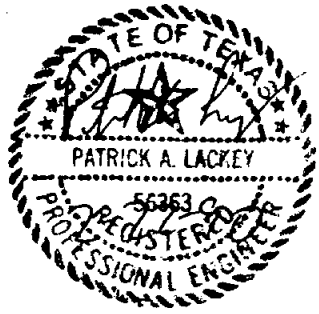
Haynie & Kallman, Inc.

CONSULTING ENGINEERS

TRAVIS COUNTY WATER CONTROL & IMPROVEMENT DISTRICT NO. 17

REGIONAL WATER STUDY



FEBRUARY 1990

Submitted to:

TRAVIS COUNTY WC&ID NO. 17
and
THE TEXAS WATER DEVELOPMENT BOARD

Prepared by:

HAYNIE & KALLMAN, INC.
800 Paloma Drive, Suite 160
Round Rock, Texas 78664
(512) 255-7861

H&K Job No. 560-2217/22
File: ER_17STUDY
Revision: 2-14-90

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

1. INTRODUCTION

Lake Travis has always been an attractive area for residential development due to its natural beauty and scenic views. A continuing trend of growth, extending from northwest Austin toward the Lake, coupled with recent expansions of industry in the area, has made the southeast Lake Travis area even more popular in recent years. However, due to the lack of a regional water and wastewater system, lake-area development has typically been characterized by private water wells and on-site septic systems, often in close proximity to each other.

Over the years, several political entities have proposed regional water concepts for this area. For several years the City of Austin has expressed an interest in providing water and wastewater service for the south Lake Travis area. The City however, has been unwilling or unable to extend major water service to most areas of the Lake. In 1984 the Lower Colorado River Authority authorized the Lake Travis (West) Regional Water and Wastewater System Feasibility Study. This Study investigated the LCRA's potential for providing regional water and wastewater service for this growing area. The Study presented alternatives and concepts for a regional water system but lacked specific recommendations for implementation of the

plan. Five years has passed since the date of that report and the area is still no closer to achieving a centralized water system. These past attempts have used too broad of an approach with too little direction. If regional water is to become a reality for this growing area, it must start with specific recommendations for existing systems. Then gradually expand in scope until a working regional water system is accomplished.

Travis County Water Control & Improvement District No. 17 (District 17) has, in recent years, taken the lead in addressing the water supply needs of southeast Lake Travis. Through an aggressive service plan, the District has expanded its size from 4,500 acres to 13,000 acres within the past five years. It is the District's goal to provide a centralized water treatment, storage, and distribution system to serve the entire southeast Lake Travis area. It is hoped that the implementation of this plan will become the initial step in the larger regional concept proposed in the LCRA's 1985 Lake Travis West Study.

1.1 Background

Travis County WC&ID No. 17, originally consisting of 4,500 acres, was created by order of the Commissioner's Court of Travis County, Texas on December 8, 1958. The creation of

the District was confirmed in an election held on February 28, 1959. In 1975 the District petitioned, and was granted, powers of authority over wastewater collection, treatment, and disposal; stormwater collection and disposal; and solid waste collection and disposal. The District currently owns and operates a public water system in Travis County, Texas. The following citation of law demonstrates the District's legal authority to plan, develop, and operate water and wastewater facilities within its service area and thus carry out the recommendations contained within this Study.

1.2 Citations of Authority

Purposes of District - (Texas Water Code, Chapter 51.121.(b)) A water control and improvement district organized under the provisions of Article XVI, Section 59, of the Texas Constitution, may provide for: (1) the control, storage, preservation, and distribution of its water and floodwater and the water of its rivers and streams for irrigation, power, and all other useful purposes; (2) the reclamation and irrigation of its arid, semi-arid, and other land which needs irrigation; (3) the reclamation, drainage, conservation and development of its forests, water, and hydroelectric power; (4) the navigation of its coastal and inland water; (5) the control, abatement, and change of any shortage or harmful excess of water; (6) the protection, preservation, and restoration of the purity and sanitary condition of water within the state; and (7) the preservation and conservation of all natural resources of the state.

Powers of District - (Texas Water Code, Chapter 51.122.) The District has the functions, powers, authority, rights, and duties which will permit the accomplishment of the purposes for which it was created, including the investigation and, in case a plan for improvements is adopted, the construction, maintenance, and operation of necessary improvements, plants, works, and facilities, and

the acquisition of water rights and all other properties, land, tenements, materials, borrow and waste ground, easements, rights-of-way, and everything considered necessary, incident, or helpful to accomplish by any practicable mechanical means any one or more of the objects authorized for the district, subject only to the restrictions imposed by the constitutions of Texas or the United States. A district may also acquire property deemed necessary for the extension or enlargement of the plant, works, improvements, or service of the district.

Planning - (Texas Water Code, Chapter 51.124.) The board may make investigations and plans necessary to the operation of the district and the construction of improvements. It may employ engineers, attorneys, bond experts, and other agents and employees required to perform this duty.

Construction of Improvements - (Texas Water Code, Chapter 51.125.) A district may construct all works and improvements necessary: (1) for the prevention of floods; (2) for the irrigation of land in the district; (3) for the drainage of land in the district, including drainage ditches or other facilities for drainage; (4) for the construction of levees to protect the land in the district from overflow; (5) to alter land elevations when correction is needed; and (6) to supply water for municipal uses, domestic uses, power and commercial purposes, and all other beneficial uses or controls.

To-date, the District has granted annexation petitions for many parcels of land and current District acreage stands at 13,000 acres. For purposes of this Study, the Study Area is assumed to include all acreage currently within the District and approximately 4,000 acres of contiguous undeveloped land, included in the District's CCN (Certificate of Convenience and Necessity) Service Area as amended by the Texas Water Commission. This provides a for a total Service and Study Area of approximately 17,000 acres. Noticeably excluded from the Study Area is Lakeway

MUD and Hurst Creek MUD. These entities currently provide water and wastewater service to their customers and have elected not to be included in a regional plan at this time. West Travis County MUD No. 1 (Double J&T Ranch) has also elected not to be included in the District's service area.

The adjoining River Place development has expressed an interest in participation in future WC&ID area-wide water system improvements. However, River Place has declined inclusion in the Study at this time but may elect to participate at a later date.

Figure 1 shows the general location of the Study Area in relation to the Austin/Lake Travis region. Figure 2 shows boundaries of the Study Area in relation to current District boundaries and surrounding developments.

FIGURE 1

General Location Map

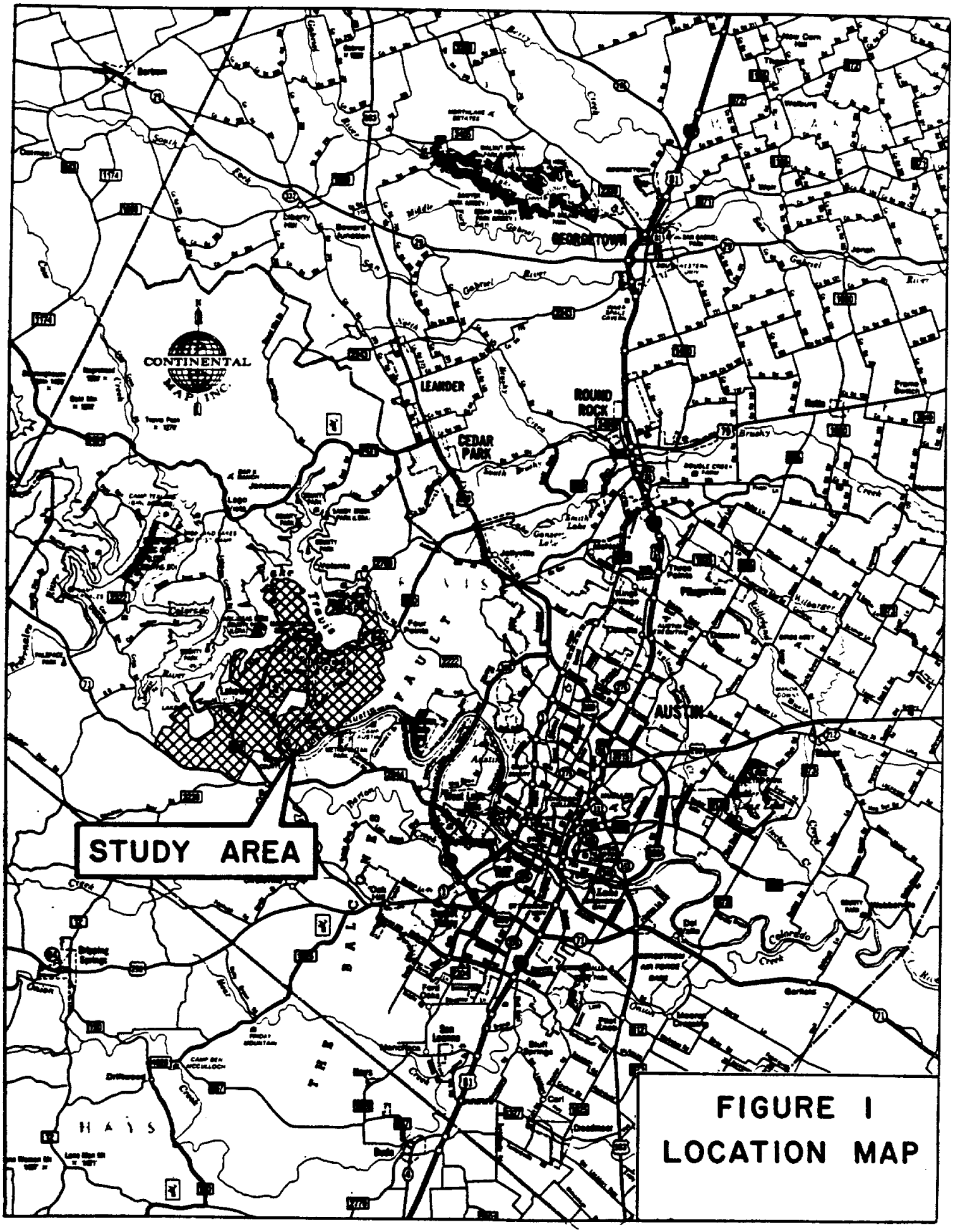


FIGURE 1
LOCATION MAP

FIGURE 2

Planning Area Boundaries

FIGURE 2
STUDY AREA
BOUNDARY

2. EXECUTIVE SUMMARY

2.1 Scope

Travis County Water Control and Improvement District No. 17 is a rapidly growing suburban water district which faces unique opportunities and challenges in developing additional area water supplies. However, the District's continuing growth and its potential for future development currently exceed initial planning efforts. This Study will identify existing areas that need additional attention and plan future improvements which will be necessary to provide adequate water service for that growth. The District gratefully acknowledges the Texas Water Development Board for its funding of the study grant.

2.2 Development Restrictions

Several political and regulatory agencies exert various restrictions upon development within the Study Area. These regulations primarily affect density by restricting development on slopes, limiting impervious cover, and requiring larger lot sizes for on-site wastewater disposal. Because of these regulations, development potential within the District will be greatly influenced by the future availability of both centralized wastewater collection and water distribution systems. Of these two,

wastewater disposal will have the greatest effect on area density and development.

Future development within the Study Area, as projected in this report, has taken into account which areas will most likely utilize on-site disposal and centralized collection and disposal methods. Although not included within the scope of this Study, wastewater service options are an area in which the District can play an important role in future development and planning of prudent and efficient collection, treatment and disposal options.

2.3 Projected Growth

The District's service area has the potential for rapid development and associated increased water demands. During the course of this Study, available utility, transportation, and planning studies were evaluated to form a basis for prediction of future growth trends. Projections indicate a compound growth rate of 8% as averaged over the next 22 years. This represents not only new growth or development within the study area, but also the annexation and service to existing development and private water systems. Currently, the Study Area is estimated to contain 2,218 LUEs. By the year 1995, this number is expected to grow to 4,346 and by the year 2010, the Study Area is expected to increase to approximately 12,000 LUEs.

2.4 Existing Water Systems

Next to the City of Austin, the District represents the largest public water utility in this area. The District's abundant raw water contract with the LCRA, combined with its central water treatment plant capacity, make alternate raw water sources such as ground water or surface water from Lake Austin less attractive than that from Lake Travis. The District's recent merging of existing smaller sub-standard water systems with its own system has developed into a regional service scenario that fits well into LCRA's long term water service plan.

2.5 Projected Water Demand

Based on past water use trends, the District's current LCRA raw water contract of 8,800 ac/ft/yr will be sufficient to provide raw water service for approximately 18,000 LUEs, which is the projected build-out of the Study Area. In addition, the Steiner Ranch contract for 5,403 ac/ft is also available to the District as a result of the recent annexation of these properties. Additional treatment, storage, and distribution improvements will be needed as the Study Area grows and are identified in detail within this report.

2.6 Proposed Improvements

The results of this Study indicate that Travis County WC&ID No. 17 is ideally suited to administer the first phases of a regional water system for Western Lake Travis. To accomplish this goal, the District needs to improve the quality of service for those areas which are currently relying on limited ground water sources by expanding its distribution network. Several major transmission lines, water storage reservoirs, pumping stations, as well as increased treatment capacity will be required to meet the future needs of the Study Area. Much of these needs can be met through expansion of existing District facilities. The remaining improvements are planned as part of Steiner Ranch development and future LCRA Lake Travis West improvements. A computer-generated water model was used to test the integrity of improvements proposed in this Study. The model confirmed the hydraulic dynamics of the proposed improvements as well as their compatibility with existing facilities.

2.7 Implementation Plan

Travis County WC&ID No. 17 has pioneered the concept of Defined Area Bond Issues in Texas and this innovative mechanism seems well suited to fund improvements recommended in this Study. The District also uses the capital recovery fee system to generate revenues for

improvements. As the District continues to merge smaller existing systems with its own, these sub-standard facilities will be upgraded to meet current State standards. Proposed new improvements will be funded through the issuance of bonds supported by either the entire District or a defined area of the District. The Apache Shores - Cardinal Hills $10,405,000 Bond Issue, currently under review, is an important first step in the District's regional planning efforts.

2.8 Environmental Concerns

The District is situated in the environmentally sensitive Lake Austin/Lake Travis watershed. At least four endangered and threatened species of flora and fauna have been identified in the area and care must be taken in planning future improvements. The District must continue to work within these environmental constraints to protect these resources, while continuing to provide quality service for potable water, irrigation, and fire protection.

The environmental portion of this Study contains a baseline evaluation of threatened or endangered species likely to occur within the Study Area. Section 3 describes both documented and probable locations of several species of concern. Future planning efforts should coordinate with area environmental authorities

such as the Austin Regional Habitat Conservation Plan (ARHCP), early in the project planning process to avoid possible lengthy approval and construction delays.

2.9 Water Conservation

Due to the ever increasing concern over local and regional water supplies, the aspects and importance of a water conservation program is included in this report. Key points for a recommended conservation plan and drought contingency plan are discussed. The District should take an active role in promoting conservation of the State's decreasing water supplies through plumbing codes, landscaping requirements, and public awareness and education. The effect that a successful conservation program will have on the District's projected revenue should also be evaluated prior to implementation of such a program.

TABLE 1

Summary of Estimated Cost for
Proposed Apache Shores-Cardinal Hills
Defined Area Bond Issue

		Total Improvements
A.	CONSTRUCTION COSTS	
1.	Improvements:	
	a. Water Distribution System	$ 4,143,000
	b. Water Treatment Facilities	2,250,000
	c. Water Storage Facilities	350,000
2.	Estimated Construction Cost	$ 6,743,000
3.	Construction Contingencies	809,000
4.	Engineering, Surveying and Permits	675,000
	TOTAL CONSTRUCTION COSTS	$ 8,227,000
B.	NON-CONSTRUCTION COSTS	
1.	Apache Shores System Purchase	$ 675,000
2.	Annexation, Elections, Preliminary Engineering and Legal Expenses	125,000
3.	Issuing and Selling Bonds (including Fiscal Agent & Legal Fees, Related Costs & Expenses)	416,000
4.	Validation Suit Contingency	40,000
5.	Non-Construction Contingency	90,000
6.	Capitalized Interest (8%, 1 yr.)	832,000
	NON-CONSTRUCTION COSTS	$ 2,178,000
C.	TOTAL BOND ISSUE	$10,405,000

Finally, the District is aware of the Texas Water Development Board and its financial programs for funding of water system improvements. While the District is grateful to the Board for their funding assistance with this regional study grant, it does not anticipate at this time the need to apply to the Board for funding of any proposed improvements. If and when this funding option is utilized by the District, it will comply with the Board's rules and regulations regarding funding.

3. SUMMARY OF AREA DEVELOPMENT RESTRICTIONS

3.1 Introduction

Development (growth) rates within a particular area are influenced by a variety of factors. These include area economy, area employers, proximity to retail centers, proximity and quality of schools, as well as housing availability itself. The availability and affordability of housing, whether it is single family, duplex, or multifamily, is directly related to the many sets of development regulations currently in effect for the area.

The Study Area includes portions of land which are under simultaneous regulation by Travis County WC&ID No. 17, the City of Austin, Travis County, the Lower Colorado River Authority, Texas Water Commission, and Texas Department of Health. Of these, the City of Austin imposes some of the more severe constraints upon development, particularly within major watersheds (of which the entire Study Area is included).

3.2 Political Subdivision Control

3.2.1 City of Austin

The City of Austin regulates development in many different ways. The current Comprehensive Watershed ordinances restricts impervious cover on various slope gradients and

within different portions of a watershed. Development is prohibited altogether within the Critical Water Quality Zone (CWQZ) of a stream, severely restricted or prohibited on slopes greater than 15%, limited within the Water Quality Buffer Zone (WQBZ), and restricted in varying degrees for all remaining areas of the watershed. Additional development restrictions apply for sites within designated Water Supply Watersheds, both Suburban and Rural. Restrictions for Suburban Watersheds are more severe than those for Rural.

The Study Area falls within three major watersheds; Barton Creek, Lake Travis, and Lake Austin. All three of these watersheds are designated by the City of Austin as Rural Water Supply Watersheds. Because development is prohibited within the CWQZ and severely limited in the WQBZ, principal development will occur in the remaining area, known as the Uplands Zone. Overall density within the Uplands Zone of a Rural Water Supply Watershed is limited to 1 single family unit per 2 acres with a minimum lot size of 3/4 acre. This overall density can be increased with certain development intensity transfers. Because of lot size restrictions associated with on-site septic systems, the presence of a centralized wastewater collection and treatment facility makes a significant difference in the overall development density of an area.

In the case of Steiner Ranch, the total development is approximately 4600 acres with an original master plan of 8,341 lots. This equates to approximately 1 unit per 1/2 acre. It should be noted however, that plats can change significantly between the master planning and final plat approval. Steiner also has since set aside acreage for habitat preservation of the Black-capped Vireo, which will reduce overall density in the development further.

3.2.2 Texas Department of Health

Development density regulations issued by the Texas Department of Health (TDH) restrict the minimum lot size for residential development with individual sewage systems. Residential development with individual sewage systems utilizing public water supply is limited to a minimum lot size of 15,000 square feet (0.34 acre). Residential development with individual water and sewage systems is limited to a minimum lot size of 20,000 square feet (0.46 acre). Poor percolation rates in underlying soils can require additional acreage for successful wastewater disposal. Existing small lot subdivisions such as Apache Shores and Cardinal Hills are exempt from more recent lot size restrictions but still must meet percolation requirements prior to the construction of on-site systems. The recently updated Travis County and

LCRA on-site disposal system regulations are more stringent than the TDH regulations and generally supersede the TDH rules.

3.2.3 Travis County

Travis County requires a minimum lot size of 1/2 acre per living unit for lots utilizing private sewage facilities. Where percolation rates are insufficient, lined evaporation systems are sometimes used. For this type of disposal, a minimum of 1 acre is required per living unit. As with TDH requirements, poor percolation rates of underlying soils can increase the necessary size of the lot even further.

3.2.4 Lower Colorado River Authority

In areas adjacent to Lake Travis, the LCRA permits and regulates septic tank construction and associated lot size requirements. Generally, LCRA requirements for on-site systems are more restrictive than those of the Texas Department of Health.

3.2.5 Texas Water Commission

The Texas Water Commission imposes restrictions upon development in the form of the current moratorium on wastewater discharges to Lake Austin and Lake Travis, and

the current Edwards Aquifer Rule. None of the Study Area lies over the defined Edwards Aquifer Recharge Zone; however, virtually all of the Study Area is subject to the moratorium on lake discharges. This moratorium prohibits any new or additional wastewater discharges to Lake Travis or Lake Austin. In effect, this requires all development not served by the City of Austin or one of several smaller plants currently permitted to discharge, to utilize private on-site systems or centralized systems with irrigation effluent disposal. Wastewater disposal is the limiting factor for development density either through large lot sizes or dedicated irrigation areas. The net effect of this moratorium is that development density is reduced significantly.

4. EXISTING WATER SYSTEMS

Travis County WC&ID No. 17, which currently derives all of its raw water supplies from Lake Travis, represents the major water purveyor within the Study Area. Within this area are several other sources of raw water. By far the largest source of raw water is that purchased from the Lower Colorado River Authority (LCRA) and withdrawn from the adjacent lakes for use in area systems.

4.1 LCRA Water Contracts

All surface water rights within the Study Area are regulated by the Lower Colorado River Authority. The LCRA operates the various dams which create the Highland Lakes chain, and issues diversion contracts for raw water withdrawals from the lakes. This authority includes Lake Austin and Lake Travis, the principal raw water sources in the Study Area.

4.1.1 Travis County WC&ID No. 17

The District purchases its raw water from the Lower Colorado River Authority and draws its supplies from Lake Travis. The contract was negotiated in September, 1985 for 8,800 acre-feet/year. Based on the District's 1988 average annual production rate of 159,140 gallons per LUE, this contract should be sufficient to serve approximately 18,000 LUEs.

Additionally, the District has, through annexation of the Steiner Ranch Development, acquired the LCRA raw water contract of 5,403 acre-feet/year for use within that development. This brings the District's total raw water supply contract to 14,203 ac-ft/yr, or approximately 29,000 LUEs. Area developments holding LCRA raw water contracts are summarized in Table 2.

TABLE 2

Area LCRA Raw Water Contracts

	Acre-Feet/Year
Lake Travis	
City of Austin (WTP #4) (includes previous TWC Contract)	270,000
WC & ID No. 17	8,800
Hurst Creek MUD	1,600
Lakeway MUD	1,228
WC & ID No. 14	1,074
Orange Service Corp.	1,000
Lake Austin	
Steiner Ranch Dev. (WC & ID No. 17)	5,403
* Riverplace MUD	3,528
* West TCMUD#1 (Double J&T Ranch)	2,420
Bohls MUD	1,901
Hidden Valley WSC	20

* **Currently being re-evaluated by LCRA**

4.2 Area Water Supplies

4.2.1 Lake Travis

The District draws its raw water supplies from Lake Travis. Their existing water treatment plant lies in close proximity to the Lake and has a service elevation of 1031.

4.2.2 Lake Austin

Lake Austin, with a lower surface elevation of 491 compared to 681 for Lake Travis, would require greater pumping energy to reach the District's 1031 system. The difference in elevation between Lake Travis and Lake Austin (the District's nearest alternate source of surface water) is approximately 200 feet. Lake Austin's water quality characteristics also make it more difficult to treat. Higher turbidity caused by sediment passed through the bottom of Mansfield Dam, more pollutants due to the more urbanized watershed, and colder water temperatures resulting from the transfer of lower levels of water through the dam require additional treatment and chemicals, thereby increasing the operating and capital costs of treatment. The addition of the River Place development to the District (at its lower elevation) could provide economical justification for development of Lake Austin water supplies. Otherwise, it is unlikely that the District will utilize Lake Austin as an alternate water source in the near future.

4.2.3 Ground Water

Ground water is utilized by many of the smaller area systems as a potable water source. The following discussion on groundwater alternatives is extracted from the LCRA's Lake Travis West report.

> The Glen Rose and Trinity Peak aquifers are the major water-bearing units in the study area. Both are members of the Trinity Group Aquifer. Groundwater in this group of aquifers has been described as a calcium carbonate water in western Hays and Travis counties and becomes a sodium sulfate or chloride type as it moves downdip to the south and east-southeast. The fault zone near the eastern edge of the study area has greatly restricted the movement of water through the aquifer. Low permeability, restricted water circulation, and an increase in temperature causes the groundwater to become more highly mineralized in the downdip portion of the aquifer. Sulfate, fluoride, and total hardness have been the major problems, and a great number of water samples collected from the Trinity Group Aquifer could not meet the primary or secondary drinking water standards (TDWR, 1983).
>
> Groundwater also has quantitative limitations in this region. Unpublished Texas Water Development Board records show wells in the lower Glen Rose Aquifer have yields ranging from 5 to 30 gpm, averaging 10 gpm. Well yields from Trinity Sands Aquifer range from 10 to 80 gpm, averaging 20 gpm (Woodruff, 1975). The well yields generally are adequate for individual rural well systems but are considered inadequate for the future developments projected in the study area.

This excerpt shows that ground water alternatives are seriously limited by both quality and quantity within the Study Area. It is unlikely that the District will develop ground water sources to meet future demands.

4.3 Review of Existing Area Water System Plans

The existing District service area is surrounded by numerous public water supply systems varying in size from the City of Austin's massive system to small individual

well systems. The following is a summary of the major water systems.

4.3.1 City of Austin

The City of Austin's water system extends northward to the edge of the WC&ID No. 17 service area. Major water transmission mains are located along RR 620 and RR 2222 north and east of the intersection. Major facilities in the area include the proposed 60 mgd Water Treatment Plant No. 4, the existing Four Points Ground Storage Tank, pump station, and elevated storage reservoir. These facilities operate at the 1130 foot Northwest "B" and 1230 foot Northwest "C" pressure zones. City service plans for the area include service to the north and east of WC&ID No. 17's boundary.

4.3.2 Lakeway MUD

Lakeway Municipal Utility District serves approximately 2200 customers. Lakeway pumps raw water from Lake Travis to three water treatment plants located within the development. The plants, 1A, 2, and 3, will serve 400, 185, and 1042 connections respectively. Service pumps transfer water to the four pressure zones that serve the District. These zones are: E-1 and E-2 at 964 feet, E-3 1077 feet, and E-4 at 1105.5 feet MSL. Lakeway is

interconnected with Hurst Creek MUD at service level E-3. This emergency interconnection allows for a two-way flow of water between the two District's if necessary. Lakeway is currently negotiating with District 17 for a second emergency tie in.

4.3.3 Travis County WC&ID No. 14

Travis County WC&ID No. 14 is located to the west of District 17 in the vicinity of State Hwy. 71 and Ranch Road 620. District 14 provides water to the Village of Bee Caves and serves approximately 900 customers. The District obtains water from the City of Austin, who also maintains the distribution system. The Bee Caves area of the system has been plagued by low water pressure and limited emergency fire flows. These are a result of the location of the system at the end of the City system and small lines at the far reaches of the District. The Village of Bee Caves has recently approached District 17 in regards to obtaining water service for the Village. The District is working with the Village in this regard.

4.3.4 Doss-Lakewind System

Located in the Hudson Bend peninsula, the Doss-Lakewind system was recently annexed into District 17. The system originally consisted of a small 50 gpm surface water treatment plant and 100,000 gallon standpipe that served

approximately 75 customers. In 1986, the system was given to the District in an annexation agreement by an area developer. The developer purchased system capacity in District 17 and the existing facilities were abandoned except for the distribution system. The development is now served by District 17's system.

4.3.5 Apache Shores

Located along Lake Austin, the Apache Shores system serves approximately 400 connections. Four wells pump water to storage tanks and the distribution system. The system suffers from poor water quality, low system pressures, and insufficient quantities. District 17 is currently proceeding with a bond issue which will fund the purchase of this system and replace it with a municipal grade system. The Apache Shores property owners will be responsible for retiring the debt through defined area bonds.

4.3.6 Montview System

Located off Low Water Crossing Road adjacent to Lake Austin, approximately 50 connections are served by three separate public water systems; Montview Acres, Montview Harbor, and Hidden Valley. Each system pumps water out of Lake Austin where it is treated and distributed. Equipment failures, insufficient treatment equipment, and

poor system reliability have plagued these systems. The Montview systems are scheduled to be replaced with new service from District 17 as part of the proposed bond issue discussed previously in Apache Shores. The Hidden Valley system has to-date declined inclusion into the District.

4.3.7 Proposed LCRA Lake Travis West Water System

In 1986, the LCRA authorized a preliminary engineering study investigating a regional water system to provide water to areas west of the Lake including the Dripping Springs area. While no construction has yet begun, the planning efforts for such a system have continued to evolve. This LCRA report is referenced throughout the Study and in fact, is proposed as a continuation of this plan. The District's efforts to serve and annex smaller area systems are in concert with the effort to provide dependable, regionalized service for the Lake Travis area.

4.3.8 Other Systems

Numerous individual well and cistern systems dot the Study Area. Ground water in the area, as previously discussed, is generally of poor quality and small quantities. Reports of potential ground water contamination caused by on-site septic systems are common in this area. Individual wells, lying in close proximity to wastewater

disposal operations and other such hazards, provide a vehicle for rapid aquifer contamination, often bypassing hundreds of feet of natural filtering limestone. In an effort to provide temporary relief for some of these residents, Travis County currently hauls water to individual customers at a nominal rate. The potential hazards of on-site septic systems, lack of adequate fire protection, and poor water quality, make these areas prime candidates for a regionalized water distribution system.

4.4 Review of Existing WC&ID 17 Facilities

Topography of the Study Area necessitates the establishment of different water service levels (pressure planes) to facilitate customer service within desired minimum and maximum water pressures. Table 3 shows the three main existing service levels along with their corresponding ground elevation and pressure limitations.

TABLE 3

Study Area
Water Service Levels

Service Level No.	Overflow Elevation (feet)	Maximum(1) Ground Elevation (feet)	Minimum(2) Ground Elevation (feet)
1	1031	950	800
2	1203	1122	972
3	1130	1049	799

(1) Based on 35 psi (81') minimum static pressure.
(2) Based on 100 psi (231') maximum static pressure.

4.4.1 Service Level 1

Service Level 1 has an overflow elevation of 1031 feet MSL and includes a majority of the District. Some small areas within this service area have surface elevations of less than 800 feet MSL and have pressures regulated through a system of pressure reducing valves (PRVs). Storage for Service Level 1 is currently provided by three elevated storage reservoirs. These include the 300,000 gallon McCormick Mountain Reservoir (standpipe), the 75,000 gallon E.C. Stewart, Jr. Reservoir (suspended), and the 429,000 gallon Round Mountain Reservoir (standpipe). Service Level 1 is the base pressure plane for the District's system, receiving its entire treated water supply from the Eck Lane Water Treatment Plant. Water is transported through high pressure service pumps which distribute water to all other pressure planes via the RR 620 24-inch water transmission mains. The existing Booster Pump Station Number 1, located at the water treatment plant is controlled by the level in the 75,000 gallon elevated storage tank and pumps from the existing 126,000 gallon clearwell. Assuming a condition with the station's largest pump out of service, the firm pumping capacity of this station's remaining three pumps is 1,500 gpm.

High Service Pump Station No. 2, included in the District's proposed 3.0 mgd water treatment plant expansion, will pump water from the proposed 1,000,000 gallon clearwell to the 1030 foot pressure plane of Service Level 1. Pump Station Number 2 and a clearwell are proposed for construction in 1989, and will be considered as an integral part of the existing system. The pump station will have two 2100 gpm pumps with a firm capacity of 2100 gpm. These pumps will be controlled by the same level controls in the 75,000 gallon elevated storage tank (ET-5) that control the plant's Booster Pump Station Number 1.

4.4.2 Service Level 2

Service Level 2, with an overflow elevation of 1200 feet MSL, is located at the extreme southwest end of the District. Storage for this service level is supplied by the 300,000 gallon Lake Travis I.S.D. Standpipe which is fed by the Lake Travis I.S.D. Booster Pump Station. The two 150 gpm centrifugal pumps give the pump station a firm capacity of 150 gpm, and obtain and raise the elevation of water supplied from Service Level 1. The pump station is controlled by level controls in the Lake Travis I.S.D. Standpipe. The major transmission and distribution lines in this pressure plane are a 12 and 8-inch lines which run in series from the booster pump station to the standpipe.

4.4.3 Service Level 3

Service Level 3 is located at the far eastern edge of the District and serves the higher elevations along the RR 620 corridor east of the Colorado River and the Steiner Ranch development. The 1,000,000 gallon Comanche Trail Ground Storage Reservoir (standpipe) provides storage for this pressure plane with an overflow elevation of 1130 feet MSL. The Comanche Trail in-line booster pump station likewise pumps from Service Level 1 with three 1250 gpm pumps. With one pump out of service, the station would have a firm pumping capacity of 2500 gpm. Level controls, located in the Comanche Trails standpipe, activate the pumps on a rotating basis. The main transmission and distribution line within this service level is a 16-inch water line extending down RR 620, Quinlan Park Road, and Steiner Ranch Boulevard to the standpipe.

4.4.4 Existing Water Treatment Facility

In 1985, a new raw water pump barge was constructed with capacity for four 1000 gpm pumps. Presently, due to treatment plant limitations, there are three 750 gpm pumps in service. These pumps are constructed for easy conversion to 1000 gpm.

The raw water pumps deliver water to an onshore connection box through a 10-inch polyethylene raw water pipe stationed on the surface of the water with floating platforms. From the onshore connection box, the raw water flows through one 8-inch polyethylene raw water pipe and one 6-inch cast iron raw water pipe to the sedimentation basins where treatment chemicals are added.

The sedimentation basins consist of an older rectangular basin without mechanical sludge removal and the newer 42 foot diameter upflow reactor clarifier. Together, they provide settling capacity for flows up to 1500 gpm.

From the sedimentation basins, three 750 gpm transfer pumps force the settled water through the pressure filters and into the 126,000 gallon clearwell (ground storage tank) located at the plant site. Of the ten pressure filters, four were added in the 1986 plant expansion. Based on the State's criteria of 2 gpm/sq.ft, each filter has a capacity of 157 gpm for a total of 1570 gpm. The filters are backwashed by means of a 35,000 gallon ground storage tank located on the plant site which is then refilled with water from the distribution system.

4.4.5 Proposed Water Treatment Facility

As previously discussed, this 3.0 mgd facility is scheduled for construction in 1989, and as such, is considered as part of the District's existing facilities. The plant site has been planned to provide capacity for 12.0 mgd in addition to the existing 2.16 mgd facility. The ultimate plant is proposed for construction in four 3.0 mgd modules with the 1989 construction being the first of these phases.

Raw Water Pumps - In order to serve the proposed expansion, raw water pumping capacity of 2018 gpm must be provided. The existing barge should be expanded to its firm design of 3000 gpm. The future capacity required for future plant expansions should be added as a fixed, submerged intake, capable of expansion for future construction. Because of the proposed piping modifications, the pumping head will be reduced to allow the barge pump capacity for both the existing 2.16 MGD plant as well as the 3 MGD expansion.

Raw Water Line - A 24 inch raw water line should be constructed from the raw water pump station to the rapid mix facility. Future construction will parallel this line. Flow metering of this line will allow for record keeping and chemical flow pacing to reduce operating costs.

Rapid Mix Zone - Due to the proposed common wall module type treatment facility, the rapid mix basin will be sized for 12 mgd. An air mix system will be used for chemical mixing and aeration of the lake water to minimize potential taste and odor problems. Presently, the District adds the following chemicals to treat its drinking water: chlorine for disinfection, alum for turbidity removal and fluoride for dental protection.

Flocculation Zone and Clarifiers - One 60 foot diameter upflow clarifier is proposed with a capacity of 3.0 mgd. Control valves will provide positive shut-off and variable flow control from the rapid mix basin to the flocculation zone. Variable speed paddle mixers will provide mixing energy for solids formation. Radial weirs in the clarifiers will provide even withdrawal from the settling zone.

Filters - Gravity backwash mixed media filters are proposed for the plant. Rated at 5 gpm/SF, they provide settled water polishing. An air scour and motorized control valve will provide efficient and cost effective treatment.

Sludge Handling - A 40 foot diameter sludge thickener will provide sludge and filter backwash storage. Settled water will be filtered through wedge wire screens before recycle

through the treatment plant. Settled sludge will be thickened prior to final off-site disposal.

Plant Clearwell - Due to space limitations plant build out will only allow for two 1,000,000 gallon clearwells on-site. Therefore, the proposed 1,000,000 gallon clearwell will provide plant storage to handle peak flow demands. Level controls in the clearwell will be used to signal plant operation. The available head will also provide gravity backwash through the filters.

Table 4 lists existing water storage reservoirs within the Study Area including their location and capacity. Table 5 lists existing booster pump stations within the Study Area along with their corresponding locations and capacities.

TABLE 4

Existing Water Storage

Ground Storage Tank	Capacity (Gallons)
1. Eck Lane WTP Clearwell (GT-1)	126,000
2. Eck Lane WTP Clearwell (GT-2) (Projected Construction 1989)	1,000,000
TOTAL GROUND STORAGE	1,000,000

Elevated (Standpipe) Storage Tank	Capacity (Gallons)
1. McCormick Mountain (ET-3)	300,000
2. Round Mountain (ET-2)	429,000
3. Lake Travis I.S.D. (ET-4)	300,000
4. Comanche Trails (ET-5)	1,000,000
TOTAL ELEVATED STORAGE (STANDPIPE TYPE)	2,029,000

Elevated (Suspended) Storage Tank	Capacity (Gallons)
1. E.C. Stewart, Jr. (ET-1)	75,000
TOTAL ELEVATED STORAGE (SUSPENDED TYPE)	75,000

TABLE 5

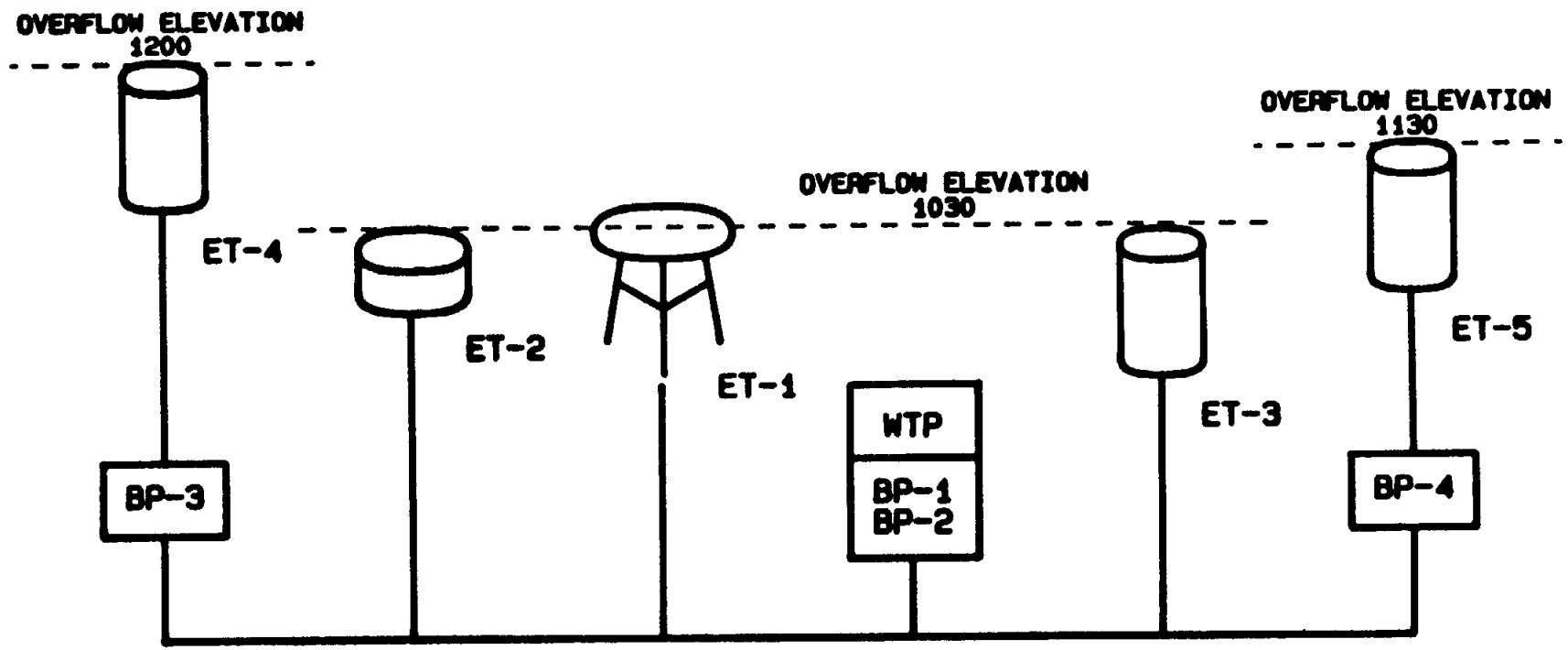
Existing Booster Pump Stations

Booster Pump Locations	Number of Pumps (Gallons)	Firm Capacity
Eck Lane WTP Pump Station No. 1 (Service Level 1, BP-1)	2 - 600 gpm 2 - 450 gpm	1,500 gpm
Eck Lane WTP Pump Station No. 2 (Service Level 1, BP-2) (Projected Construction 1989)	2 - 2100 gpm	2,100 gpm
Lake Travis I.S.D. Pump Station (Service Level 2, BP-3)	2 - 150 gpm	150 gpm
Comanche Trails Pump Station (Service Level 3, BP-4)	3 - 1250 gpm	2,500 gpm

FIGURE 3

Existing Water System Schematic

TRAVIS COUNTY W.C. & I.D. NO. 17
EXISTING WATER SYSTEM SCHEMATIC



STORAGE TANK CAPACITY	
ET-1	75,000 GAL
ET-2	429,000 GAL
ET-3	300,000 GAL
ET-4	300,000 GAL
ET-5	1,000,000 GAL

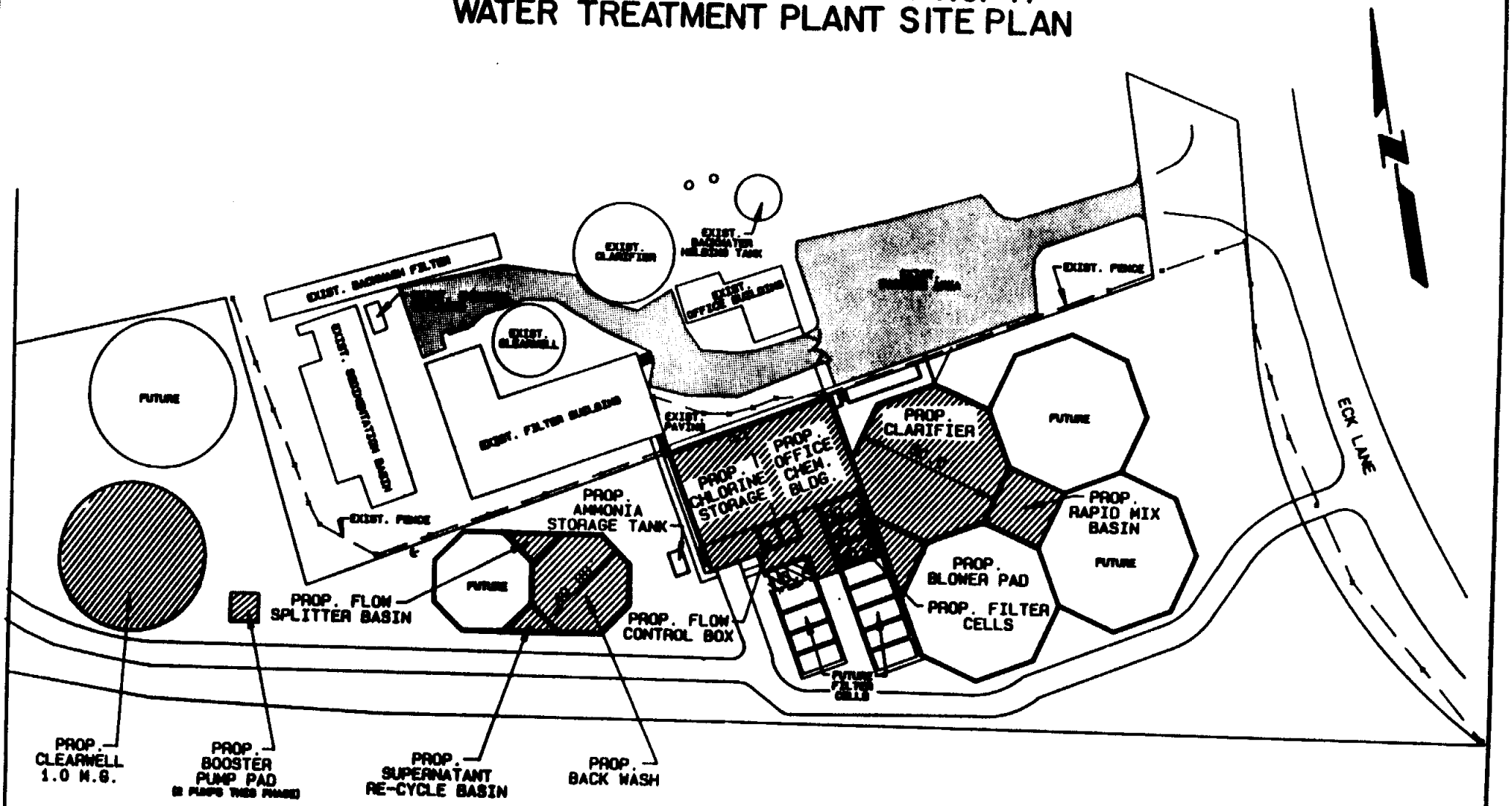
BOOSTER PUMP CAPACITY	
BP-1	1,500 GPM
BP-2	2,100 GPM
BP-3	150 GPM
BP-4	2,500 GPM

FIGURE 4

Water Treatment Plant

Site Plan

TRAVIS COUNTY W.C. & I.D. NO. 17
WATER TREATMENT PLANT SITE PLAN



HK&G

Haynie Kallman & Gray, Inc.
Consulting Engineers

5. PROJECTED GROWTH

Probably the most important factor in any analysis of this type lies in accurate predictions of the future; a task surpassed in difficulty only by predictions of Texas weather. Many different factors affect growth and development within an area. These include, but are not limited to:

* Local and regional economy;
* Local development restrictions;
* Environmental constraints;
* Current housing inventory;
* Existing and proposed roadway networks;
* Proximity to employment, schools, etc.

This section describes the population and land use forecast used in the analysis of this report. The forecast information was then used to estimate the future water needs of the Study Area.

Long term projections contained within this Study are intended to serve as a guide only. Due to the Study Area's layout, sparse customer base distributed over a large geographical area, possibility of service expansions through further annexation, and changing political and economic climates, projections beyond a five or ten year

horizon would involve a great deal of speculation. It is essential, therefore, that projected water demands and system limitations be evaluated and updated on a routine basis.

5.1 Background Research

To predict future growth within the Study Area, H&K enlisted the assistance of Mr. Sam Smith, a private consultant representing Smith Software Specialist Company. Mr. Smith has previous experience in developing population projections for the Lake Travis area, primarily for the Lake Travis Independent School District. Additional factors which will influence growth (both positive and negative) within the Study Area noted by Smith include an additional 2500 jobs in the area due to expansions of 3M and Schlumberger, the current widening of R.R. 620 from State Highway 71 to Mansfield Dam, the construction status of R.R. 620 widening from the Dam to R.R. 2222, recent de-annexation of R.R. 620 by the City of Austin, and federal environmental protection of the nesting habitat of the Golden-cheeked Warbler and Black-capped Vireo.

In order to make as accurate a prediction of future development as possible, past area growth trends were researched. These included:

* Traffic Counts for R.R. 620 west of Four Points and at Marshall Ford (1980-87) Texas Department of Highways and Public Transportation;
* Telephone Connections (1980-87) generally within the Study Area;
* City of Austin Study Department year 2010 Travis County population projections;
* Lake Travis High School enrollment (1981-87);
* Voter registration records for Precinct 312 and 207.

In addition to these records, projections contained in past studies which include the Study Area were consulted. These included:

* Water and Wastewater Utility Interim Plan (Final Report, prepared for the City of Austin by Engineering Science, December 1986;
* Transportation Plan for the Austin Metropolitan Area - Technical Report 1, Population and Employment Forecasts: Methodology and Preliminary Results, prepared for the Austin Transportation Study by Cambridge Systematics, Inc. and CRS Sirrine, Inc., January 1985;
* Austinplan, Sector 21 & 22, Background Information, prepared by the City of Austin Study and Growth Management Department, June/July 1987;
* Lake Travis (West) Water-Supply System - Long Term Plan, June 1988, original study prepared for the Lower Colorado River Authority by Turner, Collie, and Braden, Inc., 1985.

The Study Area is located entirely within Travis County yet does not include any of the higher density areas of the County. Previous studies can be used only for comparison purposes since neither the Study Area or District 17 have been broken out separately. Previous estimates on a county-wide basis will be skewed by the more densely populated Austin metropolitan area. Even Lake area subsectors are skewed by the Lakeway and Hurst Creek developments, which are not a part of the Study Area.

Therefore, growth estimates for the Study Area must be developed separately from any existing studies. After a review of available data, Smith's work produced the following compound growth rates for the District 17 Study Area:

1989-1990	4%
1991-1995	9%
1996-2010	7%

Average 20 year Growth Rate of 8%

Although the 8% growth rate may seem high, it must be remembered that it includes the annexation of existing subdivisions and private water systems into the District.

5.2 Steiner Ranch

Steiner Ranch represents a major development within the Study Area. This subdivision, currently developing its first two sections, will contribute a major portion of the Study Area's growth during the next several years. Growth rates provided by Steiner's developer indicate that 150 units/year will be developed during 1989 and 1990 and 100 units/year thereafter until build out occurs. Assuming these development projections are correct, Steiner Ranch alone will represent almost 23% of the Study Area's total population within ten years. For this reason, Steiner development has been added to Study Area projections separately.

5.3 Planning Area Projections

After growth rate percentages were developed, a starting number was needed. Because Living Unit Equivalents (LUEs) are most easily used for a variety of engineering and planning needs, growth was measured in these units. Although records of existing connections were available through Travis County WC&ID No. 17, the Study Area includes land currently outside of the District's boundaries (Apache Shores, Comanche Trail area, and Montview). Mr. Smith therefore performed a windshield survey of existing residences within the Study Area. The results of his survey indicated approximately 1,895

existing single family residences within the study area. Calculated at the rate of 1 LUE per single family residence, this yields 1,895 LUEs. Table 6 shows the breakdown of these single family residences by subdivision or area. No attempt was made to predict growth for each individual area on a yearly basis, however the total build out of these areas, as determined by plats and land plans, was taken into account in designing the overall water system requirements.

TABLE 6

Survey of Existing Single Family Residential

Subdivision/Area	Number Houses
Travis Landing	92
McCormick Mountain	95
Beacon Road	116
Hudson Bend Road	73
Median	60
Pool Canyon	19
Woods of Lake Travis	18
West Beach Road	16
Doss	73
Eck Lane	52
Alpine Village	58
HiLine	6
Rocky Ridge	80
Commander's Point	27
Mansfield Road	30
Travis Vista	55
Cedar	37
Comanche Trail	98
Ranch Road 620	14
Apache Shores	558
Flint Rock	26
Easy	2
Glen Heather	8
Gebron	35
Medway	18
Clara Van	37
Pheasant Lane	19
Flamingo	15
Cavalier	7
Vine	4
Stewart Road/Buffalo Gap	100
Elementary School Road	3
Debba Drive	38
Ft. Smith	6
Total S.F. Residential	1,895

Table 6 does not include any existing commercial or multifamily (C&M) development. Because C&M water demands are virtually impossible to determine from visual

inspection of the building, an alternative method was necessary. All development within the Study Area which is not within District 17 relies primarily upon ground water sources. Ground water in this area typically will not support C&M development. It was therefore assumed for purposes of this study that all existing C&M development within the Study Area was also within District 17. A survey of District 17's meter records for November 1988 indicated meters ranging from 5/8" (standard residential user) up to 8" in size. In order to estimate C&M water use, it was assumed that all meters larger than 5/8" were serving commercial or multifamily developments. Table 7 depicts the number of meters larger than 5/8" and the equivalent number of LUEs as indicated by District 17.

TABLE 7

Existing Planning Area Development

SIZE METER	EQUIVALENT LUE/METER*	NO. OF METERS	EQUIVALENT LUEs
1.0"	2.5	39	98
1.5"	5.0	6	30
2.0"	8.0	9	72
3.0"	16.0	1	16
4.0"	25.0	1	25
8.0"	80.0	1	80
Subtotal Comm/MF			321
Previous Single Family LUEs			1,895
Total Existing LUEs			2,216

*Travis County WC&ID No. 17 LUE Criteria.

Using the previously projected Study Area growth rates (4, 9, & 7%) and the estimated Steiner Ranch development, the following growth projections are made:

The 1985 LCRA Lake Travis West Study provides the closest population projections for comparison purposes. In the Study, projections were made for the neighboring areas of Lakeway/Hurst Creek and Bee Caves/FM 2244. Due to the size of the Study Area, actual population numbers are considerably larger than those available for comparison, however the rate of growth predicted for these areas is similar.

The 1985 Lake Travis West Study and its 1988 update both reported that projected development within the majority of this area would be too sparse during the next 15 years to support the construction of a centralized wastewater system. After a review of existing development restrictions and existing platted development, total projected build out of the Study Area was determined using two gross development densities. Areas which are not likely to be centrally sewered by an entity capable of waterway discharge within the next 20 years (primarily the City of Austin) were projected at 1 unit per 1-1/2 acres of gross land. Areas which are likely to be centrally

sewered by the City were estimated at 1 unit per 3/4 acre based on existing and planned development within the Steiner Ranch development. Figure 6 depicts those area likely to be centrally sewered by the City of Austin and those areas which will most likely be served by on-site or central collection systems utilizing land application of effluent. This differs somewhat from the Year 2020 Service Area Plan contained in the City of Austin's Water & Wastewater Utility Interim Plan (December 1986). In this Plan, areas between Ranch Road 620 and Lake Austin are proposed to be centrally sewered to the City's Walnut Creek or Govalle Plants.

TABLE 8

Projected Planning Area Growth

Title: Projected Planning Area Growth
Project: Regional Planning Study
Client: Travis Co. WC&ID No. 17
File: 50:PR01
Prepared By: M.Wehner
Revision: 22-Feb-89

YEAR	GROWTH RATE	S.F. LUEs	STEINER RANCH	TOTAL S.F. LUEs	COMM/M.F. LUEs	TOTAL LUEs	PROJECTED POPULATION BASED ON SINGLE FAMILY LUEs @ 2.7	@ 3.0	@ 3.2
1988	0.04	1895		1,895	323	2,218	5,117	5,685	6,064
1989	0.04	1,971	150	2,121	336	2,457	5,726	6,362	6,787
1990	0.04	2,050	300	2,350	349	2,699	6,344	7,049	7,519
1991	0.09	2,132	400	2,532	381	2,912	6,835	7,595	8,101
1992	0.09	2,323	500	2,823	415	3,239	7,623	8,470	9,035
1993	0.09	2,533	600	3,133	452	3,585	8,458	9,398	10,024
1994	0.09	2,761	700	3,461	493	3,954	9,343	10,382	11,074
1995	0.09	3,009	800	3,809	538	4,346	10,284	11,427	12,189
1996	0.07	3,280	900	4,180	575	4,755	11,285	12,539	13,375
1997	0.07	3,509	1000	4,509	615	5,125	12,175	13,528	14,430
1998	0.07	3,755	1100	4,855	658	5,513	13,108	14,565	15,536
1999	0.07	4,018	1200	5,218	705	5,922	14,088	15,654	16,697
2000	0.07	4,299	1300	5,599	754	6,353	15,118	16,797	17,917
2001	0.07	4,600	1400	6,000	807	6,807	16,200	18,000	19,200
2002	0.07	4,922	1500	6,422	863	7,285	17,339	19,266	20,551
2003	0.07	5,267	1600	6,867	924	7,790	18,540	20,600	21,973
2004	0.07	5,635	1700	7,335	988	8,323	19,805	22,006	23,473
2005	0.07	6,030	1800	7,830	1,057	8,887	21,140	23,489	25,055
2006	0.07	6,452	1900	8,352	1,131	9,483	22,550	25,055	26,726
2007	0.07	6,903	2000	8,903	1,211	10,114	24,039	26,710	28,491
2008	0.07	7,387	2100	9,487	1,295	10,782	25,614	28,460	30,357
2009	0.07	7,904	2200	10,104	1,386	11,490	27,280	30,311	32,332
2010	0.07	8,457	2300	10,757	1,483	12,240	29,044	32,271	34,422

* Includes Steiner Ranch Development in addition to overall growth. Steiner Ranch estimated at 150 LUEs/year through 1990 and 100 LUEs/year thereafter.

FIGURE 5

Area Population Forecasts

Comparison Graph

LAKE TRAVIS WEST STUDY

POPULATION PROJECTIONS

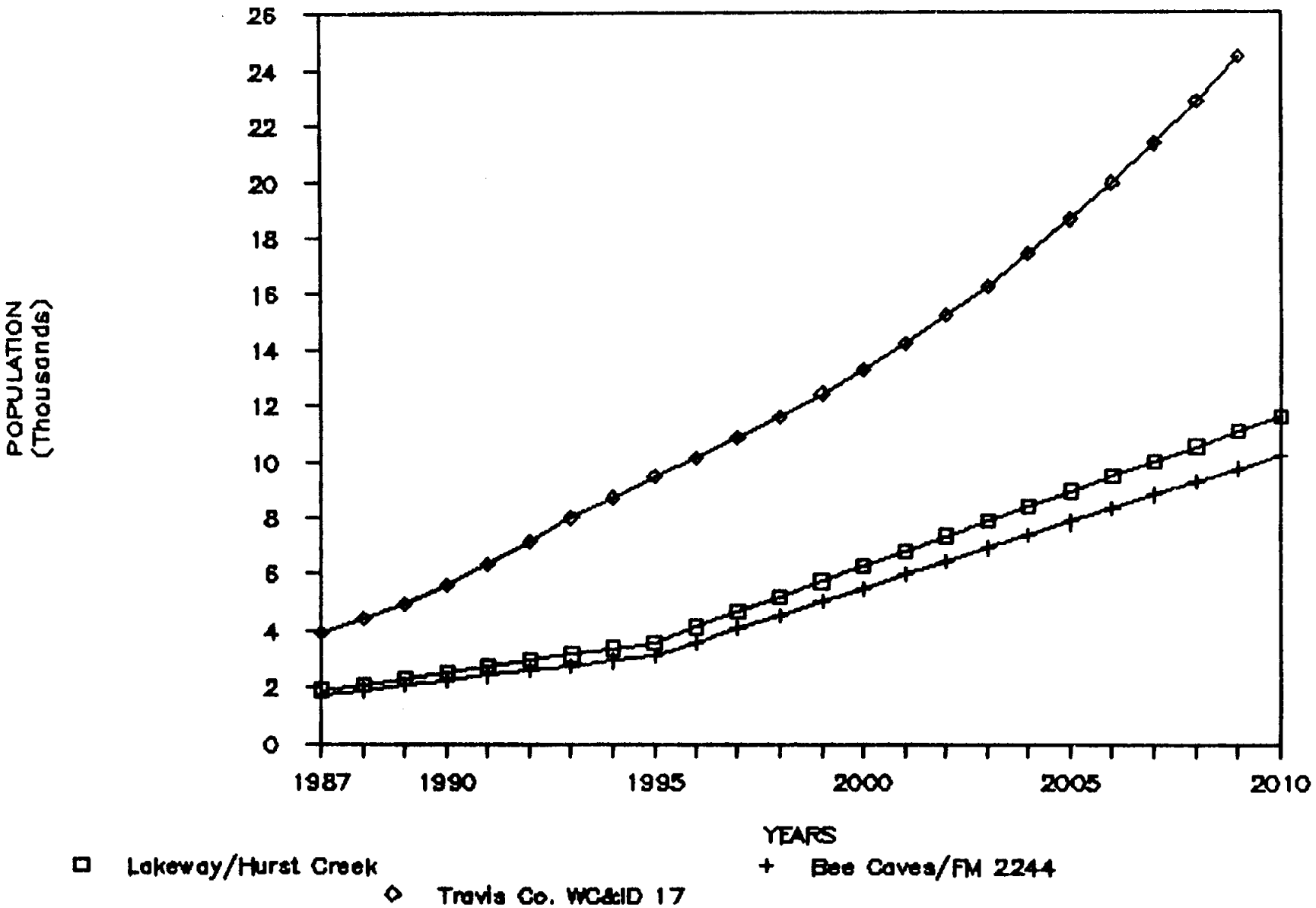


FIGURE 6

Ultimate Centrally Sewered Areas

Vs On-site & Irrigation Areas

FIGURE 6
ULTIMATE WASTEWATER DISPOSAL

6. PROJECTED WATER DEMANDS

Historic water use records within the District offer valuable insights in planning future facilities. Historic District water usage and quantification of customer water needs are further discussed herein.

6.1 Living Unit Equivalents (LUEs)

Recent growth trends have made the quantification and/or projection of water usage in terms of LUEs a necessary planning tool. By definition, a Living Unit Equivalent equates to a single family residence as located in a typical subdivision. The District has adopted the City of Austin's definition for LUE classification for both residential and commercial structures. Figure 7 is a summary of these classifications.

The District has had occurrences where water users not classified in the above list required quantification of their living unit equivalence. This has typically been accomplished by means of a fixture unit analysis. Individual plumbing fixtures are assigned a value based on their typical flow usage. The cumulative total of the service is then referred to a graph that compensates for a reduced average fixture demand as the number of fixtures increases. Table 10 and Figure 8 are reprinted from the

American Water Works Association, Sizing Water Service Lines and Meters (M22), 1975.

Based on flow projections developed from the fixture unit analysis, service meter sizes are then calculated. Table 9 lists the standard meter size, flow rate and equivalent LUE. Conversely, based on the meter size, an approximate Living Unit Equivalent can be determined.

TABLE 9

Meter Sizes and Equivalent LUEs

Meter Size	Design Flow Rate (GPM)	LUEs
5/8 x 3/4"	16	1.0
3/4"	24	1.5
1"	40	2.5
1-1/2"	80	5.0
2"	128	8.0
3"	240	15.0
4"	400	25.0
6"	800	50.0
8"	1,280	80.0

FIGURE 7

City of Austin

Water & Wastewater

LUE Criteria

CITY OF AUSTIN
WATER AND WASTEWATER UTILITY
LUE CRITERIA

EFFECTIVE DATE: FEBRUARY 7, 1986

Definition: A living unit equivalent (LUE) is defined as the typical flow that would be produced by a single family residence (SFR) located in a typical subdivision. For water, this includes consumptive uses, such as lawn watering and evaporative coolers. The wastewater system does not receive all of these flows, so the flows expected differ between water and wastewater. The number of LUE's for a project are constant; only the water and wastewater flows are different.

ONE LUE produces: 2.2 GPM (Peak Hour) of water flow
1.3 GPM (Peak Day) of water flow
350 GPD (0.243 G.P.M.) average dry weather flow

PEAK FLOW FACTOR FORMULA:

$$PFF = \frac{18 + [0.0144(F)]^{0.5}}{4 + [0.0144(F)]^{0.5}} \qquad F = \text{AVERAGE FLOW (GPM)}$$

RESIDENTIAL	LUE CONVERSION
One (1) Single Family Residence; Modular Home; Mobile Home	1 L.U.E.
One (1) Duplex	2 L.U.E.'s
One (1) Triplex; Fourplex; Condo Unit P.U.D. Unit (6+ Units/Acre to 24 Units/Acre)	0.7 L.U.E./Unit
One (1) Apartment Unit (24+ Units/Acre)	0.5 L.U.E./Unit
One (1) Hotel or Motel Room	0.5 L.U.E./Room

COMMERCIAL	LUE CONVERSION
Office	1 LUE/3000 Sq.Ft. of Floor
Office Warehouse	1 LUE/4000 Sq.Ft. of Floor
Retail; Shopping Center	1 LUE/1660 Sq.Ft. of Floor
Restaurant; Cafeteria	1 LUE/200 Sq.Ft. of Floor
Hospital	1 LUE/Bed
Rest Home	1 LUE/2 Beds
Church (Worship Services Only)	1 LUE/70 Seats
School (Includes Gym and Cafeteria)	1 LUE/13 Students

Ted Naumann, P.E., Branch Manager
Utility Developement Services
Water and Wastewater Utility

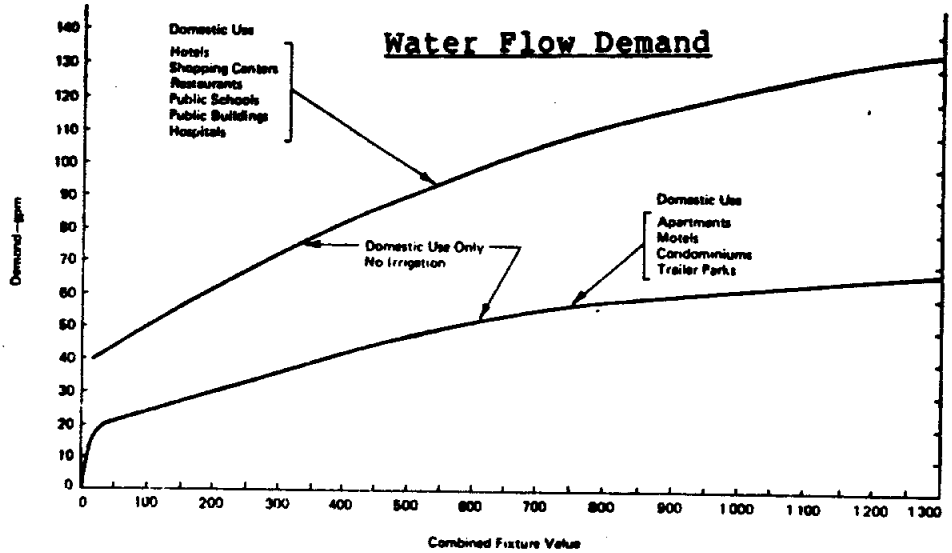
94/ms/luecriteria
REV 2/7/86

TABLE 10

Plumbing Fixture Water Values

Fixture Type	Fixture Value Based on 35 psi at Meter Outlet
Bathtub	8
Bedpan washers	10
Combination sink and tray	3
Dental unit	1
Dental lavatory	2
Drinking fountain (cooler)	1
Drinking fountain (public)	2
Kitchen sink: 1/2-in. connection	3
3/4-in. connection	7
Lavatory: 3/8-in. connection	2
1/2-in. connection	4
Laundry tray: 1/2-in. connection	3
3/4-in. connection	7
Shower head (shower only)	4
Service sink: 1/2-in. connection	3
3/4-in. connection	7
Urinal: Pedestal flush valve	35
Wall or stall	12
Trough (2-ft unit)	2
Wash sink (each set of faucets)	4
Water closet: Flush valve	35
Tank type	3
Dishwasher: 1/2-in. connection	4
3/4-in. connection	10
Washing machine: 1/2-in. connection	5
3/4-in. connection	12
1-in. connection	25
Hose connections (wash down): 1/2-in.	6
3/4-in.	10
Hose (50-ft length—wash down): 1/2-in.	6
5/8 in.	9
3/4 in.	12

FIGURE 8



Water-Flow Demand per Fixture Value—Low Range

6.2 Historic Water Usage

The District records water use information through meters located at the water treatment plant and at each individual water connection. The main meter at the water treatment plant is located on the discharge side of the high service pumps. This meter provides record information for the District's monthly LCRA water diversion. Figure 9 shows the District's water use as recorded over the past ten years.

6.3 Average Water Use

The graph reflects seasonal peaks (late summer) and valleys (late winter) typical of most water systems. Figure 10 shows the average monthly water use per connection for this same period. As shown in Figure 10, average monthly water use is approximately 13,100 gallons per connection as averaged over a twelve month period.

TABLE 11

Average Water Use Per Connection

Month	Flow (gallons)
January	8,880
February	9,390
March	8,580
April	11,020
May	12,760
June	14,040
July	18,070
August	21,260
September	19,410
October	12,020
November	10,780
December	10,030
Total	156,240
AVERAGE	13,100 G/month
	428 G/day

FIGURE 9

District Water Usage Graph

1979 - 1989 Monthly

TRAVIS COUNTY W.C. & I.D. NO. 17
HISTORIC WATER USE 1980 - 1988

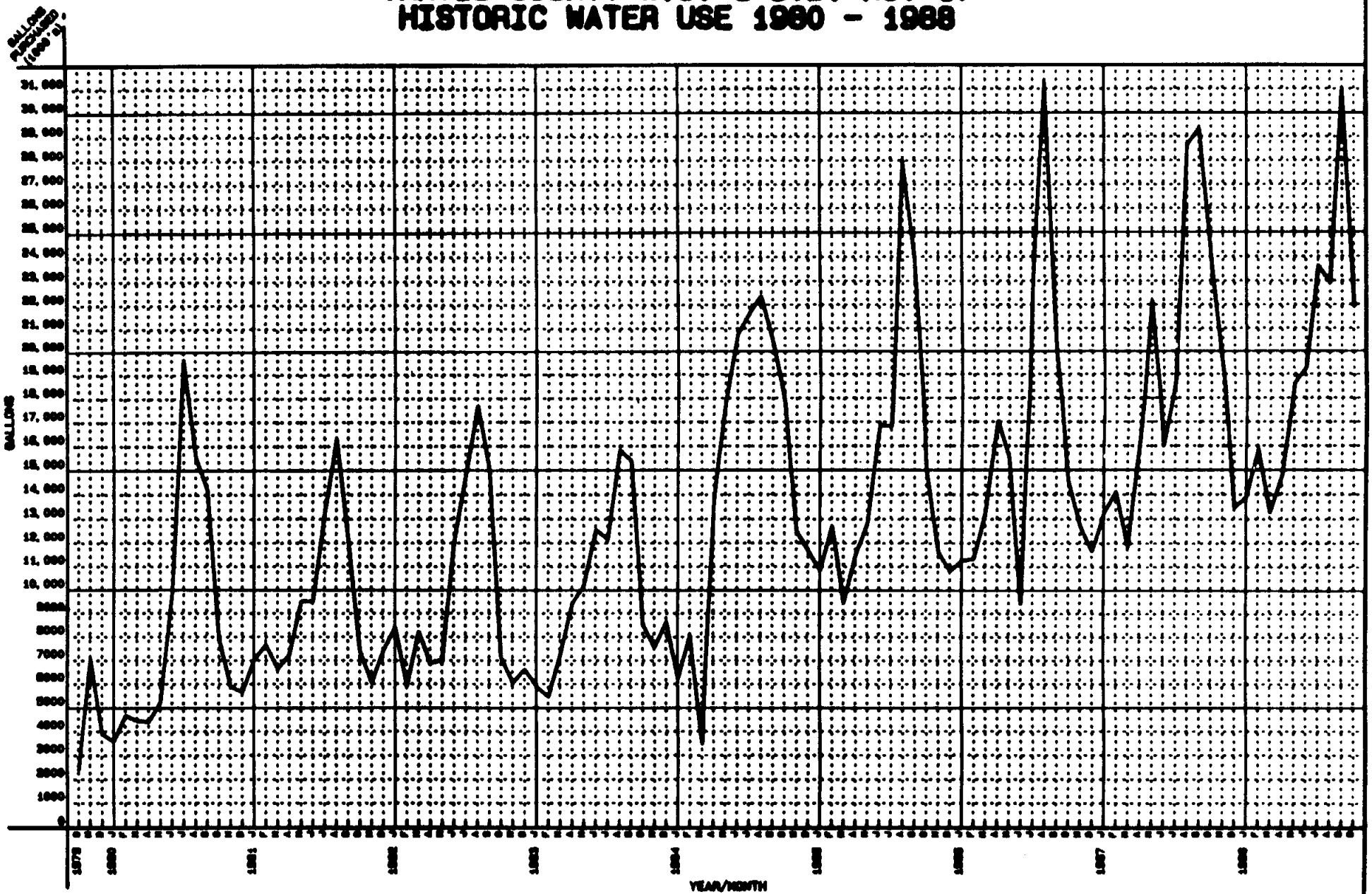
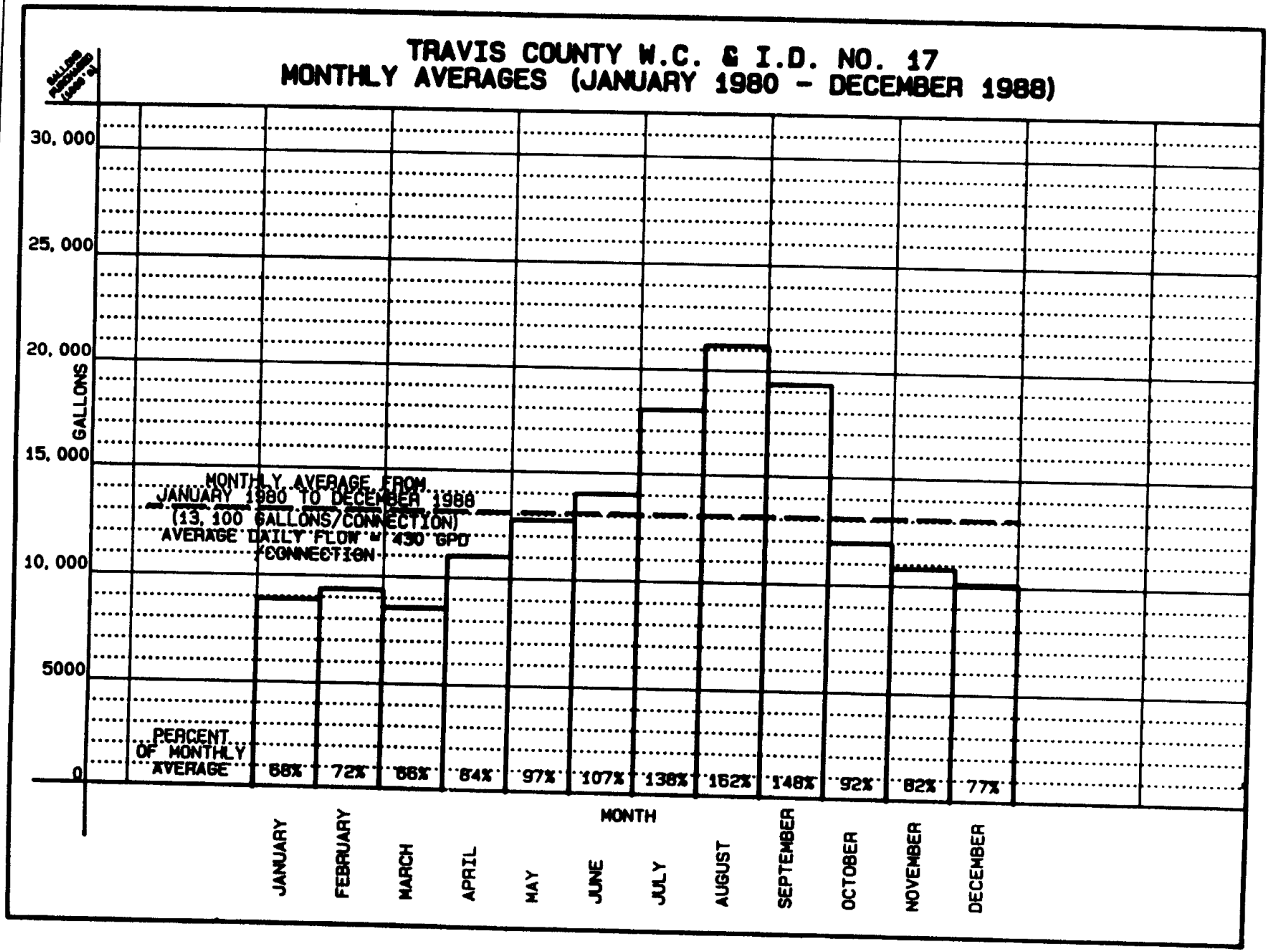


FIGURE 10

Average Monthly Water Use Bar Graph

(1979 - 1988)


TRAVIS COUNTY W.C. & I.D. NO. 17
MONTHLY AVERAGES (JANUARY 1980 - DECEMBER 1988)
GALLONS PURCHASED (1000's)
30,000
25,000
20,000
15,000
10,000
5000
0
GALLONS
MONTHLY AVERAGE FROM JANUARY 1980 TO DECEMBER 1988
(13,100 GALLONS/CONNECTION)
AVERAGE DAILY FLOW = 430 GPD
/CONNECTION
PERCENT OF MONTHLY AVERAGE
68%
72%
66%
84%
97%
107%
138%
162%
148%
92%
82%
77%
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MONTH

A further review of the District's flow records studied average water usage per LUE within the District. Table 12 reflects this information.

TABLE 12

District 17 Average Water Use

YEAR	LUEs	AVERAGE GPD	AVERAGE GPD/LUE
1985	1436	494,247	344
1986	1406	523,014	372
1987	1474	621,917	422
1988	1486	647,945	436
Average	1451	571,780	394

see Table 8

See page 54

The preceding table shows a steady increase in the average water usage per living unit equivalent. This is an important concern because average water usage is the unit of measure for raw water contracts capacity as well as required treatment and storage capacity. It is hoped that the proposed conservation measures will stop this upward water use trend.

6.4 Peak Water Use

Peak water use (and production) typically occurs on summer weekends, which also coincides with the area's peak recreational season. Table 13 shows annual peak water production.

TABLE 13

District 17 Peak Water Production

Year	Date	Pumpage (Gallons)	Conn.	GPM/Conn.	LUE's	GPM/LUE
1980	8/2	989,700	776	0.886	----	----
1981	8/11	909,000	807	0.782	----	----
1982	8/2	877,000	836	0.729	----	----
1983	8/25	855,000	899	0.660	----	----
1984	7/15	985,000	972	0.704	----	----
1985	8/11	1,253,000	1,260	0.691	1436	0.606
1986	7/27	1,288,000	1,221	0.733	1406	0.636
1987	8/22	1,370,000	1,254	0.759	1474	0.645
1988	7/4	1,243,000	1,225	0.705	1486	0.581

The Texas Department of Health's minimum standard for peak daily water production is 0.6 gpm/conn. Historically, the District has used a more conservative 0.75 gpm per connection to size and allocate treatment capacity. District water production records should continue to be monitored to determine if peak daily capacity allocations are adequate.

6.5 Design Standards

6.5.1 Texas Department of Health

"Rules and Regulations for Public Water Systems," as adopted by the Texas Department of Health, establishes the minimum water quality requirements for community type water systems. These minimum water quality requirements were established for facilities to ensure their ability to maintain a minimum residual water pressure of 20 psi and a normal operating pressure of 35 psi.

Water storage is required by the Health Department at the rate of 200 gallons per connection of ground storage capacity and elevated storage capacity of at least 100 gallons per connection in lieu of other pressure maintenance facilities. Elevated storage in the amount of 200 gallons per connection may be substituted for ground storage and pressure tank installations. Booster pump station capacity must have two or more pumping units with a total rated capacity of 2.0 gpm per connection and be sufficient to meet peak demands.

6.5.2 Travis County WC&ID No. 17

To establish the basic concepts for design of a water supply and distribution system, this Study used Travis County WC&ID No. 17 historical data. The District's design criteria, in all cases, exceeds the minimum criteria established by the Texas Department of Health and is outlined in the following text. Annual evaluations should be conducted of the average daily demand and peak daily demand water flows based on daily records of pumpage for the calendar year to enable revised design criteria to be adjusted accordingly. Typical District 17 design criteria is as follows:

02/19/90

Average Daily Demand	500 gallons/LUE/Day = 0.347 gpm/LUE
Peak Daily Demand	0.75 gpm/LUE
Peak Hour Demand	1.0gpm/LUE (+) Fire Flow
WTP Capacity	0.75 gpm/LUE
High Service Pumps	1.0 gpm/LUE
System Storage	500 Gal/LUE/Day (in addition to WTP clearwell)
WTP Clearwell	25% of System Storage (125 Gal/LUE/Day)

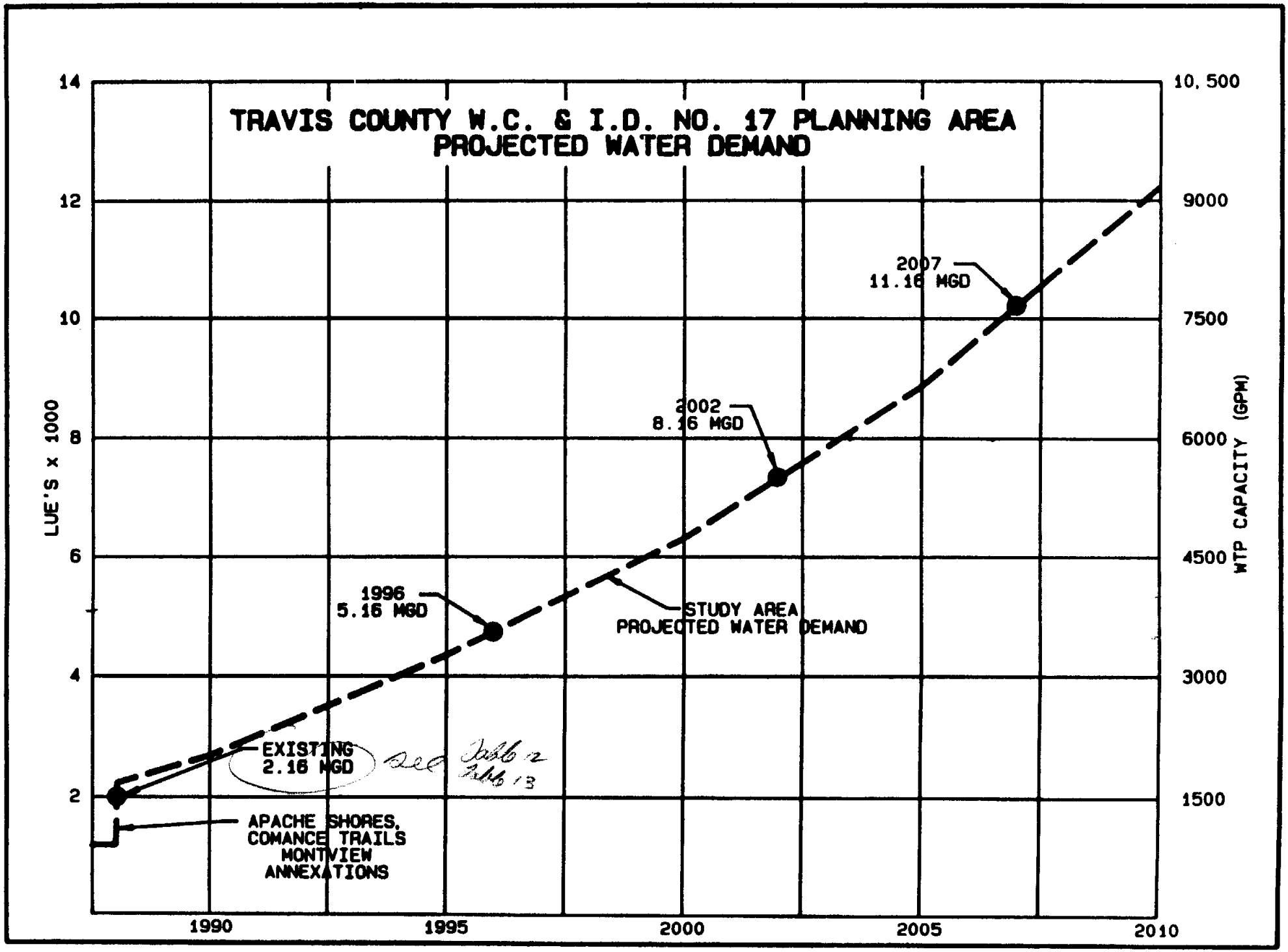
Elevated Storage:

* Standpipe (summation of following:)
(Minimum 80 foot difference between tank overflow elevation and highest service connection.)
  A. Equalization 30% of Total Volume
  B. Fire Flow 50% of Total Volume
  C. Emergency 20% of Total Volume
  where Total Volume = 500 Gal/LUE/Day

* Suspended Elevated Tank
  A. Fire Flow 250 Gal/LUE/Day
  where Fire Flow = minimum Texas State Board of Insurance
    1. Principal Mercantile & Industrial - 3000 gpm
    2. Light Mercantile - 1500 gpm
    3. Congested Residential - 750 gpm
    4. Scattered Residential - 500 gpm

FIGURE 11

Projected Water Demand Graph


TRAVIS COUNTY W.C. & I.D. NO. 17 PLANNING AREA
PROJECTED WATER DEMAND
LUE'S x 1000
WTP CAPACITY (GPM)
14
12
10
8
6
4
2
10,500
9000
7500
6000
4500
3000
1500
1990
1995
2000
2005
2010
2007
11.16 MGD
2002
8.16 MGD
1996
5.16 MGD
STUDY AREA
PROJECTED WATER DEMAND
EXISTING
2.16 MGD
APACHE SHORES,
COMANCE TRAILS
MONTVIEW
ANNEXATIONS

7. PROPOSED IMPROVEMENTS

Based on the information discussed herein, the following improvements are necessary to serve projected development within the service area.

7.1 Water Treatment Plant

With the 1990 completion of the 3.0 mgd water treatment facility previously discussed in this report, three additional 3.0 mgd modules are proposed for future construction. The main site, as presently planned, will have capacity for 14 mgd or approximately 10,000 gpm. This will provide service for approximately 13,000 LUEs. Build out projections for the District's service area estimate total development at approximately 17,000 LUEs. At some point in time, treatment capacity for the remaining 4000 LUEs must be planned. Three alternatives or combinations thereof seem likely. These are 1) construction of additional plant capacity, 2) a service tie in on the north end of the District (Comanche Trail area), or 3) participation in the proposed LCRA Lake Travis West Regional Water facilities.

The implementation of this future water supply alternative is at least 20 years away. Alternative supply evaluation at this time would not be wise due to the many variables and time lag on when these improvements will be required.

Construction of additional facilities solely for the District's use does not lend itself to the concept of regionalization. It is difficult to determine exact locations and precise time frames for construction of these facilities.

At the north end of the District are two potential large suppliers of water to fill the anticipated shortfall. These include the City of Austin with WTP No. 4, transmission, and storage facilities, and Riverplace MUD. Additionally, each source would provide an alternate feed of water to the District's facilities on the South side of the District, and this would provide an alternative to the water line crossing proposed for Lake Austin. Finally, a tie in at the 1230 foot service level would serve the upper pressure plane customers and eliminate the need to build elevated storage for these services.

LCRA's Lake Travis West plan was originally projected to provide service to western Travis and southern Hays counties. The original plan has been modified through the years to promote regionalization and to prevent the proliferation of smaller systems. The most recent plan would provide service to the southern edges at the service area.

The proposed storage and distribution improvements were developed based on build out projections and a computer model simulation of the proposed improvements.

7.2 Storage Improvements

The District is presently served by adequate storage capacity located throughout the District. Table 14 lists the District's system storage facilities and their equivalent LUE capacity.

TABLE 14

WC&ID No. 17
Ultimate Water Storage Improvements

1031 Level	
429,000 Gallon Round Mountain Tank	858 LUEs
300,000 Gallon McCormick Mountain Tank	600 LUEs
75,000 Gallon Elementary School Tank	300 LUEs
	1,758 LUEs
1130 Level	
1,000,000 Gallon Comanche Trails Tank	2000 LUEs
1200 Level	
300,000 Gallon LTISD High School Tank	600 LUEs

This abundance of system storage has, for many years, allowed the District to overcome its limited treatment and transmission main capacity. Future storage improvements will be required to serve future growth demands. The following list should be considered a general representation and each tank should be fully evaluated during its design to verify tank size, location and operating characteristics.

ST-1 An approximate 500,000 gallon standpipe to be built in Apache Shores as part of the defined area bond issue to serve the lower elevations of the development. A service level of 860 feet msl is proposed.

Estimated Construction Cost - $175,000

ST-2 Also to be constructed by the defined area bond funds is a 500,000 gallon standpipe, elevation 1031 feet msl, to be constructed in the vicinity of the LTISD elementary school for service in the main pressure elevation.

Estimated Construction Cost - $175,000

ST-3 The Steiner Ranch standpipe is a 4,000,000 gallon standpipe to be built in Steiner Ranch to serve the development. Its service elevation will be 960 feet msl. This could be phased as two tanks, depending on available site constraints. In connection with the tank construction, the Marshall Ford pump station should be relocated to this site. The proposed pump station should consist of three 1250

gpm pumps. These pumps will work off the proposed tank and pump to the 1130 foot Comanche Trails tank.

Estimated Construction Cost - $2,500,000

ST-4 At the existing Comanche Trails tank site, a proposed 100,000 gallon elevated storage tank (spheroid type) is planned to serve the 1230 foot service level. A pump station with two 500 gpm pumps will be necessary to pump from the Comanche Trails standpipe into the elevated tank.

Estimated Construction Cost - $250,000

ST-4 may be phased by the use of interim hydro-pneumatic pressure tank and pump station. Additionally, a tie in to the existing City of Austin 1230 foot service level may eliminate the need for this facility and provide the District the emergency tie in discussed in this report.

ST-5 A 300,000 gallon elevated storage tank (spheroid type), service level 960 feet is proposed for the Hudson Bend peninsula. This reservoir will be used to serve the lower elevation services and eliminate

the need for pressure reducing valves (PRV) in the distribution system.

Estimated Construction Cost - $600,000

ST-6 A proposed 500,000 gallon elevated storage tank (spheroid type) and booster pump station are necessary to serve the higher elevations (1140 foot service level) of the Gebron Road and Ranch Road 620 commercial areas. This service level will eventually tie in to the proposed LCRA West system (ST-7, 8 and 9) described below. The pump station should consist of three 1000 gpm pumps and work off the Round Mountain tank.

Estimated Construction Cost - $1,400,000

ST-7, 8, & 9

These tanks, two at elevation 1140 feet and one at elevation 1275 feet, are proposed to provide storage as described in the LCRA Lake Travis West Study. The District will benefit by participating in the regional effort.

This alternate source of water will provide backup and an alternate feed source to the District. The storage will allow service to the western service area. Approximately 2000 LUEs of storage capacity should be reserved by the District in this project.

BP-1 Replacement of the existing 2 each 150 gpm pumps with 2 each 1000 gpm pumps. This should provide capacity for 1000 LUEs.

Estimated Construction Cost - $100,000

7.3 Distribution Improvements

Several major transmission mains are required to be constructed to connect treatment facilities and storage reservoirs. Below is a brief description of the proposed transmission mains. The preliminary assignments are based on available routing. Alternative alignments should be evaluated prior to design to insure adequate service.

TM-1 A proposed 16" line to parallel the existing 16" line from the existing Marshall Ford pump station to the proposed Steiner Ranch reservoir (ST-3).

Estimated Construction Cost - $480,000

TM-2 A proposed 24" line from the Round Mountain tank down Murfin Road to access Lake Austin and up Quinlan Park Road to the Steiner Ranch reservoir (ST-3). This line loops feed to Steiner Ranch and the east side of the District. An alternate route is along the proposed Outer Loop Crossing.

Estimated Construction Cost - $3,000,000

TM-3 A parallel 16" water line between the LTISD elementary school tank and the Round Mountain tank along Ranch Road 620. This project would be constructed as part of TM-2.

Estimated Construction Cost - $300,000

TM-4 A 16" alternate feed line from Ranch Road 620 to the McCormick Mountain standpipe.

Estimated Construction Cost - $300,000

TM-5, 6 & 7

These lines are proposed in the LCRA Lake Travis West Study and would provide transmission from the LCRA Regional Water Treatment Plant site to the

proposed storage tanks and customers. TM-5 is the first of two 24" water lines from the plant. TM-6 and 7 are 16" and 24" water lines serving the Flint Rock Ranch, Ranch Road 620, and Bee Cave areas. District participation is encouraged in these facilities.

7.4 Computer Model

A computerized water model analysis was performed to test the integrity and compatibility of the existing system with proposed components. Projected demands are a critical tool used in water system modeling to assure that all improvements will be adequately sized to meet minimum requirements established by the District and the Texas Department of Health, while conversely alleviating facility oversizing and associated expenditures.

The analysis was run on an IBM compatible computer and data was entered through Pipedata, a program for creating and editing the input data file. The 1,000-pipe version of the University of Kentucky Pipe Network Analysis Program, written by Dr. Don J. Wood, was used to perform the water system analysis. The two pieces of software are interactive and allow for easy editing and updating of the program data. The program creates a computer model of the

actual system using a skeletonized layout of primary distribution lines, water storage reservoirs, and booster pump stations. Actual or proposed dimensions of storage tanks and pump curves can be entered into the system.

A 24-hour extended period simulation (EPS) using 1-hour time increments was run for each case. All simulations were started at 6:00 a.m., at which time all tanks are considered full.

Input demands are equal to the number of LUEs withdrawing water from the system at a particular node (pipe junction). A global multiplication factor was used to equate input LUEs to a corresponding flow rate in gpm. This global multiplication factor varies throughout the day to accurately portray the shifting demand patterns associated with peak day use. The existing number of LUEs drawing from a particular node was determined by the amount and size of water meters currently in the vicinity of that node. Table 8 shows factors for converting meter sizes to LUEs. Future demands are also input as LUEs and are based on growth projections discussed previously in this report.

FIGURE 12

Travis County WC&ID No. 17 Planning Area

Projected Growth Rate vs. WTP Capacity

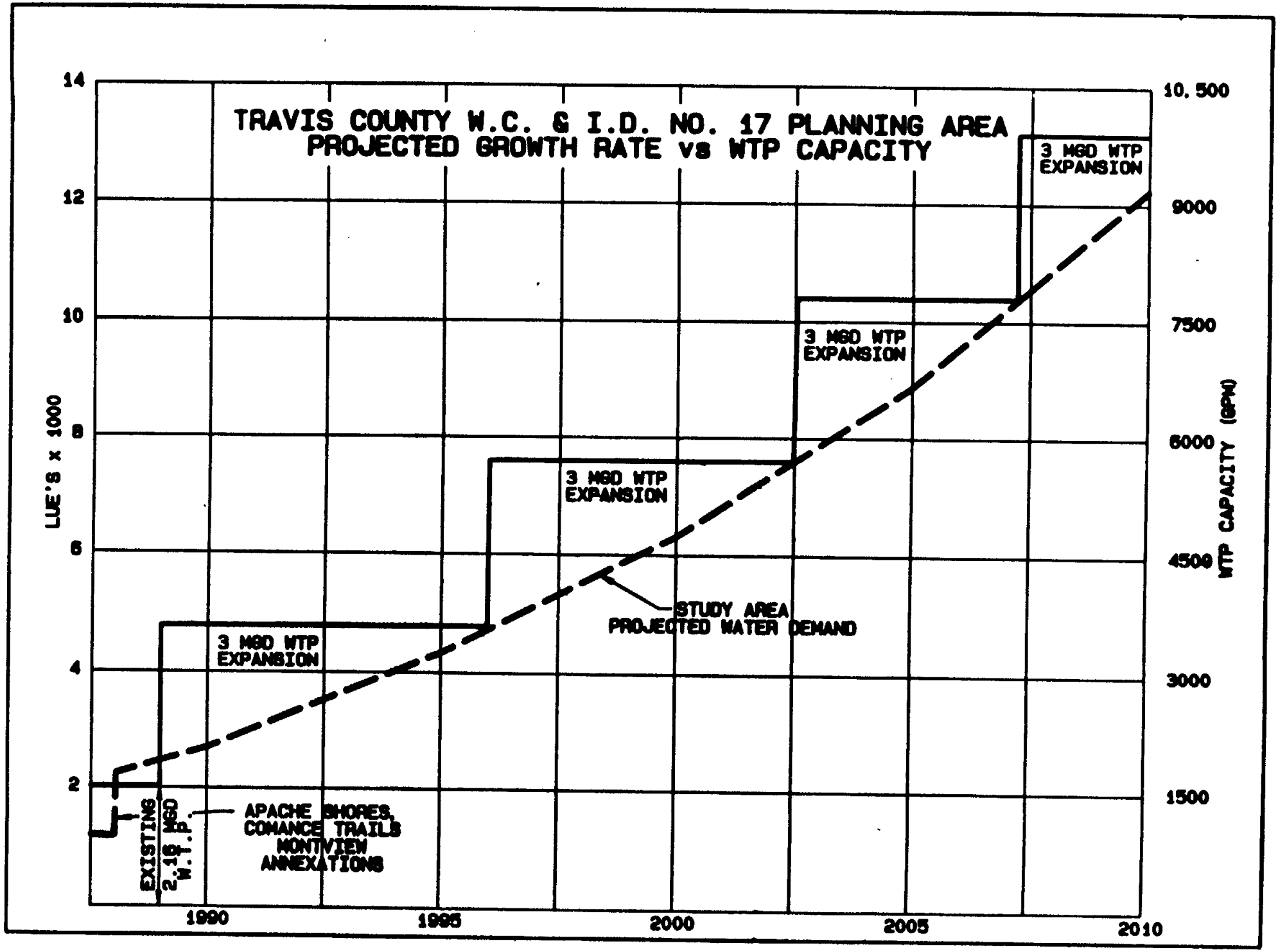

TRAVIS COUNTY W.C. & I.D. NO. 17 PLANNING AREA
PROJECTED GROWTH RATE vs WTP CAPACITY
LUE'S x 1000
WTP CAPACITY (GPM)
14
12
10
8
6
4
2
10,500
9000
7500
6000
4500
3000
1500
1990
1995
2000
2005
2010
3 MGD WTP EXPANSION
3 MGD WTP EXPANSION
3 MGD WTP EXPANSION
3 MGD WTP EXPANSION
STUDY AREA PROJECTED WATER DEMAND
EXISTING 2.16 MGD W.T.P.
APACHE SHORES, COMANCE TRAILS MONTVIEW ANNEXATIONS

FIGURE 13

Travis County WC&ID No. 17 Study Area

Proposed Improvements

8. IMPLEMENTATION PLAN

In order to complete the planned improvements developed in this report, suitable financing must be arranged. The District, as a political entity, has the option of various financial means to affect the project. Historically, area wide bond issues have been used to finance improvements. More recently, capital recovery fees and defined area bond issues have been used to finance new growth. A fourth option includes the use of TWDB funding alternatives to finance the improvements. While this is a viable option, the fact that some of the proposed projects may not meet the Board's selection criteria, it would be best for the District to first explore other financing options and use the TWDB options as a later option.

8.1 Defined Area Bond Issues

8.1.1 Cardinal Hills - Apache Shores Area

The District has the authority under the rules and regulations of its creation by the Travis County Commissioners Court (December 8, 1958) and the Texas Water Code (Chapter 51) to levy, collect and assess taxes to pay debt service on bonds. To date, the District has passed three area wide bond issues to finance the construction of necessary improvements to provide water service to the area. These bond issues were in 1959 ($950,000), 1980 ($750,000), and in 1986 ($3,025,000). These bonds are all

combined tax and revenue bonds. They are paid from ad valorem taxes, assessed annually based on the value of taxable property within the District and the net revenues of the District's water system.

Additionally, the District has the authority to issue bonds to a defined area of the District, for the purpose of financing water system improvements within that defined area. Because of public support from the Cardinal Hills, Apache Shores, and other subdivisions, the District is proposing the use of defined area bonds to finance improvements to these areas. The following table is a schedule of this proposed financing.

TABLE 15

Summary of Costs
Cardinal Hills, Apache Shores, Comanche Trail
Proposed Defined Area Bond Issue

		Total Improvements
A.	CONSTRUCTION COSTS	
1.	Improvements:	
	a. Water Distribution System	$ 4,143,000
	b. Water Treatment Facilities	2,250,000
	c. Water Storage Facilities	350,000
2.	Estimated Construction Cost	$ 6,743,000
3.	Construction Contingencies	809,000
4.	Engineering, Surveying and Permits	675,000
	TOTAL CONSTRUCTION COSTS	$ 8,227,000
B.	NON-CONSTRUCTION COSTS	
1.	Apache Shores System Purchase	$ 675,000
2.	Annexation, Elections, Preliminary Engineering and Legal Expenses	125,000
3.	Issuing and Selling Bonds (including Fiscal Agent & Legal Fees, Related Costs & Expenses)	416,000
4.	Validation Suit Contingency	40,000
5.	Non-Construction Contingency	90,000
6.	Capitalized Interest (8%, 1 yr.)	832,000
	NON-CONSTRUCTION COSTS	$ 2,178,000
C.	TOTAL BOND ISSUE	$10,405,000

Pursuant to State law, the District has adopted a tax plan whereby the tax assessed on proposed bond improvements may be either on an ad valorem or benefit basis. The ability to tax on a benefit basis will not penalize individuals for building houses or making other improvements within the defined area.

The benefit determination will be made by the Commission of Appraisement. For the purpose of this report, the assumption has been made that of the lots within the defined area, only 85% will receive a benefit. The remaining lots will either be combined, are unbuildable, or otherwise will not benefit from water service. These assumptions have been further extended to assume that a lot receiving a benefit will also receive one water service connection or Living Unit Equivalent. However, based on these assumptions, the cost of the bond issue $10,405,000 and 2820 LUEs will equal a per LUE improvement of $3,700/LUE. Assuming a bond ammortization at 8% for 20 years, and 100% tax collection rate, the annual tax would be $369.

On August 26, 1989 a bond election on the proposed improvements passed by an overwhelming margin (295 For - 36 Against). A bond application is presently being prepared for submittal to the Texas Water Commission for authorization to proceed with a bond sale and funding for the improvements. It is anticipated that the projects could be complete and operational by Spring, 1991.

8.1.2 Steiner Ranch Improvements

A successful election was held on May 7, 1988, which authorized the District to issue a maximum of $118,500,000 in defined area bonds to construct the necessary water and wastewater improvements to serve the Steiner Ranch defined area. Through agreements between the District and developer, the District controls the issue of bond reimbursement to the Developer, so as not to unduly burden the development. The initial bond issue of $1,560,000 was approved by the District on February 9, 1989. The following table is a summary of that proposed bond issue.

TABLE 16

Summary of Costs
Steiner Ranch First Defined Area Bond Issue

CONSTRUCTION ITEMS	
1. Wastewater Lift Stations	$214,616
2. Effluent Pond & Piping	501,000
3. Wastewater Treatment Plant	15,300
4. Water Main	220,314
Subtotal Construction	$951,330
5. Engineering	48,670
TOTAL CONSTRUCTION ITEMS	$1,000,000
NON-CONSTRUCTION COSTS	
6. Bond Issue Preparation	$79,400
7. Legal & Fiscal Agent Fees	78,000
8. Developer Interest	75,000
9. Capitalized Interest/Bond Discount	327,600
TOTAL NON-CONSTRUCTION COSTS	$560,000
TOTAL BOND ISSUE REQUIREMENT	$1,560,000

8.2 Capital Recovery Fees (CRFs)

An alternative in lieu of area wide bond issues, is the use of capital recovery fees. These fees, paid at the time of water service commitment, allow the District to recover facility improvement costs. These facilities include treatment, pumping, storage, and transmission. They do not include the cost of extending service to the individual customer (i.e., distribution).

Currently Senate Bill 336, regulates the use of these fees. Its intent is to direct how the fees are to be derived and used. The bill's language is broad and subject to interpretation in many areas. It does however specify punitive damages for governmental entities' failure to properly use collected funds or charge such fees. Water districts are allowed to petition the Texas Water Commission for ratification of the fees.

In preparing this report and its recommended improvements, the following is a list of the major facilities currently completed and or scheduled for completion in the next five (5) years, their equivalent LUE's of service and what the total LUE's cost equates to.

Major Facilities

1. Water Production Facilities (Intake, Treatment, Storage, Pumping) (1 mgd = 925 LUEs) Estimated Construction Cost = $925,000/925 LUEs = $1000/LUE

2. Storage and Pump Station Facilities:

Facility	Estimated Construction Cost	LUEs
Steiner Ranch GST & PS	$2,500,000	8,000
Round Mountain EST & PS	1,400,000	2,000
Comanche Trail EST & PS	250,000	400
Hudson Bend EST	600,000	600
	$4,750,000	11,000

Cost = $430/LUE

3. Transmission Lines

Facility	Estimated Construction Cost	LUEs
TM-1	$ 480,000	2,500
TM-2	3,000,000	6,000
TM-3	300,000	2,500
TM-4	300,000	2,500
	$4,080,000	13,500

Cost = $300/LUE

4. Cost Summary (per LUE)

Water Treatment Plant	$1,000
Storage	430
Transmission	300
Subtotal	$1,730
Construction Contingency (15%)	260
Legal, Engineering, Fiscal (20%)	350
ROW and Property Acquisition (15%)	260
Environmental Mitigation (10%)	180
Subtotal	$2,780
Project Administration (5%)	140
TOTAL	$2,920

Therefore, maintain existing $2,900/LUE.

APPENDIX A

Water Conservation and Drought Contingency Planning

WATER CONSERVATION AND DROUGHT CONTINGENCY PLANNING

1. INTRODUCTION

The Texas Administrative Code (TAC) 31 Section 355.15(b)(7) under which the District has received funding for this study, requires that a water conservation plan be developed as a part of the effort. This is not only a requirement, it's good sense. Water is our most important natural resource, and probably the most abused. A water conservation plan should be developed and implemented for every water supply service area, regardless of whether they are currently subject to shortages. This school of thought is evident in recent policy changes at the Texas Water Development Board and the Lower Colorado River Authority.

While the supply of clean, usable water has steadily declined over the past thirty years, the per capita water use has increased by about four gallons per person per day per decade. In many areas of the Country, water is in such short supply that mandatory water rationing and restrictions have become a part of everyday life. Travis County currently enjoys large supplies of fresh water supplied from the Colorado River basin and various underground aquifers. With proper conservation measures, this rich supply will sustain projected County growth well into the twenty first century.

Water conservation for the Study Area is a two step process. The first step is a water conservation plan utilizing techniques such as public education and awareness, local building and planning codes to reduce water consumption, and rate structures which discourage excessive water use. The second step is called a drought contingency plan. This step includes mandatory measures aimed at reducing water consumption to a level consistent with available supplies. A drought contingency plan may include such measures as economic incentives for conservation or penalties for excessive use, restrictions on non-essential water uses, and in extreme cases, civil enforcement of emergency water rationing regulations. The idea of course is that if the first step measures are followed, then hopefully the second step will not be necessary. However, extremely dry weather conditions or a catastrophic impact on the Colorado River could require a drought contingency plan to be implemented regardless of how well a general water conservation plan is followed.

Water conservation policies are currently in effect in many areas of the Country, including Texas. Reductions in residential, commercial, and industrial water use can be as high as 25 percent with conservation measures, however a reduction of 5 to 15 percent is more typical. A drought contingency plan, which includes more serious conservation

measures, can reduce water usage by 50 percent during emergency conditions.

Cutting down on water use can have significant impacts. Obviously, it will lower water bills; but since much of the water saved is hot water, it also means energy savings. Less water consumption can also mean smaller and longer lasting septic tanks or other on-site wastewater treatment systems. For centralized water and wastewater collection systems, water savings can translate into smaller facilities or longer intervals between phases. While there may be a disincentive for water conservation among suppliers who depend upon water sales to generate revenues, the District has both an opportunity and the incentive to apply these conservation measures.

One of the less obvious benefits of water conservation is decreased wastewater production. With an effective conservation program, the costs of wastewater treatment and sludge disposal are often reduced. Until conservation effects are adequately documented, wastewater systems are usually required to be designed for peak flows and no real savings are seen. When water and wastewater facility costs are reduced, taxes and utility bills should be lowered. Risks associated with wastewater pollution of surface and ground waters are reduced.

2. LONG TERM WATER CONSERVATION PLAN

In home water use accounts for approximately 65 percent of the total average day residential water use. The remaining 35 percent is used for exterior uses such as lawn watering and car washing. Several methods of water conservation will be examined in this section. They include:

2.1 Reducing Water Use Through Education and Information (i.e. changing water use habits).

The most important part of any water conservation plan is public education and acceptance. No plan can be effective without adequate public support. The key to gaining acceptance is though education. The end users in a water supply system must understand both the long term benefits of conservation as well as the immediate impacts upon their water bill. Public education can not be accomplished in a single effort. This is where many authorities fall short in implementing conservation measures. Conservation policies can be legally enacted much faster than they can effectively be implemented. It is a slow, gradual, on going process that must continually be stressed until it becomes habit.

The District will inform customers of various recommended methods for implementing a reduction in water consumption. Generally, a majority of water consumption in the District is consumed by residential customers. Therefore, the target area for educational information is to be the majority user and also contract customers. The District should initiate the conservation plan and its education program as soon as possible after its approval by the TWDB.

a. First year program or activities will consist of eight activities:

1. A Fact Sheet explaining the Conservation Plan will be developed and distributed.
2. An article will be placed in newspaper, correlated with Fact Sheet distribution.
3. Provide each new customer with "Homeowner's Guide to Water Use and Water Conservation."
4. Newspaper article advising water customers that Homeowner's Guide is available through the District.
5. Mail out one brochure to water customers - "Water...Half-A-Hundred Ways to Save It."
6. News article elaborating on brochure items.
7. Mail out one brochure to water customers either "How to Save Water Outside the Home," or "How to Save Water Inside the Home."
8. News article in newspaper highlighting certain methods for saving water.

b. Long-term program will consist of five activities each year after first year:

1. Mail out new brochures emphasizing new or innovated means for conserving water.
2. Newspaper article targeting one particular household water using utility or item and method for conserving water (dishwasher, shower, toilet, laundry).
3. Brochure relating to outside household use, car washing, lawn watering, time of day, correlated to weather predictions.

4. Newspaper item correlated to brochure mail out.
5. Continue distribution of Homeowner's Guide to customers.

c. New customers will be advised of Conservation Program and provided with a copy of Homeowner's Guide.

The District will resource materials available from the Texas Water Development Board and other agencies or organizations which develop desirable pertinent information or data.

2.2 Use of Water Saving Devices and Appliances by Existing Customers.

Approximately 40 percent of the total in-home residential water useage is used in toilet flushing and another 30 percent is used for bathing. The difference between using 50 gallons of water a day as opposed to 80 gallons a day may be as simple and inexpensive as installing a flow restricting device in the shower head and toilet dams or water filled plastic bottle to displace water in the toilet. Tests with such devices have proven successful in saving water and have presented no inconvenience or significant adjustments for the people using them. Being conscious of the use of water and making small changes in personal habits, like taking shorter showers and not letting water run while washing dishes, can result in even greater water savings.

For one person, the typical five gallon flush toilet contaminates about 13,000 gallons of fresh water each year to move only 165 gallons of actual waste. Through the use of toilet dams, tank displacement devices, and low flush toilets, the average flush can be reduced to 3.5 gallons or less; a savings of approximately 2,740 gallons per person, or 8,760 gallons per year for an average family. Present plans call for the City of Austin to adopt usage of 1.6 gallon toilets for new facility construction.

After the toilet, the heaviest water user in the house is the shower. Approximately 30 percent of the total household water consumption goes for showering and bathing; roughly 80 gallons a day for a family of four. Flow rates in shower heads generally vary from 3 gpm to 10 gpm.

Sizeable water savings can be obtained by installing a flow restricter or pressure compensating shower heads (and also for sink faucets). Because these increase water velocity, the reduction in water volume is usually not noticeable, yet water savings are in the neighborhood of 30 to 50 gallons per day. Assuming a savings of 30 gallons per day, the yearly amount of water savings would be approximately 10,950 gallons per household.

Faucet aerators mix air with the water as it leaves the faucet. This gives the illusion of more water flowing from the tap than actually is. Faucet aerators are inexpensive, easy to install, and most types use about 50 percent of the water of a regular faucet.

Automatic clothes washing machines account for about 15 percent of the water consumed in households where they are present. Top loading models which are most common require about 35 to 50 gallons per cycle. Water (and energy) savings can be achieved by using the proper water and temperature setting for the size and type of load being washed. Many appliance makers offer models which use less water and energy to clean an equivalent load. Publications such as Consumer Reports can be helpful in comparing conservation features when purchasing a washer.

2.3 Revising Plumbing Codes to Encourage the Use of Water Conservation Devices and Appliances in New Construction and Remodeling.

Institution or revision of plumbing codes to require the use of water saving devices and appliances in new home construction is perhaps the most effective method of achieving long term flow reduction within a community. Prior to the adoption of code revisions, a comprehensive study should be done to research specific items available on the market and determine which ones are effective (and

cost effective) enough to mandate specifying in new home construction. This process can be simplified somewhat by obtaining copies of similar codes already being used in other communities to use as a beginning point. This product evaluation needs to be updated periodically as products are introduced and redesigned.

Obviously, revision of the existing plumbing code will require the cooperation of area developers. Although one of the side effects of a plumbing code revision of this type may be to slightly increase the price of a new home, it is hoped that the long term benefits of lower net utility bills and fewer tax increases will outweigh this price increase. Also, it should be noted that a flow reduction program can make up to 23% more wastewater service available for proposed development. This is particularly important in areas such as Lake Travis where water and wastewater service may be the limiting factor on growth.

Attachment No. 4 hereto, is an excerpt from the City of Austin Plumbing Code which is used by the District. This Ordinance has adopted Section 912 Water Conservation, of the Uniform Plumbing Code. The City of Austin is currently updating these conservation requirements, as new data and products become available.

2.4 Retrofit Programs to Improve Water Use Efficiency in Existing Buildings or Appliances.

The District will encourage customers to utilize low demand fixtures and appliances through proposed educational sources described in this Plan. The District will advise customers of low water demand items, shower heads, toilet dams, etc., by mail outs and/or publication of newspaper articles, emphasizing the importance of water saving devices. The District will contact local suppliers of plumbing supplies advising suppliers of water saving drive content. Suppliers will be requested to stock low water fixtures and low water use items. The District may also want to investigate bulk purchase and distribution of these items to further increase their distribution.

Incentives can also be incorporated into utility rate structures to encourage customers to replace their existing appliances with less water intensive models. Local regulatory authorities which review and approve remodeling projects should be urged to require water saving appliances in all reconstruction.

2.5 Rate Incentives Which Encourage Conservation.

Rate incentives intended to encourage participation in flow reduction programs can either be positive or negative in nature. Positive incentives, such as lower rates or

rebates on utility bills for retrofiting existing homes and businesses with water saving devices or appliances, can be effective in reducing flow in communities where a great deal of the development has already taken place. This form of incentive however, can also reduce the supplier's revenue from water sales and should be examined carefully to determine the true cost effectiveness of this portion of the program.

Negative rate incentives are seldom popular and should be used as a last resort. Arbitrarily raising water rates in order to promote conservation can produce many negative side effects which can outweigh the effectiveness of the incentive. Changes in pricing structure to promote water conservation have included either a uniform unit rate or increasing block rate to achieve the same results with less customer opposition. Travis County WC&ID No. 17 currently uses an increasing block rate with a minimum charge for water service. A rate study to insure adequate cost recovery for operation and maintenance as well as encourage water conservation is recommended.

2.6 Conservation Oriented Landscaping and Outdoor Water Use. Changing the public's attitudes about landscaping can have significant effects upon the amount of residential (and commercial) water use. Virtually all of residential out-

door water use consists of watering vegetation. Choices made in selecting lawn grasses, trees, and shrubs are probably the most important factor in the effectiveness of outdoor conservation measures.

Xeriscaping consists of seven (7) landscaping principles that promote less labor, less intensive water usage and careful selection of native plant species. Planting, or leaving existing, native trees rather than using fast growing, short life, exotic species should be encouraged whenever possible. Less water intensive grasses such as Bermuda should be suggested instead of varieties like St. Augustine which require constant attention and abundant amounts of water.

Many attractive native species of shrubs and trees are available from local nurseries. Some suggested tree varieties include Live Oak, Texas (Spanish) Oak, Shumard (Red) Oak, Redbud, Little Walnut, Flameleaf Sumac, Texas (Mexican) Persimmon, and the Texas Mountain Laurel. Many hardwoods such as Oaks, which are usually considered slow growing are capable of fairly rapid growth with the added moisture provided by typical lawn watering.

Much of the Study Area will be developed as 1/2 acre or larger lots. Preliminary estimates for area development

use 2 acres per lot for overall density. These larger Hill Country lots are easily maintained as natural areas. By leaving the existing vegetation and topography intact, the natural environment is preserved and a majority of the site is maintenance free. This concept should be encouraged whenever possible.

Another area in which outdoor water use can be reduced is the methods in which vegetation is watered. The typical "set and forget" method of lawn watering can be inefficient and expensive. Hand watering, when possible, is the most efficient way to get the proper amount of water where it is needed most. Soaker hoses can be an efficient way to distribute water because they are not as subject to evaporation. Sprinkler types which offer greater flexibility in directing spray allow the user to water more of the yard and less of the sidewalk. Automatic sprinkler systems, when used properly can be one of the most efficient methods of watering because the duration can be timed and the application can be timed to occur in the early morning when evaporation is less and water pressure is best. Automatic sprinkler systems must be monitored however to be sure they don't water when it is not needed. Otherwise, they can be as wasteful as they are efficient. Commercial systems are especially guilty of this. Watering is most efficient in the early morning

while the ground and air are still cool and should be avoided on especially windy days if possible. Perhaps most important is to apply the correct amount of water. Watering less frequently and more thoroughly will benefit vegetation much more than overwatering periodically.

Educational material will include information relating to low water use landscaping. The District reviews and approves subdivision plans. Subdividers and builders, at the time Building Permits are acquired, will be provided with literature pertaining to low water demand landscaping items. Area nurseries will also be provided with mentioned literature.

2.7 Installation, Monitoring, and Repair of Meters.

Effective metering is the key to monitoring water use and conservation measures. Metering key points in the system, combined with water sale records can indicate areas of water losses which might otherwise go undetected. Because of the nature of fractured limestone, major water leaks can pour hundreds of thousands of gallons of water into underground cracks and porous rock without any surface signs. When leaks are indicated through metering records, a leak detection program should be instituted to pinpoint the exact location so repairs can be made. As with any equipment, the data is only as accurate as the meter which

produces it. Meter replacement is currently included in the District's regular maintenance program.

This should be implemented by the District. Universal metering should be initiated within six (6) months after adoption of this Plan. Meter Readers will classify apparent condition of all District meters during the following six months. During this same period, all meters larger than one inch (1") will be tested, and retested each year thereafter. The second year, a Testing Program will be initiated for all meters 1" and smaller. Repairing is to begin in areas with poor classification rated by Meter Readers. Proposed plan will provide testing of all meters 1" and smaller, during a period not to exceed ten years. Annual testing of large meters, testing, maintaining, and replacement of inoperative meters will enable water consumption to be tracked; thus providing a more efficient conservation plan.

2.8 Instituting a Leak Detection and Repair Program.

The District Audit System monitors monthly consumption and the Audit has become a major tool in System management. Classification of Meter condition as proposed in this Plan will provide a reliable and effective leak detection program. Unaccounted for water should be reduced by 5% per year for the first two years of the Water Conservation

Program. The District is aware that assistance in leak detecting surveys can be obtained from the Texas Water Development Board Staff. It has made great strides in the identification and repair of water leaks within the District. The Agency has portable leak detection equipment available for loan and can provide personnel for demonstration of equipment and assist in planning survey programs.

Meter classification and aggressive enactment of current detection program will enable District staff to determine the need for seeking further assistance from use of electronic equipment. Current detection program consists of the following observations and activities:

a. Leaks reported by customers;

b. Leak detection by Meter Readers;

c. Continual checking and servicing of production, pumping and storage facilities;

d. Quick response by Maintenance Department and staff to reported problems.

2.9 Encouraging Recycling and Reuse of Wastewater.

Reuse of wastewater can sometimes become a method of conserving raw water supplies. Usually these are applications in which treated wastewater instead of surface or ground water is used in agriculture. In some areas, certain industrial users have initiated programs

which use treated wastewater or produce wastewater which can be reused or used in agriculture. Because the Study Area does not lend itself either to significant areas of agriculture or industry, large scale recycling and reuse will not be explored further. However, the use and reuse of wastewater and gray water through septic tank drain fields for lawn and landscape areas do provide a type of recycle and reuse for the small scale water user. This use becomes quite large when viewed as the entire District.

3. MEANS OF IMPLEMENTATION AND ENFORCEMENT

To be effective, each of these methods must be implemented with a program which not only presents them in an attractive light, but also provides for enforcement measures. Not all methods are applicable to every type or stage of development, however most can be utilized to some degree or another.

The Board of Directors, through its General Manager and staff, will implement the Plan in accordance with District adoption of the Plan, adoption of Plumbing Codes and revisions thereof as set out in this Plan. Enforcement will be provided by:

a. Refusing to provide taps for customers who do not meet requirements for Water Conservation fixtures as established by Plumbing Code.

b. Nonpayment of water bills will initiate prompt discontinuation of service. Service will be disconnected.

c. Analysis of water rates and adjusting rates to eliminate Conservation Plan abuse.

Any political subdivision and/or wholesale customer contracting for water from the District must have (1) an approved Texas Water Development Board Water Conservation and Drought Contingency Plan in effect or (2) must officially adopt applicable provisions of the District's Water Conservation and Drought Contingency Plan.

4. EFFECTS OF WATER CONSERVATION

As can be seen in the following table, indoor water use can be reduced up to 23% through such simple measures as shower head inserts and water saving appliances. When those same percentages of reduction are applied to the projected build out of the Study Area, the full benefits of water conservation can be seen. Table 17 shows the effects of indoor water conservation measures on overall projected water demand. When the effects of outdoor water conservation are added, potential savings are increased even further.

A research of similar programs in other cities has revealed a reduction of 5-15% for peak day water usage and up to 25% when mandated controls such as water rationing

are enforced. The variability of the program's results comes from the effectiveness of the conservation system implementation, age of the system and efforts put forth in its education and deployment.

TABLE 17

Indoor Residential Water Use And Water Savings With Conservation

Indoor Water Use	Total Indoor Use (Percent)	Without Conservation (GPCPD)	With Conservation (GPCPD)	Reduction (Percent)
Toilet Flushing	40	25	17.5	30
Bathing	30	20	16.0	21
Lavatory Sink	5	3	3.0	-
Laundry & Dishes	20	13	9.5	27
Drinking & Cooking	5	4	4.0	-
TOTAL	100	65	50.0	23

NOTES: 1) Original data: USEPA.
2) With Conservation assumes the use of toilet dams, plastic shower head inserts, and water conserving dishwashers and washing machines.
3) GPCPD - gallons per capita per day.

TABLE 15

Possible Water Demand Reduction Through Water Conservation Measures(1)

Indoor Water Use	Total Indoor Water Use	Without Conservation (GPD)	With Conservation (GPD)	Reduction (GPD)
Toilet Flushing	40%	2,448,000	1,713,600	734,400
Bathing	30%	1,836,000	1,468,800	367,200
Lavatory Sink	5%	306,000	306,000	0
Laundry & Dishes	20%	1,224,000	795,600	428,400
Drinking & Cooking	5%	306,000	306,000	0
TOTAL	100%	6,120,000	4,590,000	1,530,000

NOTES: * Original data: USEPA.
* With Conservation assumes the use of toilet dams, plastic shower head inserts and water conserving dishwashers and washing machines.
* GPD - gallons per day.
(1) Projected for the year 2010 (12,240 LUEs @ 500 gpd/LUE)

An effective conservation program can provide immediate and long term benefits to the District as well as the individual consumers. Justification for initiation of such a program can be made in terms of short term or long term benefits but need not be justified by both. Long term monetary benefits to the District can result from postponing expansions of water and wastewater treatment facilities as well as their associated conveyance systems. On the other hand, the short term effect of reducing a community's water use may be to decrease revenues without substantially altering operating costs, since most of the utility's costs are fixed and tied to available capacity. Potential lost revenues can be recovered through the addition of new customers or by rate increases (which generally still result in an overall lower water bill). Potential lost revenues can also be avoided or at least compensated by gradual implementation of this type of program.

Individual users can also benefit in the long run in terms of capacity. Lower fixed costs associated with constructing and operating a smaller facility, or delaying facility expansion, theoretically translate to lower (or smaller increases in) water and wastewater bills as well as property taxes to pay for such improvements.

5. ANNUAL REPORTING

The District, through adoption of this Plan, commits to annual monitoring and reporting of its progress in achieving its water conservation goals. The annual report to the customers of the District will contain information describing:

a. Progress in Conservation Plan implementation.

b. Public response to plan implementation and operation.

c. Quantitative effectiveness with reference to:
   (1) System reduction; and
   (2) Reduction in customer or per capita use.

d. List of public information released during the year.

6. DROUGHT CONTINGENCY PLAN

The second phase of a comprehensive water conservation program is a Drought Contingency Plan. This plan includes specific emergency provisions which would be enacted in the case of a severe drought or other serious impact on the District's water supply. Because impacts on water supplies can occur rapidly and with little or no warning, planning ahead can save time and valuable resources of water in such an event. Because of the District's source and contract with LCRA for water supply, the District's emergency contingency provisions should be coordinated with LCRA.

The most obvious circumstance which might require implementation of such a plan is a severe drought which impacts Lake Travis and/or the waters which feed the Lake. During the late 1980s, Lake Travis has experienced alarming level fluctuations on several occasions due to LCRA operating characteristics and area weather conditions. Although droughts do not occur suddenly, emergency measures are often not enacted until the situation has reached critical stages. Other circumstances which might call for emergency conservation measures include biological or chemical contamination of water supplies, acts of God, or sabotage affecting water supplies or key water production or distribution components. Although these types of emergencies could be remedied in a shorter period of time, prior planning could make the difference between residents having little water and having no water for several days.

6.1 Drought Contingency Measures

Drought contingency measures can take a variety of forms depending upon the severity of the situation. Measures, generally in the order of implementation include:

a. Banning non-essential water uses;

b. Reducing essential usage;

c. Water rationing;

d. Enforcement through utility rates;

e. Enforcement through civil/criminal penalties; and

f. Location of alternative sources of water.

The proposed Water Conservation and Drought Contingency Rules and Regulations adopted and included as part of this plan, enables the Board of Directors to initiate action that will effectively implement the Plan. The following steps are recommended.

1. Step I.

Step I measures related to mild drought conditions and will initiate the following listed action. (Listed action is volunteered by user):

a. Develop Information Center and designate information person.

b. Advise public of condition and publicize availability of information from Center.

c. Encourage voluntary reduction of water use.

d. Contact commercial and industrial users and explain necessity for initiation of strict conservation methods.

e. Implementation of system oversite and make adjustments as required to meet changing conditions.

2. Step II.

Step II curtailment is to be initiated by the District on its identifying moderate drought conditions. Listed action is compulsory on users and is intended to prohibit water waste. ("Water Waste" is defined as washing house windows, sidings, eaves, and roof with

hose, without the use of a bucket; washing driveways, streets, curbs and gutters, washing vehicles without cutoff valve and bucket, and unattended sprinkling of landscape shrubs and grass; draining and filling swimming pools and flushing water systems.)

a. Outdoor residential use of water will be permitted on alternate days. Even number house on even days of the month and odd number house on odd number days. Outdoor residential uses consist of washing vehicles, boats, trailers, landscape sprinkler systems and irrigation, recreational use of sprinklers, outside showers (in parks) and water slides.

b. The General Manager will monitor system function and establish hours for outside water use, depending upon system performance.

c. Information Center and publicity elements shall keep public advised of curtailment status.

d. Commercial and industrial use will be visited to insure volunteered conservation has been initiated.

3. Step III.

Step III curtailment shall be initiated upon existence of severe conditions as determined by the General Manager. The General Manager will ban the use of water for:

a. Vehicle washing, window washing, outside watering (lawn, shrubs, faucet dripping, garden, etc.)

b. Public water uses which are not essential for health, safety and sanitary purposes. These uses include: street washing, fire hydrant flushing, filling pools, athletic fields and courses and dust control sprinkling.

c. Commercial uses not listed and industrial uses will be controlled to the extent dictated by the General Manager.

Businesses requiring water as a basic function of the business, such as nurseries, commercial car wash, laundromats, high pressure water cleaning, etc., will obtain written permission from the General Manager for intended water use.

The System Priority for water service shall be made on the following basis:

1. Hospitals
2. Residential
3. Schools
4. Industrial
5. Commercial
6. Recreational

6.2 Threshold Condition

The Texas Water Development Board suggests three levels or conditions for determining degree of urgency for initiation of Drought Contingency Plan. These three levels of drought conditions are as follows and relate to the District's system. Raw water is purchased from the LCRA.

1. Mild drought occurs when:
   a. Average daily water consumption reaches 90% of production capacity.
   b. Consumption (90%) has existed for a period of three days.

c. Weather conditions are to be considered in drought classification determination. Predicted long, cold or dry periods are to be considered in impact analysis.

2. Moderate drought conditions are reached when:

a. Average daily water consumption reaches 100% of rated production capacity for three day period.

b. Weather conditions indicate mild drought will exist five days or more.

c. One Ground Storage Tank or one Clearwell is taken out of service during mild drought period.

d. Storage capacity (water level) is not being maintained during period of 100% rated production period.

e. Existence of any one listed condition for a duration of 35 hours.

3. Severe drought classification is reached when:

a. Average daily water consumption reaches 110% of production capacity.

b. Average daily water consumption will not enable storage levels to be maintained.

c. System demand exceeds available high service pump capacity.

d. Any two conditions listed in moderate drought classification occurs at the same time for a 24 hour period.

e. Water system is contaminated either accidentally or intentionally. Severe condition is reached immediately upon detection.

f. Water system fails -- from acts of God, (tornados, hurricanes) or man. Severe condition is reached immediately upon detection.

6.3 Triggering Conditions

The triggering mechanisms for various phases of a Drought Contingency Plan are specific to each utility. They can

be tied to lake levels, percent of actual vs. projected demand, or other utility specific factors. Whatever the agreed upon mechanisms, the Plan should include triggers for mild, moderate, and severe conditions. Typical measures for each stage include:

Mild Conditions:
* Notification and suggestions by mail;
* Activate information center, call news media;
* Remind public of condition daily;
* Initiate voluntary lawn watering schedule;

Moderate Conditions:
* Mandatory lawn watering schedule;
* Fines for wasting water;
* Excessive use fees and surcharges;
* Prohibit non-essential uses;
* Request/require help from non-municipal users;

Severe Conditions:
* Prohibit all outdoor water use;
* Mandatory water rationing, fines for non-compliance;
* Decrease/stop water for all non-municipal uses (industry, commercial, etc.).

6.4 Initiation and Termination Procedures

Just as the District must be prepared with established triggering conditions for stages of the Drought Contingency Plan, they must also outline in advance what the initiation and termination procedures of these stages are. By what authority is each phase initiated? What steps will be taken in each phase and in what order? What are the triggering mechanisms that signal the end of a phase? All of these questions should also be addressed in the Plan.

Initiation procedures employed at any period is described in this Plan. Each condition will be met with corresponding action by the District and the District will affect curtailment, give notice, publicize and follow with implementation of curtailment.

Termination of each drought condition will begin when that specific condition has been improved to the extent that an upgraded condition can be declared by the District. This process will be employed until full service can be provided. System priority will be considered in return to upgraded condition, returning hospitals, schools, etc., in priority order.

Termination will be initiated by the District by giving notice, etc. as was given to enact drought curtailment.

6.5 Information and Education

The public will be made aware of conservation and drought conditions by information and data transfer thru the District's annual program. During periods of drought curtailment, Step I conditions establishes an information center, an information person, and utilize the most effective methods developed for information dissemination on a daily basis.

Close observation of the first year information program should develop the most effective ways to communicate with customers. Posting notices, newspaper articles, radio coverage and direct mail to customers will be used during the first year activities.

7. MODIFICATION, DELETION AND AMENDMENT

The District can add, delete, and amend rules, regulations and implementation as needed/desired, and shall advise Board of Directors of such amendments at its next regular or called meeting.

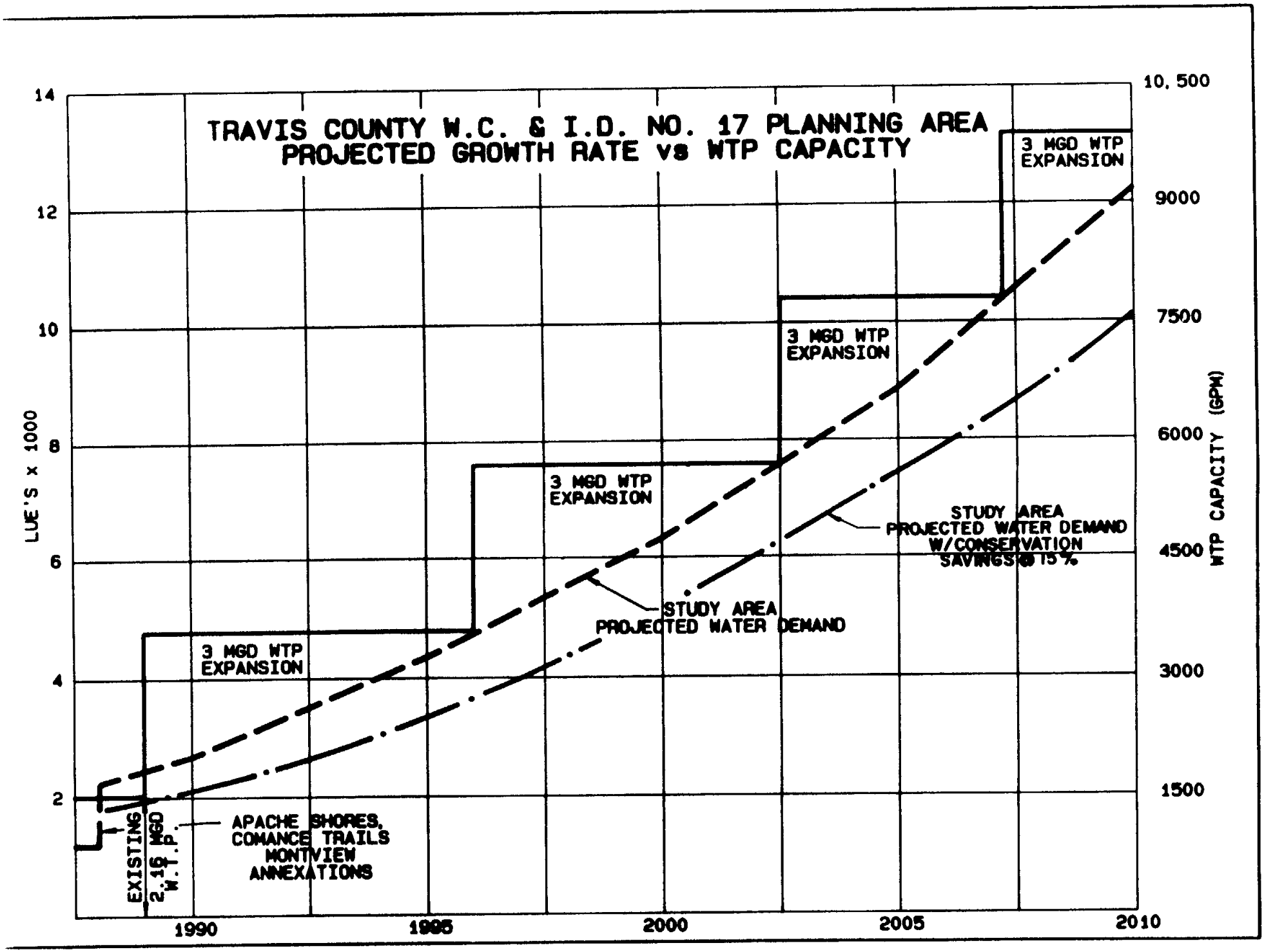
8. MEANS OF IMPLEMENTATION

Adoption of this Plan, Drought Contingency Ordinance, and modification of Plumbing Code Ordinance will enable the District to implement and carry out enforcement of enacted ordinances to make the Plan effective and workable.

FIGURE 14

Effects of Water Conservation

On The Planning Area (Graph)


TRAVIS COUNTY W.C. & I.D. NO. 17 PLANNING AREA
PROJECTED GROWTH RATE vs WTP CAPACITY
LUE'S x 1000
WTP CAPACITY (GPM)
14
12
10
8
6
4
2
10,500
9000
7500
6000
4500
3000
1500
1990
1995
2000
2005
2010
3 MGD WTP EXPANSION
3 MGD WTP EXPANSION
3 MGD WTP EXPANSION
3 MGD WTP EXPANSION
STUDY AREA PROJECTED WATER DEMAND W/CONSERVATION SAVINGS@15%
STUDY AREA PROJECTED WATER DEMAND
EXISTING 2.16 MGD W.T.P.
APACHE SHORES, COMANCE TRAILS MONTVIEW ANNEXATIONS

ATTACHMENT NO. 1

Listing of Water Conservation Literature

Texas Water Development Board

LISTING OF WATER CONSERVATION LITERATURE
TEXAS WATER DEVELOPMENT BOARD

TITLE	PUBLISHED BY	DESCRIPTION	LENGTH
Water...Half-A-Hundred Ways To Save It*	TWDB	Pamphlet	8 pages
Water Saving Ideas For Business and Industry*	TWDB	Pamphlet	8 pages
How to Save Water Outside The Home	TWDB	Pamphlet	8 pages
How to Save Water Inside The Home*	TWDB	Pamphlet	8 pages
A Homeowner's Guide to Water Use and Water Conservation*	TWDB	Booklet	22 pages
Drip Irrigation*	TWDB	Pamphlet	6 pages
Lawn Watering Guide*	TWDB	3-1/2" X 5" Plastic Card	2 sides
Toilet Tank Leak Detector Tablets*	TWDB	2 Tablets	
Municipal and Commercial Water Conservation Services	TWDB	Pamphlet with Tear-out	8 pages
Guidelines for Municipal Water Conservation and Drought Contingency Planning and Program Development	TWDB	Loose-leaf	36 pages
How to Xeriscape	NXC	Pamphlet	10 pages
Texas Sesquicentennial Native Plant Landscape (located in Austin)	TDB/TWDB	Pamphlet	8 pages
Guide for Locating and Reducing Unaccounted for Water Through the Use of the Water Audit and Leak Detection	TWDB	Guidebook	30 pages
Guide for Designing Conservation Water Rate Structures	TWDB	Guidebook	30 pages

TITLE	PUBLISHED BY	DESCRIPTION	LENGTH
Model Water Ordinances	TWDB	Guidebook	25 pages
The Authority of Cities, Water Utilities, and Water Districts to Regulate and Enforce Water Conservation Measures	TWDB	Paper	5 pages
Texas Water Resources and Conservation	TWDB	Paper	38 pages
Efficient Use of Water in the Garden and Landscape (B-1496)	TAEX	Booklet	20 pages
Xeriscape°	City of Austin	Booklet	20 pages
Water Pressure Reducing Valves°	Watts Regulator	Booklet	21 pages
Texas Native Tree and Plant Directory, 1986°	TDA	Book	161 pages
Sources of Leak Detection Equipment and Services°	TWDB	List	2 pages
Sources of Water Saving Devices°	TWDB	List	21 pages
The Cost of Conventional Water Supply Development and Treatment°	TWDB	Paper	9 pages
Potential for Utilization of Brackish Groundwater°	TWDB	Paper	21 pages
Guidelines for Water Reuse EPA-600/8-80-036°	EPA	Book	105 pages
Guidelines for Municipal Water Conservation and Drought Contingency Planning and Program Development°	TWDB	Loose-leaf	36 pages
Water Conseration and Drought Contingency Plan Development Procedures°	TWDB	Loose-leaf	58 pages
Municipal Water Conservation Workshop Notebook	TWDB	Notebook	6 sections

° These items are available either in single copies or in the Municipal Water Conservation Notebook. However, the Board is not able to give out the Notebook, but can loan a copy for a period of two weeks.

* Order in 1000 Lots.

Abbreviations:

AWWA	American Water Works Association
EPA	Environmental Protection Agency
HPUWCD #1	High Plains Underground Water Conservation District No. 1
NXC	National Xeriscape Council, Inc.
SCS	USDA - Soil Conservation Service
TAEX	Texas Agricultural Extension Service
TDA	Texas Department of Agriculture
TWDB	Texas Water Development Board

ATTACHMENT NO. 2

Public Information Suggestions

PUBLIC INFORMATION SUGGESTIONS

The Texas Administrative Code (TAC) 31 Section 355.15(b)(7) under which the District has received funding for a regional water study, requires that a water conservation plan be developed as a part of the effort. This is not only a requirement, it's good sense. Water is our most important natural resource, and probably the most abused. A water conservation plan should be developed and implemented for every water supply service area, regardless of whether they are currently subject to shortages. This school of thought is evident in recent policy changes at the Texas Water Development Board and the Lower Colorado River Authority.

While the supply of clean, usable water has steadily declined over the past thirty years, the per capita water use has increased by about four gallons per person per day per decade. In many areas of the Country, water is in such short supply that mandatory water rationing and restrictions have become a part of everyday life. Travis County currently enjoys large supplies of fresh water supplied from the Colorado River basin and various underground aquifers. With proper conservation measures, this rich supply will sustain projected County growth well into the twenty first century.

The following water conservation suggestions have been reproduced, in part, from the Texas Water Development Board Bulletin, entitled "Water...Half-A-Hundred Ways to Save It."

-----POSSIBLE SAVINGS WITH WATER CONSERVATION-----

For approximately $10.00 to $15.00 the average homeowner can install two low-flow showerheads, place dams or bottles in the toilet tanks, put low-flow aerators on the faucets, and repair dripping faucents and leaking toilets. This could save from 10,000 to 25,000 gallons/year for a family of four, and would pay for itself, in less than a year. Even more water could be saved if good outdoor water conservation is practices for laws and gardens.

CONSERVATION TIPS

A. IN THE BATHROOM

1. Take a shower instead of filling the tub and taking a bath. Showers usually use less water than tub baths.
2. Install a low-flow shower head which restricts the quantity of flow at 60 psi to no more than 3.0 gallons per minute.
3. Take short showers and install a cutoff valve or turn the water off while soaping and back on again only to rinse.
4. Do not use hot water when cold will do. Water and energy can be saved by washing hands with soap and cold water; hot water should only be added when hards are especially dirty.
5. Reduce the level of the water being used in a bath tub by one or two inches if a shower is not available.
6. Turn water off when brushing teeth until it is time to rinse.
7. Do not let the water run when washing hands. Instead, hands should be wet, and water should be turned off while soaping and scrubbing and turned on again to rinse. A cutoff valve may also be installed on the faucet.

8. Shampoo hair in the shower. Shampooing in the shower takes only a little more water than is used to shampoo hair during a bath and much less than shampooing and bathing separately.

9. Hold hot water in the basin when shaving instead of letting the faucet continue to run.

10. Test toilets for leaks. To test for leak, a few drops of food coloring can be added to the water in the tank. The toilet should not be flushed. The customer can then watch to see if the coloring appears in the bowl within a few minutes. If it does, the fixture needs adjustment or repair.

11. Use a toilet tank displacement device. A one-gallon plastic milk bottle can be filled with stones or with water, recapped, and placed in the toilet tank. This will reduce the amount of water in the tank, but still provide enough for flushing. (Bricks which some people use for this purpose are not recommended, since they crumble eventually and could damage the working mechanism, necessitating a call to the plumber). Displacement devices should never be used with new low-volume flush toilets.

12. Install faucet aerators to reduce water consumption.

13. Never use the toilet to dispose of cleansing tissues, cigarette butts, or other trash. This can waste a great deal of water and also places an unnecessary load on the sewage treatment plant or septic tank.

14. Install a new low-volume flush toilet that uses 3.5 gallons or less per flush when building a new home or remodeling a bathroom.

B. IN THE KITCHEN

1. Use a pan of water (or place a stopper in the sink) for rinsing pots and pans and cooking implements when cooking, rather than turning on the water faucet each time a rinse is needed.

2. Never run the dishwasher without a full load. In addition to saving water, expensive detergent will last longer and a significant energy savings will appear on the utility bill.

3. Use the sink disposal sparingly, and never use it for just a few scraps.

4. Keep a container of drinking water in the refrigerator. Running water from the tap until it is cool is wasteful. Better still, both water and energy can be saved by keeping cold water in a picnic jug on a kitchen counter to avoid opening the refrigerator door frequently.

5. Use a small pan of cold water when cleaning vegetables rather than letting the faucet run.

6. Use only a little water in the pot and put a lid on it for cooking most food. Not only does this method save water, but food is more nutritious since vitamins and minerals are not poured down the drain with the extra cooking water.

7. Use a pan of water for rinsing when hand washing dishes rather than running the faucet.

8. Always keep water conservation in mind, and think of other ways to save in the kitchen. Small kitchen savings from not making too much coffee or letting ice cubes melt in a sink can add to in a year's time.

C. IN THE LAUNDRY

1. Wash only a full load when using an automatic washing machine (32 to 59 gallons are required per load).

2. Use the lowest water level setting on the washing machine for light loads whenever possible.

3. Use cold water as often as possible to save energy and to conserve the hot water for uses which cold water cannot serve. (This is also better for clothing made of today's synthetic fabrics.)

D. FOR APPLIANCES AND PLUMBING

1. Check water requirements of various models and brands when considering purchasing any new appliances that uses water. Some use less water than others.

2. Check all water line connections and faucets for leaks. If the cost of water is $1.00 per 1,000 gallons, one could be paying a large bill for water that simply goes down the drain because of leakage. A slow drip can waste as much as 170 gallons of water EACH DAY, or 5,000 gallons per month, and can add as much as $5.00 per month to the water bill.

3. Learn to replace faucet washers so that drips can be corrected promptly. It is easy to do, costs very little, and can represent a substantial amount saved in plumbing and water bills.

4. Check for water leakage that the customer may be entirely unaware of, such as a leak between the water meter and the house. To check, all indoor and outdoor faucets should be turned off, and the water meter should be checked. If it continues to run or turn, a leak probably exists and needs to be located.

5. Insulate all hot water pipes to avoid the delays (and wasted water) experienced while waiting for the water to "run hot."

6. Be sure the hot water heater thermostat is not set too high. Extremely hot settings waste water and energy because the water often has to be cooled with cold water before it can be used.

7. Use a moisture meter to determine when house plants need water. More plants die from over-watering than from being on the dry side.

E. OUT-OF-DOOR USE

1. Water lawns early in the morning during the hotter summer months. Much of the water used on the lawn can simply evaporate between the sprinkler and the grass.

2. Use a sprinkler that produces large drops of water, rather than a fine mist, to avoid evaporation.

3. Turn soaker hoses so the holes are on the bottom to avoid evaporation.

4. Water slowly for better absorption, and never water in high winds.

5. Forget about watering the streets or walks or driveways. They will never grow a thing.

6. Condition the soil with compost before planting grass or flower beds so that water will soak in, rather than run off.

7. Fertilize lawns at least twice a year for root stimulation. Grass with a good root system makes better use of less water.

8. Learn to know when grass needs watering. If it has turned a dull grey-green or if footprints remain visible, it is time to water.

9. Do not water too frequently. Too much water can overload the soil so that air cannot get to the roots and can encourage plant diseases.

10. Do not over-water. Soil can absorb only so much moisture and the rest simply runs off. A timer will help, and either a kitchen timer or an alarm clock will do. An inch and one-half of water applied once a week will keep most Texas grasses alive and healthy.

11. Operate automatic sprinkler systems only when the demand on the town's water supply is lowest. Set the system to operate between 4:00 a.m. and 6:00 a.m.

12. Do not scalp lawns when mowing during hot weather. Taller grass holds moisture better. Rather, grass should be cut fairly often, so that only 1/2 to 3/4 inch is trimmed off. A better looking lawn will result.

13. Use a watering can or hand water with the hose in small areas of the lawn that need more frequent watering (those near walks or driveways, or in especially hot, sunny spots).

14. Learn what types of grass, shrubbery, and plants do best in the area and in which parts of the lawn, and then plant accordingly. If one has a heavily shaded yard, no amount of water will make roses bloom. In especially dry sections of the state, attractive arrangements of plants that are adapted to arid or semi-arid climates should be chosen.

15. Consider decorating areas of the lawn with rocks, gravel, wood chips, or other materials now available that require no water at all.

16. Do not "sweep" walks and driveways with the hose. Use a broom or rake instead.

17. Use a bucket of soapy water and use the hose only for rinsing when washing the car.

ATTACHMENT NO. 3

Conservation/Drought Contingency Plan Ordinance

ORDINANCE NO. _____

AN ORDINANCE ADOPTING A DISTRICT-WIDE WATER CONSERVATION/AND DROUGHT CONTINGENCY PLAN: PROVIDING A PENALTY OF NOT LESS THAN $10 PER DAY NOR MORE THAN $200 PER DAY FOR EACH DAY OF NON-COMPLIANCE AND/OR DISCONNECTION OF WATER SERVICES TO SUCH USERS BY THE DISTRICT: A PUBLIC NEED OF AN EMERGENCY NATURE FOR THE ADOPTION HEREOF ON ONE READING: PROVIDING FOR PUBLICATION AND ORDAINING OTHER MATTERS RELATED TO THE FOREGOING.

BE IT ORDAINED BY THE DISTRICT:

WHEREAS, the Board of Directors has determined there is an urgent need in the best interest of the District to adopt a Water Conservation Plan and Drought Contingency Plan, and the Board of Directors further determines that such public need is of an emergency nature and the legal requirements of two required separate readings of the subject ordinance be dispensed with and waived; and

WHEREAS, the Board of Directors now desires to evidence its approval of the Water Conservation/Drought Contingency Plan and adopt such plan as an official policy of the District; Now, Therefore,

BE IT ORDAINED BY THE DISTRICT:

SECTION 1: Approval of the Plan: The Board of Directors hereby approves and adopts the District's Water Conservation Plan, the Water Conservation/Drought Contingency Plan attached hereto as Exhibit "A" to be included in full as a part of this Ordinance as if recited verbatim herein. The District commits to implement the program according to the procedures set forth in the adopted plan.

SECTION II: The City shall report to the Texas Water Development Board annually on the implementation and effectiveness of the plan in accordance with the outline set forth in the plan.

SECTION III: In regards to implementation and enforcement of the Conservation/Drought Contingency Plan the General Manager is designated as the official responsible for implementation and enforcement, and the following guidelines are adopted:

1. Mild Drought occurs when:

   (a) Average daily water consumption reaches 90% of production capacity.

   (b) Consumption (90%) has existed for a period of three days.

   (c) Weather conditions are to be considered in drought classification determination. Predicted long, cold, or dry periods are to be considered in impact analysis.

2. Moderate Drought conditions are reached when:

   (a) Average daily water consumption reaches 100% of rated production capacity for three day period.

   (b) Weather conditions indicate mild drought will exist five days or more.

   (c) One Ground Storage Tank or one Clearwell is taken out of service during mild drought.

   (d) Storage capacity (water level) is not being maintained during period of 100% rated production period.

   (e) Existence of any preceding conditions listed above for a duration of 36 hours.

3. Severe Drought Classification is reached when:

   (a) Average daily water consumption reaches 110% of production capacity for a 24 hour period.

   (b) Average daily water consumption will not enable storage levels to be maintained.

(c) System demand exceeds available high service pump capacity.

(d) Any two conditions listed in Moderate Drought Classification occurs for a 24 hour period.

(e) Water system is contaminated either accidentally or intentionally. Severe condition is reached immediately upon detection.

(f) Water system fails -- from acts of God (tornados, hurricanes) or man. Severe condition is reached immediately upon detection.

In the event severe classification conditions persist (Item 3 above) for an extended period of time, the District may ration water usage and/or terminate service to selected users of the system in accordance with the following sequence:

(1) Recreational Users
(2) Commercial Users
(3) Industrial Users
(4) School Users
(5) Residential Users
(6) Hospitals, Public Health and Safety Facilities

SECTION IV: Users of District water except for the District, that do not comply with Section III of this Ordinance shall be subject to a penalty and fine of not less than $10.00 per day nor more than $200.00 per day for each day of non-compliance and/or disconnection or discontinuation of water services to such users by the District.

SECTION V: The Board of Directors finds and declares that a sufficient written notice of the date, hour, place and subject of this meeting of the Board of Directors was posted at a designated place

convenient to the public at the District Office for the time required by law preceding this meeting and that such place of posting was readily accessible at all times to the general public; that all of the foregoing was done as required by law; and that this meeteing has been open to the public as required by law at all times during which this Ordinance and the subject matter thereof has been discussed, considered and formally acted upon.

The Board of Directors further rectifies, approves and confirms such written notice and the contents and posting thereof.

PASSED AND APPROVED THIS _____ day of _____, 1989.

PRESIDENT_____

SECRETARY_____

ATTACHMENT NO. 4

Amendment to the Plumbing Code

ORDINANCE NO. 88[illegible]

PLUMBING CODE

AN ORDINANCE AMENDING CHAPTER 13-9 OF THE AUSTIN CITY CODE OF 1981; REPEALING THE UNIFORM PLUMBING CODE, 1982 EDITION, AND LOCAL AMENDMENTS TO THE 1982 UNIFORM PLUMBING CODE; ADOPTING BY REFERENCE THE UNIFORM PLUMBING CODE, 1985 EDITION, WITH APPENDIX, PUBLISHED BY THE INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS, SAVE AND EXCEPT SPECIFIC SECTIONS DELETED BY THIS ORDINANCE; ADOPTING CERTAIN LOCAL AMENDMENTS TO THE 1985 UNIFORM PLUMBING CODE; DIRECTING THE CITY CLERK TO PUBLISH THE LOCAL AMENDMENTS TO THE 1985 UNIFORM PLUMBING CODE IN A SEPARATE COMPILATION TO BE KNOWN AS "LOCAL AMENDMENTS TO THE UNIFORM PLUMBING CODE, 1985 EDITION", WAIVING THE RULE REQUIRING THE READING OF ORDINANCES ON THREE (3) SEPARATE DAYS; AND PROVIDING AN EFFECTIVE DATE.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

PART 1. Chapter 13-9 of the Code of the Austin City Code of 1981 is amended by repealing the Uniform Plumbing Code, 1982 Edition with Appendix, published by the International Association of Plumbing and Mechanical Officials, adopted by reference in Section 13-9-1. All local amendments to the Uniform Plumbing Code, 1982 Edition, are also repealed by this ordinance.

PART 2. Chapter 13-9 is further amended to adopt and incorporate by reference as Sec. 13-9-1 the publication known as the Uniform Plumbing Code, 1985 Edition with Appendix, published by the International Association of Plumbing and Mechanical Officials, a copy of which is attached and incorporated into this ordinance as Exhibit "A" (the "1985 Uniform Plumbing Code"), save and except the following numbered sections and appendices which are hereby deleted from the 1985 Uniform Plumbing Code:

Sec. 10.3	Sec. 608(c)	Sec. 1008(c)	Sec. 1305(c)
Sec. 20.4(d)	Sec. 614	Sec. 1101(d)	Sec. 1306(b)
Sec. 20.7	Sec. 708(b)	Sec. 1201	Sec. 1310(d)
Sec. 20.14	Sec. 1004(a)	Sec. 1206	Appendix H
Sec. 119(g)	Sec. 1005(c)	Sec. 1213(b)	Appendix I

PART 3. Chapter 13-9 is further amended to add the following sections as local amendments to the 1985 Uniform Plumbing Code, as follows:

Section 10.3 Scope.

The provisions of this Code shall apply to the erection, installation, alteration, addition, repair, regulation, replacement, maintenance or uses of any plumbing system, except as otherwise provided for in this Code.

vent below the floor level and a minimum slope of one-quarter (1/4) inch per foot back to the drain shall be maintained. The return bend used under the drainboard shall be a one piece fitting or an assembly of a forty-five (45) degrees, a ninety (90) degree, and a forty-five (45) degree elbow in the order named.

Deep seal P-traps may be installed under the floor of island fixtures if:(1) the trap size is at least two inches and (2) the trap is vented with a two inch soil pipe to the nearest partition wall with a cleanout installed in the riser and thence through the roof to the open air. Pipe sizing for island fixtures shall be as elsewhere required in this Code.

Section 708

(b) The size, type and location of each interceptor or separator shall be approved by the administrative authority, in accordance with its standards. Except where otherwise specifically permitted, no wastes other than those requiring treatment or separation shall be discharged into any interceptor.

Section 912 Water Conservation

(a) The following maximum flow rates and/or water usage standards shall apply for fixtures in:

* any new building or structure or portions thereof;
* additions to existing buildings that provide facilities or shelter for public assembly, education, business, mercantile, institutional, residential occupancy;
* and hotels, motels, condominiums, day care centers, nursing homes and apartments.

(1) Tank type water closets shall provide a maximum flush not to exceed 3.5 gallons.

(2) Shower heads shall have a maximum flow which does not exceed three gpm at pressure ranges from 20 to 80 psig.

(3) Lavatory and kitchen faucets shall be equipped with flow controllers, aerators or spray taps which result in a maximum delivery not to exceed 2.75 gpm (+ .25 gpm) at pressure ranges from 20 to 80 psig when both hot and cold water supply are in full open position.

(4) Flushometer type water closets shall adequately flush and clean fixtures, and shall discharge no more than three gallons per flush.

(5) Tank type urinals shall have a maximum flush not to exceed three gallons per flush.

(6) Flushometer type urinals shall adequately flush and clean fixtures, and shall discharge not more than one gallon per flush.

(7) Lavatory faucets for public facilities may be equipped with (a) outlet devices which limit the flow of hot water to a maximum of 0.5 gpm, or (b) self-closing valves that limit delivery of hot water to a maximum of 0.25 gpm and delivery of cold water to a maximum of 1.75 gpm for a maximum combined delivery of 2 gpm.

(b) The standards set forth in Section 912a shall not apply to hospitals, laboratories, and any other application where health and safety are dependent upon particular water flow rates. The Building Official shall determine whether application requires exception from these standards. The above standards shall not apply to industrial applications installed pursuant to the Industrial Waste Discharge Ordinance.

(c) Fixture flow-performance requirements shall be rated by data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure.

(d) Water conservation standards for existing buildings shall be as established by separate ordinance of the City Council.

Section 1003

(q) To protect the public water supply, a reduced pressure back flow preventer shall be installed on the customer's side of the meter of any service connection supplying water to premises where any toxic substance is handled or where any substance is handled under pressure higher than atmospheric; this backflow preventer is in addition to any such back flow protection within the water user's piping system. The reduced pressure backflow preventer shall be installed above the flood level or finished grade. The backflow preventer shall include process waters and waters originating from the public water supply which have been subject to deterioration in sanitary quality.

Section 1004

(a)(1) Water pipe and fittings shall be of brass, copper, cast iron, galvanized malleable iron, galvanized wrought iron, galvanized steel, polybutylene plastic, CPVC or other approved materials. P.E. or P.V.C. water pipe manufactured to recognized standards may be used for cold water distribution systems outside a building. All materials used in the water supply system, except valves and similar devices shall be of like material, unless otherwise approved by the administrative authority.

(a)(2) Approved plastic water piping installations shall be limited to installations permitted by the Building Code.

ATTACHMENT NO. 5

Water Rate Structure

WATER RATE STRUCTURE

==========

Water Charge

Meter Size	Minimum Bill	Gallons Included in Minimum Bill
5/8"	$ 12.00	3,000
1	20.50	8,000
1-1/2	33.40	15,000
2	52.50	24,000
3	110.00	48,000
4	174.90	75,000
6	354.90	150,000
8	534.90	225,000

Charges for gallons of water used in excess of minimum bill:

3,000 - 9,999 gallons	$ 1.70 per thousand gallons
10,000 - 19,999 gallons	1.90
20,000 +	2.40

Other Charges

	Residential	Commercial
Plumbing deposits	$ 150	$ 300
Plumbing fees (per trip)	30	50
Tap fees		
5/8" meter	325	325
1" meter	350	350
Service (Reconnection) fees	35	35
Service call (per trip)	10	10
Meter key deposit	10	10

APPENDIX B

Environmental Considerations

Horizon
ENVIRONMENTAL SERVICES, INC.

Horizon Job No. 880028

TRAVIS COUNTY WATER CONTROL AND IMPROVEMENT DISTRICT (WCID) NO. 17 REGIONAL WATER STUDY

Submitted to:

Haynie, Kallman & Gray, Inc.
Austin, Texas

Submitted by:

Horizon Environmental Services, Inc.
Austin, Texas

April 1989

P.O. Box 162017 · Austin, Texas 78716
5524 Bee Cave Rd., Suite E-3 · Austin, Texas 78746 · (512) 328-2430

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

The purpose of this report is to provide preliminary environmental support for the development of a Regional Water Supply Plan for the area encompassed by the boundaries of Travis County Water Control and Improvement District (WCID) No. 17. The report is designed to accomplish two primary goals: 1) Provide a preliminary baseline assessment of environmental and cultural features that, under Federal, State, and local regulations may become of concern in the development of regional water supply facilities; and, 2) Identify potential effects and/or constraints to the development of such facilities. Section 2.0 of this report provides an overview of existing and proposed regulatory programs and planning initiatives pertinent to the study area. Section 3.0 presents a preliminary environmental baseline and identified significant environmental features that may be of concern to Federal, State, and local regulatory agencies. Section 4.0 identifies potential environmental effects and/or constraints to the development of water supply facilities. Section 5.0 provides a synopsis of recommended actions. Finally, Section 6.0 provides a list of references cited.

2.0 REGULATORY OVERVIEW

Federal, State, and local environmental regulations are expected to influence the development of water supply facilities within the boundaries of WCID No. 17. This section reviews Federal regulations, including U.S. Fish and Wildlife Service (FWS) Section 7 consultation for threatened and endangered species; U.S. Corps of Engineers 404 permits for stream crossings; and the National Historic Preservation Act for cultural resources. The only State environmental regulation expected to be of concern is the Texas Antiquities Code which applies to all action taken by political subdivisions of the State of Texas. Local environmental regulations expected to be of particular concern include the City of Austin's Comprehensive Watersheds Ordinance (CWO) and Endangered Species Survey Ordinance. Table 1 provides a synopsis of environmental considerations which may be of concern in the development of water supply facilities.

2.1 COMPREHENSIVE WATERSHEDS ORDINANCE CONSIDERATIONS

The City of Austin's Comprehensive Watersheds Ordinance (CWO) is expected to be a major consideration in the development of water supply facilities in the Lake Austin and/or Lake Travis Watersheds. Prior to beginning construction of any facilities, site plan approval must be obtained from the City of Austin Planning Department. Information required with the site plan includes an environmental assessment which will identify critical environmental features found on the site and will describe the vegetative and hydrogeologic characteristics of the site. Additionally, it must be demonstrated that no significant environmental impacts will result from construction of the water supply facilities.

TABLE 1

SYNOPSIS OF ENVIRONMENTAL CONSIDERATIONS

ASSOCIATED WITH EXISTING AND PROPOSED

REGULATORY PROGRAMS

Program	Considerations
City of Austin Comprehensive Watershed Ordinance (see Table 3)	1) Permit required for water line construction. 2) Environmental assessment required, including alternatives analysis. 3) Any variance must be approved by Planning Commission prior to administrative approval of permit by staff.
Endangered Species Survey Ordinance	Ordinance requires: 1) Verification of the need, or lack thereof, for an endangered species survey; 2) If survey is necessary, mapping of suitable habitat; 3) Surveys for occupied territories; 4) Contact of appropriate local, State, and Federal agencies of finding.

TABLE 1 (Cont'd)

Program	Considerations
Section 7 of the Endangered Species Act of 1973, as amended	1) Formal Section 7 consultation with FWS and USCE and the applicant may be required prior to issuance of USCE permit or any other Federal Permit.
	2) It will be the responsibility of the applicant to prove whether or not Federally-listed species occur in the project area.
	3) If formal Section 7 consultation is required, schedule delays up to 90 days can be expected.
Corps of Engineers 404 Permit Requirement	1) A permit is required for pipeline crossings of surface water tributaries and waterways.
	2) A "general permit" exists which significantly reduces the time and paperwork for pipeline construction authorizations.
	3) Should have information on potential impacts to cultural resources and threatened or endangered species prior to involvement of Corps.
	4) Acquisition of Corps' authorization early in process will greatly reduce avenues for special interest group intervention.
Texas Antiquities Code	1) Applies to actions taken by political subdivisions of the State of Texas.
	2) Administered by Texas Antiquities Committee.
	3) Generally requires archaeological survey of area of primary impact, and occasionally, testing of potentially important sites.
	4) Sites which are determined to be eligible for formal designation as a State Archeological Landmark may need preservation and/or mitigation.
National Historic Preservation Act	1) Potentially applicable for any Federal action, including permits, funding.
	2) Administered by Texas Historic Commission and State Historic Preservation Officer.

TABLE 1 (Concluded)

Program	Considerations
	3) Generally requires archaeological survey of affected areas, and, occasionally, testing of more important sites; in some cases, indirect impact areas must be considered.
	4) Sites which are determined to be eligible for the National Register of Historic Places may need preservation and/or mitigation.

Environmental considerations we anticipate will be of concern to City of Austin staff, boards, and commissions include number of creek crossings for pipelines, potential disturbance of critical environmental features, impacts of construction activities to threatened or endangered species or their habitats, difficulty of restoring disturbed areas, and overall impacts to water quality.

2.2 ENDANGERED SPECIES SURVEY ORDINANCE

Three regulatory programs relating to endangered species exist or are being developed which may influence the proposed project, including the City of Austin's Endangered Species Survey Ordinance, USFWS Section 7 Consultation, and USFWS Section 10a permit (via Austin Regional Habitat Conservation Plan).

The City of Austin recently (August 1989) passed an Endangered Species Ordinance requiring surveys for endangered species prior to submitting an application for subdivision and site development. The purpose of the ordinance is to notify pertinent agencies of the status of the endangered species in the proposed areas of development. If the survey indicates the presence of endangered species, the ordinance requires notice be given to the following:

1) U.S. Fish and Wildlife Service;
2) Texas Parks and Wildlife Department - Natural Heritage Program;
3) Planning Commission;
4) Environmental Board;
5) Mayor & Council Members;
6) Travis County Judge and Commissioners Court; and
7) Regional Habitat Conservation Plan Executive Committee.

For the purposes of this ordinance, endangered species include the following:

1) Black-capped Vireo;
2) Golden-cheeked Warbler;
3) Tooth Cave Pseudoscorpion;
4) Tooth Cave Spider;
5) Bee Creek Cave Harvestman;
6) Tooth Cave Ground Beetle;
7) Kretschman Cave Mold Beetle;
8) Any species hereafter included in a Regional Habitat Conservation Plan; or
9) Any species classified as endangered by the USFWS.

This ordinance requires three distinct steps be followed:

1) Verification of the need, or lack thereof, for an endangered species survey;
2) If required, mapping of suitable habitat; and
3) Surveys for occupied territories.

It is quite possible that formal Section 7 consultation between the FWS, U.S. Corps of Engineers, and the WCID will be required before issuance of a U.S. Corps of Engineers permit because of perceived direct and indirect impacts to the Black-capped Vireo. Additionally, environmental groups may petition the FWS and the U.S. Corps of Engineers to initiate Section 7 consultation if it is not initiated by the applicant. It will be the responsibility of the applicant to prove whether or not Federally-listed threatened or endangered species occur on the project area. If Section 7 consultation is required, considerable schedule delays (60-90 days minimum) will be inevitable

during the period in which FWS will be conducting its biological assessment and forming its "biological opinions".

The City of Austin, Travis County, along with several other public and private entities have established a committee to develop the Austin Regional Habitat Conservation Plan (ARHCP) in support of a USFWS Section 10a Permit. The purpose of the ARHCP is to develop the appropriate strategy to provide a reasonable balance between protection of endangered species and economic development. The ARHCP process is currently ongoing and may take up to two years to complete.

If the Plan is completed prior to development of water facilities at WCID No. 17, compliance will be required.

2.3 FEDERAL REGULATORY CONSIDERATIONS

Section 404 of the Clean Water Act as administered by the U.S. Army Corps of Engineers regulates the placement of dredged (excavated) or fill material in "Waters of the U.S." Waters of the U.S. are defined in Section 404 rather broadly as any body of surface water (such as oceans, bays, rivers), all surface tributary streams with a defined channel (including intermittent waterways), any in-stream impoundments (i.e., lakes and ponds), many off-channel impoundments, and wetlands. "Dredged or fill material" has also been given rather broad meaning to include just about any material or object used for construction such as dirt, rocks, concrete, piles, pipes, etc. In regards to construction of a water intake structure or pipeline where a crossing or direct involvement with a surface tributary stream, impoundment, or wetland may be required, placement of the pipeline itself (regardless of construction material) and any trench backfill material within the area of jurisdiction is subject to permit requirements under 404 regulations.

The Fort Worth District Corps of Engineers, who has 404 regulatory responsibility for the Travis County area, maintains a "general permit" for most pipeline construction projects. A general permit is a pre-authorized permit for a specifically identified activity which is conducted under certain specified conditions. General permits are issued on either a nationwide or regional basis. The purpose of general permits is to provide paperwork and time expenditure relief for permitting actions which are determined to be routine and resulting in little or no impacts to waters of the U.S.

With regard to water storage and transmission facilities for the WCID, crossings of surface tributaries with water lines will be necessary and, therefore, legally subject to permitting requirements under federal law. As pipeline construction activities are considered minor works with minimal impacts to waters of the U.S. by the Fort Worth Corps (hence the general permit), the Corps does not spend much effort trying to enforce and specifically permit all pipeline construction projects. In fact, the majority of water and wastewater pipeline construction projects in the Austin area are constructed without specific notification or approval of the Corps. Even though the legal requirement for permitting exists, the Corps generally takes the position that as long as pipelines are constructed according to the conditions of the general permit (basically, return of natural contours and no permanent obstruction of watercourses); that no impacts occur to cultural resources or threatened or endangered species for which other federal regulations exist; and that no one (agency or individual) objects and complains about the activity, the activity is authorized under the general permit without formal notification and paperwork.

Under 404 regulations a general permit may be suspended for any given project and a full individual permit required if

impacts to cultural resources, threatened or endangered species, or other factors of the public health and welfare are potentially to occur. An individual permit action can require from a minimum of three months to a year or longer to complete and may also involve public hearings and Environmental Impact Statement requirements. It should be noted that any of the service options which do or have a high probability of resulting in significant impacts to cultural resources or federally listed threatened or endangered species stand a high probability of not being authorized under general permit.

2.4 ARCHAEOLOGICAL/CULTURAL RESOURCES

WCID No. 17 is considered a political subdivision of the state under the provisions of the Texas Antiquities Code, and, therefore, must consider the effects of its actions upon possible archaeological sites. Under the code, all archaeological sites, either historic or prehistoric, and significant historic structures on lands belonging to or controlled by political subdivisions of the state are automatically considered to be State Archeological Landmarks (SALs) and may be eligible for protection. Construction projects by the district will require a Texas Antiquities Permit and coordination with the Texas Antiquities Committee (TAC). In practice, this often necessitates an archaeological and historical survey of previously unsurveyed areas prior to any potentially destructive action. Sites recorded during this survey must be evaluated; those which are of significant historical or scientific value will be formally designated for SAL status and measures of protection or mitigation of adverse impact negotiated between the political subdivision and the TAC.

In addition to the State role in overseeing cultural resources, through the TAC, possible Federal involvement in the protection of cultural resource sites may be invoked through

application for a Section 404 or Section 10 permit from the U. S. Army Corps of Engineers (USCE) should structures or lines be located in waters of the United States such as Lake Travis. Should the USCE become involved, it may request the opinion of the State Historic Preservation Officer (SHPO) concerning the effect of the project on cultural resources. Because of the high potential for cultural resources in the general area, it is certainly possible that the SHPO would, like the TAC, require archaeological survey, site evaluation, and protection and/or mitigation measures for important sites located during the initial survey. In such cases, where both the TAC and the SHPO have jurisdiction, one will usually operate as lead agency.

Cultural resources studies may be coordinated through the Texas Water Development Board (TWDB) where TWDB funds are utilized, or coordinated directly through the TAC. Because of the relatively high density of sites in the Lake Travis/upper Lake Austin region, it is anticipated that either agency will ask for archaeological surveys of planned facilities in previously unsurveyed areas.

3.0 BASELINE DESCRIPTION

3.1 ECOLOGY

3.1.1 Vegetation

The WCID No. 17 service area is located within the Edwards Plateau Vegetational area described by Gould (1975). This rough, rocky area is highly dissected by small tributaries of the Colorado River. Elevations within WCID No. 17 range from about 1100 ft msl in the southern portion of the service area to about 600 ft msl. The Edwards Plateau is predominantly rangeland comprised of an excellent mixture of forage plants (Gould, 1975). Important climax grasses, according to Gould, include switchgrasses, several bluestems, buffalograss, gramas, and Indiangrass. The Edwards Plateau supports a brush overstory of live oak, shinney oak, and junipers. However, these brush species are generally considered "invaders" of the climax grasslands and open savannahs (Gould, 1975).

Four vegetative communities were identified in the WCID area; upland woodland, grassland, lowland woodland, and savannah. The upland woodland vegetation complex typically occupies the moderate to steep slopes and is generally comprised of an overstory of Ashe juniper (Juniperus ashei), Texas Oak (Quercus texana), Cedar elm (Ulmus crassifolia), and plateau live oak (Quercus fusiformis). These four overstory species vary in community dominance throughout the WCID area. The understory is typically sparse within these woodlands and consists of saplings of the overstory, yaupon (Ilex vomitoria), Texas persimmon (Diospyros texana), and coma (Bumelia lanuginosa). Grasses and forbs are sparse in these woodlands due to density of the overstory canopy.

The grasslands within the WCID No. 17 typically occupy the nearly level to moderate slopes. Common herbaceous species include side oats grama (Bouteloua curtipendula), curly mesquite (Hilaria belangeri), little bluestem (Schizachyrium scoparium), silver bluestem (Bothriochloa saccharoides), buffalograss (Buchloe dactyloides), and panic grass (Panicum sp.). Forb species occurring in the grasslands include upright coneflower (Ratibida columnaris), lemon beebalm (Monarda citriodora), and Texas yucca (Yucca rupicola).

The lowland woodlands occupy the areas along Lake Austin, Hudson Bend peninsula, and also along mesic creek bottoms. Due to the greater moisture availability in these locales, pecans (Carya illinoienensis), black willow (Salix nigra), and bald cypress (Taxodium distichum) dominate the overstory along Lake Austin. Other species that are common in the lowland woodlands includes the American sycamore (Platanus occidentalis), sugar hackberry (Celtis laevigata), cedar elm, and American elm (Ulmus americana). American beautyberry (Callicarpa americana), grapes (Vitis sp.), soapberry (Sapindus saponaria), and the occasional mesquite (Prosopis glandulosa) comprise the understory.

The savannahs of the WCID project area characteristically occupy level to moderate slopes and include Ashe junipers, plateau live oaks, and cedar elms as overstory species and Texas persimmon, flameleaf sumac (Rhus lanceolata), evergreen sumac (Rhus virens), agarito (Berberis trifoliolata), and Texas prickly pear (Opunitia lindheimer) as understory species. Completing the savannah plant composition are the grasses and forbs such as side oats grama, several bluestems, curly mesquite, buffalograss, one-seed croton (Croton monanthogynous), and upright coneflower, among others.

3.1.2 Wildlife

The WCID No. 17 project area is located in western Travis County and lies within the Balconian Biotic Province described by Blair (1950). This province is synonymous with the Edwards Plateau vegetational region described by Gould (1975). The vertebrate fauna of the Balconian Province is represented by a mixture of species from the Kansan, Texan, Austroriparian, Chihuahuan, and Tamaulipan provinces.

The major wildlife habitats occurring with the WCID are synonymous with the vegetative cover types discussed in Section 3.1.1. The woodland habitats provide cover, mast, and other food items for a diversity of wildlife. Species commonly found in the woodland habitats include the white-tailed deer (Odocoileus virginianus), fox squirrel (Sciurus niger), raccoon (Procyon lotor), Scrub Jay (Aphelocoma coerulescens), Tufted Titmouse (Parus bicolor), and the Texas spiny lizard (Sceloporus olivaceous), among others. Dense oak/juniper woodlands of the project area also provide habitat for the State-listed Golden-cheeked Warbler. The grasslands and savannahs are also important habitats. They provide a diversity of forage and forbs for species such as the white-tailed deer and eastern cottontail (Sylvilagus floridanus), seed for species such as the Northern Bobwhite (Colinus virginianus), Mourning Dove (Zenaida macroura), and Painted Bunting (Passerina ciris), and nesting habitat for the endangered Black-capped Vireo.

3.1.3 Aquatic Ecology

The WCID area lies within the Lake Travis and Lake Austin watersheds. The area is characterized as rugged hills that are highly dissected by mainly intermittent streams that flow only under wetter weather.

The WCID No. 17 boundary includes approximately 24.9 miles frontage along Lake Travis and approximately 5.4 miles along Lake Austin. The normal pool elevation for Lake Travis is 681 feet msl and for Lake Austin below Mansfield's Dam is 493 feet msl. Common fish species occurring in these two water bodies and, possibly, up the mouths of some creeks, include the bluegill (Lepomis macrochirus), carp (Cyprinus carpio), golden shiner (C. auratus), largemouth bass (Micropterus salmoides), Guadalupe bass (M. treculi), channel catfish (Ictalurus punctatus), and mosquitofish (Gambusia affinis).

The aquatic habitats within the creeks of the WCID are limited due to the intermittent nature of the streams, scouring by storm events, and the solid limestone substrate. A few springs and seeps are present within the WCID boundary and are shown on Figure 1 (map pocket). These are usually situated at the heads of the major canyons at the start of the tributaries. The springs or seeps are usually small ground water fields that are closely associated with surface flow. These springs are considered a critical environmental feature by the Comprehensive Watersheds Ordinance. These features typically do not support any substantial sustainable aquatic habitats.

3.1.4 Threatened and Endangered Species

Several plant and animal species which are considered rare, threatened or endangered by the FWS, TPWD, and TNHP are known to occur in the WCID No. 17 service area and surrounding areas. The following provides a brief description of the threatened, endangered, and rare fauna and flora which are known to occur or are highly likely to occur in the project area.

The Federally-listed Black-capped Vireo (Vireo atricapillus) is a spring and summer resident in the central Texas area. This small migratory bird is a habitat specialist

and primarily occurs in pockets of optimum habitat widely separated from other groups of vireos (City of Austin DEP, 1987). The preferred habitat of the Black-capped Vireo is a transitional type of vegetation - a seral stage typically occurring between the time of disturbance of a woodland or savannah (e.g., fire) and its eventual return to a wooded character, or following disturbance of a grassland (e.g., excessive grazing) and its invasion by brush (DLS Associates, 1988). Normally, there is an edge feature associated with the habitat such as the transition or boundary from grassland to brush. Nesting substrate is variable for the Black-capped Vireo, however, plant characteristics apparently preferred for nest substrate include the following: broad-leaved, dense foliage; foliage close to the ground; canopy height less than 10 to 12 feet; strong and rigid branches; horizontally-forked branches; and among deciduous species - adequate leaf generation prior to selection of nest site (DLS Associates, 1988).

Black-capped Vireo habitats and territories have been mapped for a large portion of the WCID No. 17 (Espey, Huston & Associates, Inc., 1988; DLS and Associates, 1988). Figure 1 (map pocket) depicts suitable and prime Black-capped Vireo habitats and Black-capped Vireo territories as mapped by DLS Associates (1988). As indicated in Figure 1, the highest concentration of vireos occurs along Comanche Trail and on the Steiner Ranch.

Five species of cave invertebrates occurring in close proximity to the WCID No. 17 were recently listed as endangered by the FWS. They include the Tooth Cave Pseudoscorpion (Microcreagris texana), Tooth Cave Spider (Leptoneta myopica), Tooth Cave Beetle (Rhadine persephone), Bee Creek Cave Harvestman (Texella reddelli), and Kretchmarr Cave Mold Beetle (Texamaurops reddelli) (FWS, 1988). Each of these is known from only six or fewer small shallow caves in Travis and Williamson counties. The

caves inhabited by these invertebrates occur in isolated "islands" of the Edwards Formation.

The Golden-cheeked Warbler (Dendroica chrysoparia) is a spring and summer resident of western Travis County. It is listed as threatened by the TPWD and is also a category 2 candidate to the Federal list of threatened and endangered species. It has the distinction of being the only bird species which nests exclusively in Texas. Its nesting range encompasses the eastern one-third of the Edwards Plateau and the western one-quarter of the Cross-Timbers and Prairies Region. Typical nesting habitat is comprised of mature juniper/oak woodlands. Within the project area, Golden-cheeked Warbler habitat occurs primarily along steep, densely wooded canyons and hillsides.

The blue sucker (Cycleptus elongatus) and the Guadalupe bass (Micropterus treculi) are both known to occur in Travis County. The blue sucker is listed as threatened by the TPWD and the Guadalupe bass is listed as a Federal category 2 candidate. It is unknown if the blue sucker occurs in Lake Travis or Lake Austin, however, the Guadalupe bass is considered locally abundant in Lake Travis and probably in Lake Austin as well.

Several rare plants are known to occur in the project area and surrounding areas and were mapped by the City of Austin DEP and the TNHP. Rare plants mapped by the City of Austin include Galium circaezans, Anemia mexicana, and Chrysactina mexicana. These plants occur on the north side of FM 620 west of Hudson Bend (Figure 1 - map pocket).

Five other rare plant species are of concern to the TNHP and are known to occur in close proximity to the WCID NO. 17. They include the Federal category 2 candidate Amorpha roemerana; the Federal category 3C candidates Onosmodium helleri and Philadelphus ernestii; Tetraclea viscida; and Polymnia

uvedalia var. densipilis. Although none of the aforementioned species have been recorded from the project area, it is quite likely that some may be present within the WCID boundaries.

3.1.5 Wetlands/404 Jurisdictional Areas

Waters of the U.S. as defined in Section 404 of the Clean Water Act include all streams and ponds of the WCID No. 17 project area in addition to Lake Austin and Lake Travis. Construction within these waters will require a Section 404 permit from the Fort Worth District Corps of Engineers.

3.2 ARCHAEOLOGICAL/CULTURAL RESOURCES

3.2.1 Cultural Background

At the most general level, the prehistory of Central Texas has been divided into four general periods or stages, as originally defined by Suhm, Krieger and Jelks (1954). In current terminology, these are the Paleoindian, the Archaic, the Late Prehistoric and the Historic.

The Paleoindian stage was originally devised to encompass the earliest inhabitants of the New World, spreading across the continent in the waning years of the Pleistocene era. These cultures are known by their distinctive lithic technology, including a series of well-made lanceolate projectile points. Site types occupied during this stage include both rockshelters and open sites. The Paleoindians have been described as nomadic big-game hunters and many of the earliest sites of this period are associated with now-extinct large mammals of the Pleistocene era. The first occupations of the New World, however, may have occurred much earlier than the 11,500 B.P. date often given as the initial date for the Paleoindian period, and, outside of the Great Plains and the Rocky Mountain West, big game hunting may

not have been the most important economic pursuit during this period (e.g., Black and McGraw 1985:36-7).

The warming climates at the end of the Pleistocene are associated with a relatively rapid cultural change. The cultures of the Archaic stage, beginning around 8,500 B.P., were originally distinguished from the earlier Paleoindian cultures by increasingly regionalized traditions with a perceived wider exploitation of available food resources. In general, it appears that the Archaic peoples began to settle into their environment, becoming increasingly familiar with the resources of the regions which they inhabited. This is a trend which must have begun during the latter part of the Paleoindian stage and continued throughout most of the Archaic. Toward the end of the Archaic period, population densities may have increased and connections may have been established between the hunter-gatherers of Central Texas and the complex cultures developing in surrounding regions. Large burial sites in some parts of south central and coastal Texas in the Late Archaic may indicate intensive reoccupation of certain sites or, possibly, increasing sedentarism of the cultural groups.

The final prehistoric period in Texas, the Late Prehistoric, is marked by the introduction of new technologies, including the bow and arrow and ceramics, as well as potentially new adaptive strategies. While the earliest part of this period, beginning about A.D. 500, may indicate introduction of new technologies into existing cultural patterns, the latest part seems to indicate the possible actual introduction of peoples following a southward extension of the range of the bison. Although the Late Prehistoric stage has been traditionally separated from the Archaic, Prewitt (1981) has cogently argued against the separation of this period into a different stage.

Although the Historic stage theoretically begins in Texas with the arrival of Alvar Nunez Cabeza de Vaca and the survivors of the Narvaez expedition on the Texas coast in 1528, there may have been earlier landings, notably by the expeditions sent by Francisco Garay, then governor of Jamaica, to the mouth of the Rio Grande between 1519 and 1523 (Salinas 1986:34-8). In any case, the influences of European colonization were not strongly felt for several centuries. By the middle of the 18th century, however, massive depopulation and cultural disintegration was evident among native Indian groups. Although the historic settlement of Texas began in earnest during the 18th century, it was not until the Anglo settlement of the 19th century that occupations occurred outside the core of early Spanish settlement.

3.2.2 Previous Research

Travis County, with more than 1400 sites, has one of the highest total number of recorded archaeological sites of any county in the state. In part this is due to the presence of the University of Texas at Austin with its long-active Anthropology Department. Another large part, however, is due to the high density of visible prehistoric archaeological sites which are found along the Balcones Escarpment and the major drainages which are cut deeply back into the uplifted limestone. The combination of Edwards Limestone Formation, which contains a relatively high-quality supply of chert used by the Indians for tools manufacture, and the Colorado River, a dependable water supply for humans and animals alike, increase the probability of sites within the region.

Archaeological work in the Lake Travis area has a long history. J. E. Pearce of the University of Texas at Austin began studying middens in the area prior to World War I (Pearce 1919; 1932; 1938). During the late 1930s, the WPA began a series of

surveys and excavations of the sites of the proposed Marshall Ford (Lake Travis) reservoir area (Jackson 1938; 1939; McLaurin 1938). Later studies include the excavations by Kelly (1961) at the Crumley site and by Alexander (1963) at the Levi site. A more recent synthetic study is the thesis on burned rock midden origins by Howard (1983). Recent cultural resource management archaeological studies have been conducted in and around the area by several contract firms (Howard and Freeman 1984; Jameson 1985; Coffman et al. 1986).

3.2.3 Background Results

A background search of the files of the Texas Archeological Research Laboratory and the Texas Historical Commission found a total of 39 cultural resource sites either within or immediately adjacent to the district boundaries. Generalized locations of these sites are shown on the enclosed figure. None of these previously recorded sites are presently listed on the National Register of Historic Places nor are any known to have been determined eligible for the Register by either the SHPO or the Advisory Council on Historic Preservation. None of the sites has been formally designated as an SAL although any of them which are on state, county, or political subdivision lands would be automatically considered SALs.

A comparison of the reported sites with WCID's planned facilities shows very few sites in and around the proposed facility locations. Several small sites are located near the proposed tanks in the Steiner Ranch area, along Quinlan Park Road, and another is located north of the proposed tank in the Apache Shores area. The lack of sites recorded in other facilities areas is no indication of their complete absence, however, since very little archaeological survey has been conducted in most of the WCID service area. Only an estimated

less than five percent of the total service area has been subjected to complete archaeological survey as of this writing.

4.0 ENVIRONMENTAL EFFECTS AND CONSTRAINTS

4.1 ECOLOGY

4.1.1 Vegetation

Vegetation within the WCID No. 17 is, for the most part, typical of the eastern Edwards Plateau. However, some of the savannah habitats support the Black-capped Vireo while portions of the woodlands support the Golden-cheeked Warbler. Under Federal legislation, the Black-capped Vireo and its habitat are protected under the Endangered Species Act of 1973, as amended. Conversely, the Golden-cheeked Warbler and its habitat are not afforded protection under the Endangered Species Act of 1973, as amended.

If the proposed Endangered Species Ordinance is passed, however, both the Golden-cheeked Warbler, Black-capped Vireo, and their habitats will be provided full protection within the City of Austin and its ETJ. Additionally, any other Federal or State-listed species, Federal or State-proposed species, or any species ranked either as G1 or S1 by the TNHP occurring within the City of Austin's jurisdiction will be protected under the proposed ordinance. Additionally, several rare plants would be protected with the passage of the proposed ordinance and would also pose potential constraints to development of the proposed facilities. In order to identify potential constraints, threatened and endangered species surveys should be conducted in the areas of proposed construction.

4.1.2 Wildlife

Several wildlife species which are currently unprotected would be protected with adoption of the proposed endangered species ordinance and would, therefore, pose potential

constraints to construction of water facilities. Within the WCID No. 17 service area, the Golden-cheeked Warbler is the primary wildlife species which poses a potential constraint. Additionally, other species receiving protection with adoption of the ordinance include all Federal or State-listed species, Federal and State-proposed species, and species ranked G1 or S1 by the TNHP.

4.1.3 Aquatic

Construction activities within the aquatic habitats of the project areas are governed by Section 404 of the Clean Water Act as administered by the Fort Worth District Corps of Engineers. These waterways pose a potential constraint because a Federal 404 permit is required to construct within them. In order to comply with the conditions of the permit, it must be demonstrated that the project will not impact cultural resources, threatened or endangered species, or other factors affecting public health and welfare.

4.2 ARCHAEOLOGICAL/CULTURAL RESOURCES

The 39 sites reported within the WCID service area are little indication of the difficulties which might arise when cultural resources are not taken into account during the planning process. As previously noted, less than five percent of the total service area has been subjected to complete archaeological survey. A complete archaeological survey of the district might reveal ten or twenty times this number of sites. Such a survey is not necessary, of course, but it points to the possibility that some of the proposed facility locations may coincide with the locations of significant archaeological sites.

The majority of the sites reported within the WCID service area are prehistoric. Locations vary considerably but

several potential location types clearly predominate in the small sample of sites. These include sites on broad hilltops, on intermediate benches along the side slopes of larger hills, at or near the head of small drainage valleys and along the margins of the larger streams. Given the siting requirements for water facilities, the first two types are likely to cause the greatest trouble. Fortunately, many of these hilltop sites are surficial and often previously disturbed. Since most disturbed sites will not be considered worthy of formal SAL designation or NRHP status, these sites should pose little obstacle to facilities construction.

5.0 RECOMMENDED ACTION

The development of water treatment and distribution facilities within the WCID service area is expected to require permits and approvals from various Federal, State, and local agencies which may include the USCE, USFWS, TAC, TWDB, and the City of Austin's Department of Environmental Protection. In order to assure the necessary permits and approvals do not unnecessarily delay the development of water supply facilities, the following actions are recommended.

5.1 PRELIMINARY COORDINATION WITH THE CITY OF AUSTIN

Preliminary coordination with the City of Austin's Department of Environmental Protection is necessary to identify concerns and acquire tentative approval of the selected option before proceeding. Preliminary coordination will include presentation to the City staff, the Environmental Review Board, and on-site field inspections with staff. In addition, preliminary coordination will aid in determining how the proposed project may be impacted by the proposed threatened and endangered ordinance if it is approved.

5.2 USCE PERMITTING

As previously mentioned, pipeline construction projects which involve crossing of waterways require permit authorization under Section 404 of the Clean Water Act by the U.S. Corps of Engineers. Recommendations to assure timely acquisition of a 404 permit include submitting development plans and a summary of threatened and endangered species, and significant cultural resources prior to construction. If the summary indicates the potential for threatened and endangered species and cultural resources exist, surveys may be required thus delaying the construction of facilities. Therefore, it is recommended that

coordination with the USCE begin immediately upon decision to develop the planned facilities and necessary (if required) surveys conducted.

5.3 PRELIMINARY CULTURAL RESOURCES COORDINATION

Recommendations include maintaining contact with an archaeologist as part of the planning process. When final locations for lines and facilities are determined, an assessment of the regulatory requirements should be made and contact made with the appropriate State and/or Federal agencies. If required, a cultural resources survey of the proposed route should be initiated immediately and any significant or potentially significant sites can be dealt with, causing as little delay as possible. Since survey of small parcels of land is relatively inefficient, particularly when an Antiquities Permit must be secured for each, it is recommended that as many as possible of the proposed facilities be grouped for cultural resources survey at one time to save time and money.

It is important to note that the time involved in acquiring the previously described permits and approvals case vary significantly depending upon the sensitivity of the environment, location of facilities, and potential for intervention by special interest groups. Based on the previously described sensitive environmental features, potential habitat for threatened and endangered species and high probability of significant cultural resource sites, it is recommended preliminary coordination with the appropriate Federal, State, and local agencies begin immediately upon decision to develop the planned facilities.

Creek Development. Reports of Investigations 37. Austin: Prewitt & Associates, Inc.

Jackson, A. T.
1938 Quarterly Progress Report, Works Progress Administration - The University of Texas Archaeological Project, October 1 to December 31, 1938. Unpublished MS, Marshall Ford Project, Texas Archeological Research Laboratory, The University of Texas at Austin.

1939 A Deep Archeological Site in Travis County, Texas. Bulletin of the Texas Archeological and Paleontological Society 11: 203-225.

Jameson, John
1985 A Cultural Resources Survey of a Portion of the Parke Development, Travis County, Texas. Espey, Huston and Associates, Inc. Document No. 85944.

Kelly, Thomas C.
1961 The Crumley Site: A Stratified Burnt Rock Midden, Travis County, Texas. Bulletin of the Texas Archeological Society 31: 239-272.

McLaurin, Farrior
1938 Some Central Texas Kitchen Middens and Camps in the Marshall Ford Basin. Unpublished M.A. Thesis, Anthropology Department, The University of Texas at Austin.

Pearce, J. E.
1919 Indian Mounds and Other Relics of Indian Life in Central Texas. American Anthropologist 21(3): 223-234.

1932 The Present Status of Texas Archeology. Bulletin of the Texas Archeological and Paleontological Society 4: 44-54.

1938 The Burnt-rock Midden - Mounds of Central and West Texas. Unpublished MS. Texas Archeological Research Laboratory, The University of Texas at Austin.

Prewitt, Elton R.
1981 Cultural Chronology in Central Texas. Bulletin of the Texas Archeological Society. 53:65-89.

Salinas, Martin
1986 Historic Indian Populations of the Rio Grande Delta and Vicinity: An Approach to Definition of Basic Units. Unpublished M.A. Thesis. Department of Anthropology. The University of Texas at Austin.

Suhm, Dee Ann, Alex D. Krieger and E. B. Jelks
1954 An Introductory Handbook of Texas Archeology. Bulletin of the Texas Archeological Society. Volume 25.

U.S. Fish and Wildlife Service (FWS)
1988 Endangered and threatened wildlife and plants; final rule to determine five Texas cave invertebrates to be endangered species. 50 CFR Part 17. September 16, 1988.

Travis County Water Control & Improvement District No. 17 Regional Water Study
Contract No. 8-483-623

The following maps are not attached to this report. They are located in the official file and may be copied upon request.

Map No. 1 - Facilities Improvements

Map No. 2 - Figure 1 - Significant Environmental Features Within The W.C.I.D. No 17 Project Boundaries

Please contact Research and Planning Fund Grants Management Division at (512) 463-7926 for copies.