	3,562	2,208	118	3,019	131,759	163	1.36

NOTES:

1. For 3 cities, population per connection was calculated from information provided by the State Data Center, with an adjustment to the City of Overton data for 1996 as described in the text. For the WSCs, population per connection was assumed at 3.0.
2. Populations for cities include population served inside and outside City limits. For 1990-1996, both inside and outside populations for the 3 cities served were provided by the State Data Center. For 2000 - 2030, TWDB projections were used for the inside City populations. Projections for the outside City populations were made the same as for the WSC's, as described below.
3. Populations for WSCs for 1990 -1996 were estimated at 3.0 persons per connection based on the number of connections reported. For 2000-2030, the WSC populations were projected at the same rate as the "municipal county total" population of the respective county as projected by the TWDB. Projection for Liberty City WSC was adjusted as described in text.
4. For 2000-2030, the no. of connections for WSCs were estimated at 3.0 persons per connection; and no. of connections for cities were estimated based on the 1996 data from the State Data Center, as adjusted. The values used were 2.32, 2.40 and 2.75 persons per connection for the Cities of Arp, Overton, and New London, respectively.
5. For 1990-1996, annual water use was provided by the State Data Center as reported by each entity. For 2000-2030, annual water use was estimated by multiplying the projected population by the average per capita usage during the 1990-1996 time period.
6. For 1990-1996, maximum month usage was from TWDB records as reported by each entity. For 2000-2030, maximum month usage was estimated by multiplying average monthly water use by the ratio of maximum month to annual average use for 1996. Average monthly water use equals annual water use divided by 12.
7. For Region Summary: Population = sum of eight entity populations; Annual Water Use = sum of eight entity annual uses in acre-feet with conversions to other units; Maximum month water use = sum of eight entity maximum month water uses in 1000 gallons with conversions to other units. Values not available (N/A) were estimated.

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HISTORICAL WATER DEMANDS AND FUTURE POPULATION AND WATER DEMAND PROJECTIONS
EXHIBIT 11

City of Arp

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
Year	No. of Connections Inside City Limits	No. of Connections Outside City Limits	Population Inside City Limits	Population Outside City Limits	Total Population Served	Annual Water Use				Maximum Month Water Use		Max/Avg Ratio
						(ac-ft/yr)	(1000 gal)	(gpcd)	(gpm)	(1000 gal)	(gpcd)	
1990	402	26	812	78	890	183	59,645	184	113	6,132	230	1.23
1991	403	26	801	78	879	199	64,871	202	123	6,263	238	1.16
1992	406	26	877	78	955	142	46,361	133	88	5,074	177	1.31
1993	406	31	895	93	988	167	54,463	151	104	6,519	220	1.44
1994	430	31	972	93	1,065	153	49,853	128	95	5,434	170	1.31
1995	423	31	936	93	1,029	174	56,841	151	108	6,118	198	1.29
1996	422	31	956	93	1,049	165	53,656	140	102	5,653	180	1.26
2000		31	1,115	93	1,208	260	84,764	156	161	8,900	246	1.26
2010		34	1,257	102	1,359	280	91,138	156	173	9,569	235	1.26
2020		35	1,391	106	1,497	294	95,926	156	183	10,072	224	1.26
2030		35	1,512	106	1,618	311	101,465	156	193	10,654	219	1.26

Liberty City WSC

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
Year	No. of Connections Inside City Limits	No. of Connections Outside City Limits	Population Inside City Limits	Population Outside City Limits	Total Population Served	Annual Water Use				Maximum Month Water Use		Max/Avg Ratio
						(ac-ft/yr)	(1000 gal)	(gpcd)	(gpm)	(1000 gal)	(gpcd)	
1990	1,200	0	3,600	0	3,600	324	105,569	80	201	11,959	222	1.36
1991	1,200	0	3,600	0	3,600	405	131,961	100	251	15,689	230	1.43
1992	1,230	0	3,690	0	3,690	441	143,691	107	273	14,744	171	1.23
1993	1,235	0	3,705	0	3,705	443	144,342	107	275	16,991	213	1.41
1994	1,268	0	3,804	0	3,804	437	142,387	103	271	17,350	165	1.46
1995	1,304	0	3,912	0	3,912	452	147,275	103	280	18,280	192	1.49
1996	1,340	0	4,020	0	4,020	446	145,320	99	276	N/A	N/A	N/A
2000			4,860	0	4,860	544	177,117	100	337	21,992	151	1.49
2010			5,736	0	5,736	643	209,364	100	398	25,996	151	1.49
2020			6,423	0	6,423	720	234,440	100	446	29,110	151	1.49
2030			6,873	0	6,873	770	250,865	100	477	31,149	151	1.49

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HISTORICAL WATER DEMANDS AND FUTURE POPULATION AND WATER DEMAND PROJECTIONS
EXHIBIT 11

New London

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
Year	No. of Connections Inside City Limits	No. of Connections Outside City Limits	Population Inside City Limits	Population Outside City Limits	Total Population Served	Annual Water Use				Maximum Month Water Use		Max/Avg Ratio
						(ac-ft/yr)	(1000 gal)	(gpcd)	(gpm)	(1000 gal)	(gpcd)	
1990	393	340	926	1,020	1,946	331	107,949	152	205	10,546	181	1.17
1991	390	350	916	1,050	1,966	341	111,026	155	211	14,398	244	1.56
1992	447	300	992	900	1,892	377	122,942	178	234	14,541	256	1.42
1993	431	289	991	867	1,858	384	125,219	185	238	18,268	328	1.75
1994	431	289	990	867	1,857	393	128,014	189	244	13,911	250	1.30
1995	367	353	984	1,059	2,043	455	148,331	199	282	17,241	281	1.39
1996	397	323	1,010	969	1,979	414	134,941	187	257	15,474	261	1.38
2000		366	1,039	1,098	2,137	452	147,255	178	280	16,934	264	1.38
2010		395	1,069	1,185	2,254	466	151,930	178	289	17,472	258	1.38
2020		453	1,079	1,359	2,438	492	160,302	178	305	18,435	252	1.38
2030		512	1,127	1,536	2,663	533	173,757	178	331	19,982	250	1.38

Overton

Year	No. of Connections Inside City Limits	No. of Connections Outside City Limits	Population Inside City Limits	Population Outside City Limits	Total Population Served	Annual Water Use				Maximum Month Water Use		Max/Avg Ratio
						(ac-ft/yr)	(1000 gal)	(gpcd)	(gpm)	(1000 gal)	(gpcd)	
						(ac-ft/yr)	(1000 gal)	(gpcd)	(gpm)	(1000 gal)	(gpcd)	
1990	953	12	2,105	36	2,141	357	116,321	149	205	N/A		
1991	N/R	N/R	2,105	0	2,105	357	116,321	151	211	N/A		
1992	922	32	2,163	96	2,259	357	116,323	141	234	13245	195	1.37
1993	916	38	2,163	114	2,277	390	127,018	153	238	15848	232	1.50
1994	1,032	32	2,156	96	2,252	379	123,296	150	244	13730	203	1.34
1995	1,032	32	2,229	96	2,325	602	196,075	231	282	23040	330	1.41
1996	972	199	2,216	597	2,813	756	246,327	240	257	N/A	0	
2000		199	2,205	597	2,802	576	187,691	174	280	22,054	262	1.41
2010		202	2,250	606	2,856	567	184,691	174	289	21,701	253	1.41
2020		207	2,218	621	2,839	541	176,217	174	305	20,705	243	1.41
2030		212	2,180	636	2,816	528	171,978	174	331	20,207	239	1.41

HISTORICAL WATER DEMANDS AND FUTURE POPULATION AND WATER DEMAND PROJECTIONS
EXHIBIT 11

Wright City WSC

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Year	No. of Connections Reported by Entity	Population = Conn * 3	Annual Water Use				Maximum Month Water Use			Max/Avg Ratio
			(1000 gal)	(ac-ft/yr)	(gpm)	(gpcd)	(1000 gal)	(gpcd)	(gpm)	
1990	736	2,208	105,637	324	201	131	11,220	169	260	1.27
1991	752	2,256	95,959	295	183	117	9,899	146	229	1.24
1992	748	2,244	77,694	238	148	95	7,301	108	169	1.13
1993	746	2,238	74,354	228	141	91	10,186	152	236	1.64
1994	760	2,280	79,941	245	152	96	8,767	128	203	1.32
1995	770	2,310	82,501	253	157	98	8,708	126	202	1.27
1996	780	2,340	81,688	251	155	96	8,749	125	203	1.29
2000	871	2,613	98,514	302	187	103	10,590	135	245	1.29
2010	956	2,868	107,822	331	205	103	11,591	135	268	1.29
2020	994	2,982	112,108	344	213	103	12,052	135	279	1.29
2030	991	2,973	111,770	343	213	103	12,015	135	278	1.29

Leveretts Chapel WSC

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Year	No. of Connections Reported by Entity	Population = Conn * 3	Annual Water Use				Maximum Month Water Use			Max/Avg Ratio
			(1000 gal)	(ac-ft/yr)	(gpm)	(gpcd)	(1000 gal)	(gpcd)	(gpm)	
1990	170	510	13,688	42	26	74	1,452	95	33	1.27
1991	170	510	13,703	42	26	74	1,528	100	35	1.34
1992	170	510	16,258	50	31	87	1,601	105	37	1.18
1993	165	495	15,539	48	30	86	1,653	111	38	1.28
1994	165	495	17,411	53	33	96	1,710	115	39	1.18
1995	165	495	17,913	55	34	99	1,807	122	41	1.21
1996	165	495	19,682	60	37	109	1,989	134	45	1.21
2000	183	549	17,890	55	34	89	1,804	110	41	1.21
2010	198	594	19,296	59	37	89	1,946	109	44	1.21
2020	227	681	22,122	68	42	89	2,231	109	51	1.21
2030	257	771	25,046	77	48	89	2,525	109	58	1.21

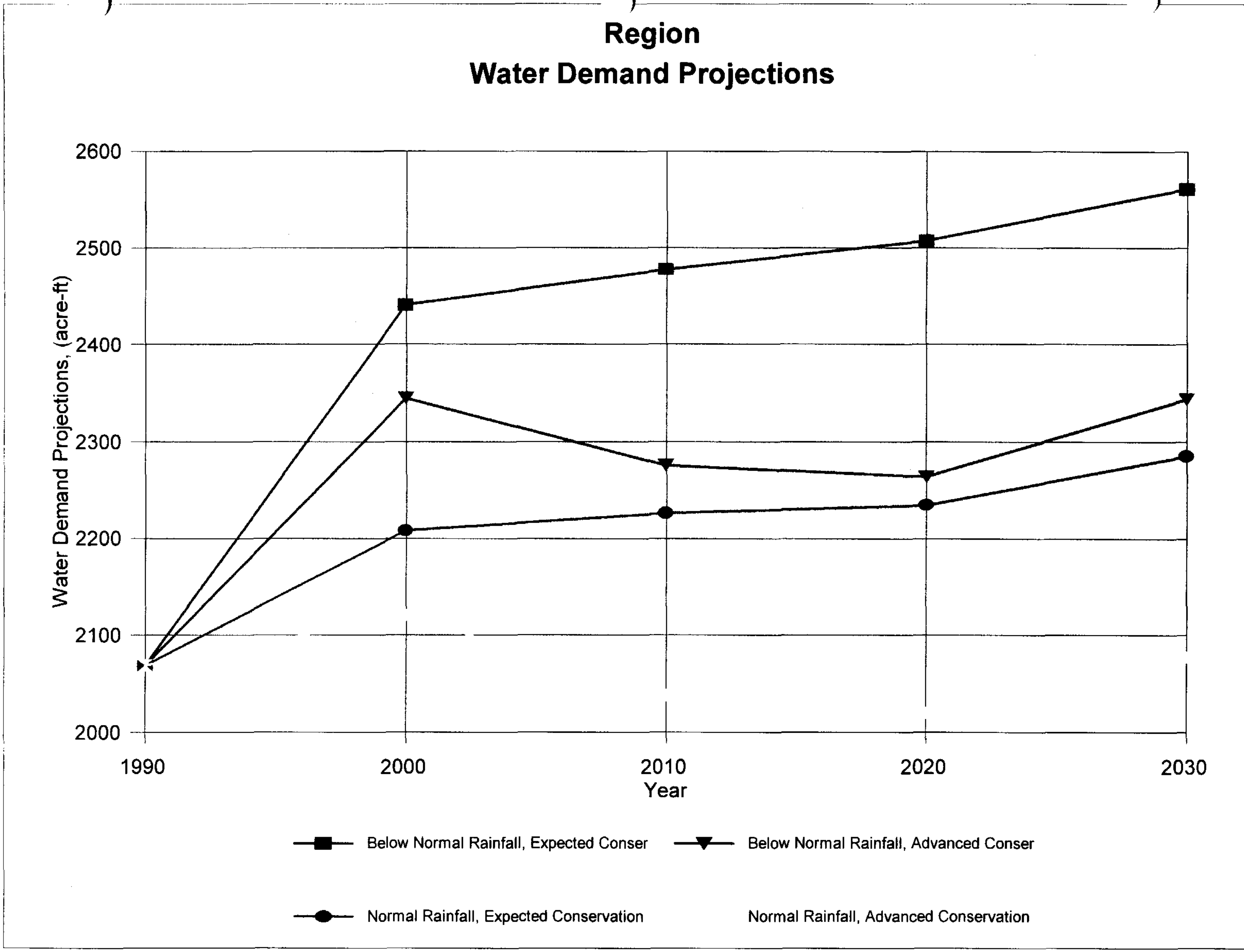
HISTORICAL WATER DEMANDS AND FUTURE POPULATION AND WATER DEMAND PROJECTIONS
EXHIBIT 11

Jackson WSC

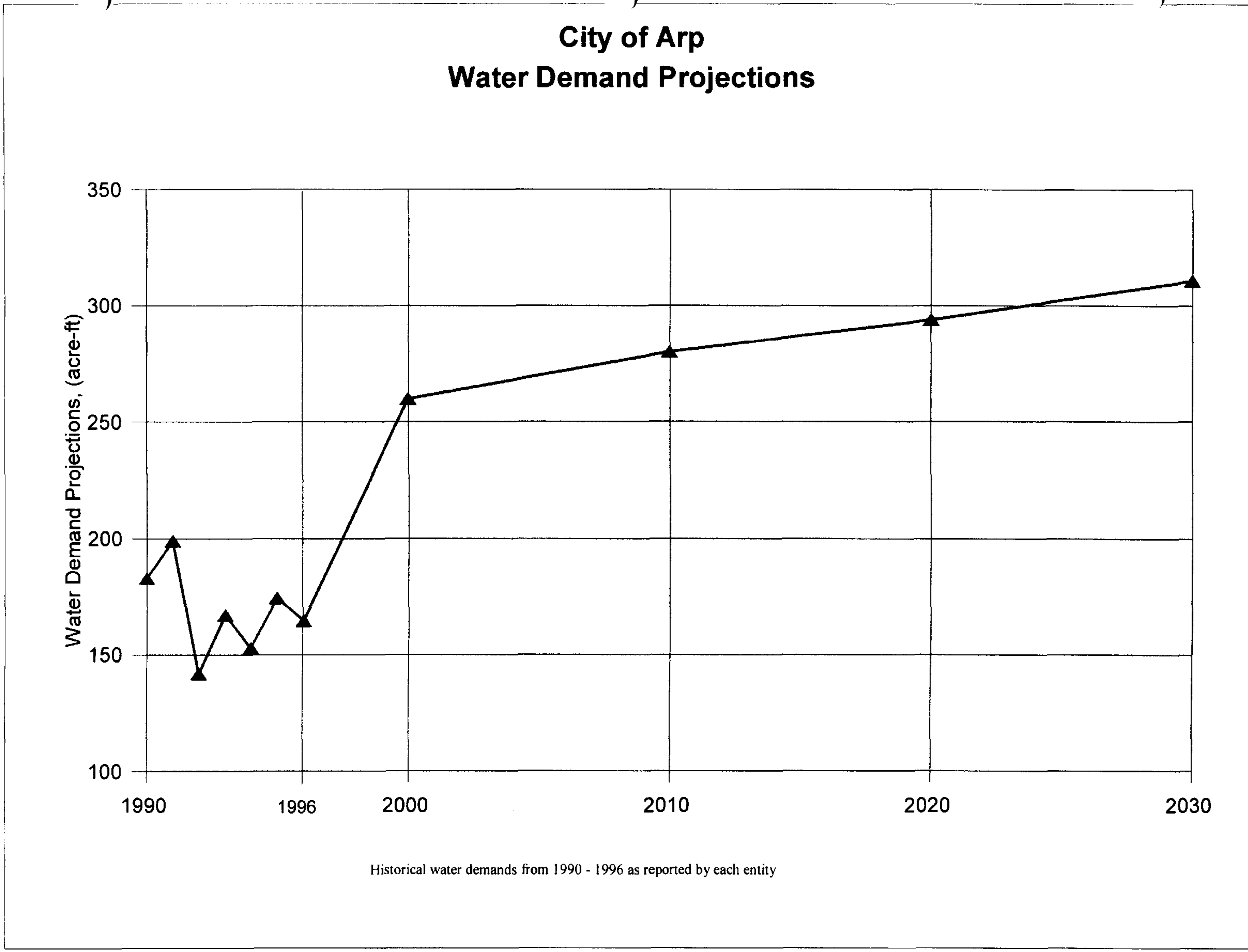
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Year	No. of Connections Reported by Entity	Population = Conn * 3	Annual Water Use				Maximum Month Water Use			Max/Avg Ratio
			(1000 gal)	(ac-ft/yr)	(gpm)	(gpcd)	(1000 gal)	(gpcd)	(gpm)	
1990	814	2442	68,710	211	131	77	7,675	105	175	1.34
1991	830	2490	70,079	215	133	77	7,335	98	167	1.26
1992	841	2523	74,976	230	143	81	7,198	95	164	1.15
1993	858	2574	75,842	233	144	81	8,529	110	195	1.35
1994	879	2637	83,560	256	159	87	8,813	111	201	1.27
1995	901	2703	88,068	270	168	89	8,825	109	201	1.20
1996	937	2811	85,424	262	163	83	8,373	99	191	1.18
2000	963	2889	87,522	269	167	83	8,606	99	196	1.18
2010	1057	3171	96,065	295	183	83	9,446	99	216	1.18
2020	1099	3297	99,883	307	190	83	9,822	99	224	1.18
2030	1096	3288	99,610	306	190	83	9,795	99	224	1.18

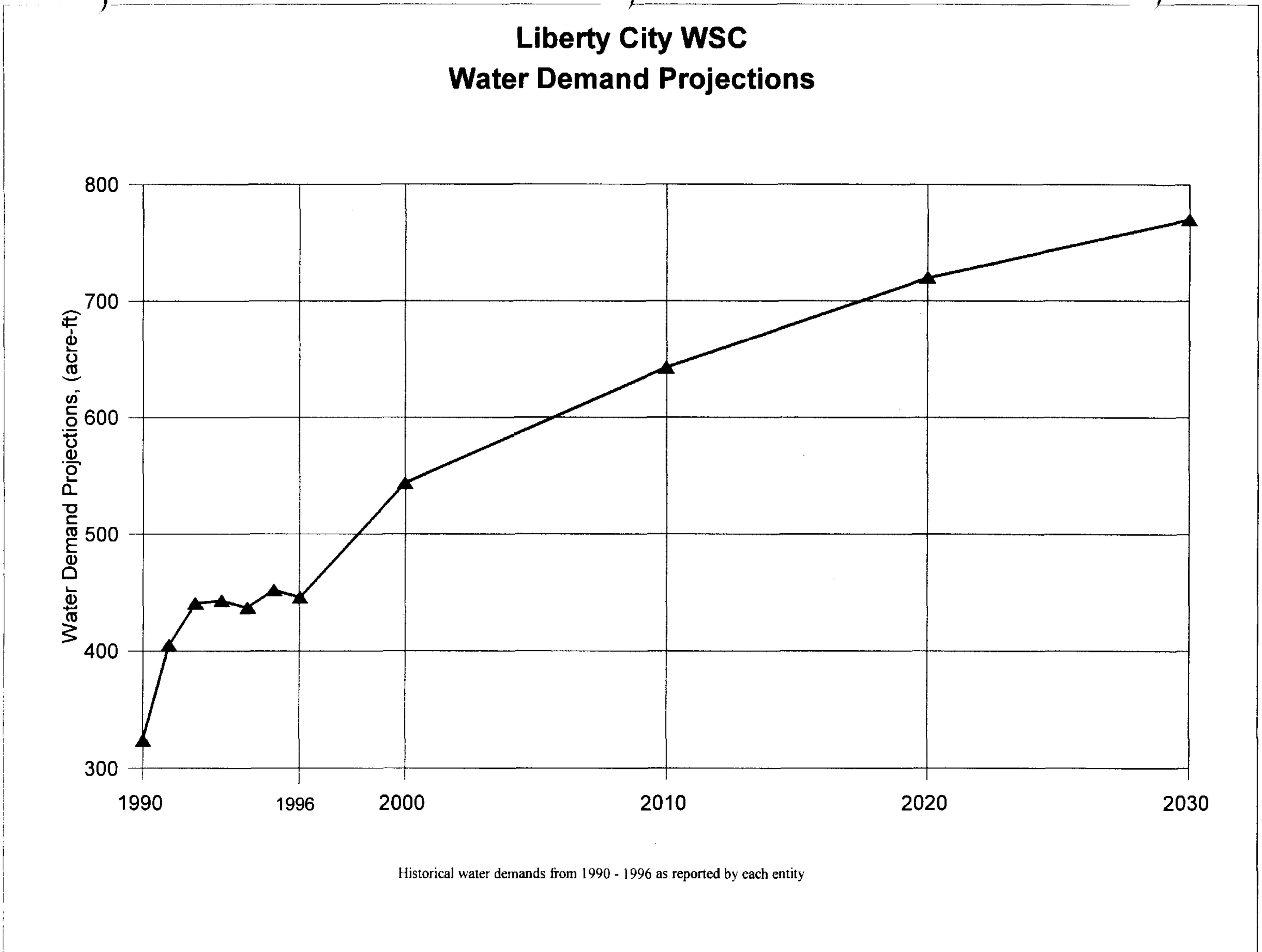
W. Gregg WSC

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Year	No. of Connections Reported by Entity	Population = Conn * 3	Annual Water Use				Maximum Month Water Use			Max/Avg Ratio
			(1000 gal)	(ac-ft/yr)	(gpm)	(gpcd)	(1000 gal)	(gpcd)	(gpm)	
1990	1040	3120	124,059	381	236	109	13,152	141	590	1.27
1991	1052	3156	127,660	392	243	111	13,978	148	607	1.31
1992	1090	3270	131,589	404	250	110	17,905	183	626	1.63
1993	1090	3270	123,945	380	236	104	14,673	150	590	1.42
1994	1157	3471	114,007	350	217	90	14,346	138	542	1.51
1995	1198	3594	128,760	395	245	98	13,784	128	612	1.28
1996	1239	3717	141,005	433	268	104	15,886	142	671	1.35
2000	1404	4212	159,433	489	303	104	17,936	142	409	1.35
2010	1656	4968	188,585	579	359	104	21,216	142	485	1.35
2020	1855	5565	211,247	648	402	104	23,765	142	543	1.35
2030	1985	5955	226,052	694	430	104	25,431	142	581	1.35

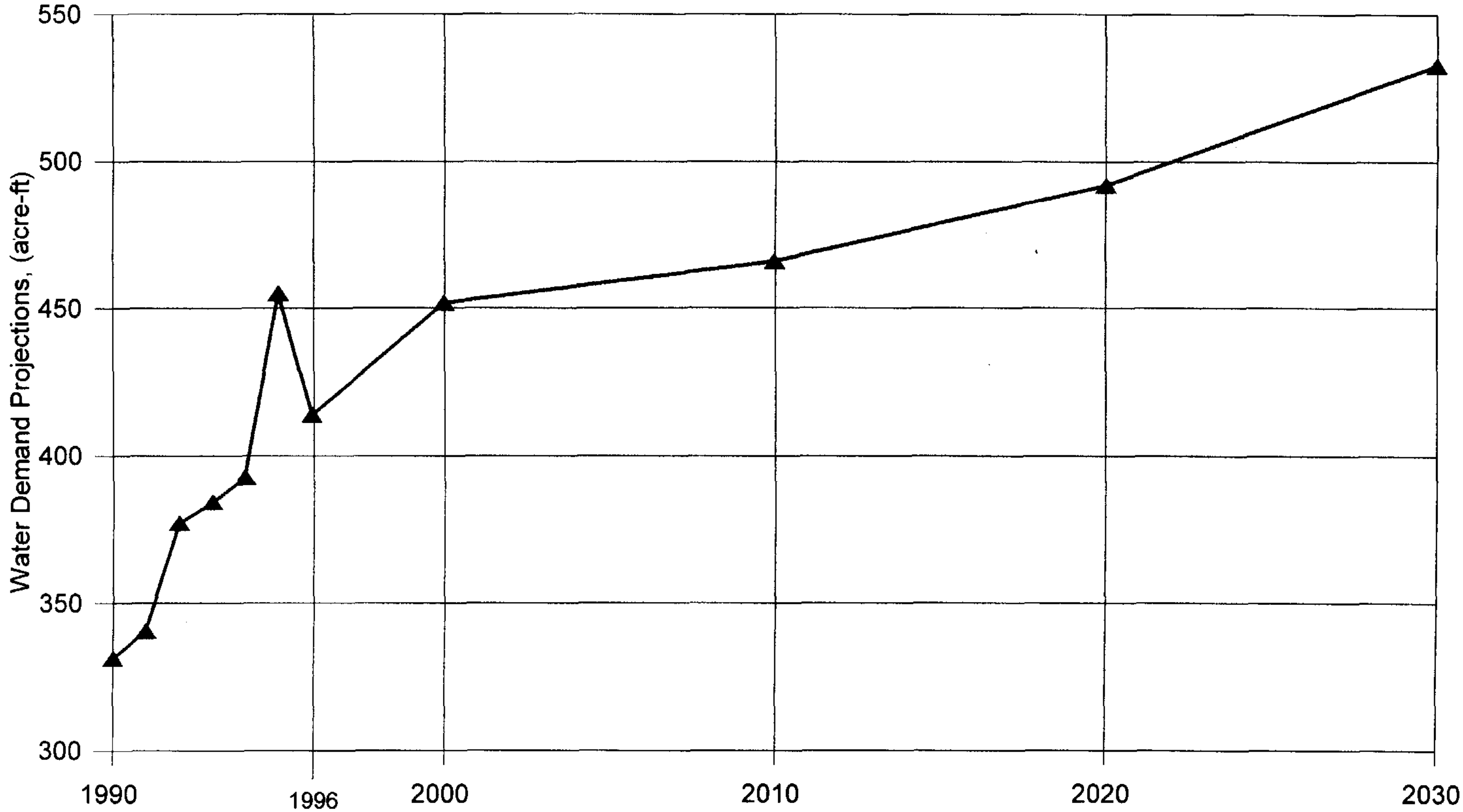


Region
Water Demand Projections
Water Demand Projections, (acre-ft)
2600
2500
2400
2300
2200
2100
2000
1990
2000
2010
2020
2030
Year
Below Normal Rainfall, Expected Conser
Below Normal Rainfall, Advanced Conser
Normal Rainfall, Expected Conservation
Normal Rainfall, Advanced Conservation


City of Arp
Water Demand Projections
Water Demand Projections, (acre-ft)
350
300
250
200
150
100
1990
1996
2000
2010
2020
2030
Historical water demands from 1990 - 1996 as reported by each entity

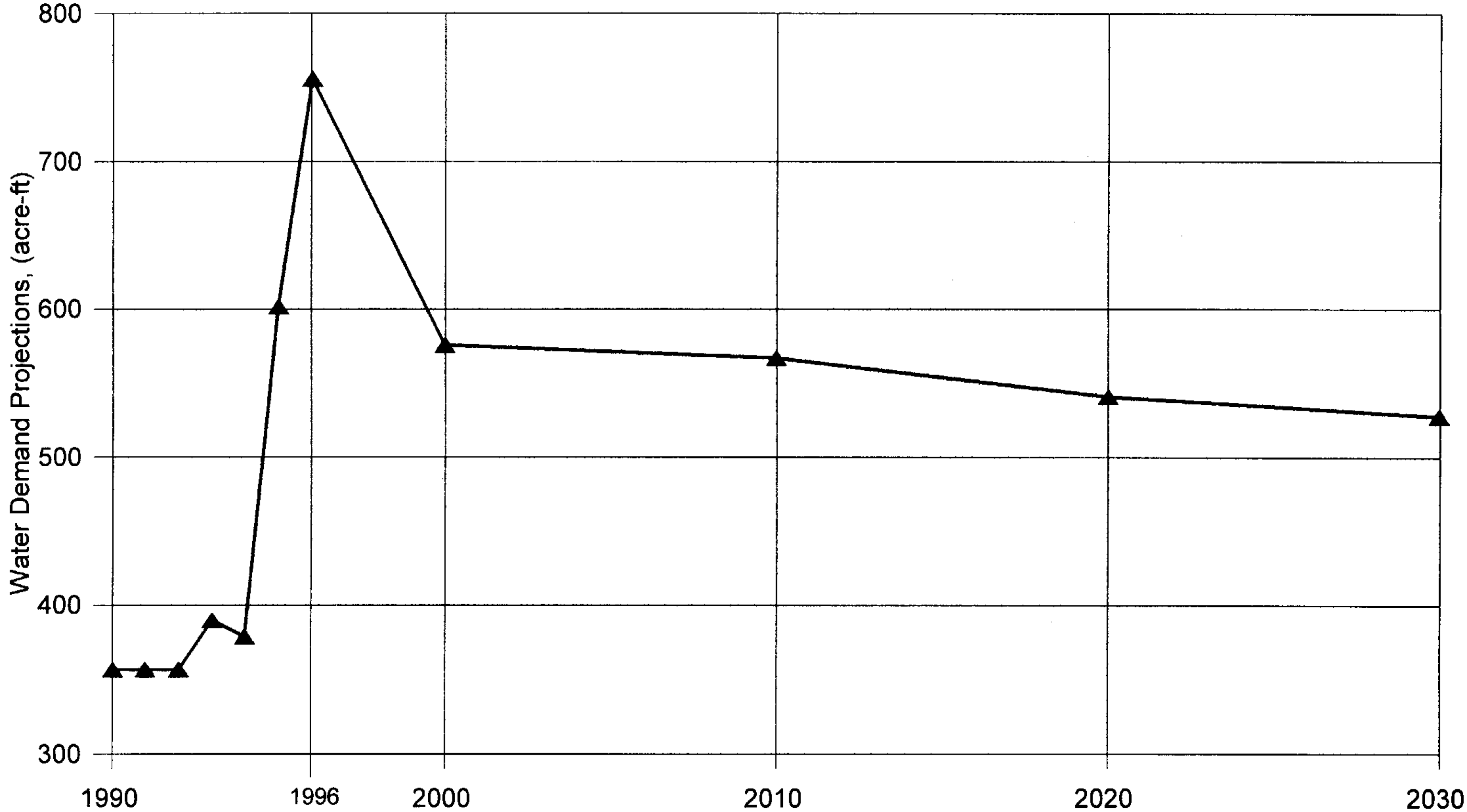

Liberty City WSC
Water Demand Projections
Water Demand Projections, (acre-ft)
800
700
600
500
400
300
1990
1996
2000
2010
2020
2030
Historical water demands from 1990 - 1996 as reported by each entity

City of New London
Water Demand Projections

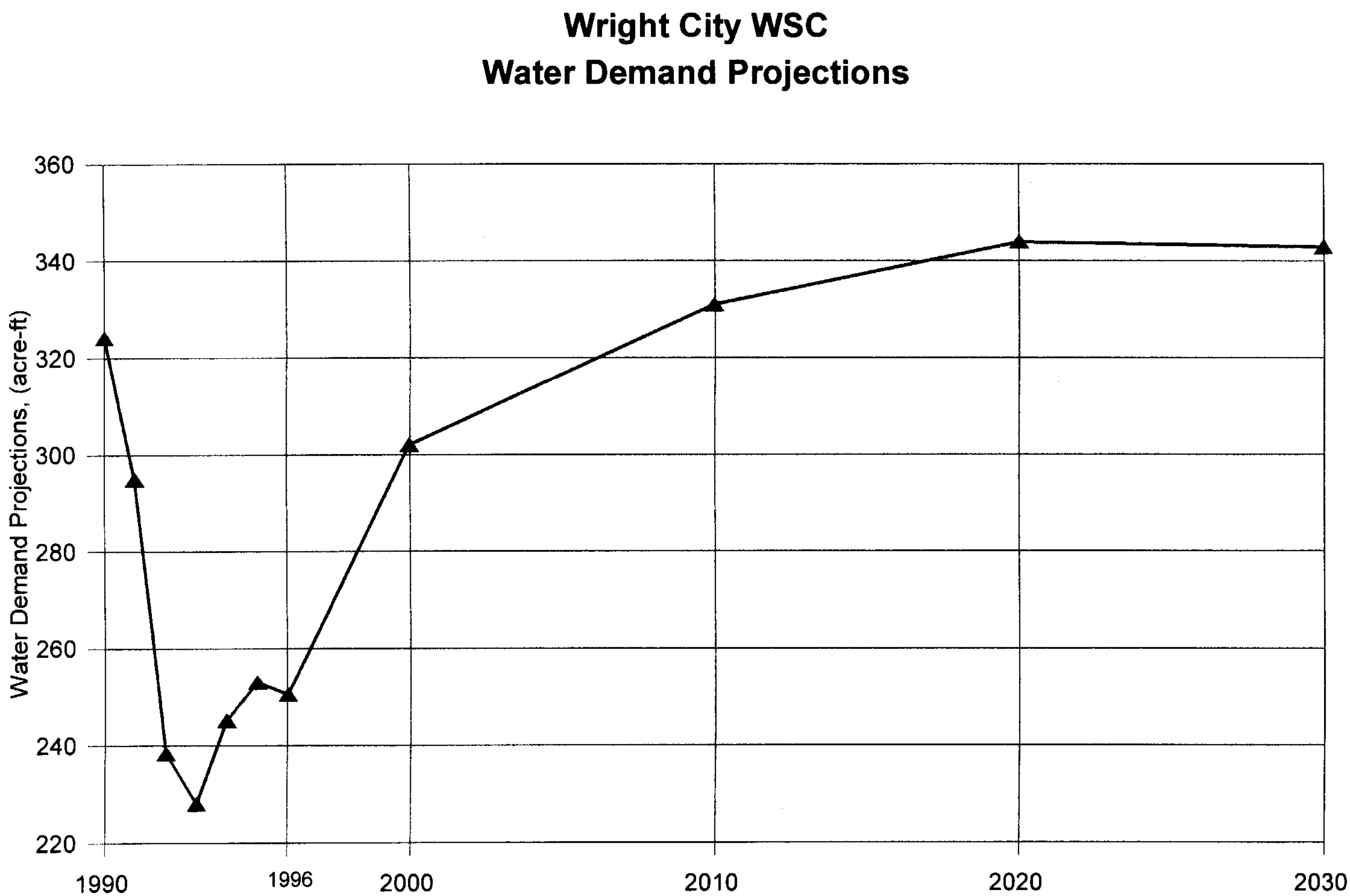


Historical water demands from 1990 - 1996 as reported by each entity

City of Overton
Water Demand Projections

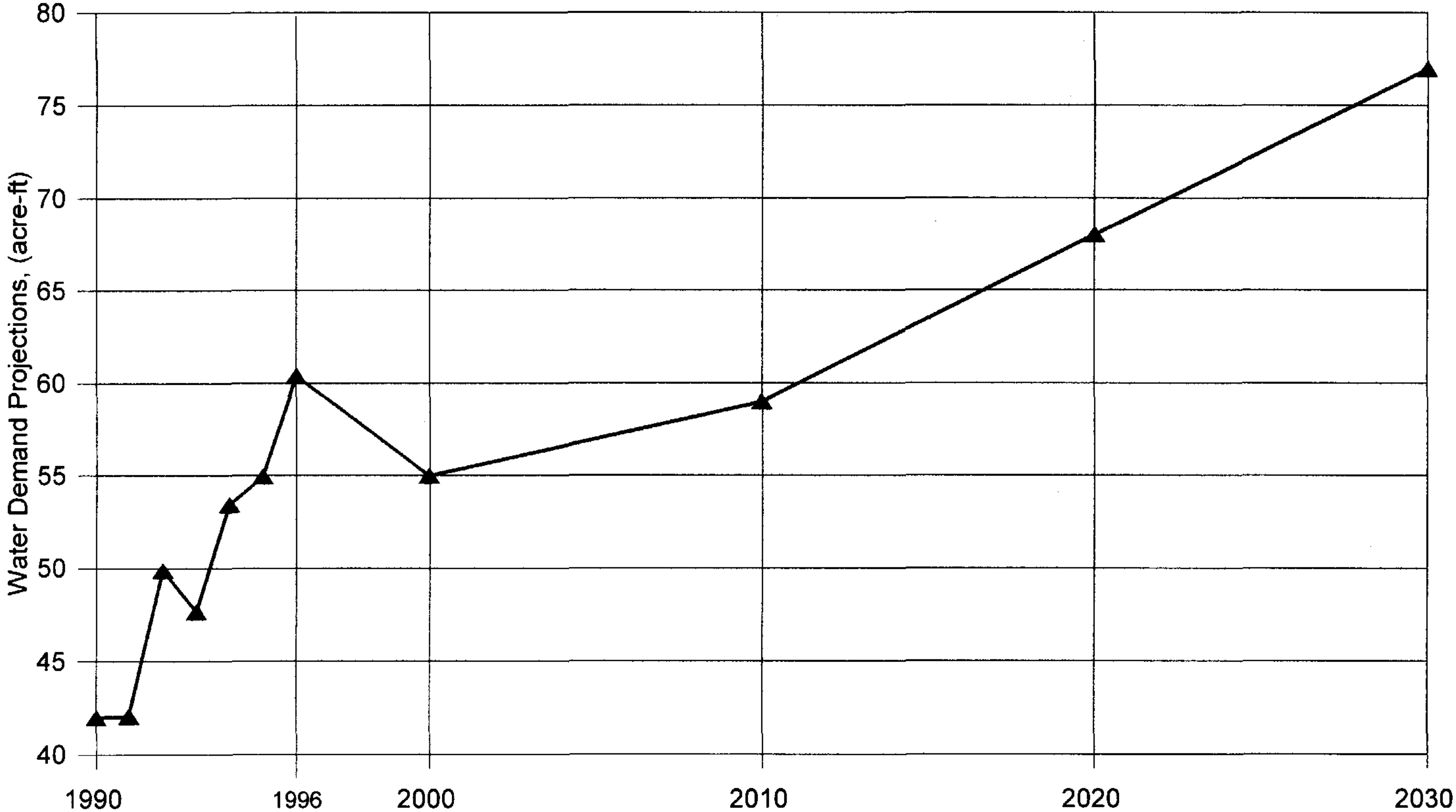


Historical water demands from 1990 - 1996 as reported by each entity



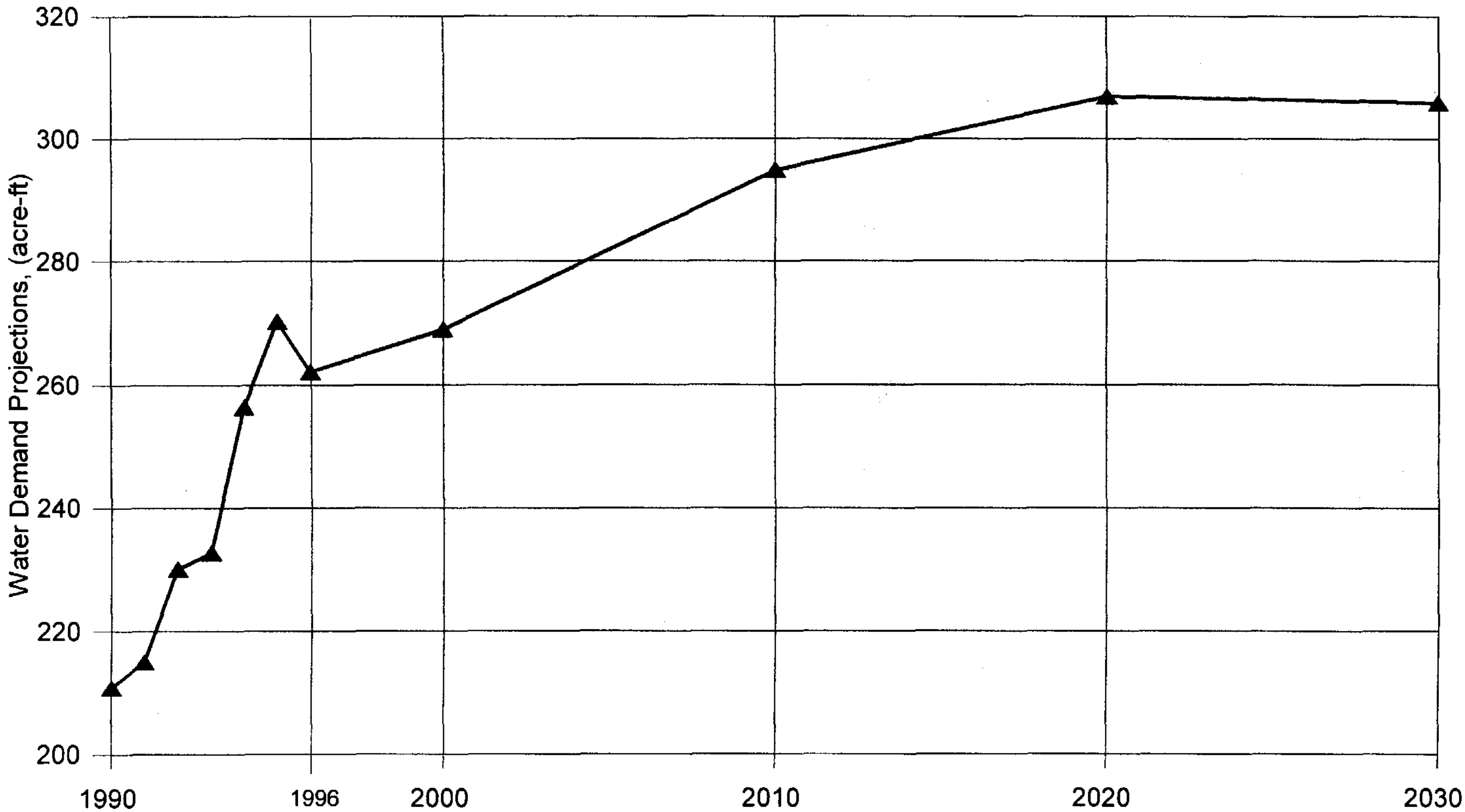
Historical water demands from 1990 - 1996 as reported by each entity

Leverrets Chapel WSC
Water Demand Projections



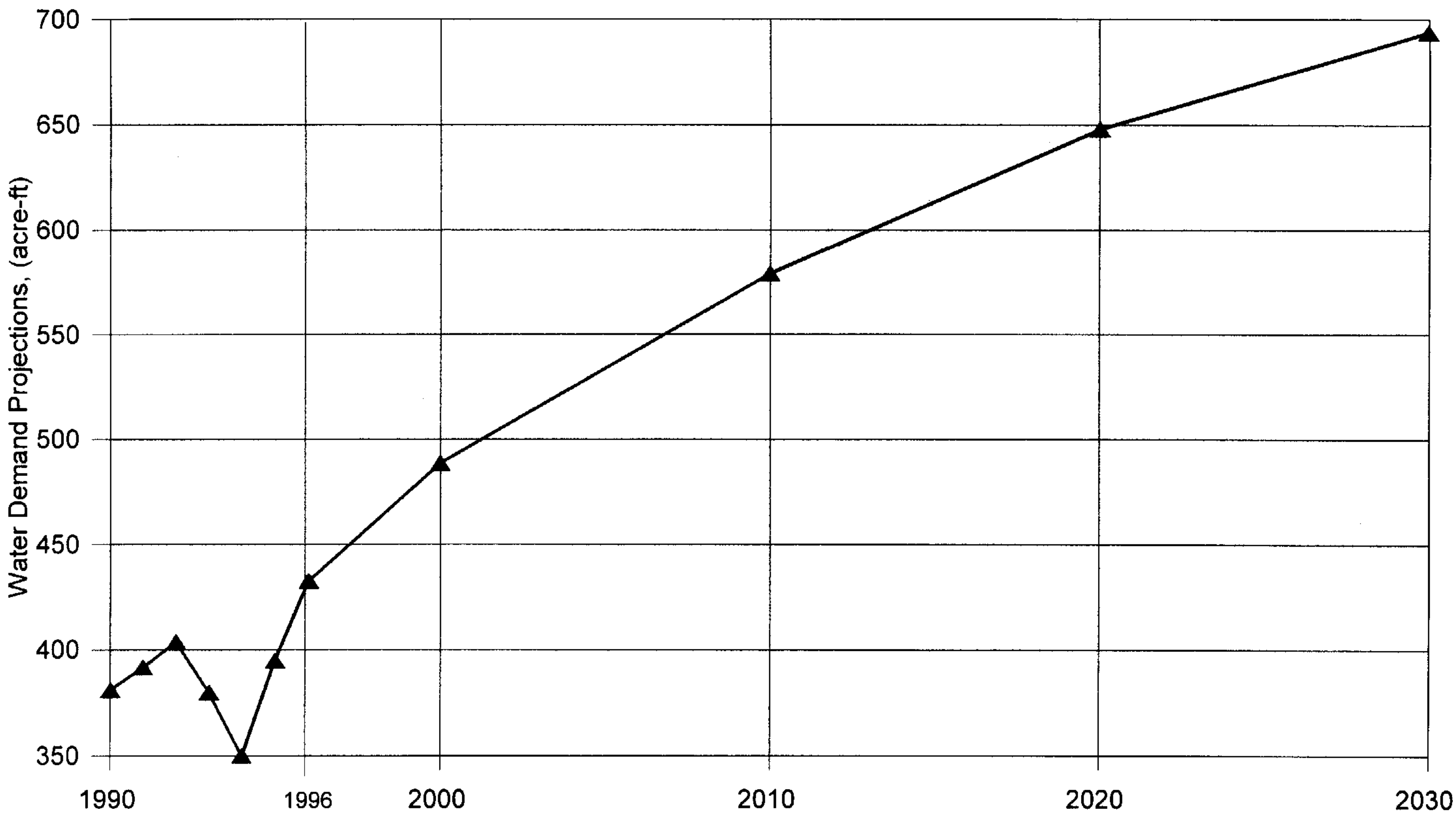
Historical water demands from 1990 - 1996 as reported by each entity

Jackson WSC
Water Demand Projections

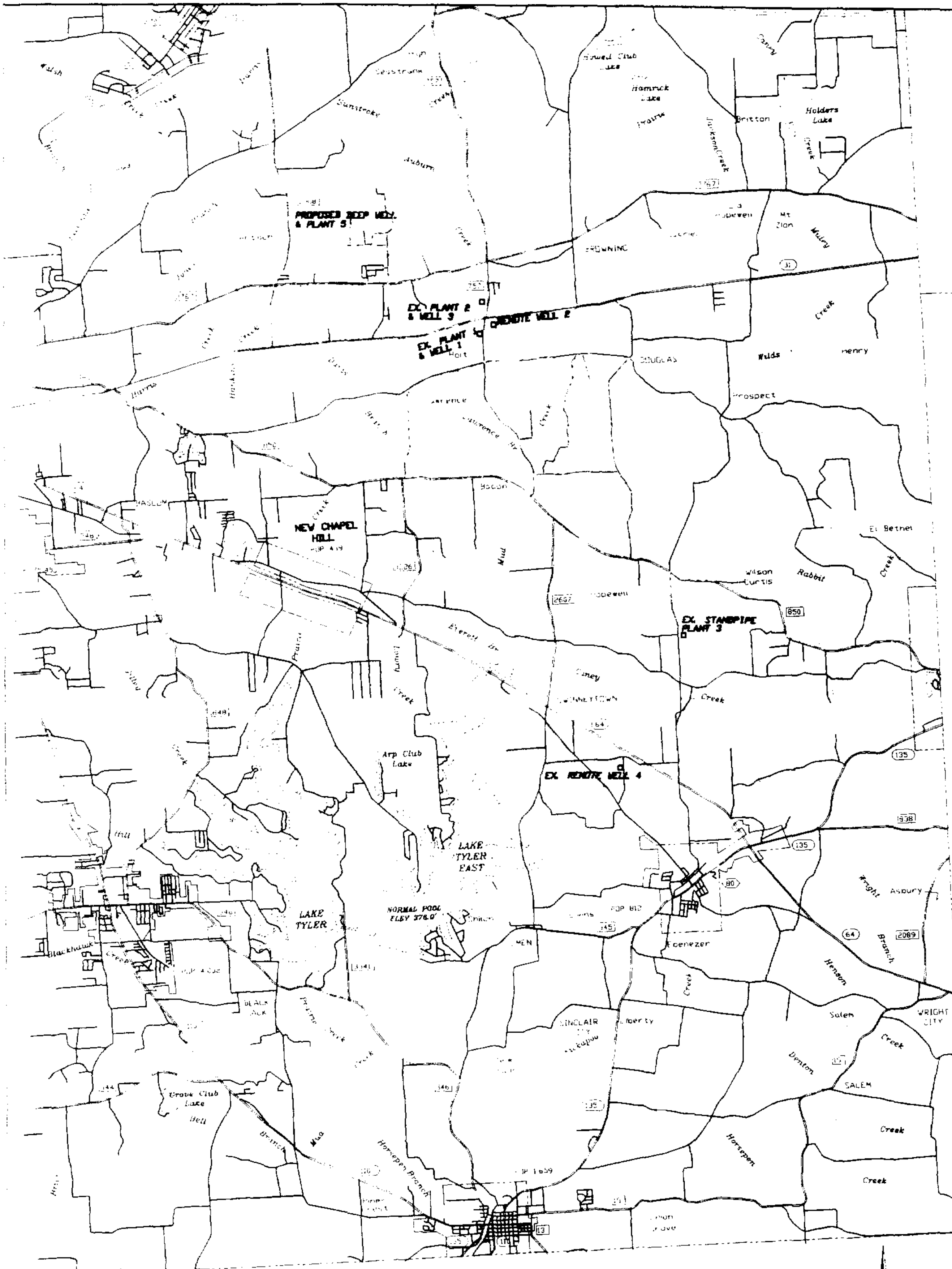


Historical water demands from 1990 - 1996 as reported by each entity

West Gregg WSC
Water Demand Projections



Historical water demands from 1990 - 1996 as reported by each entity



JACKSON

WATER SUPPLY CORPORATION

WATER SYSTEM DISTRIBUTION MAP

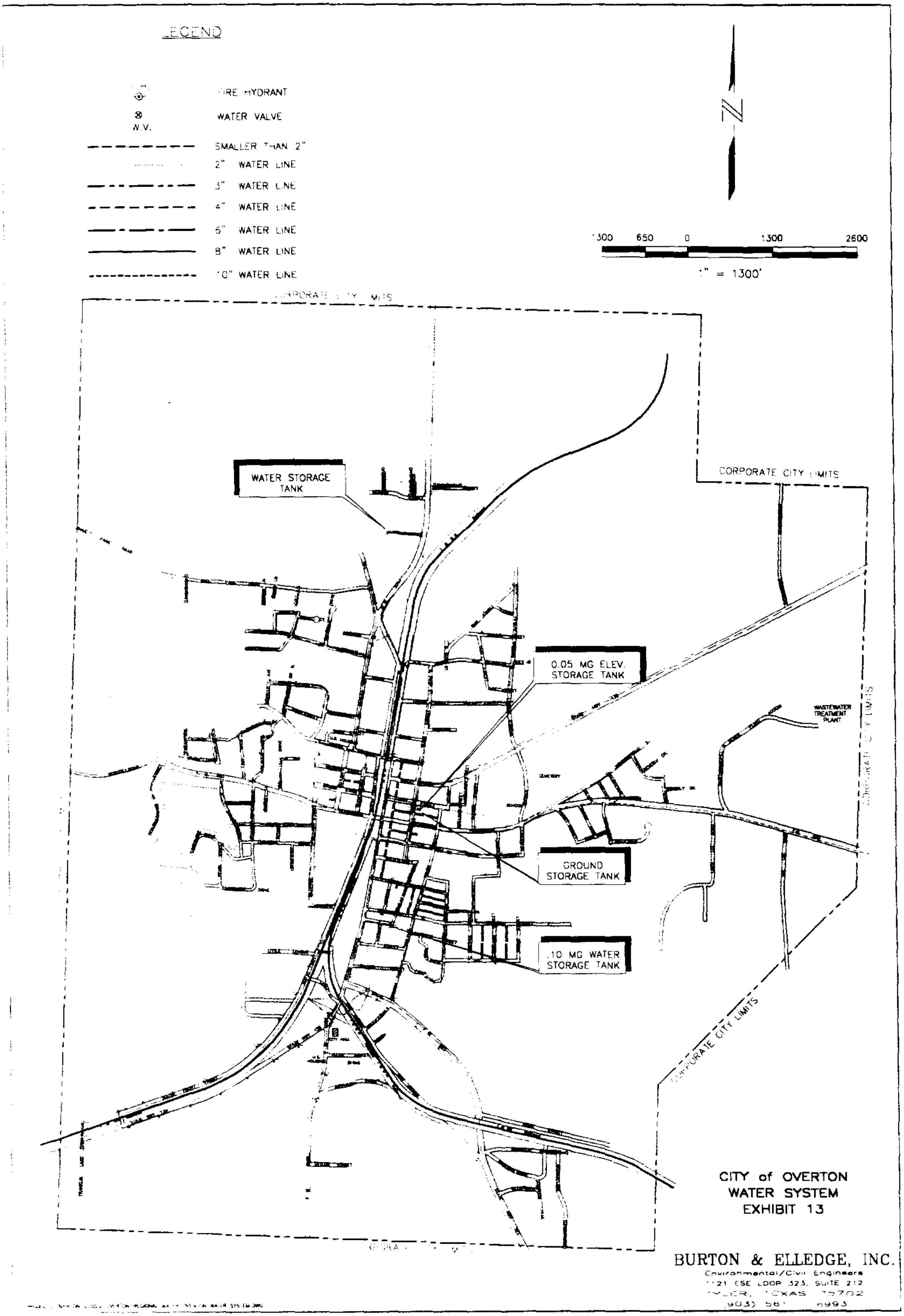
EXHIBIT 12

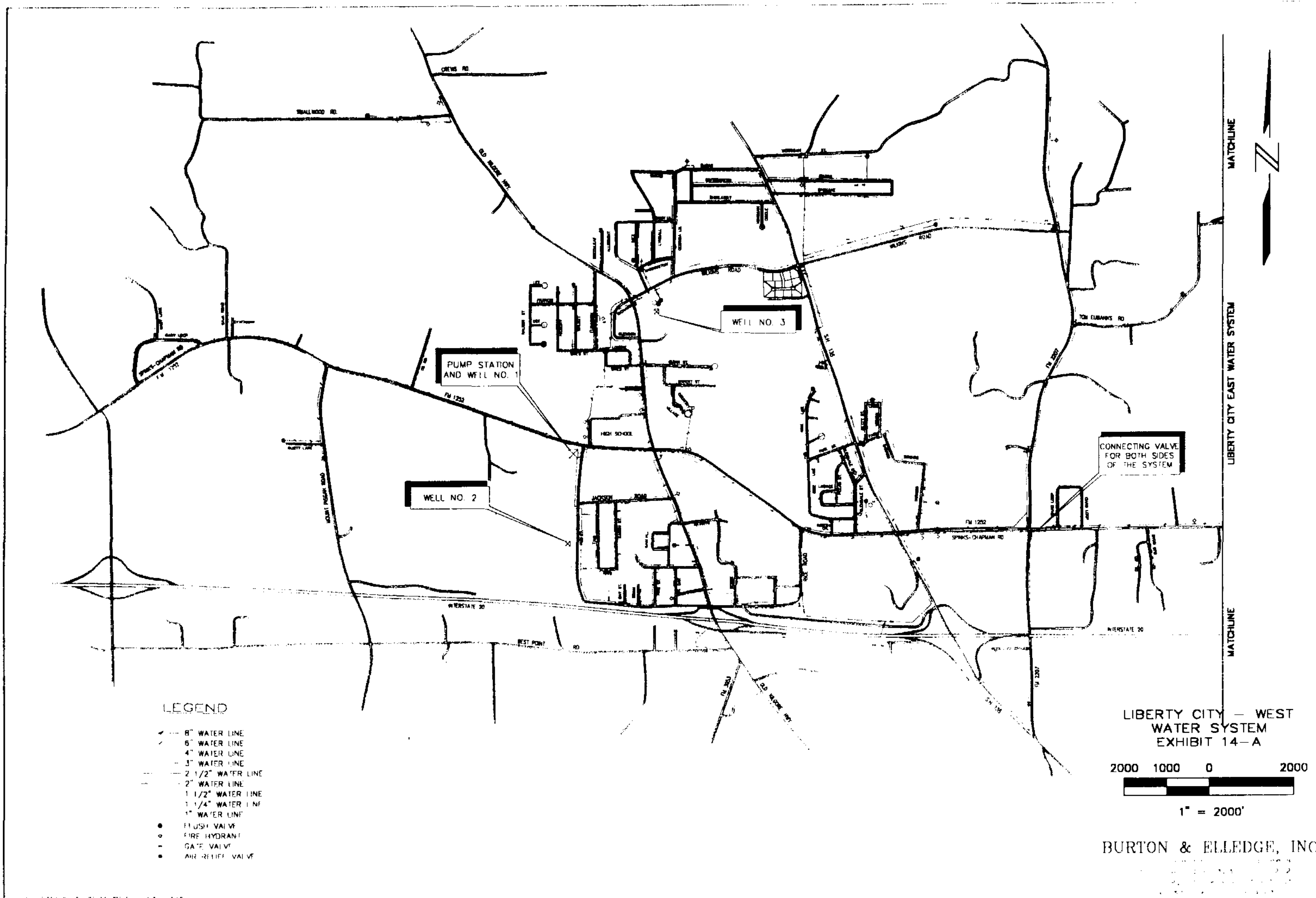
EXISTING WATER MAIN

EXISTING CREEK

CITY LIMITS

SCALE 1" = 6000'


LEGEND
FIRE HYDRANT
WATER VALVE
W.V.
SMALLER THAN 2"
2" WATER LINE
3" WATER LINE
4" WATER LINE
6" WATER LINE
8" WATER LINE
10" WATER LINE
1300 650 0 1300 2600
1" = 1300'
N
CORPORATE CITY LIMITS
WATER STORAGE TANK
0.05 MG ELEV. STORAGE TANK
WASTEWATER TREATMENT PLANT
GROUND STORAGE TANK
.10 MG WATER STORAGE TANK
CITY of OVERTON
WATER SYSTEM
EXHIBIT 13
BURTON & ELLEDGE, INC.
Environmental/Civil Engineers


LIBERTY CITY — WEST
WATER SYSTEM
EXHIBIT 14—A
2000 1000 0 2000
1" = 2000'
BURTON & ELLEDGE, INC.
LEGEND
8" WATER LINE
6" WATER LINE
4" WATER LINE
3" WATER LINE
2 1/2" WATER LINE
2" WATER LINE
1 1/2" WATER LINE
1 1/4" WATER LINE
1" WATER LINE
FLUSH VALVE
FIRE HYDRANT
GATE VALVE
AIR RELIEF VALVE
PUMP STATION AND WELL NO. 1
WELL NO. 2
WELL NO. 3
CONNECTING VALVE FOR BOTH SIDES OF THE SYSTEM
MATCHLINE
LIBERTY CITY EAST WATER SYSTEM
MATCHLINE
HIGH SCHOOL
JACKSON ROAD
RICE ROAD
WILKINS ROAD
SMALLWOOD RD
CREWS RD
OLD KILGORE HWY
MOUNT PISGAH ROAD
INTERSTATE 20
WEST POINT RD
FM 1252
FM 2207
FM 3053
SH 135
SPRINKS-CHAPMAN RD
TOM EUBANKS RD

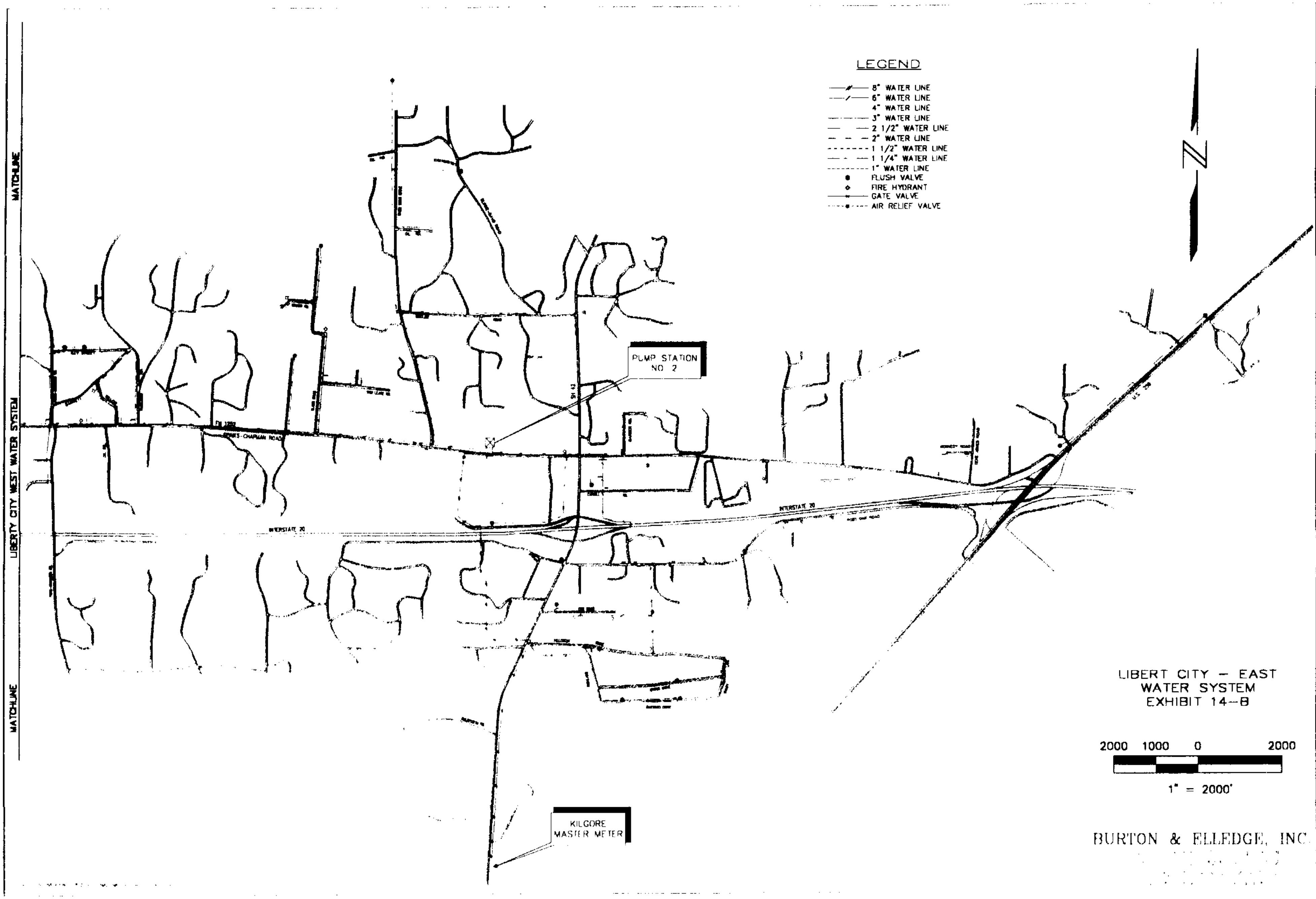
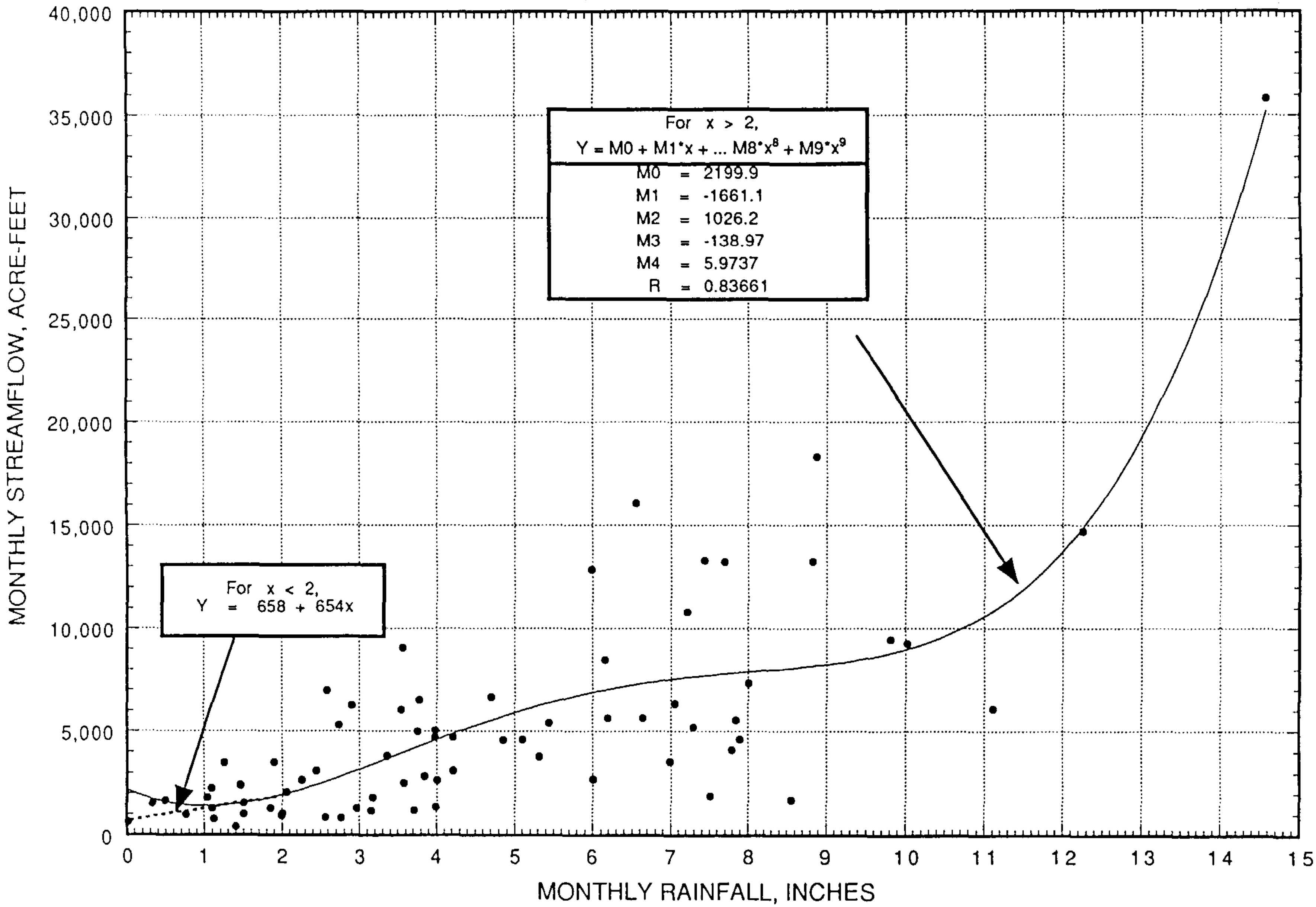
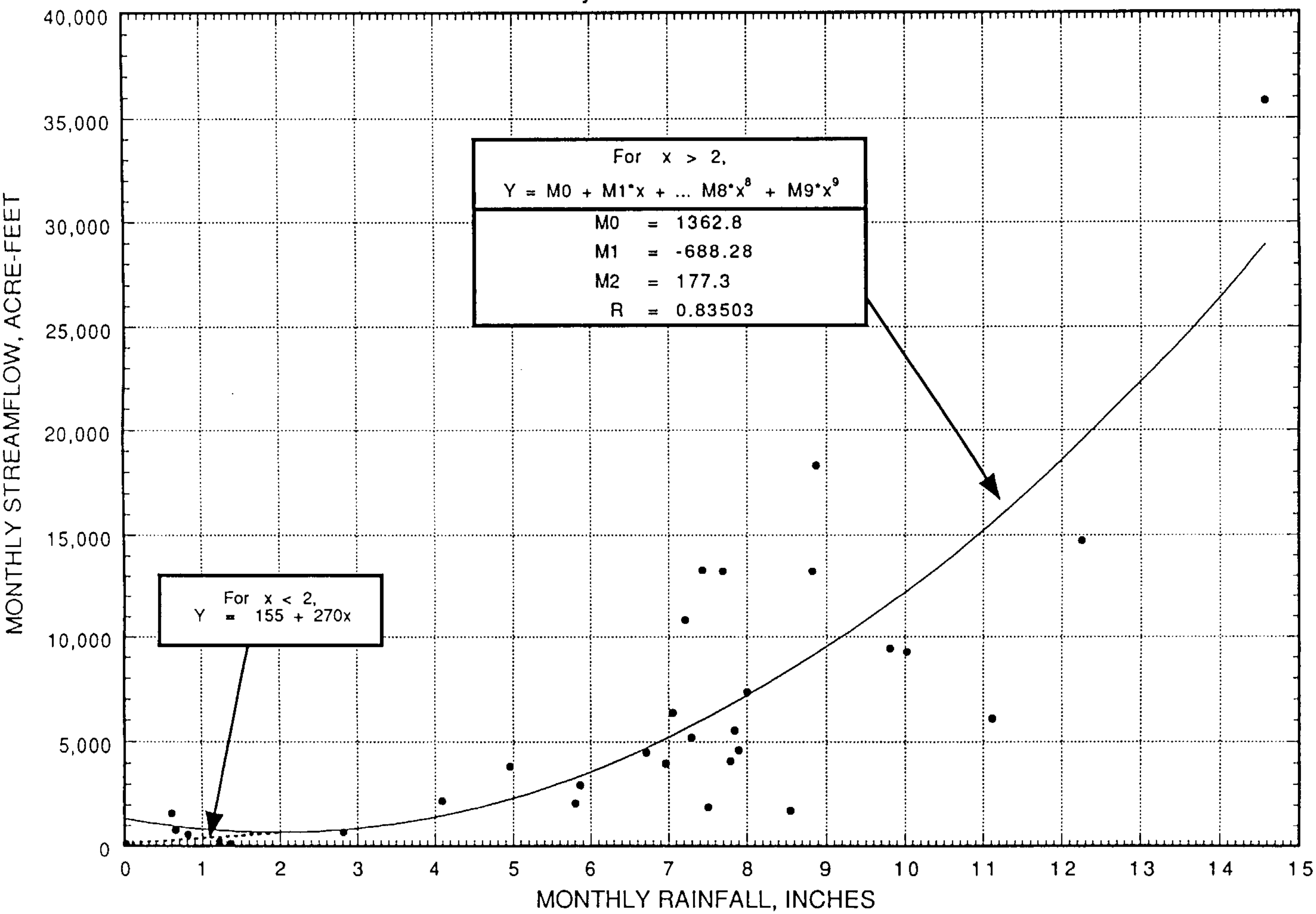

LEGEND
8" WATER LINE
6" WATER LINE
4" WATER LINE
3" WATER LINE
2 1/2" WATER LINE
2" WATER LINE
1 1/2" WATER LINE
1 1/4" WATER LINE
1" WATER LINE
FLUSH VALVE
FIRE HYDRANT
GATE VALVE
AIR RELIEF VALVE
N
MATCHLINE
LIBERTY CITY WEST WATER SYSTEM
MATCHLINE
PUMP STATION
NO. 2
INTERSTATE 20
INTERSTATE 20
KILGORE
MASTER METER
LIBERT CITY - EAST
WATER SYSTEM
EXHIBIT 14-B
2000 1000 0 2000
1" = 2000'
BURTON & ELLEDGE, INC.

FIGURE IV-1
JANUARY THRU MAY
CORRELATION BETWEEN STREAMFLOW OF RABBIT CREEK AT KILGORE
AND RAINFALL MEASURED AT OVERTON (2/3) AND LONGVIEW (1/3)
Based On Monthly Data For 1964-1976 Period



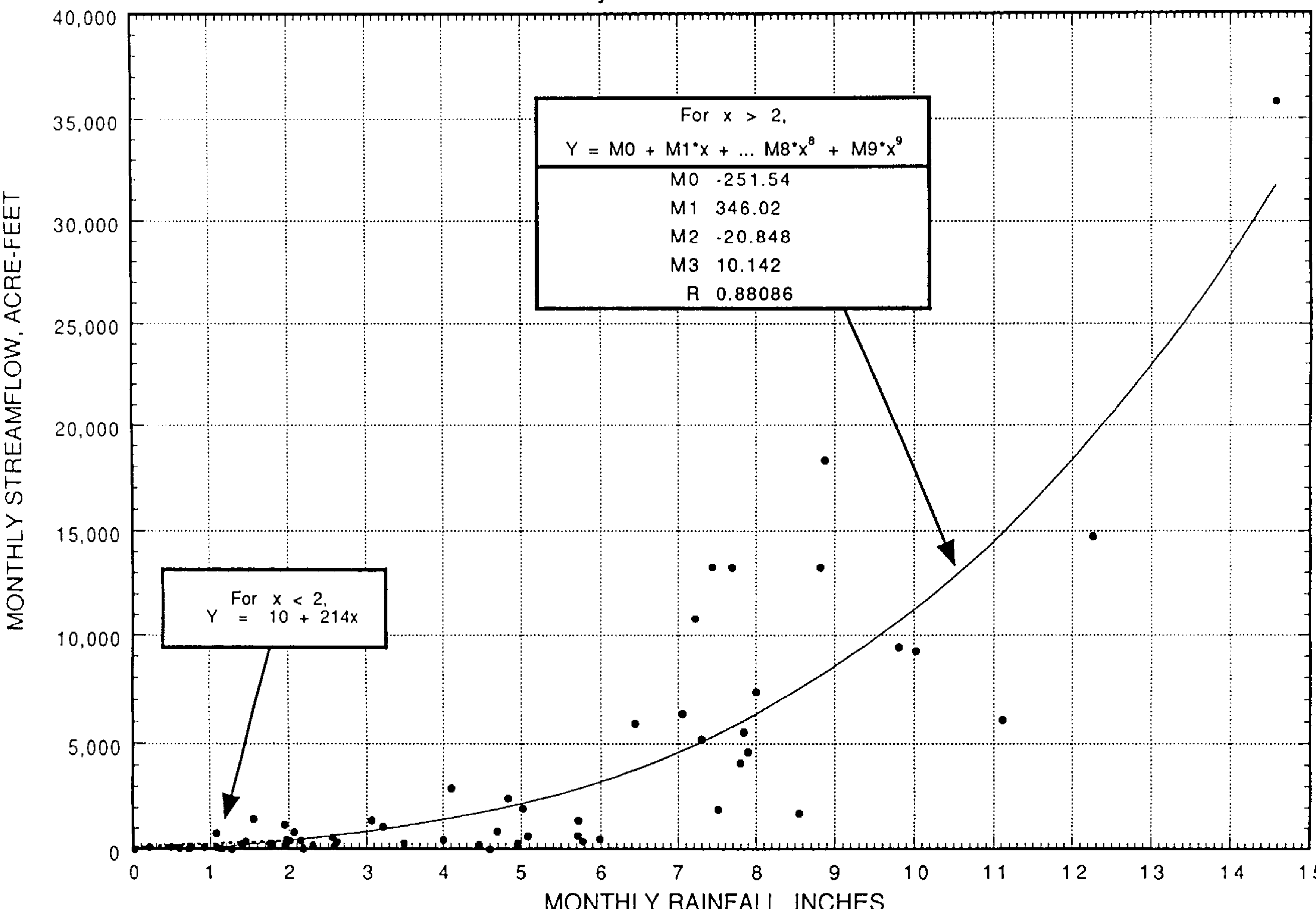
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-2
JUNE CORRELATION BETWEEN STREAMFLOW OF RABBIT CREEK AT KILGORE
AND RAINFALL MEASURED AT OVERTON (2/3) AND LONGVIEW (1/3)
Based On Monthly Data For 1964-1976 Period



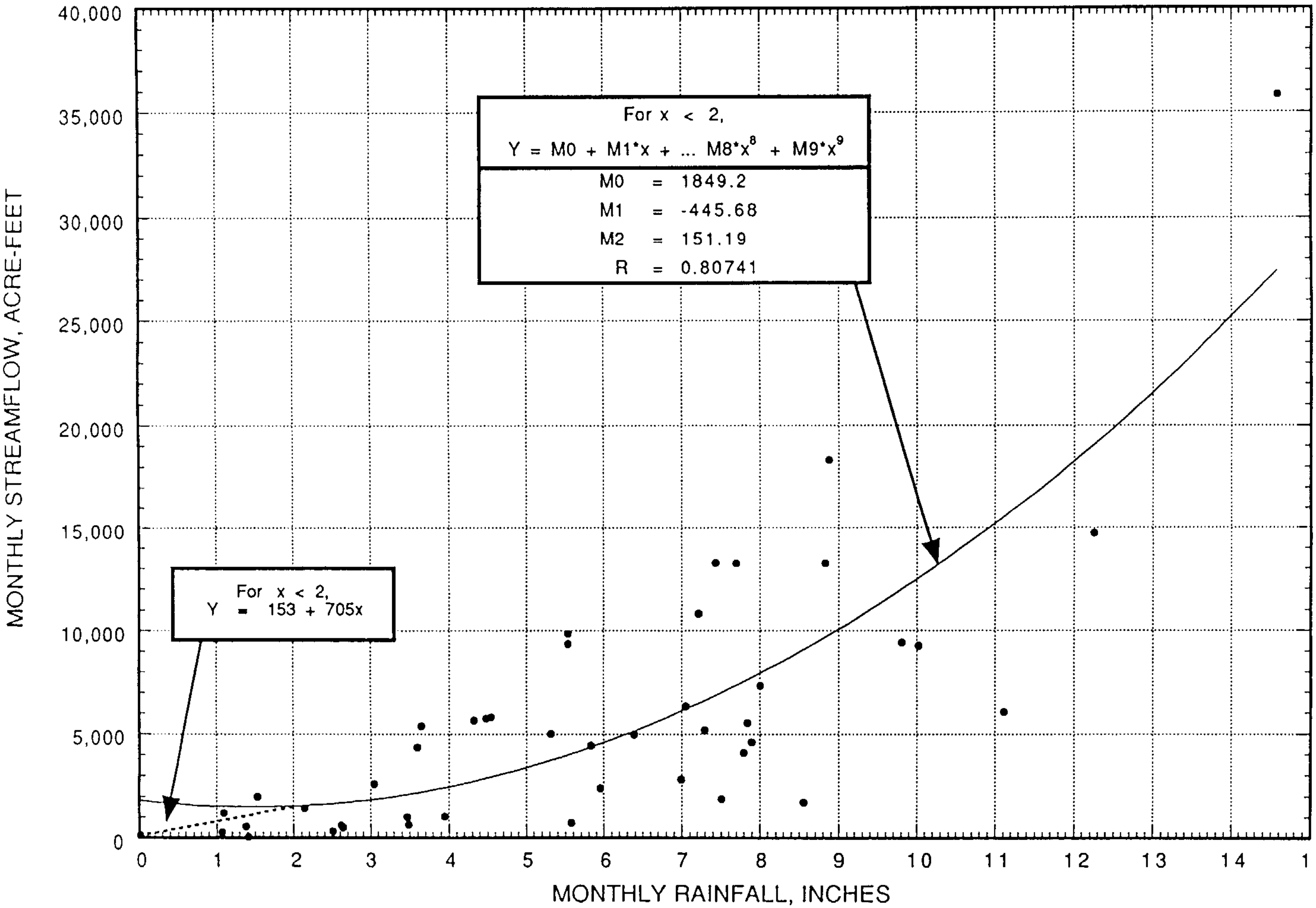
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-3
JULY THROUGH OCTOBER
CORRELATION BETWEEN STREAMFLOW OF RABBIT CREEK AT KILGORE
AND RAINFALL MEASURED AT OVERTON (2/3) AND LONGVIEW (1/3)
Based On Monthly Data For 1964-1976 Period



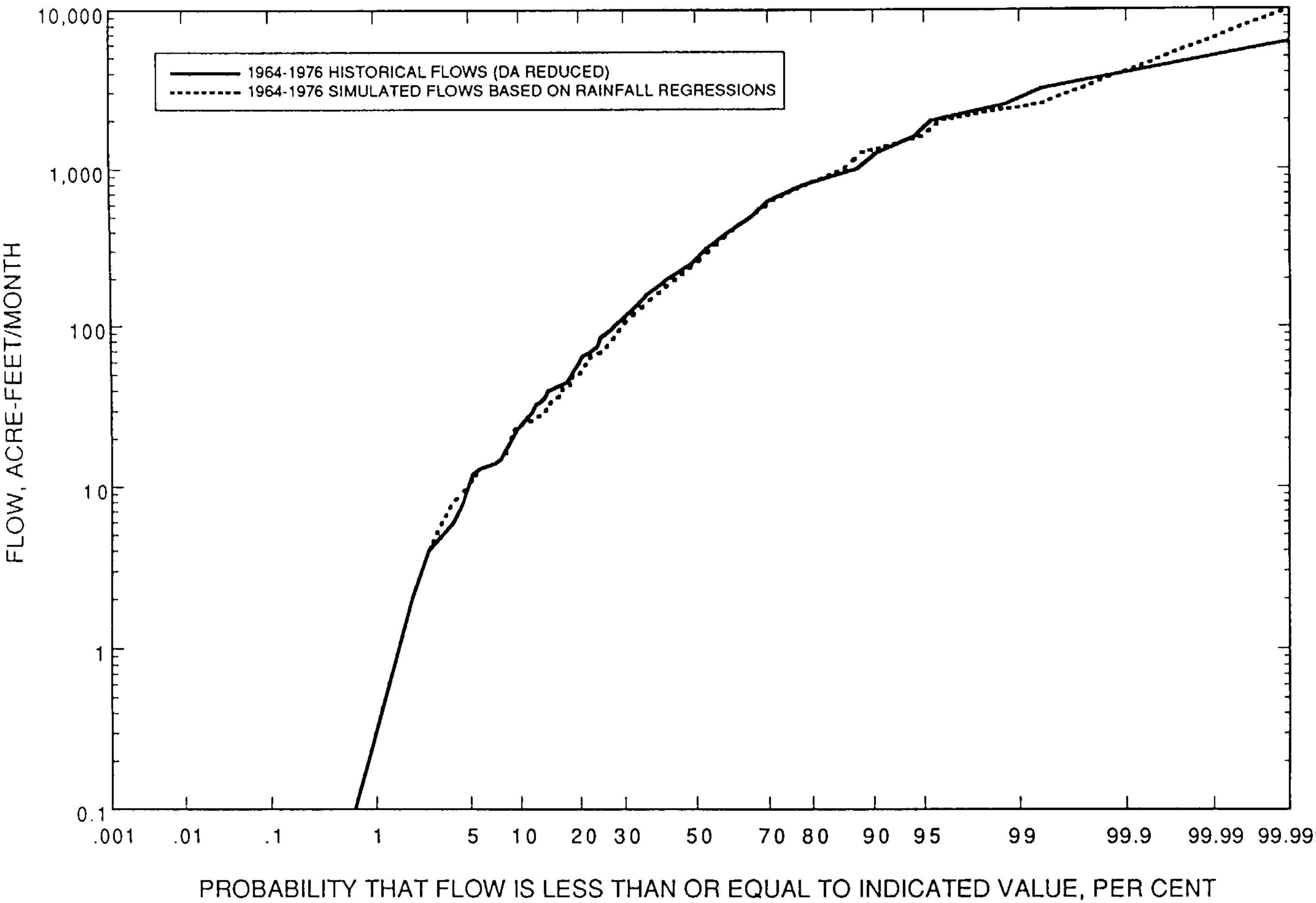
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-4
NOVEMBER AND DECEMBER
CORRELATION BETWEEN STREAMFLOW OF RABBIT CREEK AT KILGORE
AND RAINFALL MEASURED AT OVERTON (2/3) AND LONGVIEW (1/3)
Based On Monthly Data For 1964-1976 Period



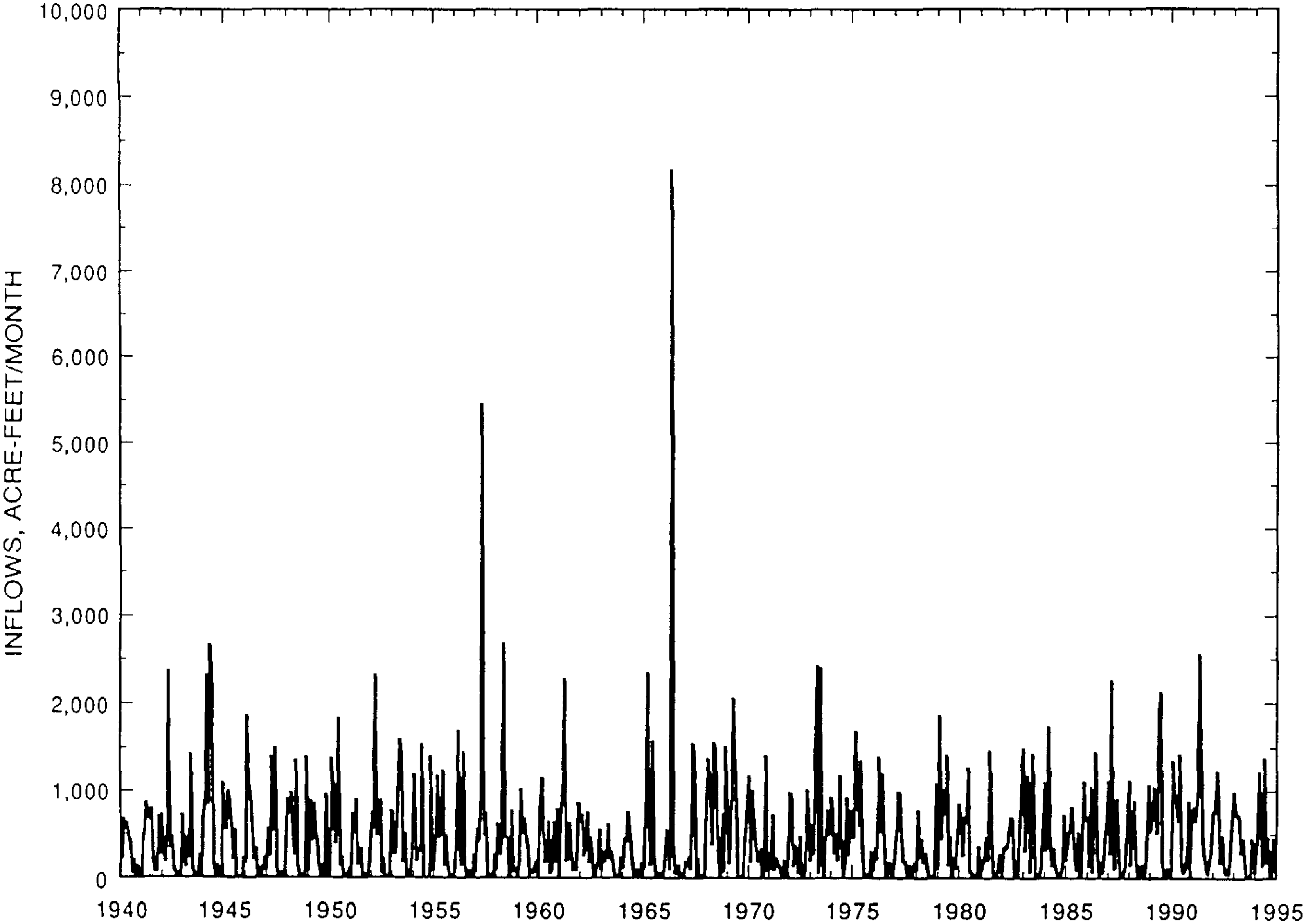
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-5
MONTHLY FLOW-DURATION ANALYSIS
HISTORICAL AND SIMULATED INFLOWS TO RABBIT CREEK



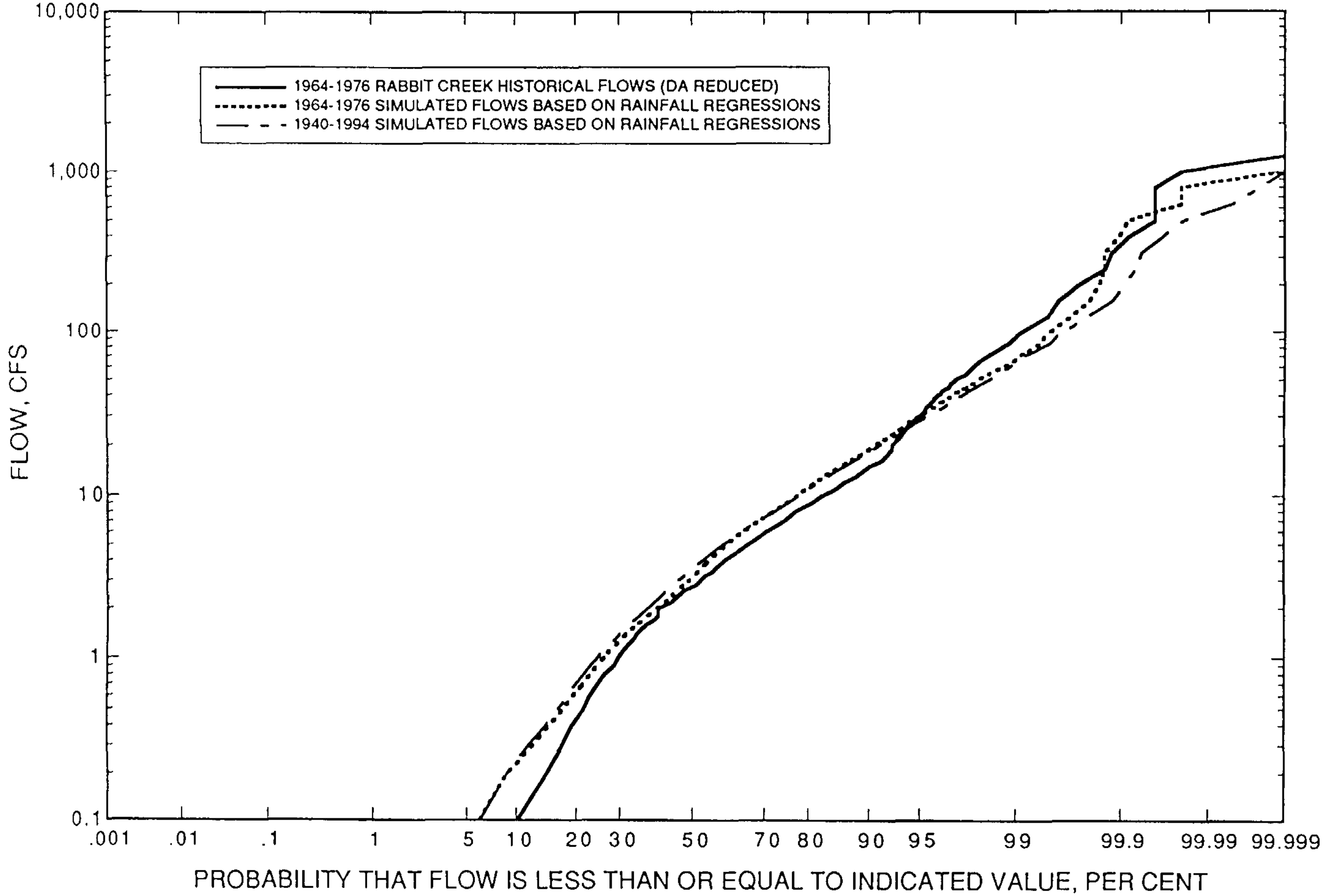
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-6
1940-1994 MONTHLY REGRESSION INFLOWS TO
PROPOSED RABBIT CREEK RESERVOIR



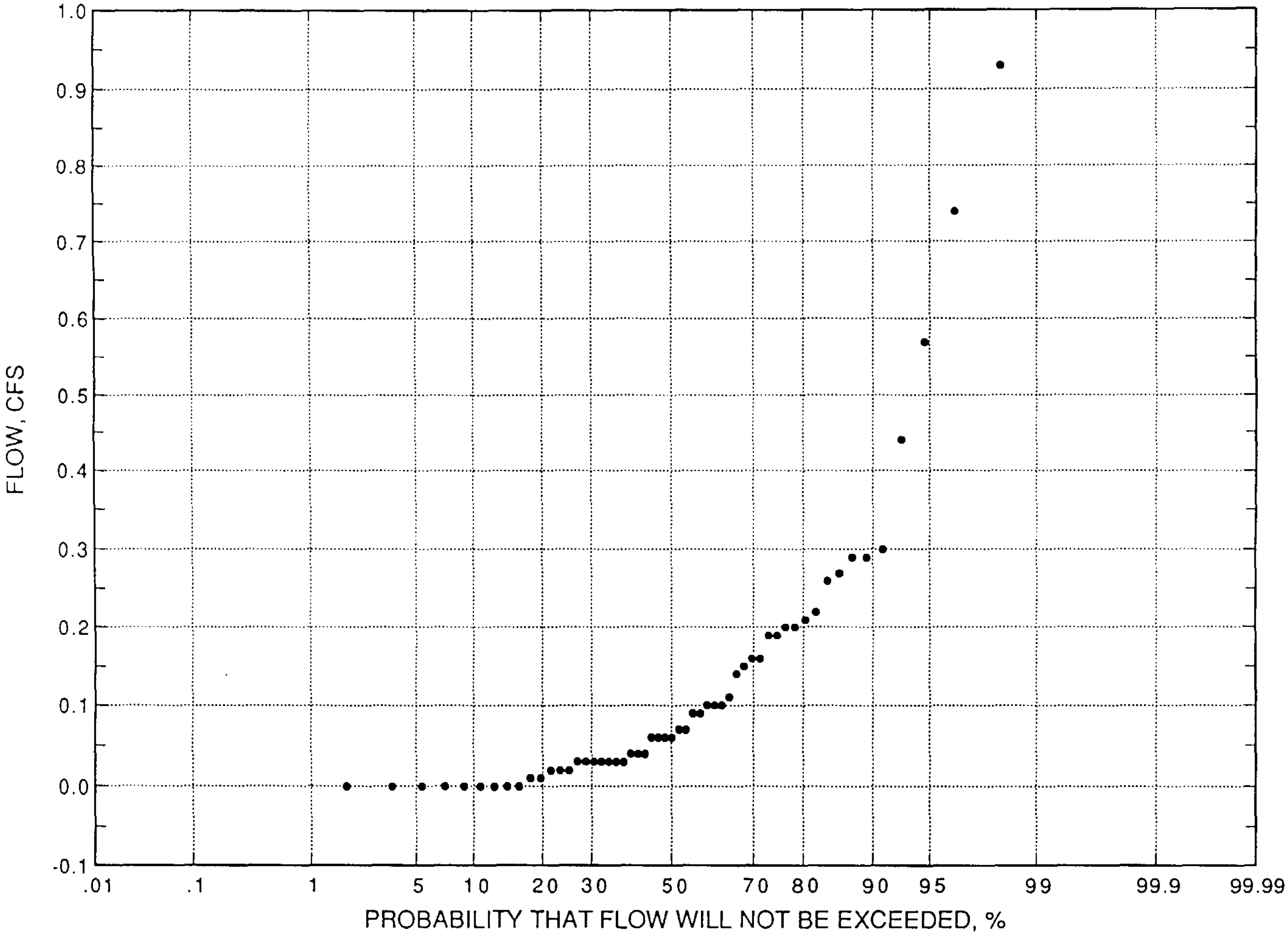
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-7
DAILY FLOW-DURATION ANALYSIS
HISTORICAL AND SIMULATED INFLOWS TO RABBIT CREEK



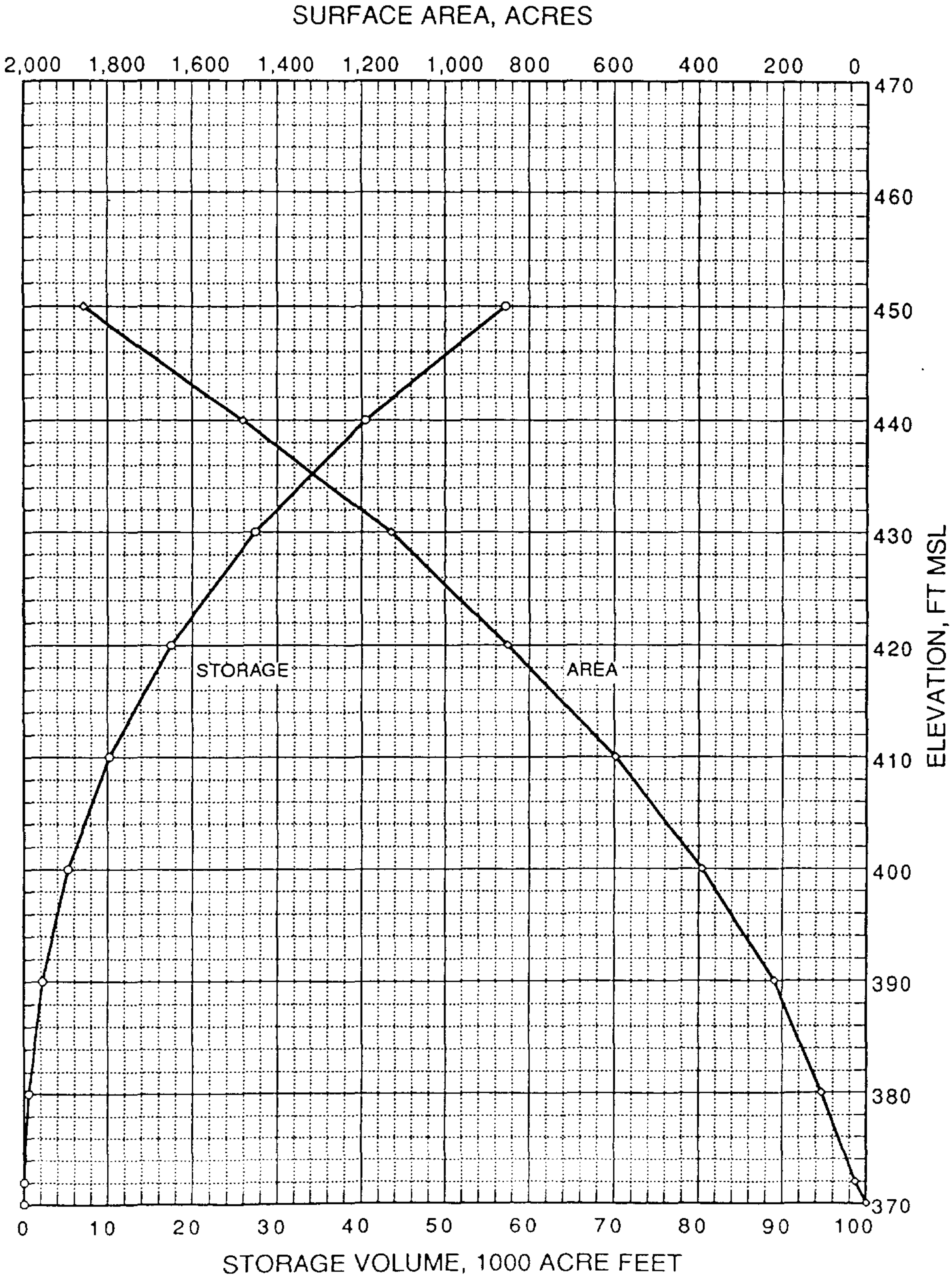
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-8
RABBIT CREEK DAILY REGRESSION
7-DAY AVERAGE MINIMUM FLOWS, 1940-1994



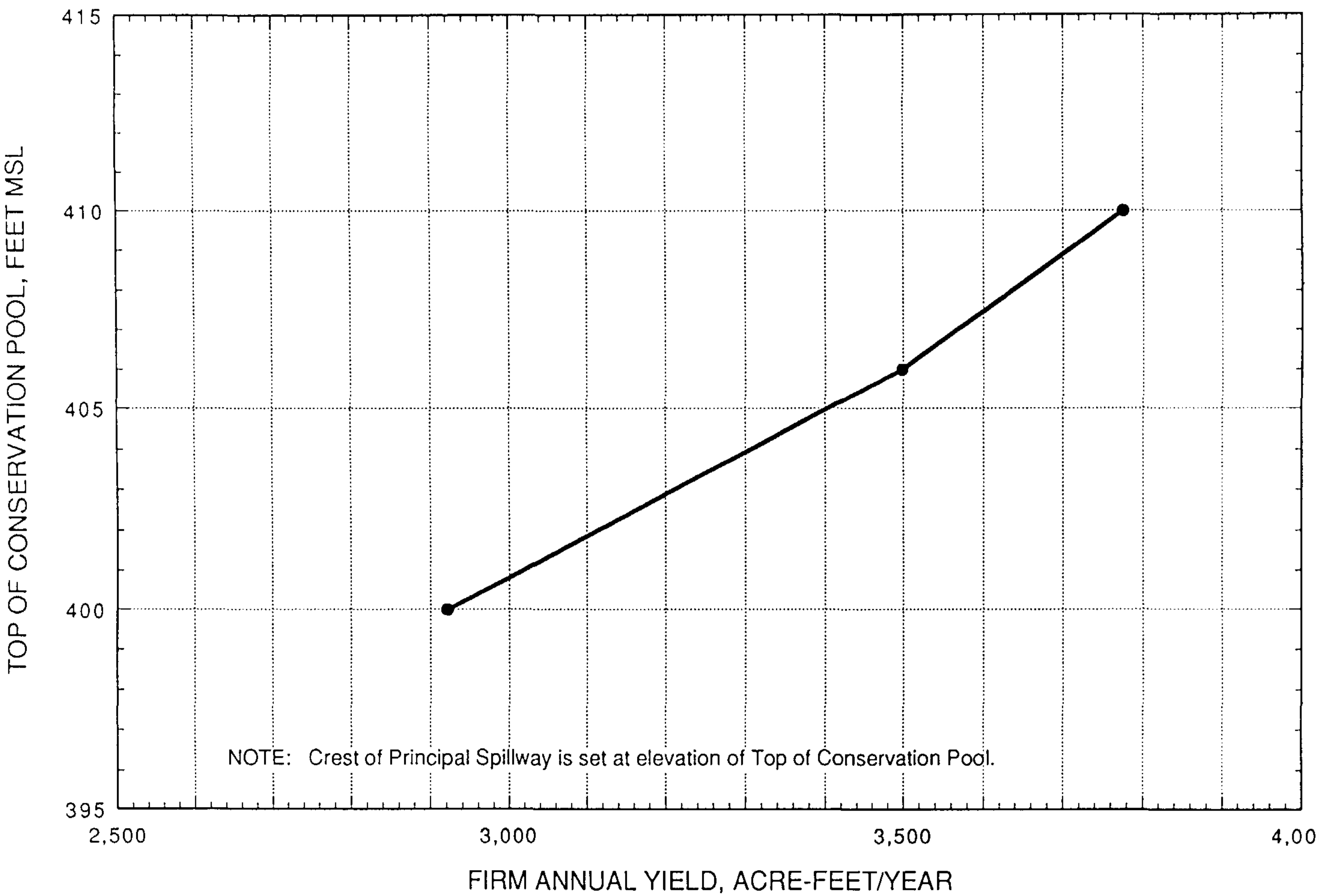
BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-9
OVERTON RESERVOIR AREA-CAPACITY RELATIONSHIP



BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE IV-10
RELATIONSHIP BETWEEN CONSERVATION POOL ELEVATION
AND FIRM ANNUAL YIELD OF PROPOSED RABBIT CREEK RESERVOIR



BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

TABLE IV-1

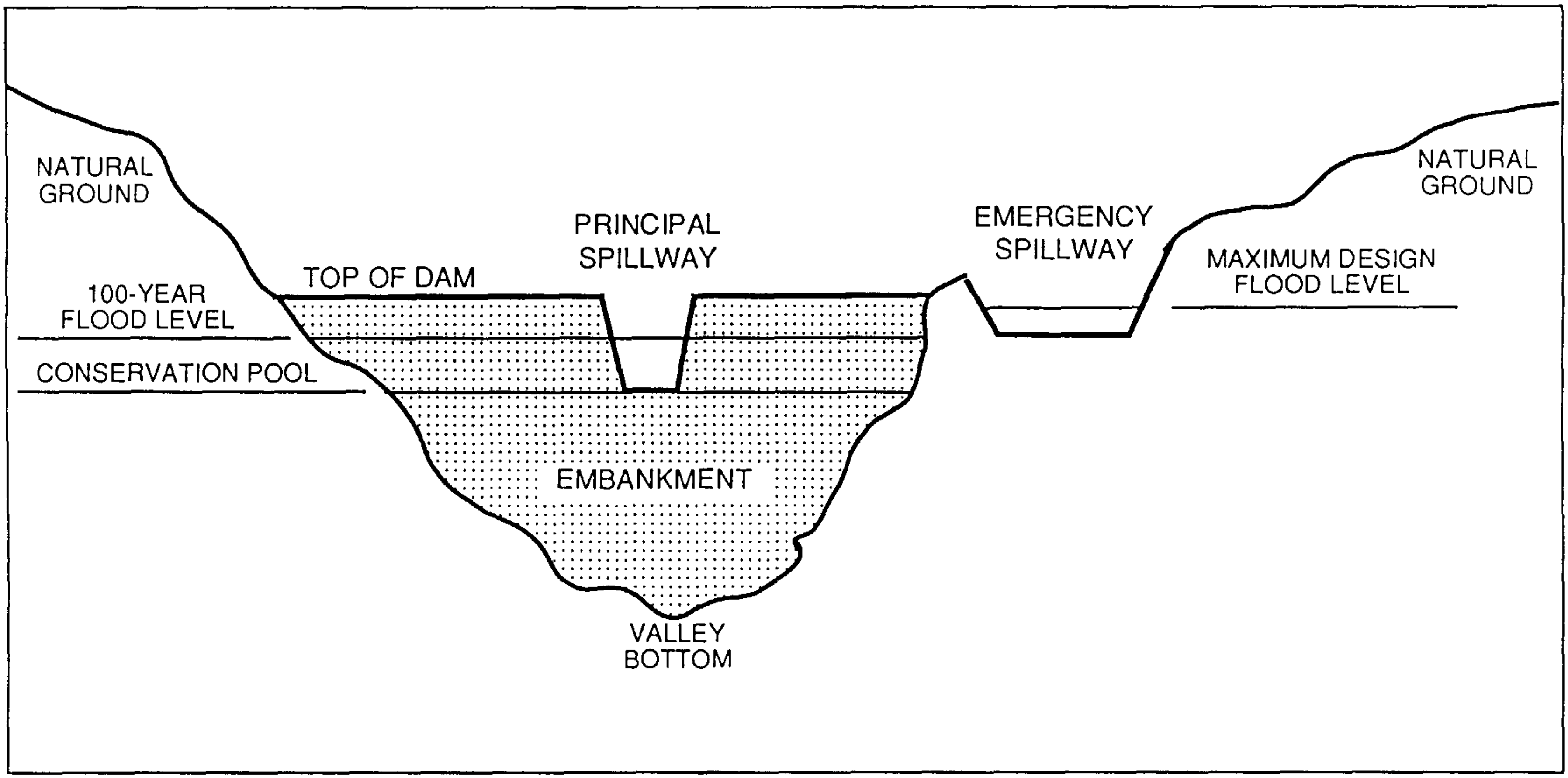
RABBIT CREEK RESERVOIR INSTREAM FLOW ANALYSIS

Sabine River Basin, Smith County, Texas

Based on 1940-1994 Historical Flow Conditions

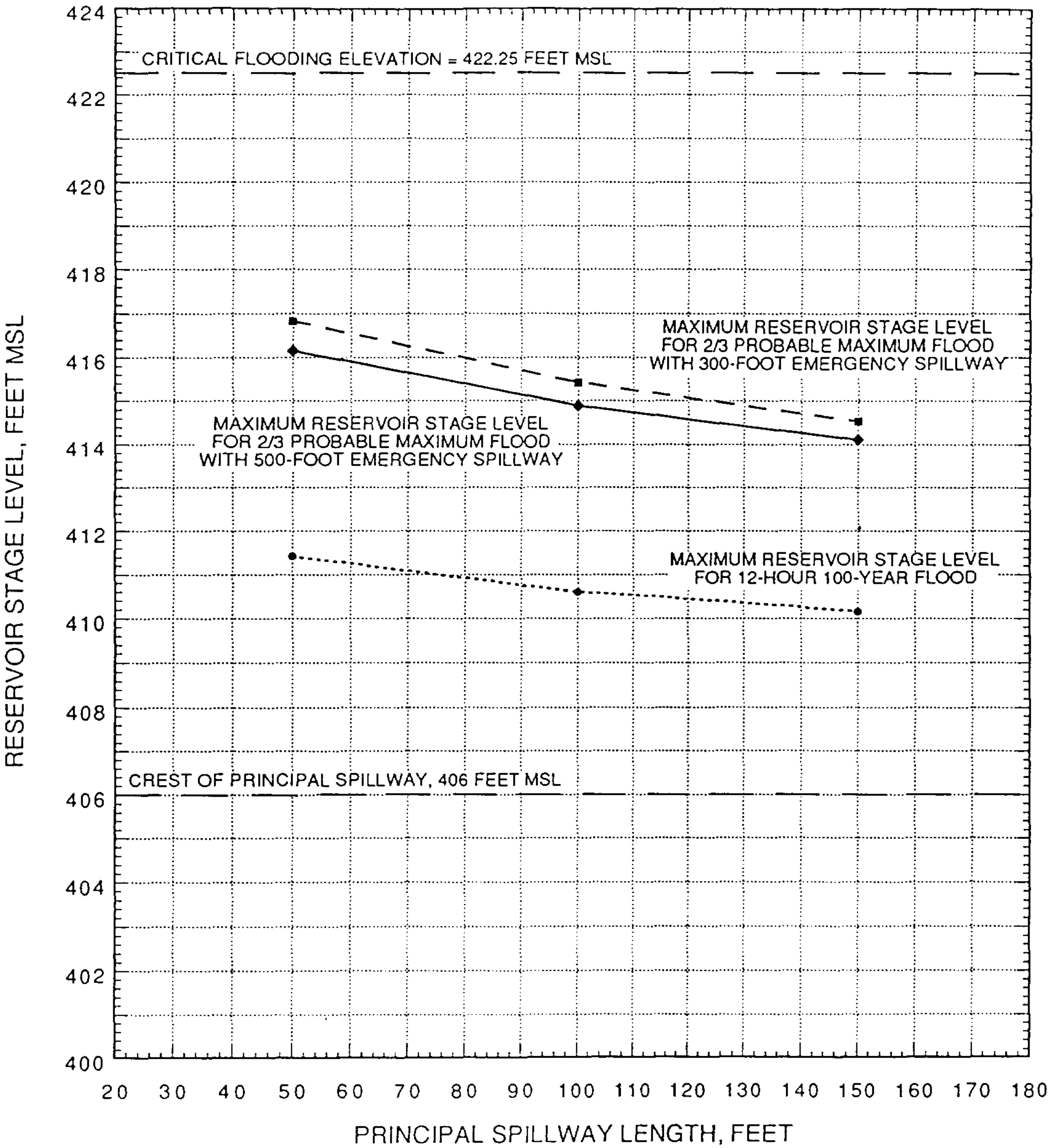
MONTH	CONCENSUS WATER PLANNING CRITERIA		
	ZONE 1	ZONE 2	ZONE 3
	MONTHLY MEDIAN FLOW cfs	MONTHLY 25th PERCENTILE FLOW cfs	ANNUAL 7-DAY, 2-YEAR LOW FLOW cfs
January	7.1	4.3	0.06
February	8.5	4.8	0.06
March	8.3	5.2	0.06
April	5.8	3.1	0.06
May	7.1	2.9	0.06
June	3.1	1.7	0.06
July	0.7	0.3	0.06
August	0.5	0.2	0.06
September	0.6	0.2	0.06
October	1.4	0.3	0.06
November	4.2	1.6	0.06
December	3.0	1.3	0.06
ANNUAL	3.5	1.0	0.06

FIGURE VI-1
PROFILE ALONG TYPICAL DAM CENTERLINE WITH SPILLWAY FACILITIES

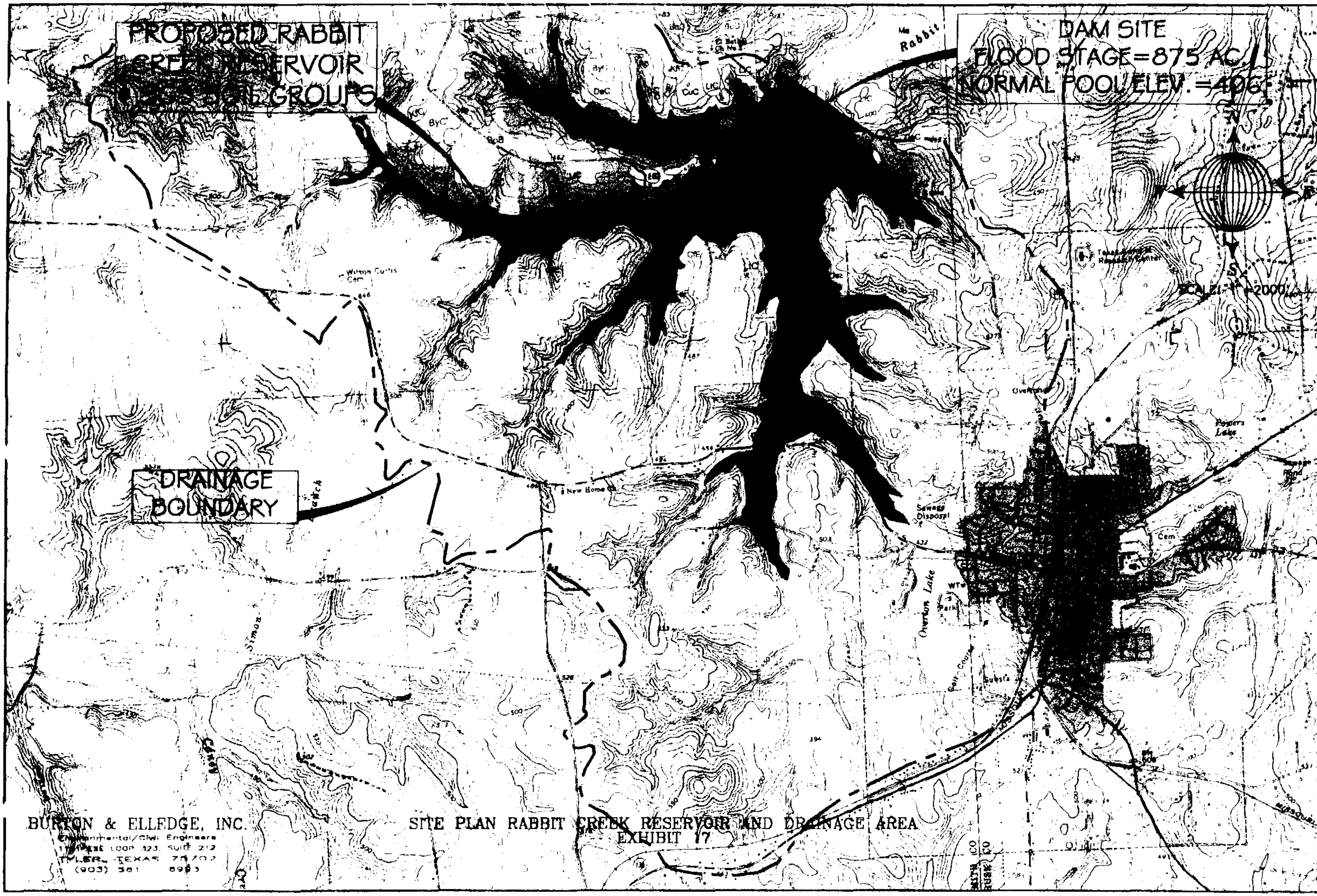


BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

FIGURE VI-2
RELATIONSHIPS BETWEEN PEAK RESERVOIR STAGE LEVELS
AND PRINCIPAL SPILLWAY LENGTH FOR RABBIT CREEK RESERVOIR

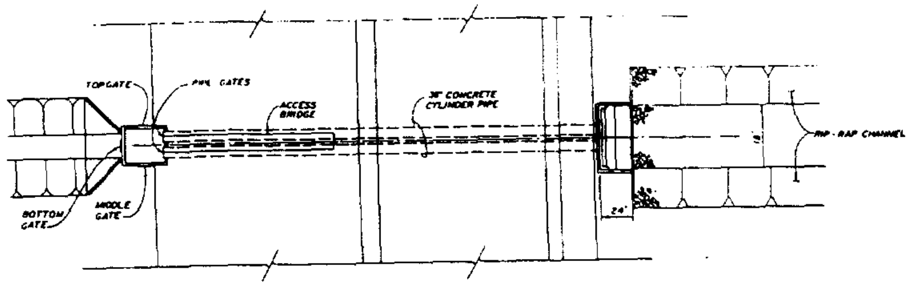


BURTON & ELLEDGE, INC.
Environmental / Civil Engineers

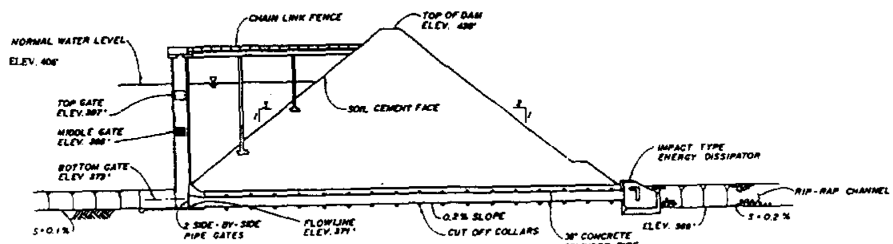


BURTON & ELLEDGE, INC.
Environmental/Civil Engineers
LOOP 323, SUITE 212
TYLER, TEXAS 75703
(903) 561 6903

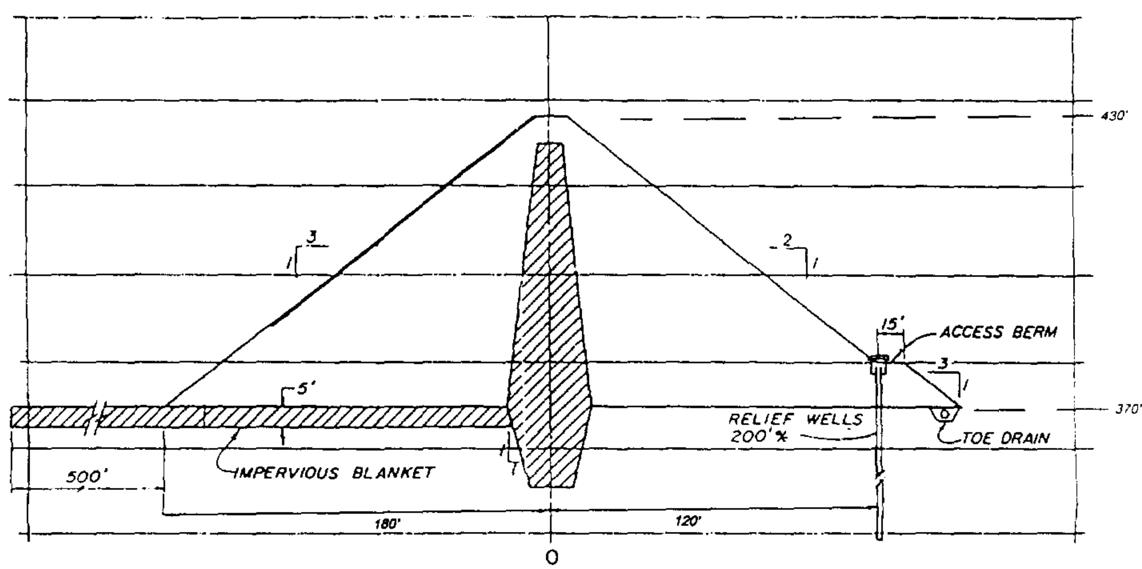
SITE PLAN RABBIT CREEK RESERVOIR AND DRAINAGE AREA
EXHIBIT 17



PLAN OF OUTLET WORKS
NOT TO SCALE



OUTLET WORKS SECTION
NOT TO SCALE



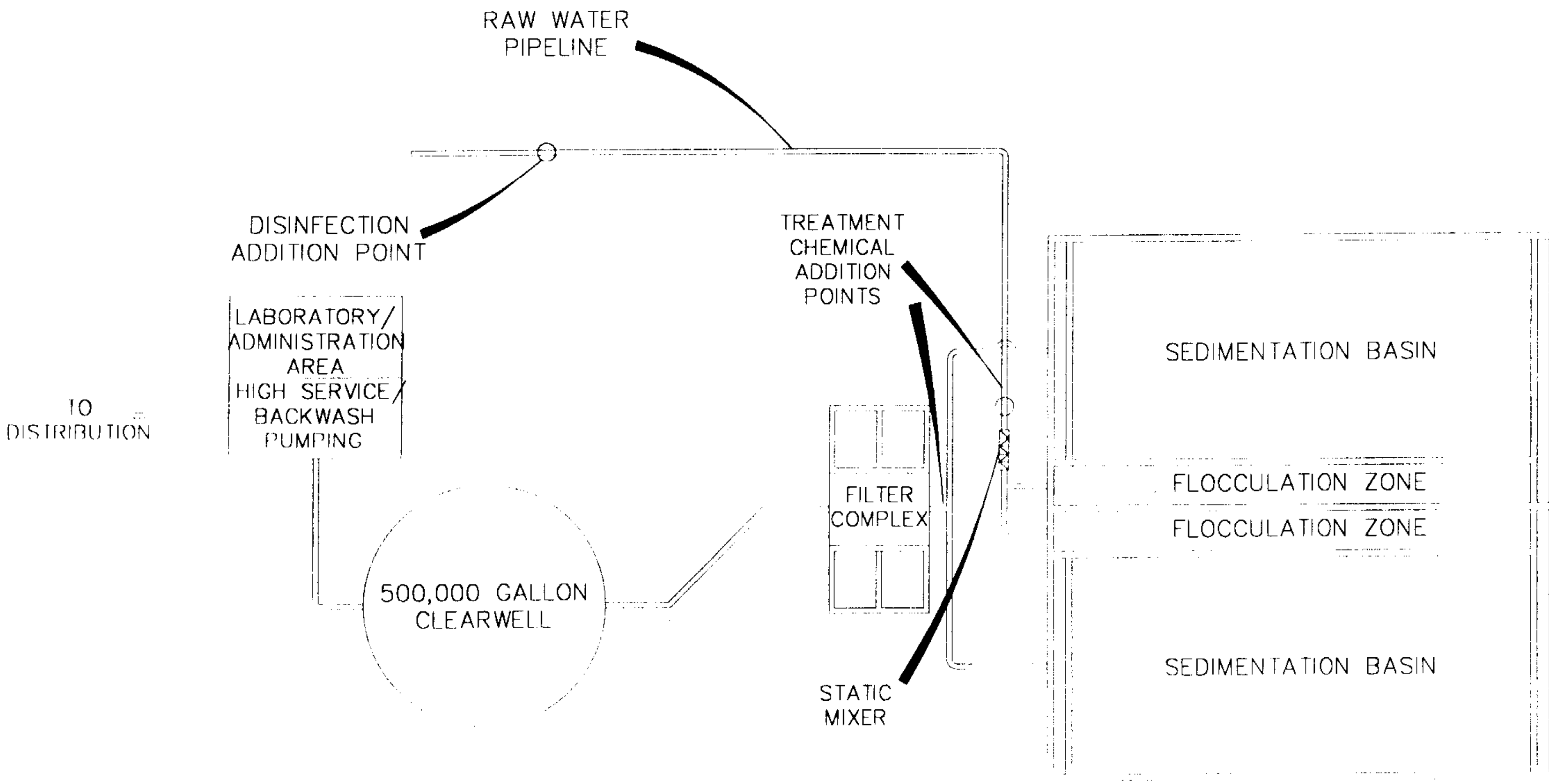
(B) DAM SECTION

NOT TO SCALE

EXHIBIT 17

BURTON & ELLEDGE, INC
Environmental/Civil Engineers
1121 ESE LOOP 323, SUITE 212
TYLER, TEXAS 75702
(903) 561 – 6993

C:\PROJECTS\OVERTON\0705.2\OVERTON\REGIONAL WATER\DAM EXHIBIT208

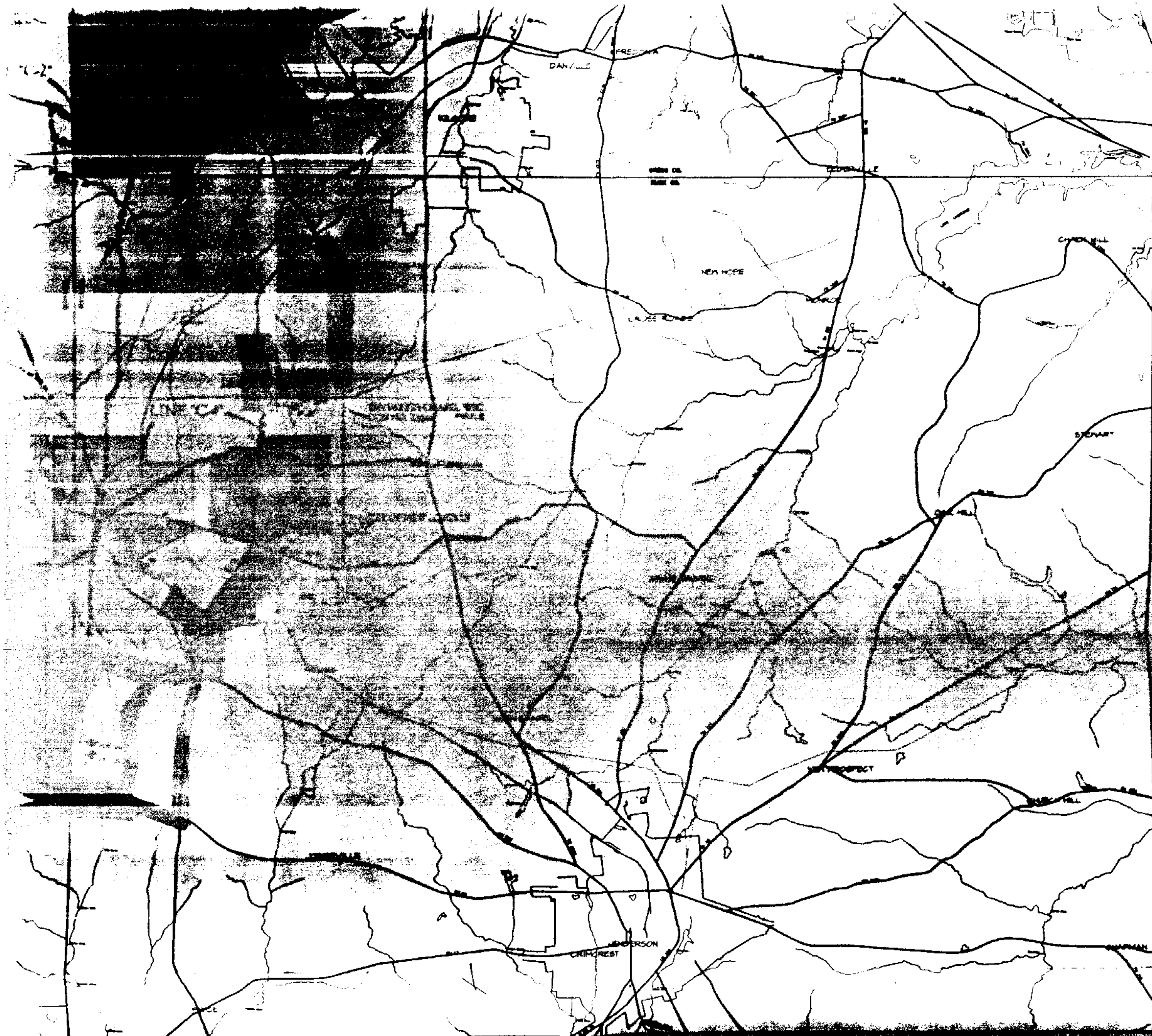


PROPOSED LAYOUT FOR 3.1 MILLION GALLON WATER TREATMENT PLANT

EXHIBIT 18

BURTON & ELLEDGE, INC.


WEST GREGG WSC
CCN NO. 10409
LINE "C-2"
JACKSON WSC
CCN NO. 10763
LINE "A"
LEVERETTS CHAPEL WSC
CCN NO. 11646
LINE "C4"
CITY OF NEW LONDON
LINE "C-5"
CITY OF OVERTON
JACKSON WSC
LINE "B"
CITY OF ARP
LINE "C-3"
WRIGHT CITY
CCN NO. 10774
WRIGHT CITY
CCN NO. 10774
KILGORE
DANVILLE
NEW HOPE
CROSS ROADS
UNION CHAPEL
NEW PROSPECT
JOINERVILLE
HENDERSON
TROUP



REGIONAL WATER STUDY
DISTRIBUTION SYSTEM

REGIONAL WATER SUPPLY STUDY
ALTERNATIVE A
RABBIT CREEK RESERVOIR
OPINION OF PROBABLE COST
EXHIBIT 20

Construction of Rabbit Creek Reservoir and Land Aquisition	$10,335,186
Construction of 3.1 MGD Water Treatment Plant	$5,146,000
Construction of Water Distribution System	$13,391,099
Subtotal	*$28,872,285*
Amortize Construction Cost (20 yrs, 6% interest)	$2,480,707
Total Pump Stations Operation and Maintenance Cost	$111,520
Total Operation and Maintenance Cost for Water Treatment Plant	$636,260
Total Annual Cost	**$3,228,487**

COST PER THOUSAND GALLONS
= $3, 228,487/(3.1 x 1000 x 365) = $2.85 per thousand gallons

NOTE: Unit cost based on 3.1 MGD usage because reservoir yield = 3.1 MGD and future demand of region exceeds 3.1 MGD. Refer to Exhibit 25 for unit costs at usages less than 3.1 MGD

RABBIT CREEK RESERVOIR
OPINION OF PROBABLE COST

EXHIBIT 20

	Quantity	Unit	Unit Price	Total
1 Dam & Spillway				
Clearing & Grubbing	5	AC	$1,000	$5,000
Stripping				$0
Embankment	631,026	CY	$2	$1,262,052
Core	278,713	CY	$7	$1,950,991
Excavation	88,105	CY	$1.50	$132,158
Spillway Walls	504	CY	$500	$252,000
Spillway Slab	1,407	CY	$350	$492,450
Rock Rip Rap	9,334	Tons	$40	$373,360
Toe Drain/Seepage System	3, 000	LF	$10	$30,000
Sodding/Seeding/Erosion ontrol	7	AC	$1, 500	$10,500
Low Flow Metering Station	1	LS	$30, 000	$30,000
Subtotal				*$4,538,511*
2 Raw Water Intake				
Intake Tower & Raw Water umps	1	LS	$400,000	$400,000
15' Pump Station Access ridge	200	LF	$500	$100,000
24" Water Supply Conduit	1,000	LF	$55	$55,000
Electrical Controls	1	LS	$100,000	$100,000
Channel Excavation	200	LF	$100	$20,000
Subtotal				*$675,000*
3 Reservoir Clearing	100	AC	$1,000	$100,000
4 County Road Relocation	5,000	LF	$100	$500,000
5 Contingencies -- 15%				$872,027
6 Construction Observation & Testing				$120,000
7 Basic Engineering Services -- 5.2%				$347,648
8 Permitting & Mitigation				$1,700,000
9 Surveying for Design				$30,000
Subtotal				*$3,669,675*

	Quantity	Unit	Unit Price	Total
10 Land Acquisition				
Deed Research & Boundary Surveying				$100,000
Parcel Descriptions				$50,000
Legal				$100,000
Property Purchase	1,000	AC	$1,000	$1,000,000
Subtotal				*$1,250,000*
11 Fiscal (Cost of Insurance) -- 2%				$202,000
TOTAL Dam & Reservoir				***$10,335,186***

ALTERNATIVE A
RABBIT CREEK RESERVOIR PUMP STATIONS
OPERATION AND MAINTENANCE COST
OPINION OF PROBABLE COST
EXHIBIT 20

Raw Water Pump Station

Each Pump ; 2200 US GPM @ 175 Ft , 150 Hp.

1 Operation Time -

a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs
Total High Flow Time = 8 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

2. Power Consumption

Total Power = (50(8) + 100(8)) 0.7457/0.84
= 1, 065 Kwh/day

Yearly Power Cost = 1, 065 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 20, 000

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

Distribution Pump Station

High Flow Pump ; 4300 US GPM @ 280 Ft , 500 Hp
Low Flow Pump ; 2200 US GPM @ 190 Ft , 150 Hp

2. Operation Time -

a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs
Total High Flow Time = 8 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

3. Power Consumption

Total Power = (150(8) + 500(8)) 0.7457/0.9
= 4, 308 Kwh/day

Yearly Power Cost = 4, 308 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 80, 000

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

TOTAL OPERATION AND MAINTENANCE COST
= $20, 000 + $5, 760 + $80, 000 + $5, 760.00 **= $ 111, 520/year**

RABBIT CREEK RESERVOIR
WATER TREATMENT PLANT O& M COST ANALYSIS
OPINION OF PROBABLE COST
EXHIBIT 20

1. Chemical for alum and chlorine = **$180,000**

2. Employees salaries
   a. Base Salaries
   3 Operator at $20.00/hr x 2, 080hrs/yr =$124, 800/yr
   2 Maintenance and Service Worker at $10.00/hr x 8 x 5days x 52 weeks/yr = $41, 600/yr
   1 Chief Operator at $32.00/hr x 8 x 5 days x 52 weeks/yr = $66, 560.00
   Total Employees Base Salary = $232, 960

   b. Additional Salary Costs for Overtime, etc. = $42, 600
   Total Salary Costs = $232, 960 + $42, 000 = **$275,560**

3. Equipment services and replacement cost = **$ 12,000/year**

4. Other Annual Operating Costs = $168, 700

Total Annual O & M Cost = $180,000 + $275,560 + $12,000 +168,700 = $ 636,260

RABBIT CREEK RESERVOIR STUDY
WATER TREATMENT PLANT
OTHER ANNUAL O&M COST ANALYSIS

EXHIBIT 20

I. City of Overton

A. Chemical — $180,000/yr

Chlorine	Caustic	Carbon
Alum	Pottassium Permanganate	Polymer
Lime	Ammonia	

Raw Water Treated 3,100,000,000 gallons

B. Employees (1 Chief Operator, 3 Operators & 2 Laborers)

Overtime (18 hrs /wk @$30/hr)	$28,100/yr
Employee Stability	$3,000/yr
Salary Adjustment	$11,500/yr

C. Power (excluding pumping) $2, 000 /mo — $24,000/yr

D. Maintenance & Replacement Costs $1,000/mo — $12,000/yr

Maintenance of Machinery/Implements
Maintenance of Instrumentation
Maintenance of Buildings
Maintenance of Vehicles
Maintenance of Light Systems
Maintenance of Computers
Replacement of Hand Tools/Supplies
Replacement of Motors & Wear Items
Replacement of Office Supplies

E. Other Annual Operating Cost

Residuals, Handling & Disposal	$10,000
Instrument Repair	$4,000
Cloth/Dry Goods	$900
Laundry/Cleaning	$1,300
Botanical Supplies	$2,500
Office Fixtures	$250
Expendable Machines	$2,000
Instrument & Apparatus	$2,000
Communications (Phone, fax, postage)	$4,000
Rental Equipment	$3,200
Special Services (Lab)	$11,000

Advertising, Publishing, Printing	$250
Meetings/Travel	$1,500
Rentals - Uniforms	$4,000
Employee Training	$2,600
Dues/Subscriptions	$300
Water/Garbage/Sewer	$1,200
Fencing	$1,000
Vehicle Amortization	$7,600
Painting	$1,000
TMRS Pension	$36,000
Social Security	$25,000
Hospital Insurance	$38,000
Dental Insurance	$2,400
Worker's Compensation Insurance	$2,300
Life Insurance	$900
Medicare Premium	$600
Employee License	$400
Transfer Employee Claim	$500
Subtotal	**$168,700**

REGIONAL WATER SUPPLY STUDY
ALTERNATIVE A
WATER DISTRIBUTION SYSTEM
OPINION OF PROBABLE COST
EXHIBIT 20

DESCRIPTION	COST
Line A	$1,633,000
Line B	$1,657,725
Line B-1	$91,425
Line C	$491,625
Line C-1	$2,105,650
Line C-2	$767,050
Line C-3	$677,350
Line C-4	$856,750
Line C-5	$190,900
2 MG Elevated Storage Tank	$2,200,000
Subtotal	*$10,671,475*
Contingencies	$1,600,721
Subtotal	$12,272,196
Basic Engineering Services	$736,332
Construction Observation	$70,000
Surveying & Aerial Photo	$50,000
Total	$13,128,528
Fiscal 2%	$262,571
Total Distribution System	**$13,391,099**

* Based on constructing all lines in public right-of-way. Does not include any cost or easement aquisition.

REGIONAL WATER SUPPLY STUDY
RABBITT CREEK RESERVOIR
WATER SUPPLY SYSTEM
OPINION OF PROBABLE COSTS

EXHIBIT 20

Line A:

Item	Qty.		Price/Unit	Total Amount
18" Water Main	24,000	LF	$30	$720,000
15" Water Main	24,000	LF	$25	$600,000
Encased Road Bores	200	LF	$150	$30,000
Creek Crossing	1,000	LF	$70	$70,000
Valves and Other (15%)				$213,000
SUBTOTAL				$1,633,000

Line B:

Item	Qty.		Price/Unit	Total Amount
15" Water Main	28,000	LF	$25	$700,000
10" Water Main	34,500	LF	$17	$586,500
Encased Road Bores	800	LF	$150	$120,000
Creek Crossing	500	LF	$70	$35,000
Valves and Other (15%)				$216,225
SUBTOTAL				$1,657,725

Line B-1:

Item	Qty.		Price/Unit	Total Amount
10" Water Main	3,500	LF	$17	$59,500
Encased Road Bores	200	LF	$100	$20,000
Creek Crossing	0	LF	$70	$0
Valves and Other (15%)				$11,925
SUBTOTAL				$91,425

Line C:

Item	Qty.		Price/Unit	Total Amount
18" Water Main	13,000	LF	$30	$390,000
Encased Road Bores	250	LF	$150	$37,500
Creek Crossing	0	LF	$70	$0
Valves and Other (15%)				$64,125
SUBTOTAL				$491,625

Line C-1:

Item	Qty.		Price/Unit	Total Amount
18" Water Main	34,000	LF	$30	$1,020,000
12" Water Main	30,000	LF	$20	$600,000
Encased Road Bores	800	LF	$150	$120,000
Creek Crossing	1,300	LF	$70	$91,000
Valves and Other (15%)				$274,650
SUBTOTAL				$2,105,650

Regional Water Supply Study
Rabbit Creek Reservoir
Water Supply System
Opinion of Probable Costs

Line C-2:

Item	Qty.	Price/Unit	Total Amount
18" Water Main	20,500 LF	$30	$615,000
Encased Road Bores	300 LF	$150	$45,000
Creek Crossing	100 LF	$70	$7,000
Valves and Other (15%)			$100,050
SUBTOTAL			$767,050

Line C-3:

Item	Qty.	Price/Unit	Total Amount
10" Water Main	28,000 LF	$17	$476,000
Encased Road Bores	850 LF	$100	$85,000
Creek Crossing	400 LF	$70	$28,000
Valves and Other (15%)			$88,350
SUBTOTAL			$677,350

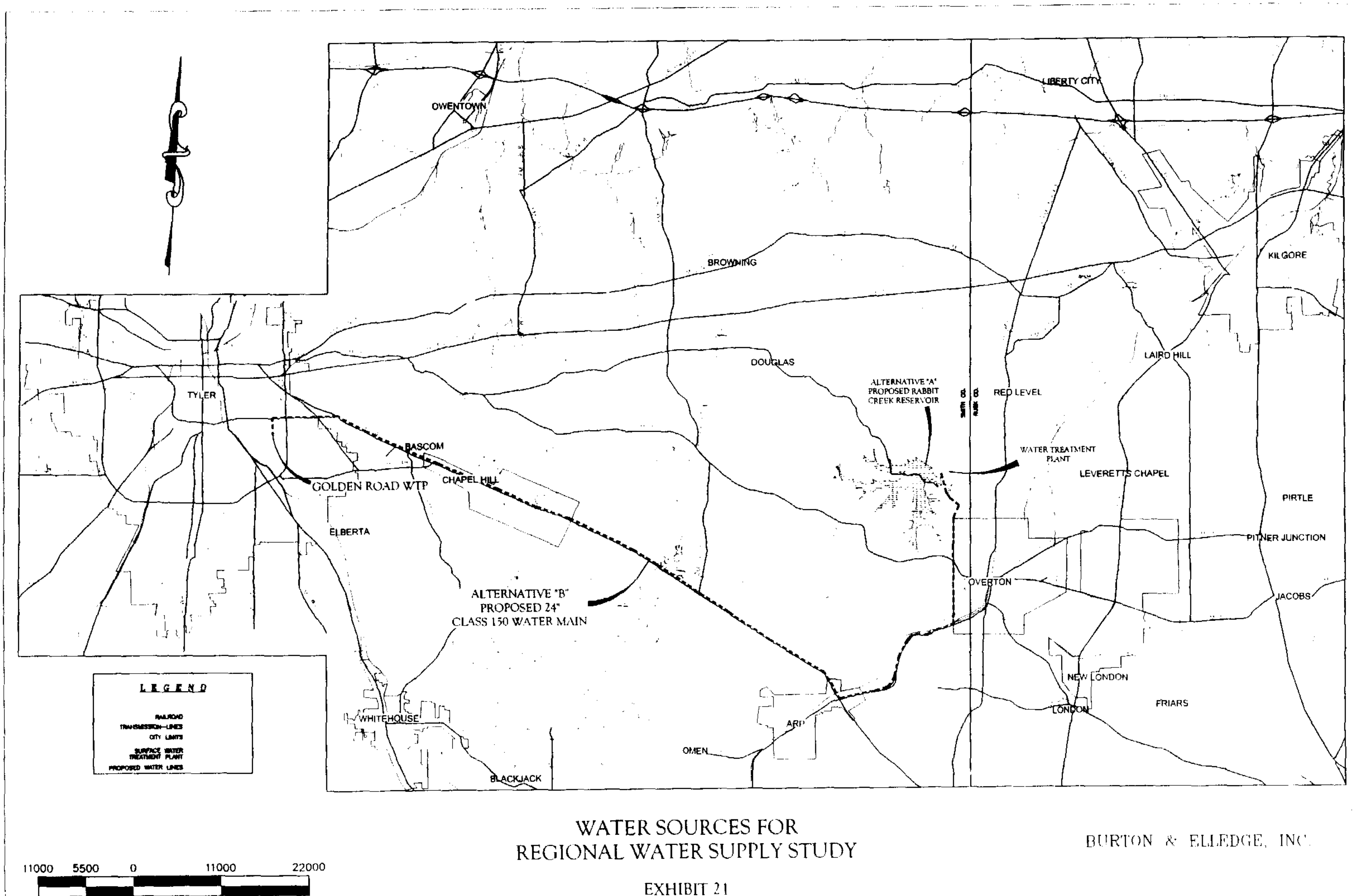
Line C-4:

Item	Qty.	Price/Unit	Total Amount
15" Water Main	19,500 LF	$25	$487,500
6" Water Main	8,500 LF	$11	$93,500
Encased Road Bores	1,000 LF	$150	$150,000
Creek Crossing	200 LF	$70	$14,000
Valves and Other (15%)			$111,750
SUBTOTAL			$856,750

Line C-5:

Item	Qty.	Price/Unit	Total Amount
10" Water Main	8,000 LF	$17	$136,000
Encased Road Bores	300 LF	$100	$30,000
Creek Crossing	0 LF	$70	$0
Valves and Other (15%)			$24,900
SUBTOTAL			$190,900

Item	Qty.	Price/Unit	Total Amount
2 MG Elevated Storage Tank, including installation and painting (fluted column)	1 EA	$2,200,000	$2,200,000
Contingencies			$1,067,148
Basic Engineering Services			$774,000
Special Engineering Services			$65,000
Construction Observation			$33,000
TOTAL			**$10,410,623**



WATER SOURCES FOR
REGIONAL WATER SUPPLY STUDY

EXHIBIT 21

BURTON & ELLEDGE, INC.

REGIONAL WATER SUPPLY STUDY
ALTERNATIVE B
PURCHASE TREATED WATER FROM TYLER
EXHIBIT 22

Construction of Water Main from Golden Road WTP, Tyler, TX	$11,008,135
Construction of Water Distribution System	$13,391,099
Subtotal	*$24,399,234*
Amortized Construction Cost (20 yrs, 6% interest)	$2,096,382
Pump Stations Operation and Maintenance Cost	$144,581
Total Annual Cost (Debt Service plus O&M)	**$2,240,963**

Cost per thousand gallons
= $2, 240,963/(3.1 x 1000 x 365) = $1.98 per ten thousand gallons

Cost for treated water purchase from City of Tyler
= $1.50 - $2.00 per thousand gallons

Total cost per thousand gallons = $3.48 - $3.98 per thousand gallons

NOTE: Unit cost based on 3.1 MGD usage in order to compare with unit cost for Alternative A. Refer to Exhibit 25 for unit costs at usages less than 3.1 MGD

REGIONAL WATER SUPPLY STUDY
WATER TRANSMISSION MAIN
GOLDEN ROAD WTP, TYLER TO RABBIT CREEK RESERVOIR SITE
OPINION OF PROBABLE COST
EXHIBIT 22

Quantity	Unit	Description	Unit Cost	Total Cost
146	Acre	Clear and Grub	$1,000	$146,000
125,000	LF	24" Water Main	$45	$5,625,000
1	LS	Add 5% for Valves & Fittings		$281,250
283,000	SY	Erosion Control	$2	$566,000
127,000	LF	Pollution Prevention	$2	$254,000
60	Acre	Easement	$2,000	$120,000
2,300	LF	River Crossing	$300	$690,000
1,300	LF	Road Bore	$250	$325,000
1	LS	Pump Station	$650,000	$650,000
		Subtotal		*$8,657,250*
		Contingencies		$1,731,450
		Engineering		$519,435
		Construction Observation		$60,000
		Surveying & Aerial Photo		$40,000
		Total		**$11,008,135**

ALTERNATIVE B
TREATED WATER FROM TYLER
OPERATION AND MAINTENANCE COST
OPINION OF PROBABLE COST
EXHIBIT 22

Golden Road Pump Station
Each Pump ; 2200 US GPM @ 175 Ft , 150 Hp.

1 Operation Time -
a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

2. Power Consumption
Total Power = (150(8) + 300(8)) 0.7457/0.9
= 2, 983 Kwh/day

Yearly Power Cost = 2, 983 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 54, 440

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months = **$5, 760/year**

Distribution Pump Station
High Flow Pump ; 4300 US GPM @ 280 Ft , 500 Hp
Low Flow Pump ; 2200 US GPM @ 190 Ft , 150 Hp

2. Operation Time -
a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs

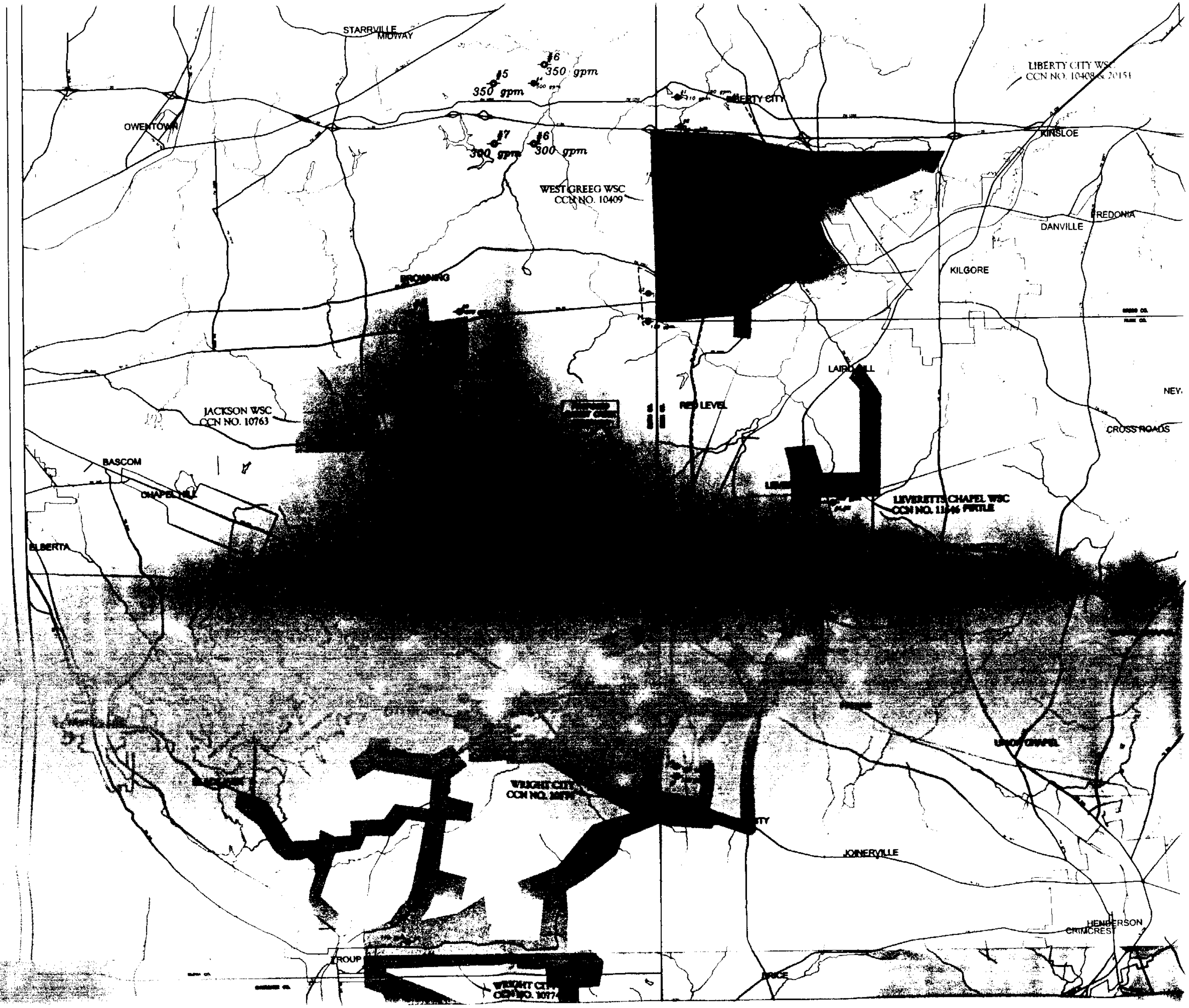
b. Low Flow = 24 - 8(2) = 8 hrs.

3. Power Consumption
Total Power = (150(8) + 500(8)) 0.7457/0.9
= 4, 308 Kwh/day

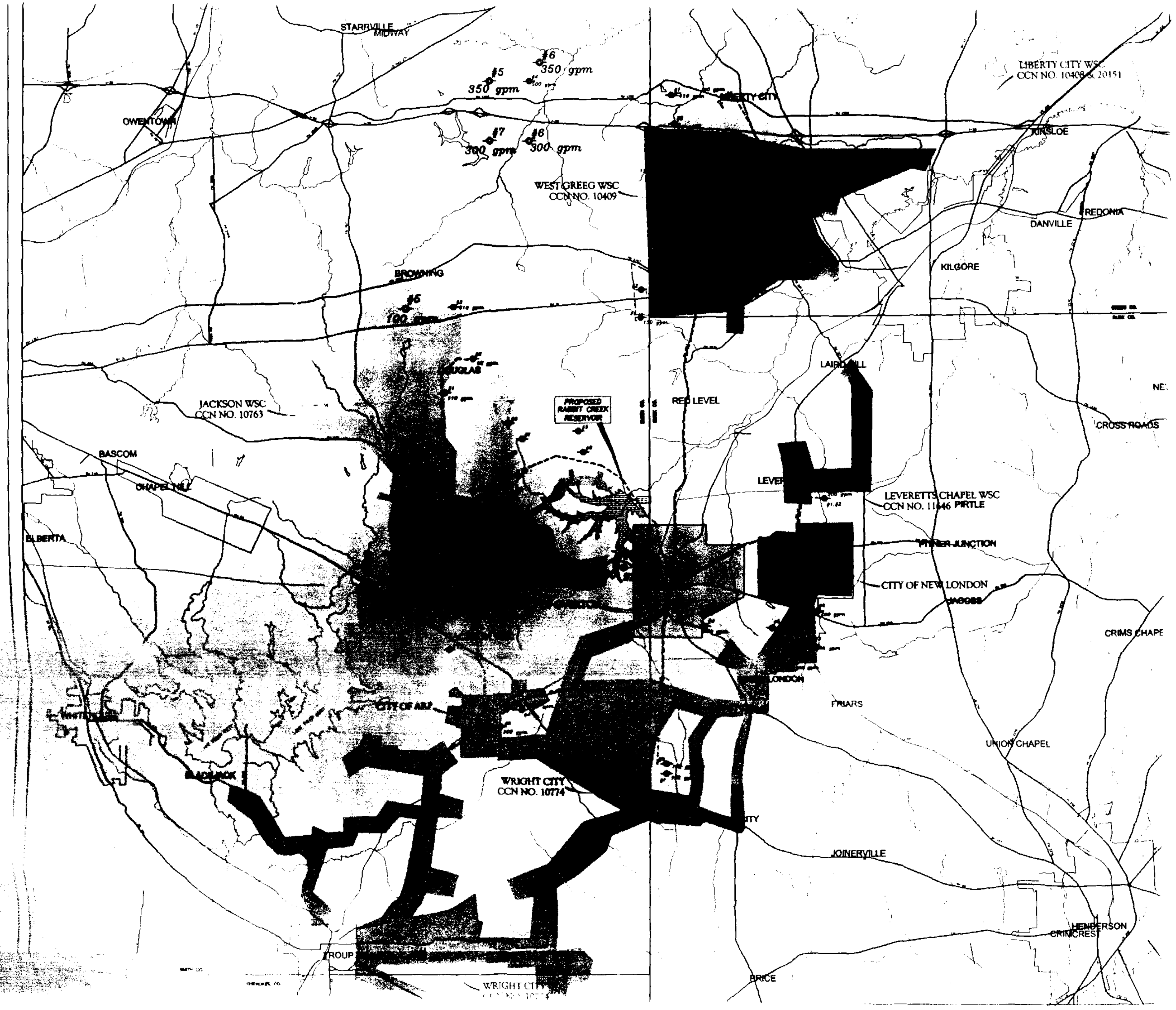
Yearly Power Cost = 4, 308 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 78, 621

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months = **$5, 760/year**

TOTAL OPERATION AND MAINTENANCE COST
= $54, 440 + $5, 760 + $78, 621 + $5, 760 = **$ 144, 581**



STARRVILLE
MIDWAY
#5
350 gpm
#6
350 gpm
LIBERTY CITY WSC
CCN NO. 10408 & 20151
OWENTOWN
LIBERTY CITY
KINSLOE
#7
300 gpm
#6
300 gpm
WEST GREEG WSC
CCN NO. 10409
FREDONIA
DANVILLE
KILGORE
BROWNING
LAIRD HILL
JACKSON WSC
CCN NO. 10763
RED LEVEL
CROSS ROADS
BASCOM
CHAPEL HILL
LEVERETTS CHAPEL WSC
CCN NO. 11646 PIRTLE
ELBERTA
UNION CHAPEL
JOINERVILLE
HENDERSON
CRIMCREST
TROUP


STARRVILLE
MIDWAY
#6
350 gpm
#5
350 gpm
LIBERTY CITY WSC
CCN NO. 10408 & 20151
OWENTOWN
#7
300 gpm
#8
300 gpm
WEST GREEG WSC
CCN NO. 10409
REDONIA
DANVILLE
KILGORE
BROWNING
#6
100 gpm
JACKSON WSC
CCN NO. 10763
PROPOSED
RABBIT CREEK
RESERVOIR
RED LEVEL
LAIRD HILL
CROSS ROADS
BASCOM
CHAPEL HILL
LEVERETTS CHAPEL WSC
CCN NO. 11646
PIRTLE
ELBERTA
PITNER JUNCTION
CITY OF NEW LONDON
JACOBS
LONDON
FRIARS
CITY OF ARP
UNION CHAPEL
WRIGHT CITY
CCN NO. 10774
JOINERVILLE
HENDERSON
CRIMCREST
TROUP
PRICE
WRIGHT CITY

REGIONAL WATER SUPPLY STUDY
JACKSON WSC
ADDITIONAL WATER WELL CAPACITY AT EACH SITE

EXHIBIT 24

QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTAL
Water Well Pump Package				
1	Ea	100 Gpm, 25 Hp Pumps	$50,000	$50,000
1	Ea	Water Well & Casing	$140,000	$140,000
3	Ea	Test Holes and Water Samples	$80,000	$240,000
2	EA	Plug and abandon test hole	$7,000	$14,000
5	Acre	Land Aquisition	$1,000	$5,000
		Subtotal for Well and Pump		*$449,000*
Disinfection Package				
1	LS	Chlorine Package	$25,000	$25,000
1	LS	Building, fencing & sitework	$50,000	$50,000
Water Well Line to System Main				
6000	LF	8 inch Water Main	$14	$84,000
3	EA	200 Gpm, 30 Hp Pumps and Controls	$16,000	$48,000
1	LS	40, 000 Gallon Ground Storage Tank	$40,000	$40,000
1	LS	3, 500 Gallon Pressure Tank	$10,000	$10,000
		Subtotal		*$706,000*
		Contingency		$141,200
		Basic Engineering Services		$66,082
		Surveying		$15,000
		Construction Observation		$10,000
		Total		**$938,282**

Total Annual O&M Cost	=	$35,482
Amortized Construction Cost (20 yrs, 6% int)	=	$80,617
Total Annual Cost For Comparison	=	**$116,099**

REGIONAL WATER SUPPLY STUDY
JACKSON WSC WELL AND PUMP STATION
OPERATION AND MAINTENANCE COST

EXHIBIT 24

Water Well Pump Station
Each Pump ; 100 US GPM @ 600 Ft , 25 Hp.

1 Operation Time -
a. Take 6.7 hours to fill up 40, 000 gallon tank

b. Pump design to operate for 24 hours/day

2. Power Consumption
Total Power = (25(24)) 0.7457/0.75
= 597 Kwh/day

Yearly Power Cost = 597 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 10, 895

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs/mo. x 2 people x 12 months **= $5, 760/year**

Jackson WSC Distribution Pump Station
High Flow Pumps ; 2 - 200 US GPM @ 190 Ft , 60 Hp
Low Flow Pump ; 200 US GPM @ 190 Ft , 30 Hp

2. Operation Time -
a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs
Total = 8 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

3. Power Consumption
= 716 Kwh/day

Yearly Power Cost = 716 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 13, 067

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

TOTAL OPERATION AND MAINTENANCE COST
= $10, 895 + $5, 760 + $13, 067 + $5, 760 **= $ 35, 482/year**

REGIONAL WATER SUPPLY STUDY
CITY OF OVERTON
ADDITIONAL WATER WELL CAPACITY AT EACH SITE

EXHIBIT 24

QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTAL
Water Well Pump Package				
1	Ea	100 Gpm, 25 Hp Pumps	$50,000	$50,000
1	Ea	Water Well & Casing	$140,000	$140,000
3	Ea	Test Holes and Water Samples	$80,000	$240,000
2	EA	Plug and abandon test hole	$7,000	$14,000
5	Acre	Land Aquisition	$1,000	$5,000
		Subtotal for Well & Pump		$449,000
Ozonation Package				
1	LS	Ozone System Package	$280,000	$280,000
Filtration System				
1	LS	Filtration System package	$90,000	$90,000
Ph Adjustment Package				
1	LS	Ph Meters, Tank & Caustic Pumps	$30,000	$30,000
Disinfection Package				
1	LS	Chlorine Package	$25,000	$25,000
Water Well Line to System Main				
6000	LF	8 inch Water Main	$14	$84,000
3	EA	150 Gpm Pump, 20 Hp & Controls	$14,000	$42,000
1	LS	25, 000 Gallon Ground Storage Tank	$25,000	$25,000
1	LS	2, 500 Gallon Pressure Tank	$7,000	$7,000
		Subtotal		*$1,032,000*
		Contingency		$206,400
		Basic Engineering Services		$89,165
		Surveying		$15,000
		Construction Observation		$10,000
		Total		**$1,352,565**

Total Annual O&M Cost	=	$31,120
Amortized Construction Cost (20 yrs, 6% int)	=	$116,212
Total Annual Cost For Comparison	=	**$147,332**

REGIONAL WATER SUPPLY STUDY
OVERTON WELL PUMP STATION
OPERATION AND MAINTENANCE COST

EXHIBIT 24

Water Well Pump Station
Each Pump ; 100 US GPM @ 600 Ft , 25 Hp.

1 Operation Time -
a. Take 4 hours to fill up 25, 000 gallon tank

b. Pump design to operate for 24 hours/day

2. Power Consumption
Total Power = (25(24)) 0.7457/0.75
= 597 Kwh/day

Yearly Power Cost = 597 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 10, 895

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

Overton Distribution Pump Station
High Flow Pumps ; 2 - 150 US GPM @ 190 Ft , 20 Hp
Low Flow Pump ; 150 US GPM @ 190 Ft , 20 Hp

2. Operation Time -
a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs
Total = 8 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

3. Power Consumption
Total Power = (20(8) + 40(8)) 0.7457/0.75
= 477 Kwh/day

Yearly Power Cost = 477 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 8, 705.25

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

TOTAL OPERATION AND MAINTENANCE COST
= $10, 895 + $5, 760 + $8, 705 + $5, 760 **= $ 31, 120/year**

REGIONAL WATER SUPPLY STUDY
LIBERTY CITY WSC
ADDITIONAL WATER WELL CAPACITY AT EACH SITE

EXHIBIT 24

QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTAL
Water Well Pump Package				
1	Ea	350 Gpm, 70 Hp Pumps	$75,000	$75,000
1	Ea	Water Well & Casing	$150,000	$150,000
3	Ea	Test Holes and Water Samples	$80,000	$240,000
2	EA	Plug and abandon test hole	$7,000	$14,000
5	Acre	Land Acquisition	$1,000	$5,000
		Subtotal for Well & Pump		$484,000
Ozone Package				
1	LS	Ozone System Package	$410,000	$410,000
Disinfection Package				
1	LS	Chlorine Package	$25,000	$25,000
Water Well Line to System Main				
6000	LF	12 inch Water Main	$20	$120,000
1	EA	Pump Station - 3 700 Gpm Pumps, 85 Hp &Controls and Building	$250,000	$250,000
2	LS	100, 000 Gallon Ground Storage Tank	$80,000	$160,000
1	LS	10, 000 Gallon Pressure Tank	$25,000	$25,000
		Subtotal		*$1,474,000*
		Contingency		$294,800
		Basic Engineering Services		$127,354
		Surveying		$15,000
		Construction Observation		$10,000
		Total		**$1,921,154**

Total Annual O&M Cost	=	$77,842
Amortized Construction Cost (20 yrs, 6% int)	=	$165,066
Total Annual Cost For Comparison	=	**$242,908**

REGIONAL WATER SUPPLY STUDY
LIBERTY CITY WSC WELL PUMP STATION
OPERATION AND MAINTENANCE COST

EXHIBIT 24

Water Well Pump Station

Each Pump ; 350 US GPM @ 600 Ft , 80 Hp.

1 Operation Time -

a. Take 5 hours to fill up 100,000 gallon tank

b. Pump design to operate for 24 hours/day

2. Power Consumption

Total Power = (70(24)) 0.7457/0.78
= 1,606 Kwh/day

Yearly Power Cost = 1,606 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 29,311

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

Liberty City WSC Distribution Pump Station

High Flow Pumps ; 2 - 700 US GPM @ 190 Ft , 170 Hp
Low Flow Pump ; 700 US GPM @ 190 Ft , 85 Hp

2. Operation Time -

a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs
Total = 8 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

3. Power Consumption

Total Power = (85(8) + 170(8)) 0.7457/0.75
= 2,028 Kwh/day

Yearly Power Cost = 2,028 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 37,011

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

TOTAL OPERATION AND MAINTENANCE COST
= $29,311 + $5,760 + $37,011 + $5,760 **= $ 77,842/year**

REGIONAL WATER SUPPLY STUDY
WEST GREGG WSC
ADDITIONAL WATER WELL CAPACITY AT EACH SITE

EXHIBIT 24

QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTAL
Water Well Pump Package				
1	Ea	300 Gpm, 65 Hp Pumps	$70,000	$70,000
1	Ea	Water Well & Casing	$150,000	$150,000
3	Ea	Test Holes and Water Samples	$80,000	$240,000
2	EA	Plug and abandon test hole	$7,000	$14,000
5	Acre	Land Aquisition	$1,000	$5,000
		Pump Subtotal		$479,000
Disinfection Package				
1	LS	Chlorine Package	$25,000	$25,000
1	LS	Chlorine Building	$25,000	$25,000
Water Well Line to System Main				
10560	LF	10 inch Water Main	$16	$168,960
1	EA	Pump Station - 3 - 600 Gpm Pumps, 75 Hp & Controls and Building	$110,000	$110,000
1	LS	100, 000 Gallon Ground Storage Tank	$80,000	$80,000
1	LS	10, 000 Gallon Pressure Tank	$25,000	$25,000
		Subtotal		*$912,960*
		Contingency		$182,592
		Basic Engineering Services		$78,880
		Surveying		$15,000
		Construction Observation		$10,000
		Total		**$1,199,432**

Total Annual O&M Cost	=	$60,649
Amortized Construction Cost (20 yrs, 6% int)	=	$103,055
Total Annual Cost For Comparison	=	**$163,704**

REGIONAL WATER SUPPLY STUDY
WEST GREGG WSC WELL PUMP STATION
OPERATION AND MAINTENANCE COST

EXHIBIT 24

Water Well Pump Station
Each Pump ; 300 US GPM @ 600 Ft , 65 Hp.

1 Operation Time -
a. Take 6 hours to fill up 100, 000 gallon tank

b. Pump design to operate for 24 hours/day

2. Power Consumption
Total Power = (65(24)) 0.7457/0.78
= 1, 492 Kwh/day

Yearly Power Cost = 1, 492 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 27, 229

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

West Gregg WSC Distribution Pump Station
High Flow Pumps ; 2-600 US GPM @ 190 Ft , 100 Hp
Low Flow Pump ; 600 US GPM @ 190 Ft , 50 Hp

2. Operation Time -
a. High Flow Times - 6 - 9 am = 3 hrs
- 11-2 noon = 3 hrs
- 5 - 7 pm = 2 hrs

b. Low Flow = 24 - 8(2) = 8 hrs.

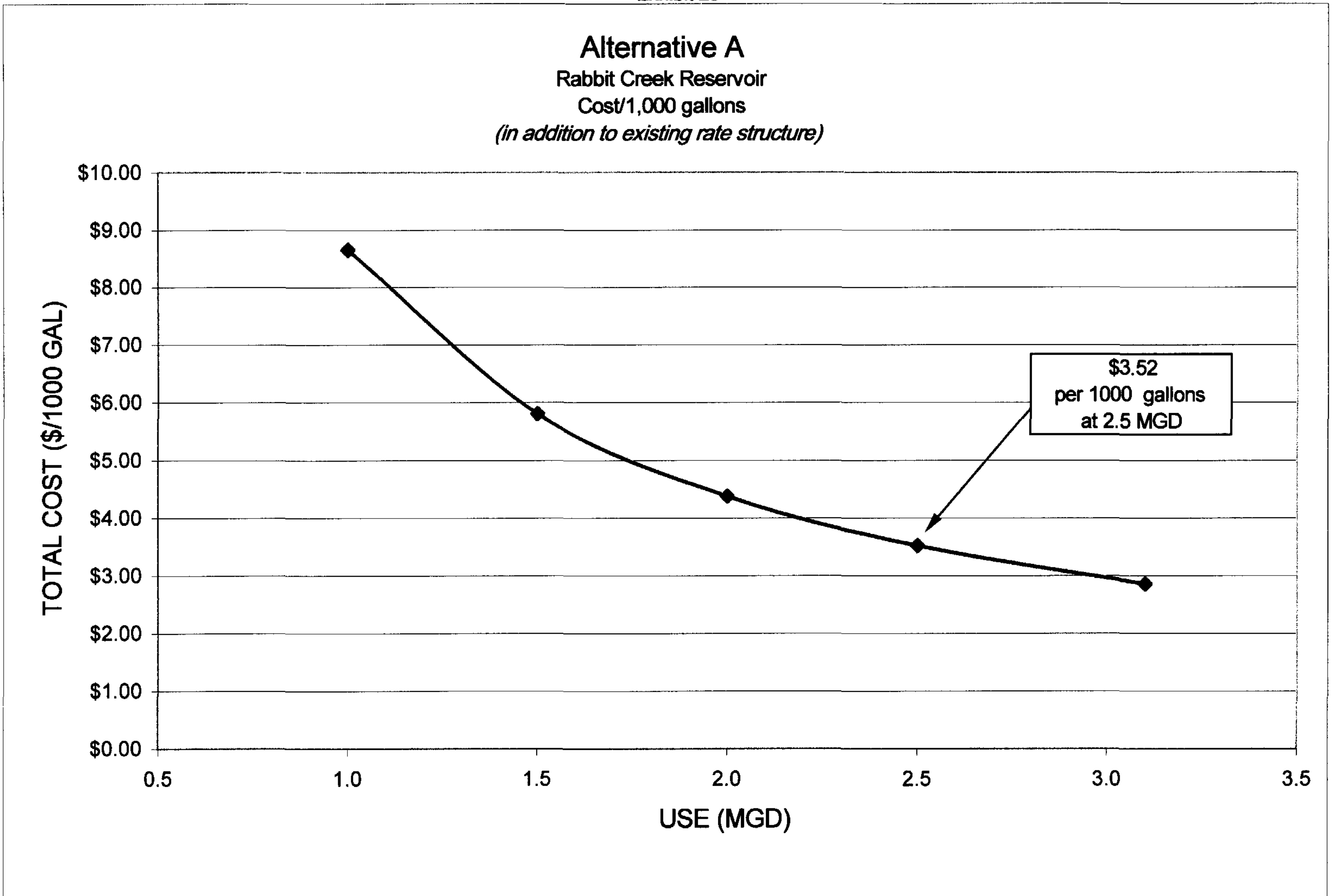
3. Power Consumption
Total Power = (50(8) + 100(8)) 0.7457/0.75
= 1, 200 Kwh/day

Yearly Power Cost = 1, 200 Kwh/day x 365 days/yr x $0.05 kw/hr
= $ 21, 900

Service and Maintenence Cost
Use $ 20.00/ hr x 12 hrs /day x 2 people x 12 months **= $5, 760/year**

TOTAL OPERATION AND MAINTENANCE COST
= $27, 229 + $5, 760 + $21,900 + $5, 760 **= $60, 649**

Regional Water Supply Plan
Rabbit Creek Reservoir
Exhibit 25

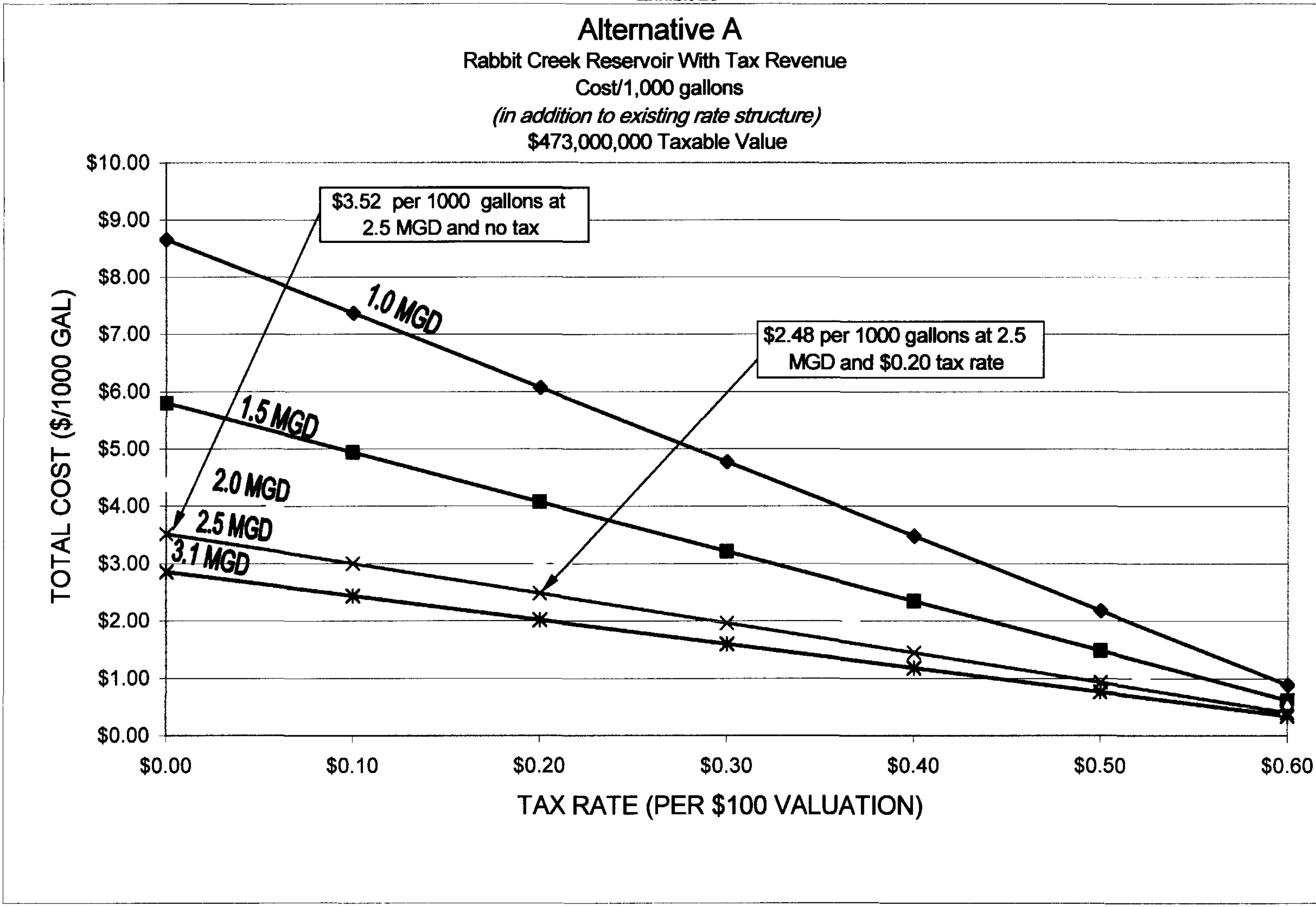


ALTERNATIVE A:
Rabbit Creek Reservoir With Tax Revenue

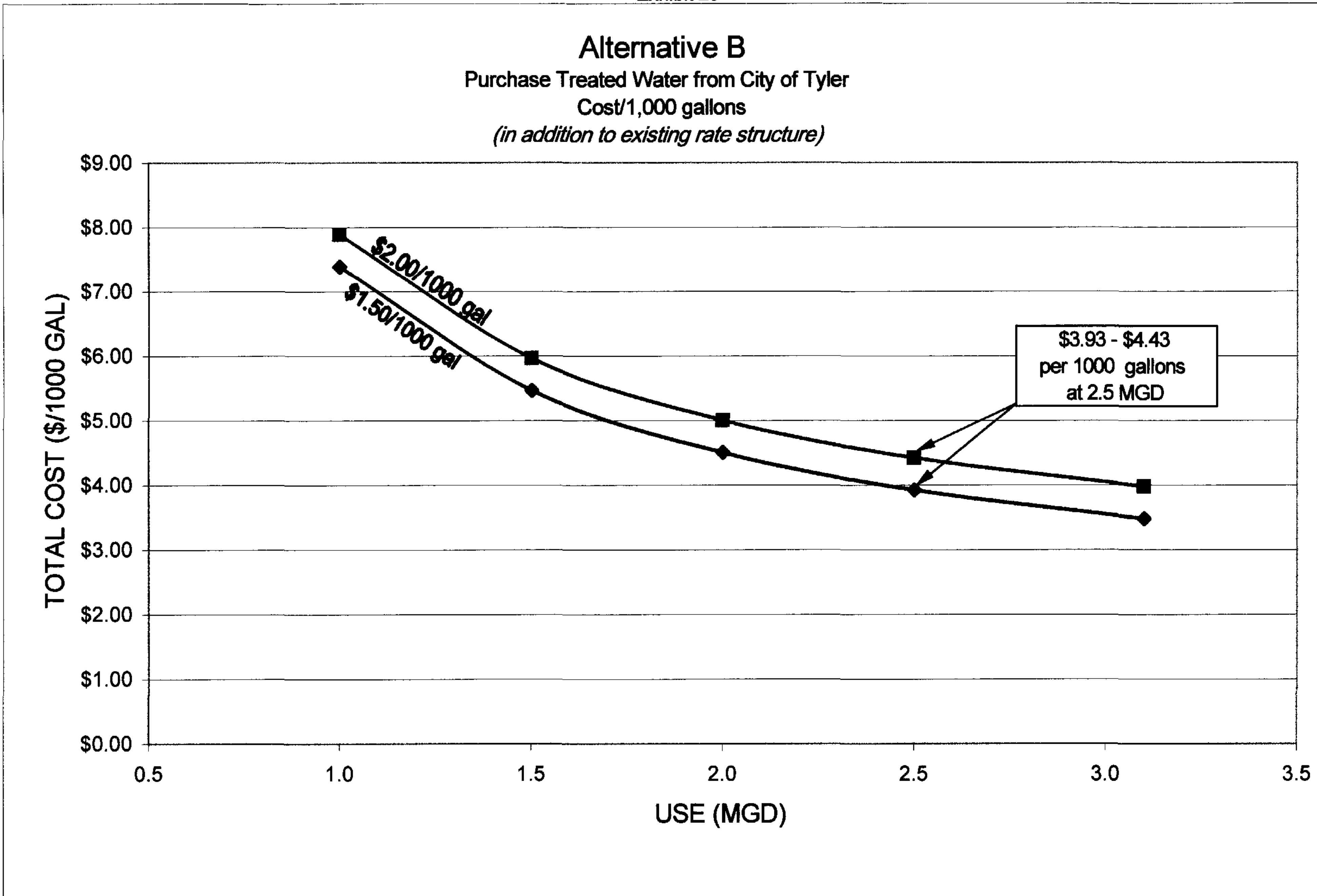
Assumed Tax Base: $473,000,000

Use (MGD)	P.S. ($/yr)	WTP ($/yr)	D.S. ($/yr)	Water Cost (Total O&M + D.S.) ($/yr)	Water Cost (Total O&M + D.S.) ($/1000 gal)	Tax Rate ($ per $100)	Tax Revenue ($ per year)	Water Cost with Revenue ($/1000 gal)
1.0	$43,780	$636,260	$2,480,707	$3,160,747	$8.66	$0.00	$0	$8.66
						$0.10	$473,000	$7.36
						$0.20	$946,000	$6.07
						$0.30	$1,419,000	$4.77
						$0.40	$1,892,000	$3.48
						$0.50	$2,365,000	$2.18
						$0.60	$2,838,000	$0.88
1.5	$59,910	$636,260	$2,480,707	$3,176,877	$5.80	$0.00	$0	$5.80
						$0.10	$473,000	$4.94
						$0.20	$946,000	$4.07
						$0.30	$1,419,000	$3.21
						$0.40	$1,892,000	$2.35
						$0.50	$2,365,000	$1.48
						$0.60	$2,838,000	$0.62
2.0	$76,020	$636,260	$2,480,707	$3,192,987	$4.37	$0.00	$0	$4.37
						$0.10	$473,000	$3.73
						$0.20	$946,000	$3.08
						$0.30	$1,419,000	$2.43
						$0.40	$1,892,000	$1.78
						$0.50	$2,365,000	$1.13
						$0.60	$2,838,000	$0.49
2.5	$92,170	$636,260	$2,480,707	$3,209,137	$3.52	$0.00	$0	$3.52
						$0.10	$473,000	$3.00
						$0.20	$946,000	$2.48
						$0.30	$1,419,000	$1.96
						$0.40	$1,892,000	$1.44
						$0.50	$2,365,000	$0.93
						$0.60	$2,838,000	$0.41
3.1	$111,520	$636,260	$2,480,707	$3,228,487	$2.85	$0.00	$0	$2.85
						$0.10	$473,000	$2.44
						$0.20	$946,000	$2.02
						$0.30	$1,419,000	$1.60
						$0.40	$1,892,000	$1.18
						$0.50	$2,365,000	$0.76
						$0.60	$2,838,000	$0.35

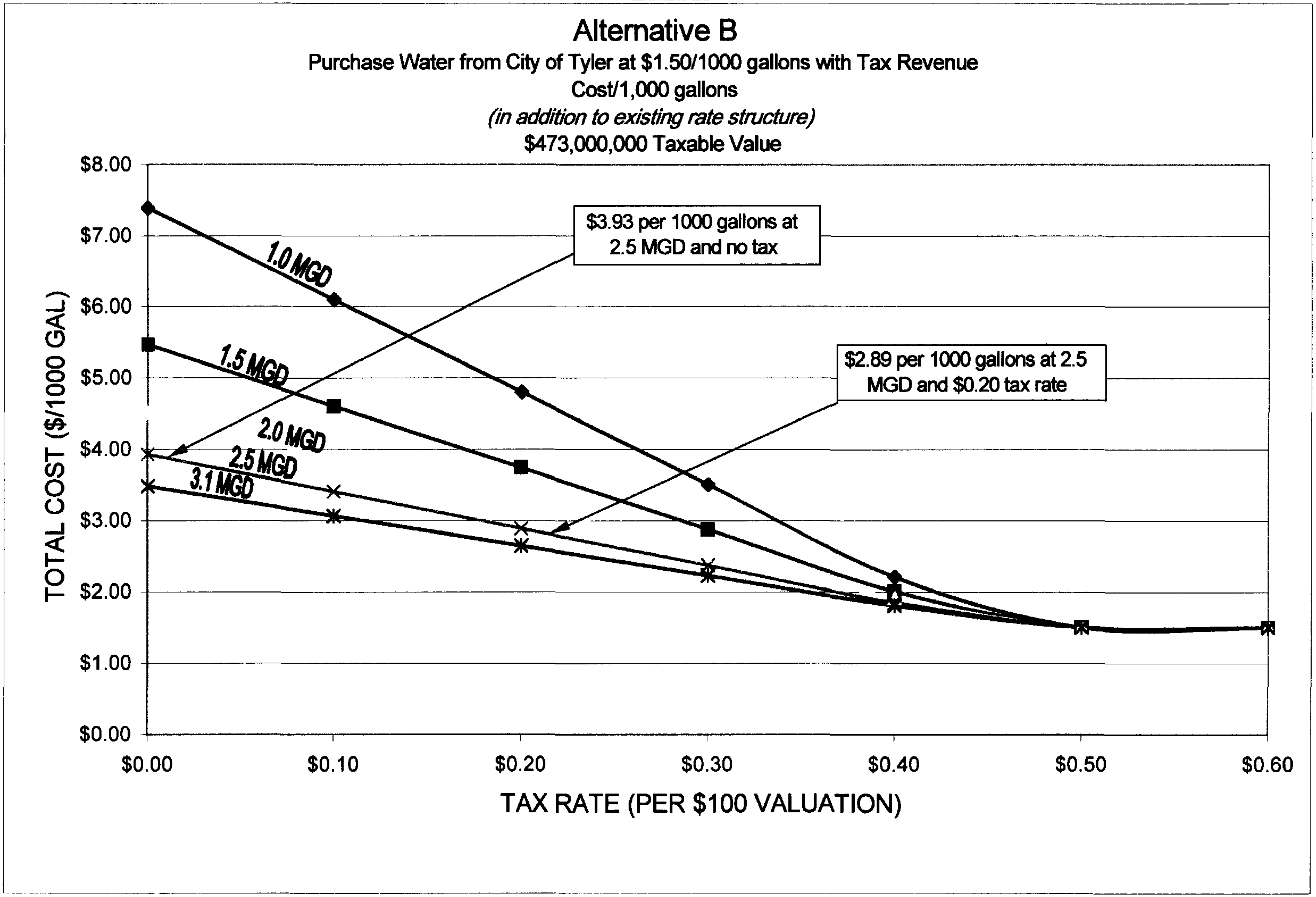
Regional Water Supply Plan
Rabbit Creek Reservoir
Exhibit 25



Regional Water Supply Plan
Rabbit Creek Reservoir
Exhibit 25



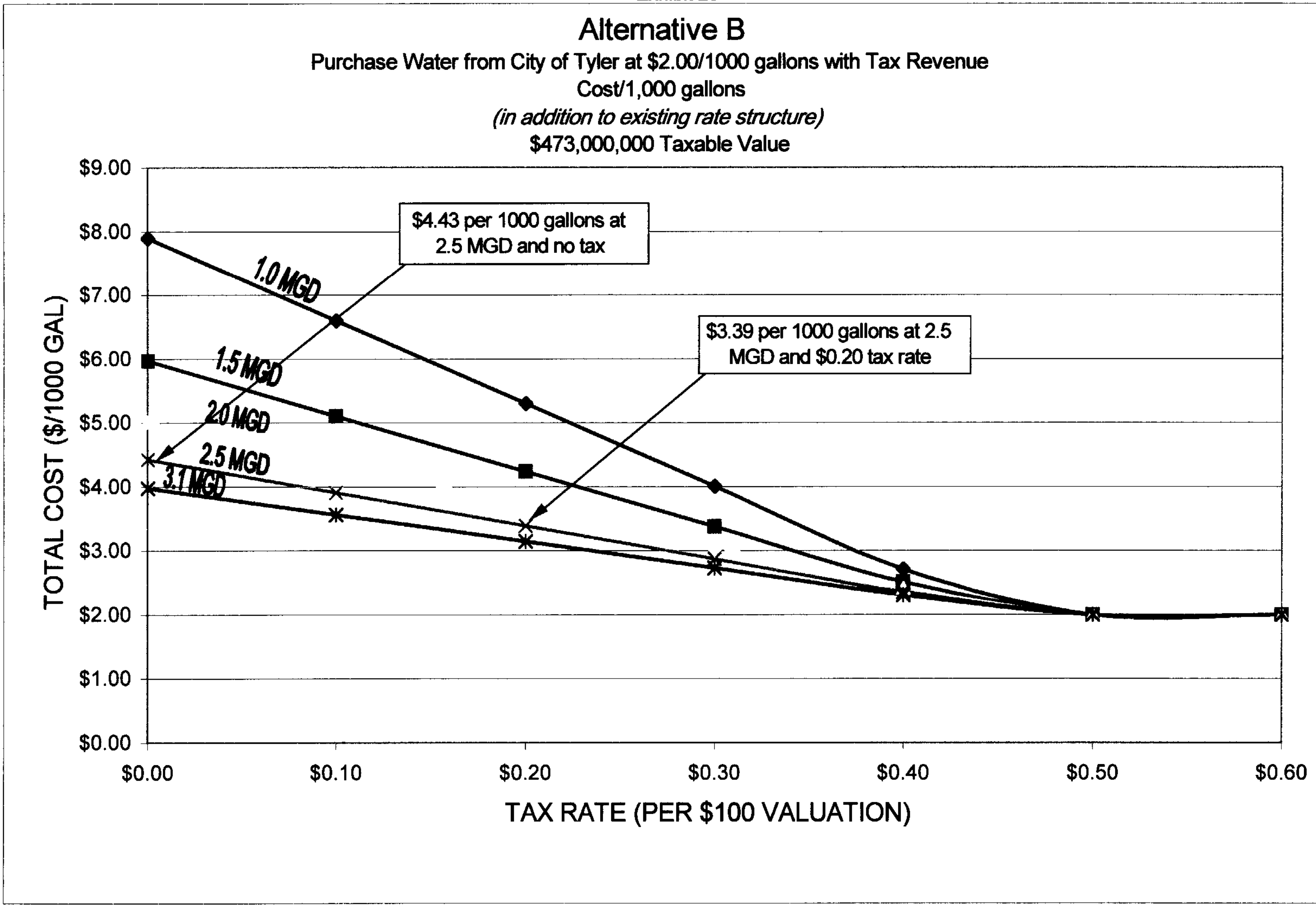
Regional Water Supply Plan
Rabbit Creek Reservoir
Exhibit 25



g:\Projects\Overton\705.2\Regional Water\Report\Exhibits\Ex-25 Alternative costs\Alt B, Charts Chart 1

Burton and Elledge, Inc.

Regional Water Supply Plan
Rabbit Creek Reservoir
Exhibit 25



ALTERNATIVE A:
Rabbit Creek Reservoir With Tax Revenue

Assumed Tax Base: $473,000,000

Use (MGD)	P.S. ($/yr)	WTP ($/yr)	D.S. ($/yr)	Water Cost (Total O&M + D.S.) ($/yr)	Water Cost (Total O&M + D.S.) ($/1000 gal)	Tax Rate ($ per $100)	Tax Revenue ($ per year)	Water Cost with Revenue ($/1000 gal)
1.0	$43,780	$636,260	$2,480,707	$3,160,747	$8.66	$0.00	$0	$8.66
						$0.10	$473,000	$7.36
						$0.20	$946,000	$6.07
						$0.30	$1,419,000	$4.77
						$0.40	$1,892,000	$3.48
						$0.50	$2,365,000	$2.18
						$0.60	$2,838,000	$0.88
1.5	$59,910	$636,260	$2,480,707	$3,176,877	$5.80	$0.00	$0	$5.80
						$0.10	$473,000	$4.94
						$0.20	$946,000	$4.07
						$0.30	$1,419,000	$3.21
						$0.40	$1,892,000	$2.35
						$0.50	$2,365,000	$1.48
						$0.60	$2,838,000	$0.62
2.0	$76,020	$636,260	$2,480,707	$3,192,987	$4.37	$0.00	$0	$4.37
						$0.10	$473,000	$3.73
						$0.20	$946,000	$3.08
						$0.30	$1,419,000	$2.43
						$0.40	$1,892,000	$1.78
						$0.50	$2,365,000	$1.13
						$0.60	$2,838,000	$0.49
2.5	$92,170	$636,260	$2,480,707	$3,209,137	$3.52	$0.00	$0	$3.52
						$0.10	$473,000	$3.00
						$0.20	$946,000	$2.48
						$0.30	$1,419,000	$1.96
						$0.40	$1,892,000	$1.44
						$0.50	$2,365,000	$0.93
						$0.60	$2,838,000	$0.41
3.1	$111,520	$636,260	$2,480,707	$3,228,487	$2.85	$0.00	$0	$2.85
						$0.10	$473,000	$2.44
						$0.20	$946,000	$2.02
						$0.30	$1,419,000	$1.60
						$0.40	$1,892,000	$1.18
						$0.50	$2,365,000	$0.76
						$0.60	$2,838,000	$0.35

)))

ALTERNATIVE B:
Purchase Treated Water From Tyler With Tax Revenue

Assumed Tax Base: $473,000,000

							Tyler water @ $1.50/1000 gallons				Tyler water @ $2.00/1000 gallons			
Use (MGD)	O & M ($/yr)	D.S. ($/yr)	Water Cost (Total O&M + D.S.) ($/yr)	Water Cost (Total O&M + D.S.) ($/1000 gal)	Tyler Water Price ($/1000 gal)	Water Cost + Tyler Purchase ($/1000 gal)	Tax Rate ($/$100)	Tax Revenue ($)	Water Cost with Revenue ($/1000 gal)	Water Cost w/Revenue + Tyler Purchase ($/1000 gal)	Tax Rate ($/$100)	Tax Revenue ($)	Water Cost ($/1000 gal)	Water Cost w/Revenue + Tyler Purchase ($/1000 gal)
1.0	$54,443	$2,096,382	$2,150,825	$5.89	$1.50	$7.39	$0.00	$0	$5.89	$7.39	$0.00	$0	$5.89	$7.89
					$2.00	$7.89	$0.10	$473,000	$4.60	$6.10	$0.10	$473,000	$4.60	$6.60
							$0.20	$946,000	$3.30	$4.80	$0.20	$946,000	$3.30	$5.30
							$0.30	$1,419,000	$2.01	$3.51	$0.30	$1,419,000	$2.01	$4.01
							$0.40	$1,892,000	$0.71	$2.21	$0.40	$1,892,000	$0.71	$2.71
							$0.50	$2,365,000	$0.00	$1.50	$0.50	$2,365,000	$0.00	$2.00
							$0.60	$2,838,000	$0.00	$1.50	$0.60	$2,838,000	$0.00	$2.00
1.5	$75,904	$2,096,382	$2,172,286	$3.97	$1.50	$5.47	$0.00	$0	$3.97	$5.47	$0.00	$0	$3.97	$5.97
					$2.00	$5.97	$0.10	$473,000	$3.10	$4.60	$0.10	$473,000	$3.10	$5.10
							$0.20	$946,000	$2.24	$3.74	$0.20	$946,000	$2.24	$4.24
							$0.30	$1,419,000	$1.38	$2.88	$0.30	$1,419,000	$1.38	$3.38
							$0.40	$1,892,000	$0.51	$2.01	$0.40	$1,892,000	$0.51	$2.51
							$0.50	$2,365,000	$0.00	$1.50	$0.50	$2,365,000	$0.00	$2.00
							$0.60	$2,838,000	$0.00	$1.50	$0.60	$2,838,000	$0.00	$2.00
2.0	$97,366	$2,096,382	$2,193,748	$3.01	$1.50	$4.51	$0.00	$0	$3.01	$4.51	$0.00	$0	$3.01	$5.01
					$2.00	$5.01	$0.10	$473,000	$2.36	$3.86	$0.10	$473,000	$2.36	$4.36
							$0.20	$946,000	$1.71	$3.21	$0.20	$946,000	$1.71	$3.71
							$0.30	$1,419,000	$1.06	$2.56	$0.30	$1,419,000	$1.06	$3.06
							$0.40	$1,892,000	$0.41	$1.91	$0.40	$1,892,000	$0.41	$2.41
							$0.50	$2,365,000	$0.00	$1.50	$0.50	$2,365,000	$0.00	$2.00
							$0.60	$2,838,000	$0.00	$1.50	$0.60	$2,838,000	$0.00	$2.00
2.5	$118,827	$2,096,382	$2,215,209	$2.43	$1.50	$3.93	$0.00	$0	$2.43	$3.93	$0.00	$0	$2.43	$4.43
					$2.00	$4.43	$0.10	$473,000	$1.91	$3.41	$0.10	$473,000	$1.91	$3.91
							$0.20	$946,000	$1.39	$2.89	$0.20	$946,000	$1.39	$3.39
							$0.30	$1,419,000	$0.87	$2.37	$0.30	$1,419,000	$0.87	$2.87
							$0.40	$1,892,000	$0.35	$1.85	$0.40	$1,892,000	$0.35	$2.35
							$0.50	$2,365,000	$0.00	$1.50	$0.50	$2,365,000	$0.00	$2.00
							$0.60	$2,838,000	$0.00	$1.50	$0.60	$2,838,000	$0.00	$2.00
3.1	$144,581	$2,096,382	$2,240,963	$1.98	$1.50	$3.48	$0.00	$0	$1.98	$3.48	$0.00	$0	$1.98	$3.98
					$2.00	$3.98	$0.10	$473,000	$1.56	$3.06	$0.10	$473,000	$1.56	$3.56
							$0.20	$946,000	$1.14	$2.64	$0.20	$946,000	$1.14	$3.14
							$0.30	$1,419,000	$0.73	$2.23	$0.30	$1,419,000	$0.73	$2.73
							$0.40	$1,892,000	$0.31	$1.81	$0.40	$1,892,000	$0.31	$2.31
							$0.50	$2,365,000	$0.00	$1.50	$0.50	$2,365,000	$0.00	$2.00
							$0.60	$2,838,000	$0.00	$1.50	$0.60	$2,838,000	$0.00	$2.00

Entity	Conn. Inside City	Conn. Outside City	Population Inside City	Population Outside City	Total Population Served	Annual Water Use Acre-feet
Arp						
1990	402	26	812 _1/	78	890	183
1991	403	26	801	78	879	199
1992	406	26	877	78	955	142
1993	406	31	895	93	988	167
1994	430	31	972	93	1,065	153
1995	423	31	936	93	1,029	174
1996	422	31	956	93	1,049	165
Liberty City WSC						
1990	1,200	0	3,600	0	3,600	324
1991	1,200	0	3,600	0	3,600	405
1992	1,230	0	3,690	0	3,690	441
1993	1,235	0	3,705	0	3,705	443
1994	1,268	0	3,804	0	3,804	437
1995	1,304	0	3,912	0	3,912	452
1996	1,340	0	4,020	0	4,020	446
Overton						
1990	953	12	2105 _1/	36	2,141	357
1991	No Report	No Report	2,105	0	2,105	No Report
1992	922	32	2,163	96	2,259	357
1993	916	38	2,163	114	2,277	390
1994	1,032	32	2,156	96	2,252	379
1995	1,032	32	2,229	96	2,325	602
1996	972	0	2,216	0	2,216	756
New London						
1990	393	340	926 _1/	1,020	1,946	331
1991	390	350	916	1,050	1,966	341
1992	447	300	992	900	1,892	377
1993	431	289	991	867	1,858	384
1994	431	289	990	867	1,857	393
1995	367	353	984	1,059	2,043	455
1996	397	323	1,010	969	1,979	414

_1/ City Population Estimates (1990-1996) Provided by the State Data Center

TWDB Population and Water Use Projections for Cities

City	Population _1/	Water Requirements _2/ Acre-feet
Overton		
1990	2105	352
2000	2205	457
2010	2250	446
2020	2218	417
2030	2180	401
2040	2185	392
2050	2188	389
New London		
1990	926	195
2000	1039	233
2010	1069	230
2020	1079	221
2030	1127	227
2040	1191	235
2050	1256	246
Arp		
1990	812	171
2000	1115	244
2010	1257	262
2020	1391	276
2030	1512	293
2040	1614	306
2050	1689	318

_1/ Population projections are for the City only and do not include service areas outside the City

_2/ Water requirements are for dry weather conditions with expected water conservation savings

1996 CONSENSUS TEXAS WATER PLAN
POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)

GREGG COUNTY
MOST LIKELY GROWTH SCENARIO

City	1990	2000	2010	2020	2030	2040	2050
GLADEWATER (P)							
Population	3747	4288	4697	5135	5550	5942	6362
1990 Use	687						
Below Normal Rainfall							
* Expected Conservation		749	773	800	845	885	941
Advanced Conservation		720	721	725	777	819	869
Normal Rainfall							
Expected Conservation		639	663	684	715	745	791
Advanced Conservation		620	616	621	659	699	741
KILGORE (P)							
Population	8258	9560	10297	11125	11819	12500	13220
1990 Use	1650						
Below Normal Rainfall							
* Expected Conservation		2045	2099	2168	2251	2338	2458
Advanced Conservation		1981	1961	1981	2079	2184	2295
Normal Rainfall							
Expected Conservation		1628	1672	1720	1774	1834	1925
Advanced Conservation		1574	1557	1570	1642	1722	1807
LIBERTY CITY							
Population	1607	2177	2565	2863	3073	3200	3332
1990 Use	198						
Below Normal Rainfall							
* Expected Conservation		410	454	481	506	520	537
Advanced Conservation		395	422	436	465	477	493
Normal Rainfall							
Expected Conservation		324	359	378	396	405	418
Advanced Conservation		312	333	346	365	376	388
LONGVIEW (P)							
Population	68655	76438	82596	89188	95336	101080	107170
1990 Use	11983						
Below Normal Rainfall							
* Expected Conservation		15498	15913	16484	17193	17889	18847
Advanced Conservation		14984	14896	15085	15912	16757	17647
Normal Rainfall							
Expected Conservation		13528	13878	14286	14844	15398	16206
Advanced Conservation		13014	12953	13087	13883	14493	15246
WHITE OAK							
Population	5136	5882	6466	7089	7682	8246	8851
1990 Use	767						
Below Normal Rainfall							
* Expected Conservation		824	847	873	912	951	1011
Advanced Conservation		791	775	778	826	868	922
Normal Rainfall							
Expected Conservation		784	804	826	869	905	962
Advanced Conservation		751	739	738	783	822	872
COUNTY-OTHER							
Population	17545	15254	14265	13299	12344	11309	10130
1990 Use	2381						
Below Normal Rainfall							
* Expected Conservation		2103	1842	1585	1474	1303	1159
Advanced Conservation		2018	1666	1466	1335	1202	1069
Normal Rainfall							
Expected Conservation		1984	1730	1496	1391	1227	1092
Advanced Conservation		1898	1570	1377	1253	1138	1000

1996 CONSENSUS TEXAS WATER PLAN
POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)

GREGG COUNTY
MOST LIKELY GROWTH SCENARIO

Forecast item	1990	2000	2010	2020	2030	2040	2050
MUNICIPAL COUNTY TOTAL							
Population	104948	113599	120886	128699	135804	142277	149065
1990 Use	17666						
Below Normal Rainfall							
* Expected Conservation		21629	21928	22391	23181	23886	24953
Advanced Conservation		20889	20441	20471	21394	22307	23295
Normal Rainfall							
Expected Conservation		18887	19106	19390	19989	20514	21394
Advanced Conservation		18169	17768	17739	18585	19250	20054
MANUFACTURING	14634	16538	18576	20934	23507	26515	29716
S.E. POWER COOLING	465	2500	3000	3000	3000	3000	4000
MINING	124	96	67	46	37	29	27
IRRIGATION - Case A	0	0	0	0	0	0	0
LIVESTOCK	230	265	265	265	265	265	265
TOTAL COUNTY WATER USE	33119						
Below Normal Rainfall							
* Expected Conservation		41028	43836	46636	49990	53695	58961
Advanced Conservation		40288	42349	44716	48203	52116	57303
Normal Rainfall							
Expected Conservation		38286	41014	43635	46798	50323	55402
Advanced Conservation		37568	39676	41984	45394	49059	54062

* Municipal use for cities excludes any wholesale municipal sales and identified sales to industrial users.
* Below normal rainfall with expected conservation is the primary municipal water use scenario.
Advanced conservation is implemented prior to project construction.

1996 CONSENSUS TEXAS WATER PLAN
POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)

SMITH COUNTY
MOST LIKELY GROWTH SCENARIO

City	1990	2000	2010	2020	2030	2040	2050
LINDALE							
Population	2428	2744	2981	3131	3251	3353	3418
1990 Use	458						
Below Normal Rainfall							
* Expected Conservation		522	534	533	542	548	556
Advanced Conservation		502	494	477	488	500	506
Normal Rainfall							
Expected Conservation		414	424	420	422	424	428
Advanced Conservation		400	390	376	386	390	394
OVERTON (P)							
Population	123	136	148	156	162	167	170
1990 Use	21						
Below Normal Rainfall							
* Expected Conservation		28	29	29	30	30	30
Advanced Conservation		28	28	26	28	28	28
Normal Rainfall							
Expected Conservation		23	23	23	23	23	24
Advanced Conservation		21	21	21	21	22	22
TROUP (P)							
Population	1626	1887	2050	2153	2236	2306	2351
1990 Use	164						
Below Normal Rainfall							
* Expected Conservation		319	328	328	331	333	337
Advanced Conservation		309	305	297	303	307	311
Normal Rainfall							
Expected Conservation		256	259	258	258	258	261
Advanced Conservation		245	241	234	238	243	245
TYLER							
Population	75450	78883	83131	86947	94063	102216	111076
1990 Use	15275						
Below Normal Rainfall							
* Expected Conservation		15994	16017	15973	16859	17862	19285
Advanced Conservation		15463	14805	14316	15277	16488	17668
Normal Rainfall							
Expected Conservation		15022	14992	14902	15700	16717	18041
Advanced Conservation		14491	13874	13342	14329	15343	16548
WHITEHOUSE							
Population	4032	7230	9535	11289	11724	11806	11889
1990 Use	516						
Below Normal Rainfall							
* Expected Conservation		972	1186	1328	1353	1336	1332
Advanced Conservation		931	1100	1201	1234	1217	1225
Normal Rainfall							
Expected Conservation		802	972	1075	1090	1071	1065
Advanced Conservation		761	897	974	998	992	985
COUNTY-OTHER							
Population	67650	80010	87824	91329	91041	88976	83991
1990 Use	10831						
Below Normal Rainfall							
* Expected Conservation		12416	12801	12580	12133	11568	10849
Advanced Conservation		11878	11719	11250	11011	10572	10002
Normal Rainfall							
Expected Conservation		11968	12309	12069	11725	11070	10473
Advanced Conservation		11519	11325	10841	10604	10173	9626

1996 CONSENSUS TEXAS WATER PLAN
POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)

SMITH COUNTY
MOST LIKELY GROWTH SCENARIO

Forecast item	1990	2000	2010	2020	2030	2040	2050
MUNICIPAL COUNTY TOTAL							
Population	151309	170890	185669	195005	202477	208824	212895
1990 Use	27265						
Below Normal Rainfall							
* Expected Conservation		30251	30895	30771	31248	31677	32389
Advanced Conservation		29111	28451	27567	28341	29112	29740
Normal Rainfall							
Expected Conservation		28485	28979	28747	29218	29563	30292
Advanced Conservation		27437	26748	25788	26576	27163	27820
MANUFACTURING	3341	3678	4003	4230	4441	4659	4872
S.E. POWER COOLING	0	0	0	0	0	0	0
MINING	696	690	16360	16277	16222	8213	243
IRRIGATION - Case A	180	180	180	180	180	180	180
LIVESTOCK	1208	1106	1106	1106	1106	1106	1106
TOTAL COUNTY WATER USE	32690						
Below Normal Rainfall							
* Expected Conservation		35905	52544	52564	53197	45835	38790
Advanced Conservation		34765	50100	49360	50290	43270	36141
Normal Rainfall							
Expected Conservation		34139	50628	50540	51167	43721	36693
Advanced Conservation		33091	48397	47581	48525	41321	34221

* Municipal use for cities excludes any wholesale municipal sales and identified sales to industrial users.
* Below normal rainfall with expected conservation is the primary municipal water use scenario.
Advanced conservation is implemented prior to project construction.

1996 CONSENSUS TEXAS WATER PLAN
POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)

RUSK COUNTY
MOST LIKELY GROWTH SCENARIO

City	1990	2000	2010	2020	2030	2040	2050
HENDERSON							
Population	11139	12006	12161	11866	11584	11554	11524
1990 Use	2264						
Below Normal Rainfall							
* Expected Conservation		2461	2384	2233	2115	2058	2053
Advanced Conservation		2394	2248	2047	1973	1941	1936
Normal Rainfall							
Expected Conservation		2233	2166	2020	1920	1864	1859
Advanced Conservation		2179	2043	1861	1790	1760	1756
KILGORE (P)							
Population	2808	3207	3408	3519	3616	3770	3931
1990 Use	561						
Below Normal Rainfall							
* Expected Conservation		686	695	686	689	705	731
Advanced Conservation		665	649	627	636	659	683
Normal Rainfall							
Expected Conservation		546	554	544	543	553	572
Advanced Conservation		528	515	497	502	519	537
OVERTON (P)							
Population	1982	2069	2102	2062	2018	2018	2018
1990 Use	331						
Below Normal Rainfall							
* Expected Conservation		429	417	388	371	362	359
Advanced Conservation		415	386	351	339	335	335
Normal Rainfall							
Expected Conservation		343	330	307	292	282	280
Advanced Conservation		332	306	279	269	264	262
TATUM (P)							
Population	1034	1063	1077	1053	1031	1029	1027
1990 Use	128						
Below Normal Rainfall							
* Expected Conservation		141	134	123	117	112	110
Advanced Conservation		135	122	110	105	103	101
Normal Rainfall							
Expected Conservation		123	117	107	100	96	94
Advanced Conservation		118	106	96	91	89	87
COUNTY-OTHER							
Population	26772	28849	31191	35785	40473	43161	44745
1990 Use	3035						
Below Normal Rainfall							
* Expected Conservation		3429	3463	3692	3993	4113	4264
Advanced Conservation		3300	3184	3331	3676	3824	3913
Normal Rainfall							
Expected Conservation		3041	3044	3211	3495	3582	3663
Advanced Conservation		2913	2764	2890	3178	3340	3413

1996 CONSENSUS TEXAS WATER PLAN
POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)

RUSK COUNTY
MOST LIKELY GROWTH SCENARIO

Forecast item	1990	2000	2010	2020	2030	2040	2050
MUNICIPAL COUNTY TOTAL							
Population	43735	47194	49939	54285	58722	61532	63245
1990 Use	6319						
Below Normal Rainfall							
* Expected Conservation		7146	7093	7122	7285	7350	7517
Advanced Conservation		6909	6589	6466	6729	6862	6968
Normal Rainfall							
Expected Conservation		6286	6211	6189	6350	6377	6468
Advanced Conservation		6070	5734	5623	5830	5972	6055
MANUFACTURING	305	344	382	425	469	512	559
S.E. POWER COOLING	28320	30000	35000	40000	45000	45000	45000
MINING	2291	1498	901	399	238	137	14
IRRIGATION - Case A	75	75	75	75	75	75	75
LIVESTOCK	1269	1237	1237	1237	1237	1237	1237
TOTAL COUNTY WATER USE	38579						
Below Normal Rainfall							
* Expected Conservation		40300	44688	49258	54304	54311	54402
Advanced Conservation		40063	44184	48602	53748	53823	53853
Normal Rainfall							
Expected Conservation		39440	43806	48325	53369	53338	53353
Advanced Conservation		39224	43329	47759	52849	52933	52940

* Municipal use for cities excludes any wholesale municipal sales and identified sales to industrial users.
* Below normal rainfall with expected conservation is the primary municipal water use scenario.
Advanced conservation is implemented prior to project construction.

GREGG COUNTY (#092) TWDB CODE: 931830 SYSTEM CLASS: PRIVATE
USED CNTY: 092 WEST GREGG WATER SUPPLY CORP. STATUS: ACTIVE
SABINE BASIN (#5)
USED BASN: 005 P.O. BOX 1196

KILGORE, TEXAS 75662 TELEPHONE#: 983-1816

TWDB CODE: 931830 1996
WEST GREGG WATER SUPPLY CORP. REMARKS:

1996 SG-> ANNUAL TOTAL: 141005400 GALLONS 432.73 AC_FEET

RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	11197000	JUL	15885600
FEB	10147200	AUG	13084500
MAR	10108300	SEP	11211600
APR	11113300	OCT	11244300
MAY	13152200	NOV	10055900
JUN	12456800	DEC	11348700

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 5
SELLER #:

POPULATION SERVED: 3678
TOTAL CONNECTIONS: 1239
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 931830 1995
WEST GREGG WATER SUPPLY CORP. REMARKS:

1995 SG-> ANNUAL TOTAL: 128759640 GALLONS 395.15 AC_FEET

RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	9058800	JUL	13783490
FEB	7700800	AUG	13203600
MAR	12035250	SEP	11979200
APR	9737350	OCT	9675000
MAY	9574200	NOV	9850700
JUN	12505550	DEC	9655700

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 5
SELLER #:

POPULATION SERVED: 3563
TOTAL CONNECTIONS: 1198
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 931830 1994
WEST GREGG WATER SUPPLY CORP. REMARKS:

1994 SG-> ANNUAL TOTAL: 114006470 GALLONS 349.87 AC_FEET

RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	8917100	JUL	10252500
FEB	8679400	AUG	14345600
MAR	8078000	SEP	10482100
APR	9513200	OCT	8042170
MAY	9295600	NOV	7942500
JUN	10828200	DEC	7630100

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 5
SELLER #:

POPULATION SERVED: 2895
TOTAL CONNECTIONS: 1157
OUTSIDE CONNECTIONS: 95
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER: 26434750 GALLONS
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: % %CONN_COMMERCIAL: % %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 90% %VOL__APARTMENTS: 10% %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 931830 1993
WEST GREGG WATER SUPPLY CORP. REMARKS:

1993 SG-> ANNUAL TOTAL: 123944500 GALLONS 380.37 AC_FEET

RAW: %
TREATED: %
MTRD/EST:

SELF-SUPPLIED GROUND

JAN	9152900	JUL	14672900
FEB	7030600	AUG	14655700
MAR	8430700	SEP	11676100
APR	8496500	OCT	10901000
MAY	9589300	NOV	9301700
JUN	10621200	DEC	9415900

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS:
SELLER #:

POPULATION SERVED:
TOTAL CONNECTIONS: 1090
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: %
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: % %CONN_COMMERCIAL: % %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 931830 1992

WEST GREGG WATER SUPPLY CORP.

REMARKS:

SELF-SUPPLIED GROUND

1992								
	ANNUAL TOTAL:	JAN	12212900	JUL	14572000	163	SMITH COUNTY (#212)	
SG->	131589300 GALLONS	FEB	9837700	AUG	17904700		SOURCE CNTY:	212
	403.83 AC_FEET	MAR	10679800	SEP	9402600		SOURCE BASN:	05
RAW: %		APR	11228500	OCT	9317700		RESERVOIR:	
TREATED: %		MAY	11867800	NOV	6989700		AQUIFER:	#10-CARIZO-WI
MTRD/EST:		JUN	12188000	DEC	5387900		NUMBER WELLS:	5
							SELLER #:	

POPULATION SERVED: 2725
TOTAL CONNECTIONS: 1090
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 931830 1991

WEST GREGG WATER SUPPLY CORP.

REMARKS:

SELF-SUPPLIED GROUND

1991								
	ANNUAL TOTAL:	JAN	9220200	JUL	13978000	131	SMITH COUNTY (#212)	
SG->	127660100 GALLONS	FEB	8477900	AUG	12235800		SOURCE CNTY:	212
	391.77 AC_FEET	MAR	9880200	SEP	10689600		SOURCE BASN:	05
RAW: %		APR	9702200	OCT	10216600		RESERVOIR:	
TREATED: %		MAY	11335500	NOV	10567500		AQUIFER:	#10-CARIZO-WI
MTRD/EST:		JUN	10640800	DEC	10715800		NUMBER WELLS:	5
							SELLER #:	

POPULATION SERVED: 3512
TOTAL CONNECTIONS: 1052
OUTSIDE CONNECTIONS: 1052
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 931830 1990

WEST GREGG WATER SUPPLY CORP.

REMARKS:

SELF-SUPPLIED GROUND

1990								
	ANNUAL TOTAL:	JAN	11295500	JUL	12093600	127	SMITH COUNTY (#212)	
SG->	124058800 GALLONS	FEB	8180300	AUG	13151800		SOURCE CNTY:	212
	380.72 AC_FEET	MAR	9228800	SEP	11052400		SOURCE BASN:	05
RAW: %		APR	8845900	OCT	9448500		RESERVOIR:	
TREATED: %		MAY	9237300	NOV	9265900		AQUIFER:	#10-CARIZO-WI
MTRD/EST:		JUN	11780200	DEC	10478600		NUMBER WELLS:	
							SELLER #:	

POPULATION SERVED: 3520
TOTAL CONNECTIONS: 1040
OUTSIDE CONNECTIONS: 1040
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

RUSK COUNTY (#201) TWDB CODE: 492650 SYSTEM CLASS: WATER SUPPLY CORP
USED CNTY: 201 LEVERETTS CHAPEL WATER SUP CORP STATUS: ACTIVE
SABINE BASIN (#5) C/O PRESIDENT
USED BASN: 005 ROUTE 2, BOX 20AA

OVERTON, TEXAS 75684 TELEPHONE#: 903-834-3878

TWDB CODE: 492650 — 1996
LEVERETTS CHAPEL WATER SUP CORP — REMARKS:
C/O PRESIDENT — SELF-SUPPLIED GROUND — RUSK COUNTY (#201)

1996	ANNUAL TOTAL:						SOURCE CNTY:	201
SG->	19682000 GALLONS	JAN	1593000	JUL	1822000		SOURCE BASN:	05
	60.40 AC_FEET	FEB	1909000	AUG	1989000	1.21	RESERVOIR:	
RAW: %		MAR	1509000	SEP	1451000		AQUIFER:	#10-CARIZO-WI
TREATED: %		APR	1421000	OCT	1685000		NUMBER WELLS:	1
MTRD/EST: METERED		MAY	1769000	NOV	1346000		SELLER #:	
		JUN	1687000	DEC	1501000			

POPULATION SERVED: 500 — EFFLUENT CODE: — INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 165 — WATER USE RESTRICTIONS: — IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: — UNACCOUNTED WATER: — OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% — ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 99% — %CONN_COMMERCIAL: % — %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 99% — %VOL__APARTMENTS: % — %VOL__COMMERCIAL: % — %VOL__INDUSTRIAL: %

TWDB CODE: 492650 — 1995
LEVERETTS CHAPEL WATER SUP CORP — REMARKS:
C/O PRESIDENT — SELF-SUPPLIED GROUND — RUSK COUNTY (#201)

1995	ANNUAL TOTAL:						SOURCE CNTY:	201
SG->	17913000 GALLONS	JAN	1495000	JUL	1720000		SOURCE BASN:	05
	54.97 AC_FEET	FEB	1238000	AUG	1807000	1.21	RESERVOIR:	
RAW: %		MAR	1380000	SEP	1616000		AQUIFER:	#10-CARIZO-WI
TREATED: %		APR	1232000	OCT	1482000		NUMBER WELLS:	1
MTRD/EST: METERED		MAY	1405000	NOV	1470000		SELLER #:	
		JUN	1604000	DEC	1464000			

POPULATION SERVED: 500 — EFFLUENT CODE: — INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 165 — WATER USE RESTRICTIONS: — IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: — UNACCOUNTED WATER: — OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% — ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 99% — %CONN_COMMERCIAL: 1% — %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 99% — %VOL__APARTMENTS: % — %VOL__COMMERCIAL: 1% — %VOL__INDUSTRIAL: %

TWDB CODE: 492650 — 1994
LEVERETTS CHAPEL WATER SUP CORP — REMARKS:
C/O PRESIDENT — SELF-SUPPLIED GROUND — RUSK COUNTY (#201)

1994	ANNUAL TOTAL:						SOURCE CNTY:	201
SG->	17411000 GALLONS	JAN	1216000	JUL	1655000		SOURCE BASN:	05
	53.43 AC_FEET	FEB	1226000	AUG	1707000		RESERVOIR:	
RAW: %		MAR	1241000	SEP	1671000		AQUIFER:	#10-CARIZO-WI
TREATED: %		APR	1335000	OCT	1710000	1.18	NUMBER WELLS:	1
MTRD/EST: METERED		MAY	1275000	NOV	1306000		SELLER #:	
		JUN	1478000	DEC	1591000			

POPULATION SERVED: 500 — EFFLUENT CODE: — INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 165 — WATER USE RESTRICTIONS: — IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: — UNACCOUNTED WATER: — OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% — ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 99% — %CONN_COMMERCIAL: % — %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: 99% — %VOL__APARTMENTS: % — %VOL__COMMERCIAL: % — %VOL__INDUSTRIAL: 1%

TWDB CODE: 492650 — 1993
LEVERETTS CHAPEL WATER SUP CORP — REMARKS:
C/O PRESIDENT — SELF-SUPPLIED GROUND — RUSK COUNTY (#201)

1993	ANNUAL TOTAL:						SOURCE CNTY:	201
SG->	15539000 GALLONS	JAN	1317000	JUL	1653000	1.28	SOURCE BASN:	05
	47.69 AC_FEET	FEB	935000	AUG	1622000		RESERVOIR:	
RAW: %		MAR	1181000	SEP	1411000		AQUIFER:	#10-CARIZO-WI
TREATED: %		APR	1208000	OCT	1168000		NUMBER WELLS:	1
MTRD/EST:		MAY	1264000	NOV	1195000		SELLER #:	
		JUN	1362000	DEC	1223000			

POPULATION SERVED: 475 — EFFLUENT CODE: — INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 165 — WATER USE RESTRICTIONS: — IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: — UNACCOUNTED WATER: — OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% — ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 99% — %CONN_COMMERCIAL: 1% — %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % — %VOL__APARTMENTS: % — %VOL__COMMERCIAL: % — %VOL__INDUSTRIAL: %

TWDB CODE: 492650 1992
LEVERETTS CHAPEL WATER SUP CORP REMARKS:
C/O PRESIDENT

1992	ANNUAL TOTAL:	JAN	1124000	JUL	1601000	1.18	RUSK COUNTY (#201)
SG->	16258000 GALLONS	FEB	1144000	~~AUG~~	~~1395000~~		SOURCE CNTY: 201
	49.89 AC_FEET	MAR	1299000	SEP	1430000		SOURCE BASN: 05
RAW: %		APR	1246000	OCT	1460000		RESERVOIR:
TREATED: %		MAY	1272000	NOV	1428000		AQUIFER: #10-CARIZO-WI
MTRD/EST: METERED		JUN	1306000	DEC	1553000		NUMBER WELLS: 1
							SELLER #:

SELF-SUPPLIED GROUND

POPULATION SERVED: 525
TOTAL CONNECTIONS: 170
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% %CONN_COMMERCIAL: % %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 492650 1991
LEVERETTS CHAPEL WATER SUP CORP REMARKS:
C/O PRESIDENT

1991	ANNUAL TOTAL:	JAN	1101000	JUL	1528000	1.34	RUSK COUNTY (#201)
SG->	13703000 GALLONS	FEB	957000	AUG	1383000		SOURCE CNTY: 201
	42.05 AC_FEET	MAR	1034000	SEP	1144000		SOURCE BASN: 05
RAW: %		APR	1020000	OCT	1187000		RESERVOIR:
TREATED: %		MAY	1134000	NOV	1019000		AQUIFER: #10-CARIZO-WI
MTRD/EST:		JUN	1166000	DEC	1030000		NUMBER WELLS: 1
							SELLER #:

SELF-SUPPLIED GROUND

POPULATION SERVED: 525
TOTAL CONNECTIONS: 170
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% %CONN_COMMERCIAL: % %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 492650 1990
LEVERETTS CHAPEL WATER SUP CORP REMARKS:
C/O PRESIDENT

1990	ANNUAL TOTAL:	JAN	1152000	JUL	1159000		RUSK COUNTY (#201)
SG->	13688000 GALLONS	FEB	915000	AUG	1417000		SOURCE CNTY: 201
	42.01 AC_FEET	MAR	997000	SEP	1387000		SOURCE BASN: 05
RAW: %		APR	959000	OCT	1025000		RESERVOIR:
TREATED: %		MAY	1153000	NOV	923000		AQUIFER: #10-CARIZO-WI
MTRD/EST:		JUN	1149000	DEC	1452000	1.27	NUMBER WELLS: 1
							SELLER #:

SELF-SUPPLIED GROUND

POPULATION SERVED: 525
TOTAL CONNECTIONS: 170
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 100% %CONN_COMMERCIAL: % %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

GREGG COUNTY (#092) TWDB CODE: 494900 SYSTEM CLASS: WATER SUPPLY CORP
USED CNTY: 092 LIBERTY CITY WSC STATUS: ACTIVE
SABINE BASIN (#5)
USED BASN: 005 C/O MAX CONLIN
200 GATEWAY CENTER - STE 349
KILGORE, TEXAS 75662 TELEPHONE#: 903-984-9593

TWDB CODE: 494900 — 1996
LIBERTY CITY WSC — REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

1996 — PG-> ANNUAL TOTAL: 30721000 GALLONS, 94.28 AC_FEET

RAW: %
TREATED: 100%
MTRD/EST: METERED

Month	Gallons	Month	Gallons
JAN	2005000	JUL	4960000
FEB	1530000	AUG	3473000
MAR	1465000	SEP	2324000
APR	2220000	OCT	1745000
MAY	3568000	NOV	1077000
JUN	4980000	DEC	1374000

1.95

SMITH COUNTY (#212) — SOURCE CNTY: 212; SOURCE BASN: 05; RESERVOIR: ; AQUIFER: ; NUMBER WELLS: ; SELLER #: 465800

POPULATION SERVED: 4020
TOTAL CONNECTIONS: 1340
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS: Y
UNACCOUNTED WATER: 15998800 GALLONS
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 93% %CONN_COMMERCIAL: 7% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 91% %VOL__APARTMENTS: 2% %VOL__COMMERCIAL: 7% %VOL__INDUSTRIAL: %

TWDB CODE: 494900 — 1995
LIBERTY CITY WSC — REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

1995 — PG-> ANNUAL TOTAL: 39188000 GALLONS, 120.26 AC_FEET

RAW: %
TREATED: 100%
MTRD/EST: METERED

Month	Gallons	Month	Gallons
JAN	1042000	JUL	7660000
FEB	476000	AUG	5510000
MAR	3202000	SEP	2730000
APR	2870000	OCT	3091000
MAY	2590000	NOV	1897000
JUN	5440000	DEC	2680000

2.35

SMITH COUNTY (#212) — SOURCE CNTY: 212; SOURCE BASN: 05; RESERVOIR: ; AQUIFER: ; NUMBER WELLS: ; SELLER #: 465800

POPULATION SERVED: 3900
TOTAL CONNECTIONS: 1304
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 494900 — 1994
LIBERTY CITY WSC — REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

1994 — PG-> ANNUAL TOTAL: 40943000 GALLONS, 125.65 AC_FEET

RAW: %
TREATED: 100%
MTRD/EST: METERED

Month	Gallons	Month	Gallons
JAN	2241000	JUL	6119000
FEB	2036000	AUG	5599000
MAR	2088000	SEP	3896000
APR	3254000	OCT	3740000
MAY	2228000	NOV	1099000
JUN	5123000	DEC	3520000

1.79

SMITH COUNTY (#212) — SOURCE CNTY: 212; SOURCE BASN: 05; RESERVOIR: ; AQUIFER: ; NUMBER WELLS: ; SELLER #: 465800

POPULATION SERVED: 3804
TOTAL CONNECTIONS: 1268
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER: 21672000 GALLONS
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 95% %CONN_COMMERCIAL: 5% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 494900 — 1993
LIBERTY CITY WSC — REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

1993 — PG-> ANNUAL TOTAL: 36716000 GALLONS, 112.68 AC_FEET

RAW: %
TREATED: 100%
MTRD/EST: METERED

Month	Gallons	Month	Gallons
JAN	2796000	JUL	6238000
FEB	2000000	AUG	5619000
MAR	2785000	SEP	2826000
APR	3052000	OCT	1862000
MAY	2527000	NOV	2499000
JUN	3409000	DEC	1103000

2.03

SMITH COUNTY (#212) — SOURCE CNTY: 212; SOURCE BASN: 05; RESERVOIR: ; AQUIFER: ; NUMBER WELLS: ; SELLER #: 465800

POPULATION SERVED: 3705
TOTAL CONNECTIONS: 1235
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 96% %CONN_COMMERCIAL: 6% %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 494900 1992

LIBERTY CITY WSC

REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

SMITH COUNTY (#212)

1992	ANNUAL TOTAL:						
PG->	50736000 GALLONS	FEB	1462000	AUG	7532000	SOURCE BASN:	05
	155.70 AC_FEET	MAR	2411000	SEP	3065000	RESERVOIR:	
RAW: %		APR	2565000	OCT	4218000	AQUIFER:	
TREATED: 100%		MAY	4141000	NOV	3526000	NUMBER WELLS:	
MTRD/EST: METERED		JUN	7983000	DEC	3804000	SELLER #:	465800

JAN 2377000 | JUL 7652000 | SOURCE CNTY: 212

POPULATION SERVED: 3690
TOTAL CONNECTIONS: 1230
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 93% %CONN_COMMERCIAL: 6% %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 494900 1991

LIBERTY CITY WSC

REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

SMITH COUNTY (#212)

1991	ANNUAL TOTAL:						
		JAN	1857000	JUL	6958000 2.63	SOURCE CNTY:	212
PG->	31772000 GALLONS	FEB	2017000	AUG	3437000	SOURCE BASN:	05
	97.50 AC_FEET	MAR	2814000	SEP	2815000	RESERVOIR:	
RAW: 100%		APR	1547000	OCT	3443000	AQUIFER:	
TREATED: %		MAY	1581000	NOV	2009000	NUMBER WELLS:	
MTRD/EST: METERED		JUN	1603000	DEC	1691000	SELLER #:	465800

POPULATION SERVED: 4800
TOTAL CONNECTIONS: 1200
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 94% %CONN_COMMERCIAL: 5% %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 494900 1990

LIBERTY CITY WSC

REMARKS: FROM KILGORE/WELLS ALSO PURCHASED GROUND

SMITH COUNTY (#212)

1990	ANNUAL TOTAL:						
		JAN	2431000	JUL	3550000	SOURCE CNTY:	212
PG->	44678000 GALLONS	FEB	4117000	AUG	6653000	SOURCE BASN:	05
	137.11 AC_FEET	MAR	3378000	SEP	4283000	RESERVOIR:	
RAW: %		APR	2000000	OCT	7516000 2.02	AQUIFER:	
TREATED: 100%		MAY	3343000	NOV	3108000	NUMBER WELLS:	
MTRD/EST: METERED		JUN	2269000	DEC	2030000	SELLER #:	465800

POPULATION SERVED: 3600
TOTAL CONNECTIONS: 1200
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 90%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 90% %CONN_COMMERCIAL: 10% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

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==========================================================================================================
SMITH COUNTY (#212)          TWDB CODE:  035800                 SYSTEM CLASS:  MUNICIPAL
USED CNTY:  212              CITY OF ARP                              STATUS:  ACTIVE
NECHES BASIN (#6)            C/O CITY SEC.
USED BASN:  006              P.O. DRAWER 68

                             ARP, TEXAS  75750                 TELEPHONE#:  903-859-6472
==========================================================================================================
TWDB CODE:  035800                                                                                    1996
CITY OF ARP                                  REMARKS:
C/O CITY SEC.                                      SELF-SUPPLIED GROUND                SMITH COUNTY (#212)
1996                   | ANNUAL TOTAL:         | JAN     4706000 | JUL     5653000 |    SOURCE CNTY:      212
                 SG->  |   53656100 GALLONS    | FEB     3998000 | AUG     4529300 |    SOURCE BASN:       06
                       |     164.66 AC_FEET    | MAR     4005000 | SEP     4097800 |      RESERVOIR:
    RAW:    %                                  | APR     4049000 | OCT     4074700 |       AQUIFER:  #10-CARIZO-WI
 TREATED:   %                                  | MAY     4920000 | NOV     3760400 |  NUMBER WELLS:        3
MTRD/EST:                                      | JUN     4609000 | DEC     5253900 |       SELLER #:
 -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -
    POPULATION SERVED:      1300           EFFLUENT CODE:          INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:      453       WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:    31         | UNACCOUNTED WATER:   |          OTHER EFFLUENT:
 %CONNECTIONS_METERED: 100%           |    15644100 GALLONS  |         ANNUAL EFFLUENT:
                                                                     EFFLUENT USED BY:
%CONN_RESIDENTIAL:  88%                          %CONN_COMMERCIAL:  12%     %CONN_INDUSTIRAL:     %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:     %    %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:     %
----------------------------------------------------------------------------------------------------------
TWDB CODE:  035800                                                                                    1995
CITY OF ARP                                  REMARKS:
C/O CITY SEC.                                      SELF-SUPPLIED GROUND                SMITH COUNTY (#212)
1995                   | ANNUAL TOTAL:         | JAN     3909000 | JUL     6118000 |    SOURCE CNTY:      212
                 SG->  |   56841000 GALLONS    | FEB     3639000 | AUG     5871000 |    SOURCE BASN:       06
                       |     174.44 AC_FEET    | MAR     4056000 | SEP     4859000 |      RESERVOIR:
    RAW:    %                                  | APR     5465000 | OCT     4443000 |       AQUIFER:  #10-CARIZO-WI
 TREATED:   %                                  | MAY     4768000 | NOV     3988000 |  NUMBER WELLS:        3
MTRD/EST: METERED                              | JUN     5442000 | DEC     4283000 |       SELLER #:
 -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -
    POPULATION SERVED:      1300           EFFLUENT CODE:          INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:      454       WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:    31         | UNACCOUNTED WATER:   |          OTHER EFFLUENT:
 %CONNECTIONS_METERED: 100%           |    17790000 GALLONS  |         ANNUAL EFFLUENT:
                                                                     EFFLUENT USED BY:
%CONN_RESIDENTIAL:  88%                          %CONN_COMMERCIAL:  12%     %CONN_INDUSTIRAL:     %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:     %    %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:     %
----------------------------------------------------------------------------------------------------------
TWDB CODE:  035800                                                                                    1994
CITY OF ARP                                  REMARKS:
C/O CITY SEC.                                      SELF-SUPPLIED GROUND                SMITH COUNTY (#212)
1994                   | ANNUAL TOTAL:         | JAN     3652000 | JUL     5434000 |    SOURCE CNTY:      212
                 SG->  |   49853000 GALLONS    | FEB     3270000 | AUG     4996000 |    SOURCE BASN:       06
                       |     152.99 AC_FEET    | MAR     3651000 | SEP     4735000 |      RESERVOIR:
    RAW:    %                                  | APR     4175000 | OCT     4239000 |       AQUIFER:  #10-CARIZO-WI
 TREATED:   %                                  | MAY     3772000 | NOV     3601000 |  NUMBER WELLS:        1
MTRD/EST: METERED                              | JUN     4501000 | DEC     3827000 |       SELLER #:
 -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -
    POPULATION SERVED:      1300           EFFLUENT CODE:          INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:      461       WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:    31         | UNACCOUNTED WATER:   |          OTHER EFFLUENT:
 %CONNECTIONS_METERED: 100%           |    14853400 GALLONS  |         ANNUAL EFFLUENT:
                                                                     EFFLUENT USED BY:
%CONN_RESIDENTIAL:  88%                          %CONN_COMMERCIAL:  12%     %CONN_INDUSTIRAL:     %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:     %    %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:     %
----------------------------------------------------------------------------------------------------------
TWDB CODE:  035800                                                                                    1993
CITY OF ARP                                  REMARKS:
C/O CITY SEC.                                      SELF-SUPPLIED GROUND                SMITH COUNTY (#212)
1993                   | ANNUAL TOTAL:         | JAN     3545000 | JUL     6483000 |    SOURCE CNTY:      212
                 SG->  |   54463200 GALLONS    | FEB     3166000 | AUG     6519000 |    SOURCE BASN:       06
                       |     167.14 AC_FEET    | MAR     3134200 | SEP     5180000 |      RESERVOIR:
    RAW:    %                                  | APR     3632000 | OCT     5641000 |       AQUIFER:  #10-CARIZO-WI
 TREATED:   %                                  | MAY     3940000 | NOV     5346000 |  NUMBER WELLS:        3
MTRD/EST:                                      | JUN     4460000 | DEC     3417000 |       SELLER #:
 -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -
    POPULATION SERVED:      1300           EFFLUENT CODE:          INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:      437       WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:    31         | UNACCOUNTED WATER:   |          OTHER EFFLUENT:
 %CONNECTIONS_METERED: 100%           |                      |         ANNUAL EFFLUENT:
                                                                     EFFLUENT USED BY:
%CONN_RESIDENTIAL:  88%                          %CONN_COMMERCIAL:  12%     %CONN_INDUSTIRAL:     %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:     %    %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:     %
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```

TWDB CODE: 035800 1992

CITY OF ARP

C/O CITY SEC.

1992

REMARKS:

SELF-SUPPLIED GROUND

SG-> ANNUAL TOTAL: 46361000 GALLONS, 142.28 AC_FEET

JAN	3864000	JUL	5074000
FEB	2996000	AUG	4602000
MAR	3480000	SEP	4099000
APR	3874000	OCT	3749000
MAY	3824000	NOV	3167000
JUN	4258000	DEC	3374000

RAW: %
TREATED: %
MTRD/EST: METERED

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 06
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 860
TOTAL CONNECTIONS: 432
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 87% %CONN_COMMERCIAL: 12% %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 035800 1991

CITY OF ARP

C/O CITY SEC.

1991

REMARKS:

SELF-SUPPLIED GROUND

SG-> ANNUAL TOTAL: 64871000 GALLONS, 199.08 AC_FEET

JAN	6251000	JUL	6263000
FEB	6015000	AUG	5743000
MAR	5146000	SEP	5078000
APR	4709000	OCT	5575000
MAY	5003000	NOV	4905000
JUN	5019000	DEC	5164000

RAW: %
TREATED: %
MTRD/EST:

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 06
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 860
TOTAL CONNECTIONS: 429
OUTSIDE CONNECTIONS: 26
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 87% %CONN_COMMERCIAL: 12% %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 035800 1990

CITY OF ARP

C/O CITY SEC.

1990

REMARKS:

SELF-SUPPLIED GROUND

SG-> ANNUAL TOTAL: 59644500 GALLONS, 183.04 AC_FEET

JAN	4183500	JUL	5944000
FEB	3829000	AUG	5881000
MAR	4113000	SEP	5344000
APR	3975000	OCT	5190000
MAY	4101000	NOV	5532000
JUN	5420000	DEC	6132000

RAW: %
TREATED: %
MTRD/EST: METERED

SMITH COUNTY (#212)
SOURCE CNTY: 212
SOURCE BASN: 06
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 860
TOTAL CONNECTIONS: 428
OUTSIDE CONNECTIONS: 26
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 87% %CONN_COMMERCIAL: 12% %CONN_INDUSTIRAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

SMITH COUNTY (#212) | TWDB CODE: 957500 | SYSTEM CLASS: WATER SUPPLY CORP
USED CNTY: 212 | WRIGHT CITY WATER SUPPLY CORP. | STATUS: ACTIVE
NECHES BASIN (#6)
USED BASN: 006

C/O SEC.
24065 LYLES LANE
TROUP, TEXAS 75789-9771 TELEPHONE#: 903-859-1281

TWDB CODE: 957500 1996
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

1996		SELF-SUPPLIED GROUND				SMITH COUNTY (#212)	
SG->	ANNUAL TOTAL: 81688000 GALLONS 250.69 AC_FEET	JAN	6551000	JUL	8749000	SOURCE CNTY:	212
		FEB	6494000	AUG	7487000	SOURCE BASN:	06
		MAR	6276000	SEP	6521000	RESERVOIR:	
RAW: %		APR	5859000	OCT	6422000	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	7938000	NOV	5697000	NUMBER WELLS:	4
MTRD/EST: METERED		JUN	7482000	DEC	6212000	SELLER #:	

POPULATION SERVED: 2240 | EFFLUENT CODE: | INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 780 | WATER USE RESTRICTIONS: | IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 780 | UNACCOUNTED WATER: | OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% | | ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% | %CONN_COMMERCIAL: 1% | %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % | %VOL__APARTMENTS: % | %VOL__COMMERCIAL: % | %VOL__INDUSTRIAL: %

TWDB CODE: 957500 1995
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

1995		SELF-SUPPLIED GROUND				SMITH COUNTY (#212)	
SG->	ANNUAL TOTAL: 82501000 GALLONS 253.19 AC_FEET	JAN	6654000	JUL	8708000	SOURCE CNTY:	212
		FEB	5658000	AUG	7985000	SOURCE BASN:	06
		MAR	5590000	SEP	8050000	RESERVOIR:	
RAW: %		APR	5298000	OCT	7605000	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	6152000	NOV	6529000	NUMBER WELLS:	4
MTRD/EST: METERED		JUN	7542000	DEC	6730000	SELLER #:	

POPULATION SERVED: 2240 | EFFLUENT CODE: | INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 770 | WATER USE RESTRICTIONS: | IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 770 | UNACCOUNTED WATER: | OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% | | ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% | %CONN_COMMERCIAL: 1% | %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % | %VOL__APARTMENTS: % | %VOL__COMMERCIAL: % | %VOL__INDUSTRIAL: %

TWDB CODE: 957500 1994
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

1994		SELF-SUPPLIED GROUND				SMITH COUNTY (#212)	
SG->	ANNUAL TOTAL: 79940990 GALLONS 245.33 AC_FEET	JAN	5797000	JUL	8767000	SOURCE CNTY:	212
		FEB	4552990	AUG	7649000	SOURCE BASN:	06
		MAR	6159000	SEP	7259000	RESERVOIR:	
RAW: %		APR	6265000	OCT	7125000	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	6478000	NOV	6015000	NUMBER WELLS:	4
MTRD/EST: METERED		JUN	7521000	DEC	6353000	SELLER #:	

POPULATION SERVED: 2240 | EFFLUENT CODE: | INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 760 | WATER USE RESTRICTIONS: | IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 760 | UNACCOUNTED WATER: | OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% | | ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% | %CONN_COMMERCIAL: 1% | %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % | %VOL__APARTMENTS: % | %VOL__COMMERCIAL: % | %VOL__INDUSTRIAL: %

TWDB CODE: 957500 1993
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

1993		SELF-SUPPLIED GROUND				SMITH COUNTY (#212)	
SG->	ANNUAL TOTAL: 74354000 GALLONS 228.18 AC_FEET	JAN	4500000	JUL	9433000	SOURCE CNTY:	212
		FEB	4905000	AUG	10186000	SOURCE BASN:	06
		MAR	5367000	SEP	8269000	RESERVOIR:	
RAW: %		APR	5030000	OCT	6121000	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	4749000	NOV	5573000	NUMBER WELLS:	3
MTRD/EST:		JUN	4737000	DEC	5484000	SELLER #:	

POPULATION SERVED: 2240 | EFFLUENT CODE: | INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 746 | WATER USE RESTRICTIONS: | IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 746 | UNACCOUNTED WATER: | OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% | | ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% | %CONN_COMMERCIAL: 1% | %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % | %VOL__APARTMENTS: % | %VOL__COMMERCIAL: % | %VOL__INDUSTRIAL: %

TWDB CODE: 957500 1992
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

SELF-SUPPLIED GROUND — SMITH COUNTY (#212)

1992 SG-> ANNUAL TOTAL: 77694000 GALLONS, 238.43 AC_FEET

JAN	7156000	JUL	7168000
FEB	6048000	AUG	7301000
MAR	6261000	SEP	6343000
APR	5360000	OCT	6477000
MAY	6497000	NOV	5787000
JUN	7010000	DEC	6286000

RAW: %
TREATED: %
MTRD/EST: METERED

SOURCE CNTY: 212
SOURCE BASN: 06
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2240
TOTAL CONNECTIONS: 748
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% %CONN_COMMERCIAL: 1% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 957500 1991
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

SELF-SUPPLIED GROUND — SMITH COUNTY (#212)

1991 SG-> ANNUAL TOTAL: 95958900 GALLONS, 294.49 AC_FEET

JAN	9364300	JUL	9898500
FEB	7335500	AUG	8589000
MAR	7724000	SEP	7939000
APR	7302000	OCT	6962000
MAY	7960600	NOV	7056000
JUN	8521000	DEC	7307000

RAW: %
TREATED: %
MTRD/EST: METERED

SOURCE CNTY: 212
SOURCE BASN: 06
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2250
TOTAL CONNECTIONS: 752
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% %CONN_COMMERCIAL: 1% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 957500 1990
WRIGHT CITY WATER SUPPLY CORP. REMARKS:

SELF-SUPPLIED GROUND — SMITH COUNTY (#212)

1990 SG-> ANNUAL TOTAL: 105636900 GALLONS, 324.19 AC_FEET

JAN	7935100	JUL	11010000
FEB	7144700	AUG	11219500
MAR	7631700	SEP	8801500
APR	7717600	OCT	8524800
MAY	8721900	NOV	8120400
JUN	9885800	DEC	8923900

RAW: %
TREATED: %
MTRD/EST: METERED

SOURCE CNTY: 212
SOURCE BASN: 06
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2250
TOTAL CONNECTIONS: 736
OUTSIDE CONNECTIONS:
%CONNECTIONS_METERED: 100%

EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:

INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 99% %CONN_COMMERCIAL: 1% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

RUSK COUNTY (#201) | TWDB CODE: 603000 | SYSTEM CLASS: MUNICIPAL
USED CNTY: 201 | CITY OF NEW LONDON | STATUS: ACTIVE
SABINE BASIN (#5) | C/O ROBERT SEDGWICK
USED BASN: 005 | P. O. BOX 428

NEW LONDON, TEXAS 75682 TELEPHONE#: 903-895-4466

TWDB CODE: 603000 1996
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK

1996 SG-> ANNUAL TOTAL: 134940600 GALLONS, 414.12 AC_FEET
RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	10824600	JUL	14506500
FEB	9497600	AUG	15473900
MAR	9216200	SEP	12033100
APR	9259100	OCT	10942600
MAY	11792900	NOV	9333900
JUN	11787700	DEC	10272500

1.38

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2250
TOTAL CONNECTIONS: 720
OUTSIDE CONNECTIONS: 323
%CONNECTIONS_METERED: 99%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER: 51507600 GALLONS
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 86% %CONN_COMMERCIAL: 14% %CONN_INDUSTRIAL: %
%VOL__RESIDENTIAL: 86% %VOL__APARTMENTS: % %VOL__COMMERCIAL: 14% %VOL__INDUSTRIAL: %

TWDB CODE: 603000 1995
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK

1995 SG-> ANNUAL TOTAL: 148330700 GALLONS, 455.21 AC_FEET
RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	9526400	JUL	17095300
FEB	8892700	AUG	17240700
MAR	10039800	SEP	15416900
APR	10271000	OCT	12400500
MAY	13282500	NOV	9378900
JUN	15072400	DEC	9713600

1.39

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2230
TOTAL CONNECTIONS: 720
OUTSIDE CONNECTIONS: 353
%CONNECTIONS_METERED: 99%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER: 66478700 GALLONS
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 85% %CONN_COMMERCIAL: 14% %CONN_INDUSTRIAL: 1%
%VOL__RESIDENTIAL: 85% %VOL__APARTMENTS: % %VOL__COMMERCIAL: 14% %VOL__INDUSTRIAL: 1%

TWDB CODE: 603000 1994
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK

1994 SG-> ANNUAL TOTAL: 128013900 GALLONS, 392.86 AC_FEET
RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	9198800	JUL	13911200
FEB	8095800	AUG	13113800
MAR	9258700	SEP	11312800
APR	8849200	OCT	13879600
MAY	9803300	NOV	10381300
JUN	10763200	DEC	9446200

1.304

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2230
TOTAL CONNECTIONS: 720
OUTSIDE CONNECTIONS: 289
%CONNECTIONS_METERED: 99%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER: 63001900 GALLONS
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 85% %CONN_COMMERCIAL: 14% %CONN_INDUSTRIAL: 1%
%VOL__RESIDENTIAL: 85% %VOL__APARTMENTS: % %VOL__COMMERCIAL: 14% %VOL__INDUSTRIAL: 1%

TWDB CODE: 603000 1993
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK

1993 SG-> ANNUAL TOTAL: 125219400 GALLONS, 384.28 AC_FEET
RAW: %
TREATED: %
MTRD/EST:

SELF-SUPPLIED GROUND

JAN	8794200	JUL	15372300
FEB	7509100	AUG	18268400
MAR	8047200	SEP	12438100
APR	7822200	OCT	9476800
MAY	9176600	NOV	9148300
JUN	9936300	DEC	9229900

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2230
TOTAL CONNECTIONS: 720
OUTSIDE CONNECTIONS: 289
%CONNECTIONS_METERED: 99%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 85% %CONN_COMMERCIAL: 14% %CONN_INDUSTRIAL: 1%
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 603000 1992
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK SELF-SUPPLIED GROUND RUSK COUNTY (#201)

1992	ANNUAL TOTAL:	JAN	10432100	JUL	14540700	SOURCE CNTY:	201
SG->	122941500 GALLONS	FEB	7538800	AUG	11312000	SOURCE BASN:	05
	377.29 AC_FEET	MAR	8393500	SEP	10319300	RESERVOIR:	
RAW: %		APR	9769800	OCT	10214900	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	11215100	NOV	8281400	NUMBER WELLS:	3
MTRD/EST: METERED		JUN	12170700	DEC	8753200	SELLER #:	

POPULATION SERVED: 2300 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 747 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 300 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 86% %CONN_COMMERCIAL: 14% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 603000 1991
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK SELF-SUPPLIED GROUND RUSK COUNTY (#201)

1991	ANNUAL TOTAL:	JAN	9785600	JUL	14398100	SOURCE CNTY:	201
SG->	111026100 GALLONS	FEB	7470900	AUG	10031400	SOURCE BASN:	05
	340.73 AC_FEET	MAR	8766600	SEP	9336500	RESERVOIR:	
RAW: %		APR	7981300	OCT	10175400	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	7778500	NOV	8721500	NUMBER WELLS:	3
MTRD/EST:		JUN	8219000	DEC	8361300	SELLER #:	

POPULATION SERVED: 2000 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 740 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 350 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 86% %CONN_COMMERCIAL: 14% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 603000 1990
CITY OF NEW LONDON REMARKS:
C/O ROBERT SEDGWICK SELF-SUPPLIED GROUND RUSK COUNTY (#201)

1990	ANNUAL TOTAL:	JAN	7883500	JUL	10457300	SOURCE CNTY:	201
SG->	107948700 GALLONS	FEB	7170000	AUG	12253900	SOURCE BASN:	05
	331.28 AC_FEET	MAR	7032500	SEP	10712200	RESERVOIR:	
RAW: %		APR	7896100	OCT	8454200	AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY	8041700	NOV	7670900	NUMBER WELLS:	3
MTRD/EST: METERED	1.17	JUN	10546000	DEC	9830400	SELLER #:	

POPULATION SERVED: 2000 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 733 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 340 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 86% %CONN_COMMERCIAL: 14% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

RUSK COUNTY (#201) TWDB CODE: 631600 SYSTEM CLASS: MUNICIPAL
USED CNTY: 201 CITY OF OVERTON STATUS: ACTIVE
SABINE BASIN (#5) ATTN: CITY MANAGER
USED BASN: 005 DRAWER D

OVERTON, TEXAS 75684 TELEPHONE#: 903-834-3171

TWDB CODE: 631600 1995
CITY OF OVERTON REMARKS:
ATTN: CITY MANAGER

1995 SG-> ANNUAL TOTAL: 196075000 GALLONS, 601.73 AC_FEET

RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	14501000	JUL	23040000
FEB	12134000	AUG	21322000
MAR	9224000	SEP	19702000
APR	15171000	OCT	18124000
MAY	16195000	NOV	17182000
JUN	13035000	DEC	16445000

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2600
TOTAL CONNECTIONS: 1064
OUTSIDE CONNECTIONS: 32
%CONNECTIONS_METERED: 95%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 83% %CONN_COMMERCIAL: 17% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 70% %VOL__APARTMENTS: 13% %VOL__COMMERCIAL: 17% %VOL__INDUSTRIAL: %

TWDB CODE: 631600 1994
CITY OF OVERTON REMARKS:
ATTN: CITY MANAGER

1994 SG-> ANNUAL TOTAL: 123296000 GALLONS, 378.38 AC_FEET

RAW: %
TREATED: %
MTRD/EST:

SELF-SUPPLIED GROUND

JAN	9063000	JUL	13730000
FEB	7584000	AUG	12064000
MAR	5765000	SEP	10212000
APR	9482000	OCT	11028000
MAY	10086000	NOV	9455000
JUN	11764000	DEC	13063000

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2101
TOTAL CONNECTIONS: 1064
OUTSIDE CONNECTIONS: 32
%CONNECTIONS_METERED: 95%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 83% %CONN_COMMERCIAL: 17% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 70% %VOL__APARTMENTS: 13% %VOL__COMMERCIAL: 17% %VOL__INDUSTRIAL: %

TWDB CODE: 631600 1993
CITY OF OVERTON REMARKS:
ATTN: CITY MANAGER

1993 SG-> ANNUAL TOTAL: 127018000 GALLONS, 389.80 AC_FEET

RAW: %
TREATED: %
MTRD/EST:

SELF-SUPPLIED GROUND

JAN	9054000	JUL	15302000
FEB	7775000	AUG	15848000
MAR	8765000	SEP	13250000
APR	8285000	OCT	10865000
MAY	9477000	NOV	9603000
JUN	10520000	DEC	8274000

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2300
TOTAL CONNECTIONS: 954
OUTSIDE CONNECTIONS: 38
%CONNECTIONS_METERED: 96%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 85% %CONN_COMMERCIAL: 15% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

TWDB CODE: 631600 1992
CITY OF OVERTON REMARKS:
ATTN: CITY MANAGER

1992 SG-> ANNUAL TOTAL: 116323000 GALLONS, 356.98 AC_FEET

RAW: %
TREATED: %
MTRD/EST: METERED

SELF-SUPPLIED GROUND

JAN	8608000	JUL	13245000
FEB	7807000	AUG	11025000
MAR	8423000	SEP	10647000
APR	8858000	OCT	10285000
MAY	9877000	NOV	8709000
JUN	10433000	DEC	8406000

RUSK COUNTY (#201)
SOURCE CNTY: 201
SOURCE BASN: 05
RESERVOIR:
AQUIFER: #10-CARIZO-WI
NUMBER WELLS: 3
SELLER #:

POPULATION SERVED: 2175
TOTAL CONNECTIONS: 954
OUTSIDE CONNECTIONS: 32
%CONNECTIONS_METERED: 99%
EFFLUENT CODE:
WATER USE RESTRICTIONS:
UNACCOUNTED WATER:
INDUSTRIAL EFFLUENT:
IRRIGATION EFFLUENT:
OTHER EFFLUENT:
ANNUAL EFFLUENT:
EFFLUENT USED BY:

%CONN_RESIDENTIAL: 91% %CONN_COMMERCIAL: 9% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTRIAL: %

SMITH COUNTY (#212) TWDB CODE: 432850 SYSTEM CLASS: WATER SUPPLY CORP
USED CNTY: 212 JACKSON WATER SUPPLY CORP. STATUS: ACTIVE
NECHES BASIN (#6) C/O PAT ARMSTRONG, MGR.
USED BASN: 006 17764 CR 26

TYLER, TEXAS 75707 TELEPHONE#: 903-566-1320

TWDB CODE: 432850 1996
JACKSON WATER SUPPLY CORP. REMARKS:
C/O PAT ARMSTRONG, MGR. SELF-SUPPLIED GROUND

1996	ANNUAL TOTAL:	JAN 6932800	JUL 8372900	SMITH COUNTY (#212)	SOURCE CNTY:	212
SG->	85424500 GALLONS	FEB 6850100	AUG 7512100		SOURCE BASN:	06
	262.16 AC_FEET	MAR 6657400	SEP 6750200		RESERVOIR:	
RAW: %		APR 6774500	OCT 6679000		AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY 7883700	NOV 6187200		NUMBER WELLS:	4
MTRD/EST: METERED		JUN 8064500	DEC 6760100		SELLER #:	

POPULATION SERVED: 3100 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 937 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 937 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% 13624810 GALLONS ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 93% %CONN_COMMERCIAL: 7% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 96% %VOL__APARTMENTS: % %VOL__COMMERCIAL: 4% %VOL__INDUSTIRAL: %

TWDB CODE: 432850 1995
JACKSON WATER SUPPLY CORP. REMARKS:
C/O PAT ARMSTRONG, MGR. SELF-SUPPLIED GROUND

1995	ANNUAL TOTAL:	JAN 7859690	JUL 8824730	SMITH COUNTY (#212)	SOURCE CNTY:	212
SG->	88068550 GALLONS	FEB 6131060	AUG 8672790		SOURCE BASN:	06
	270.27 AC_FEET	MAR 6297300	SEP 7441500		RESERVOIR:	
RAW: %		APR 6383270	OCT 7359500		AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY 7017060	NOV 7130300		NUMBER WELLS:	4
MTRD/EST: METERED		JUN 8109650	DEC 6841700		SELLER #:	

POPULATION SERVED: 3100 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 901 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 901 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% 16882300 GALLONS ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 93% %CONN_COMMERCIAL: 7% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 96% %VOL__APARTMENTS: % %VOL__COMMERCIAL: 4% %VOL__INDUSTIRAL: %

TWDB CODE: 432850 1994
JACKSON WATER SUPPLY CORP. REMARKS:
C/O PAT ARMSTRONG, MGR. SELF-SUPPLIED GROUND

1994	ANNUAL TOTAL:	JAN 6208030	JUL 8366560	SMITH COUNTY (#212)	SOURCE CNTY:	212
SG->	83560350 GALLONS	FEB 5612710	AUG 8813440		SOURCE BASN:	06
	256.44 AC_FEET	MAR 6326450	SEP 7249690		RESERVOIR:	
RAW: %		APR 6758490	OCT 6843440		AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY 6995200	NOV 6342540		NUMBER WELLS:	4
MTRD/EST: METERED		JUN 7086320	DEC 6957480		SELLER #:	

POPULATION SERVED: 3100 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 879 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 879 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% 15431570 GALLONS ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 93% %CONN_COMMERCIAL: 7% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: 96% %VOL__APARTMENTS: % %VOL__COMMERCIAL: 4% %VOL__INDUSTIRAL: %

TWDB CODE: 432850 1993
JACKSON WATER SUPPLY CORP. REMARKS:
C/O PAT ARMSTRONG, MGR. SELF-SUPPLIED GROUND

1993	ANNUAL TOTAL:	JAN 6125200	JUL 8528900	SMITH COUNTY (#212)	SOURCE CNTY:	212
SG->	75842200 GALLONS	FEB 4736100	AUG 8424800		SOURCE BASN:	06
	232.75 AC_FEET	MAR 5340700	SEP 6916300		RESERVOIR:	
RAW: %		APR 5403400	OCT 6235300		AQUIFER:	#10-CARIZO-WI
TREATED: %		MAY 5650600	NOV 5773900		NUMBER WELLS:	4
MTRD/EST:		JUN 6669600	DEC 6037400		SELLER #:	

POPULATION SERVED: 4000 EFFLUENT CODE: INDUSTRIAL EFFLUENT:
TOTAL CONNECTIONS: 858 WATER USE RESTRICTIONS: IRRIGATION EFFLUENT:
OUTSIDE CONNECTIONS: 858 UNACCOUNTED WATER: OTHER EFFLUENT:
%CONNECTIONS_METERED: 100% ANNUAL EFFLUENT:
EFFLUENT USED BY:
%CONN_RESIDENTIAL: 93% %CONN_COMMERCIAL: 7% %CONN_INDUSTIRAL: %
%VOL__RESIDENTIAL: % %VOL__APARTMENTS: % %VOL__COMMERCIAL: % %VOL__INDUSTIRAL: %

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TWDB CODE:  432850                                                                                           1992
JACKSON WATER SUPPLY CORP.                    REMARKS:
C/O PAT ARMSTRONG, MGR.                                 SELF-SUPPLIED GROUND                   SMITH COUNTY (#212)
1992                | ANNUAL TOTAL:         | JAN       5871100 | JUL       7198100 |          SOURCE CNTY:      212
                SG->|     74976000 GALLONS  | FEB       6139500 | AUG       6539100 |          SOURCE BASN:       06
                    |        230.09 AC_FEET | MAR       6462500 | SEP       6076200 |            RESERVOIR:
    RAW:     %                              | APR       5932800 | OCT       6008900 |              AQUIFER:  #10-CARIZO-WI
 TREATED:    %                              | MAY       6275200 | NOV       5503300 |         NUMBER WELLS:        4
MTRD/EST: METERED                           | JUN       6977100 | DEC       5992200 |             SELLER #:
-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -
     POPULATION SERVED:      4000              EFFLUENT CODE:         INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:       841         WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:                  | UNACCOUNTED WATER:    |          OTHER EFFLUENT:
  %CONNECTIONS_METERED: 100%             |                       |         ANNUAL EFFLUENT:
                                                                          EFFLUENT USED BY:
%CONN_RESIDENTIAL:  93%                              %CONN_COMMERCIAL:   7%     %CONN_INDUSTIRAL:    %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:    %     %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:    %
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TWDB CODE:  432850                                                                                           1991
JACKSON WATER SUPPLY CORP.                    REMARKS:
C/O PAT ARMSTRONG, MGR.                                 SELF-SUPPLIED GROUND                   SMITH COUNTY (#212)
1991                | ANNUAL TOTAL:         | JAN       5659700 | JUL       7334700 |          SOURCE CNTY:      212
                SG->|     70079100 GALLONS  | FEB       5162600 | AUG       6417600 |          SOURCE BASN:       06
                    |        215.06 AC_FEET | MAR       5472700 | SEP       5621300 |            RESERVOIR:
    RAW:     %                              | APR       5131000 | OCT       5706300 |              AQUIFER:  #10-CARIZO-WI
 TREATED:    %                              | MAY       5401000 | NOV       5596200 |         NUMBER WELLS:        4
MTRD/EST: METERED                           | JUN       6635000 | DEC       5941000 |             SELLER #:
-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -
     POPULATION SERVED:      5000              EFFLUENT CODE:         INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:       830         WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:                  | UNACCOUNTED WATER:    |          OTHER EFFLUENT:
  %CONNECTIONS_METERED: 100%             |                       |         ANNUAL EFFLUENT:
                                                                          EFFLUENT USED BY:
%CONN_RESIDENTIAL:  93%                              %CONN_COMMERCIAL:   7%     %CONN_INDUSTIRAL:    %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:    %     %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:    %
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TWDB CODE:  432850                                                                                           1990
JACKSON WATER SUPPLY CORP.                    REMARKS:
C/O PAT ARMSTRONG, MGR.                                 SELF-SUPPLIED GROUND                   SMITH COUNTY (#212)
1990                | ANNUAL TOTAL:         | JAN       5809700 | JUL       7675300 |          SOURCE CNTY:      212
                SG->|     68709500 GALLONS  | FEB       5503600 | AUG       6434200 |          SOURCE BASN:       06
                    |        210.86 AC_FEET | MAR       4870200 | SEP       5895500 |            RESERVOIR:
    RAW:     %                              | APR       5302300 | OCT       5260800 |              AQUIFER:  #10-CARIZO-WI
 TREATED:    %                              | MAY       5443500 | NOV       4890800 |         NUMBER WELLS:        4
MTRD/EST: METERED                           | JUN       5794300 | DEC       5829300 |             SELLER #:
-  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -
     POPULATION SERVED:      5000              EFFLUENT CODE:         INDUSTRIAL EFFLUENT:
     TOTAL CONNECTIONS:       814         WATER USE RESTRICTIONS:     IRRIGATION EFFLUENT:
   OUTSIDE CONNECTIONS:                  | UNACCOUNTED WATER:    |          OTHER EFFLUENT:
  %CONNECTIONS_METERED: 100%             |                       |         ANNUAL EFFLUENT:
                                                                          EFFLUENT USED BY:
%CONN_RESIDENTIAL:  93%                              %CONN_COMMERCIAL:   7%     %CONN_INDUSTIRAL:    %
%VOL__RESIDENTIAL:    %       %VOL__APARTMENTS:    %     %VOL__COMMERCIAL:    %     %VOL__INDUSTRIAL:    %
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RECEIVED AUG 17 1998

TEXAS WATER DEVELOPMENT BOARD

August 10, 1998

The Honorable Norma J. Hunter
Mayor, City of Overton
Drawer D
Overton, Texas 75684

Re: Review of the Revised Draft Final Report for a Water Supply Planning Study with the City of Overton (City) and the Texas Water Development Board (TWDB), TWDB Contract No. 97-483-207

Dear Mayor Hunter:

Staff of the Texas Water Development Board have completed a review of the revised draft report under TWDB Contract No. 97-483-207. As stated in the above referenced contract, the City will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The City must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Ms. Glynda Mercier, the Board's Contract Manager, at (512) 936-0862, if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles

Tommy Knowles
Deputy Executive Administrator
for Planning

cc: Robert J. Brandes, R. J. Brandes Company
Gary Burton, Burton & Elledge, Inc.
James M. Wiersema, Horizon Environmental Services, Inc.

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ATTACHMENT 1

TEXAS WATER DEVELOPMENT BOARD

COMMENTS ON THE REGIONAL WATER SUPPLY STUDY
RABBIT CREEK RESERVOIR
CITY OF OVERTON
Contract No. 97-483-207

Comment I: Section III page III-5 section c. It is suggested that this section should read as follows: "c. Current supply capacity for the region is approximately 4,844 gpm or 7 MGD, which far exceeds current annual average demand of approximately 1,700 gpm or 2.5 MGD. The projected annual average demand of approximately 2,200 gpm or 3.2 MGD for 2030 is still less than half of the current total reported capacity."

Comment II: In section d. of the same page, be sure to give the gpm value as well as the MGD value.

Comment III: In section g. of page III-6, the paragraph ends with the phrase "831 gpm could be met with two or three additional wells." It is suggested that the phrase "high production" be inserted in front of the word "wells" and that the paragraph be continued as follows: "However, as mentioned in Section II, the public water supply wells in the study area produce from 60 to 400 gpm, with an average capacity per well of 186 gpm. Therefore, a more realistic scenario is presented in Exhibit 24, where wells with capacities more typical of the region are placed to increase the supply capacities of those four entities which would otherwise have water supply deficiencies."

Comment IV: In Section VIII, page VIII-2, under "Cost Comparisons of Alternatives", first paragraph, be sure to note that the costs for the three alternatives is for costs additional to what the region is experiencing already, and that the existing supply source locations are assumed to still exist regardless of which of the three alternatives is chosen.

Comment V: Section IX, page IX-4 the maximum tax rate values shown are incorrect. After discussion with the engineer, it was determined that the correct calculation should be based on the $473 million tax valuation.

Comment VI: The four graphs in Exhibit 25, with their supporting spreadsheet calculations, are good. It is suggested that the subtitles on each graph where the phrase "Cost/1,000 gallons" appears be amended to read "Cost/1,000 gallons (in addition to existing rate structure)" - this would clarify that these costs do NOT include the costs already in place.

Comment VII: The document should be searched and Section IX in particular, for the word "principal" and the word "principle" because sometimes "principal" is used when what is meant is "principle".

RECEIVED FEB 17 1998

TEXAS WATER DEVELOPMENT BOARD

February 10, 1998

The Honorable Norma J. Hunter
Mayor, City of Overton
Drawer D
Overton, Texas 75684

Re: Review of the Draft Final Report for a Water Supply Planning Study with the City of Overton (City) and the Texas Water Development Board (TWDB), TWDB Contract No. 97-483-207

Dear Mayor Hunter:

Staff of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 97-483-207. As stated in the above referenced contract, the City will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The City must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

Considering the nature of the Board's comments, Board staff would appreciate the opportunity to review, at your earliest convenience, a second draft report which addresses or incorporates the Board's comments.

Please contact Ms. Glynda Mercier, the Board's designated Contract Manager, at (512) 936-0862, if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles
Deputy Executive Administrator
for Planning

cc: Bill Hilliard, Hilliard Governmental Consulting
Robert J. Brandes, R. J. Brandes Company
Gary Burton, Burton & Elledge, Inc.
James M. Wiersema, Horizon Environmental Services, Inc.

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ATTACHMENT 1

TEXAS WATER DEVELOPMENT BOARD

COMMENTS ON THE REGIONAL WATER SUPPLY STUDY
RABBIT CREEK RESERVOIR
CITY OF OVERTON

Contract No. 97-483-207

1) The report should be proofed and corrected for readability and some misleading sentences in the report. In addition, proof for poor grammar and spelling, and inconsistencies in the report format.

2) Exhibits 2,3, and 5 did not reproduce very well. Also, on Exhibit 7, it is not possible to distinguish between the various aquifers on the figures. Please provide better reproductions.

3) The report does not adequately address the availability of ground water in the study area. The section on treatment of ground water quality problems is misleading, indicating that any new wells drilled will have all of the listed problems. The indicated problems do not occur in ground water from all wells in the area. It should be possible to drill and complete wells in which the indicated quality problems are at least minimized, therefore, measuring ground water availability and lowering the projected costs for additional water from ground water sources.

4) Tables 3 and 4 are five (5) pages of useless information if water chemistry data from regional wells is not available to compare to the mcl's.

5) Connection and water use data presented in Tables 6, 7, 8, 9, and 10: Connections and historical water use for the City of Arp, Overton, New London, and the Liberty City WSC have errors. The number of connections column in Table 5 may also need to be changed to agree with the correct data. A table with the correct data for use in the study is attached.

6) Population projections presented in Tables, 6, 7, 8, 9, and 10: It appears that the consultants applied an average number of persons per connection to the total number of connections for each entity to develop historical population projections. This procedure is acceptable for the Water Supply Corporations but is not acceptable for the cities because historical population estimates not available for areas serviced by water supply corporations are available for the cities. The portion of the population within the service area of a city, such as Arp, Overton, and New London, which must be

estimated, is the population being served lying outside the city limits of each city. Therefore, the population being served outside the city limits of these entities should be estimated based on the number of connections outside the city limits and an average number of persons per connection, with these population estimates then added to the known population residing within the city limits. The State Data Center has estimated the population for each of these cities and this data is presented in the attachments.

7) Population projections:
The notations that the population projections are the Board's should be changed to show that these projections are the consultant's population projections and not the Board's. The draft report incorrectly states that the population projections in the text and graphs are the Texas Water Development Board's population projections. The Board does not prepare population projections for water supply corporations nor for city service areas. The Board's population projections are for counties and for cities with populations of 1,000 or more residents residing within the city limits. In a few instances, the Board has developed city population projections for cities having less than 1,000 residents in the year 1990. The population projections for the City of Arp and New London have been prepared and are attached to this review.

Additionally, the text indicates that the unincorporated service areas of the entities are projected to grow at the same rate as the Board's population projections for the unincorporated population of each county. This appears not to be the case with the Jackson WSC (74% growth) and Gregg WSC (91%) where the Board's population projections for the unincorporated area of Smith and Shelby Counties are projected to grow at a rate much less than the consultant's projected rate for the two WSCs.

8) All rates for all the alternatives should be consistent in the report, in tables as well as figures -- either $ per 1,000 gallon or $ per 10,000 gallon.

9) In Section IV, please note why the proposed dam location considered in this report is actually somewhat upstream of the locations previously evaluated. Also, "consensus" is a correct spelling (not concensus).

10) In Section VI, the reservoir has been simulated through a HEC-1 routing model for a range of different principal spillway lengths and then simulated again under a 2/3 probable Maximum Flood for two different emergency spillway lengths. The report states that a 300-foot long emergency spillway should be more than adequate for dam safety purposes, that a 200-foot long emergency spillway probably would be sufficient but that a final selection of the emergency spillway length should be made after more detailed investigations. Has the consultant(s) made these investigations, and if so, what was the final selection of the

emergency spillway length? What was the optimum combination of principal spillway length/emergencies spillway length chosen? (Exhibit 20-A is unclear; see comment #16). If these detailed investigations have not been done, the report should state that fact, then state that for purposes of the current study, such-and-such spillway length is chosen.

11) Section VIII, page 20, "Economic considerations" for Alt. C gives proposed cost per thousand gallons as $1.16 and refers to Table 14. But Table 14 has a cost for the alternative as $1.87 per 1000 gallons. However, the equation given on Table 14 is $1.87 per 1000 gallons. This makes all the calculations given in Sections VI, VII and VIII suspect. It is recommended to verify all calculations. If $1.16 is used to compare Alt A & B, please describe how $1.16 was calculated.

12) Page 20, CONCLUSIONS, 1st sentence says that the lowest construction and annual cost comparison is Alt. C (repeating that the unit cost is $1.87 per 1,000 gals). Given the first sentence, the third sentence is extremely misleading. The third sentence currently reads "Even though Alternative A has a much higher construction cost than Alternative C, the proposed water rate for Alternative C would be $28.50 per 10,000 gals if all 3.1 MGD were used."

The third sentence should read "Alternative A has a much higher construction cost than does Alternative C, and the proposed water rate for Alternative A would be $2.85 per 1,000 gals if all 3.1 MGD were used." Since the CONCLUSIONS section is often the only portion that readers actually read, the CORRECT water rates and other facts MUST be presented. To add another source of confusion, the cost derived for Alt. C is based on providing 2.45 million gallon, but it is being compared to Alt. A which provides 3.1 million gallons. The test should refer the reader to Exhibit 22, which gives the cost for the surface water reservoir as plotted against MGD. To compare surface water cost at 2.45 MGD against groundwater cost at 2.45 MGD, the reader can infer from Exhibit 22 that the surface water cost at 2.45 MGD would be approximately $34 per 10,000 gals or $3.40 per 1,000 gals. This can be compared to groundwater cost at 2.45 MGD which is $1.87 per 1,000 gals (according to Table 14, but elsewhere cited as $1.16 per 1,000 gals. See comment #11).

13) Page 20, CONCLUSIONS, 4th sentence reads "Another benefit Alternative A has is that it provides a new water source . . ." We suggest that this sentence be changed to read, "Even though the unit cost of Alternative A is higher than the unit cost for Alternative C ($2.85 per 1,000 gals versus $1.87[or $1.47 or $1.16, whatever it should be] per 1,000 gals), Alternative A does offer a benefit in that it provides a new water source, . . ."

14) Page 20, bottom of page, next-to-last sentence says that Alternative A's advantage would be the potential reduction in overall costs for the region. This is

misleading and should state that Alt A could set a potential reduction in operation and maintenance costs over Alt C. It should also be clear that by regionalizing the O&M of Alt C, i.e., a single service crew rather than a separate crew for each of the eight (8) different entities, this advantage of Alt A over Alt C by reducing costs would be negated or severely diminished. In addition, note that the total costs being compared ($2.85 to $1.47) has O&M costs considered, including the eight (8) service areas of Alt. C, therefore, only the O&M costs could be less which is a small percentage of total costs.

15) Section IX on the institutional and legal considerations and financial plan, the paragraph on PROJECTED REVENUES indicates that projected revenues will be projected in detail in the final draft report. The draft report states that the subconsultant has not had an opportunity to review projections and offer any opinion at this time. Therefore, it seems premature to recommend the surface water reservoir. It is not known if the $2.85 per 1,000 gal unit cost can be recovered. There is some merit to the argument that constructing a reservoir provides a new source of supply so that both surface water and groundwater can be used conjunctively. However, the cost of such conjunctive use must be clearly spelled out so that the benefit of conjunctive use can be weighed against that cost. The subconsultant should provide a detailed analysis of projected revenues prior to the final report so that any final recommendation can be made and supported.

16) Regarding Exhibit 20-A, it is assumed that "service spillway" is the same as "principal spillway". The exhibit should refer to "principal spillway" to remain consistent. In the profile sheet, the service (principal) spillway is noted as "150' wide" and the emergency spillway is 350' wide. However, the 350' dimension on the profile is noted as 250' on the plan. Correct this error. In addition, specify the lengths of both spillways, both in notes and as proper dimensions in scale.

17) Table 12-A gives cost estimates on excavation, building of embankment, etc., for the dam and spillway. However, since again the lengths of the principal and emergency spillways are not given, it is difficult to determine if the cost of excavating the emergency spillway and cost for dam embankment and construction of principal spillway are reasonable. Also, the optimum combination of principal spillway length/emergency spillway lengths that is chosen is not made clear in this table, in the text, or in Exhibit 20-A.

18) In the text regarding the estimation of capital cost for Rabbit Creek reservoir construction and associated treatment plant and water distribution system, a reference is made to Exhibit 23 (a layout of the distribution pipe network) and to Exhibit 24 (a tabulation of the pipe network costs). However, these Exhibits are missing from the report.

19) Page 15, an alternative surface water source is addressed briefly by a paragraph regarding the possibility of purchasing water from the City of Tyler. A reference is made to Table 15 (costs for constructing the pipeline necessary to convey the purchased water). However, there is no Table 15. The correct reference might be to Table 13. However, the amount listed in text does not appear in Table 13, 13-A or 13-B. There is no cost detail for the water distribution system, just the water main.

20) The possibility of purchasing water from the City of Dallas is mentioned, via information from the Sabine River Authority. Does the report refer to Dallas' share of Lake Fork or Lake Tawakoni? What is the volume available? What is the cost? If this information is not available or if Dallas has not made at least a tentative decision on the price of this water, then the report should so state.