West Harris County
Surface Water Supply Corporation
Implementation Plan Summary

Prepared for:

West Harris County
Surface Water Supply Corporation
and Texas Water Development Board

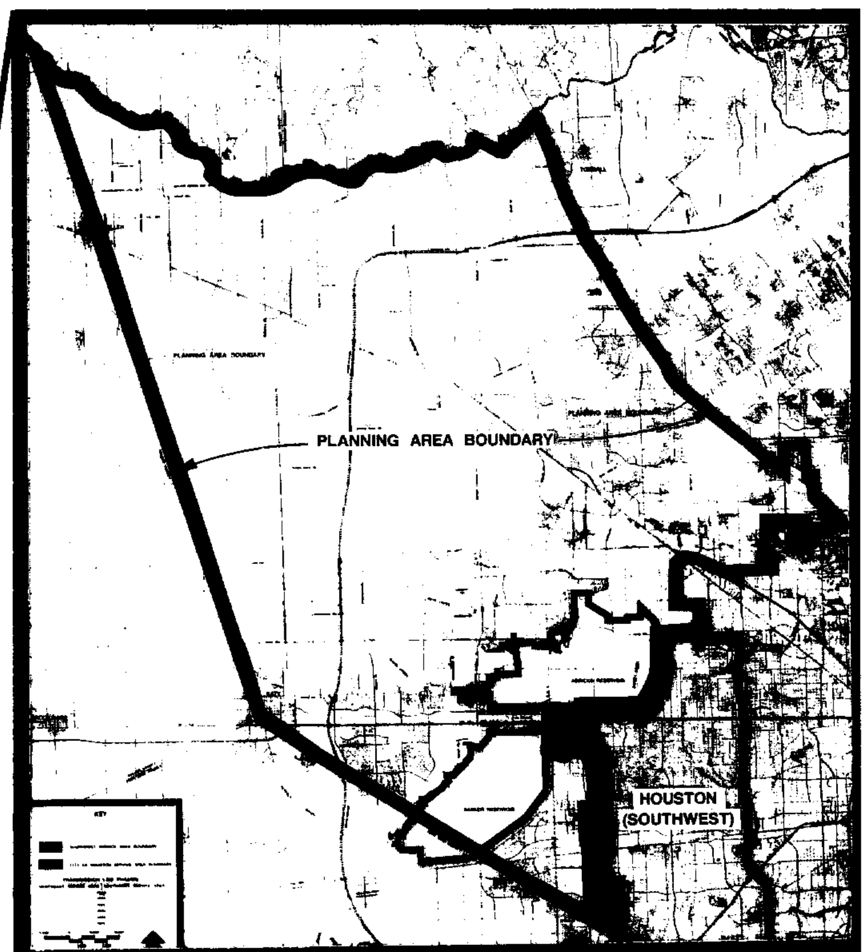
Prepared by:

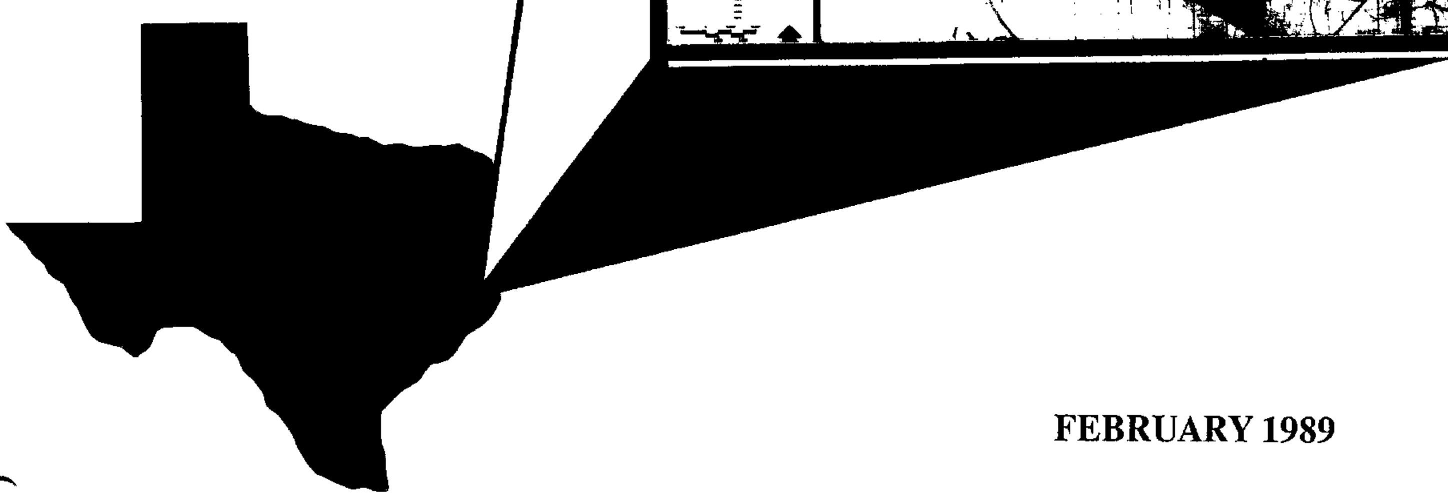
Dannenbaum Engineering Corporation

in association with:

Vinson & Elkins (legal)

Underwood, Neuhaus & Co., Incorporated and
Masterson & Company (co-Financial Advisors)





FEBRUARY 1989

Background

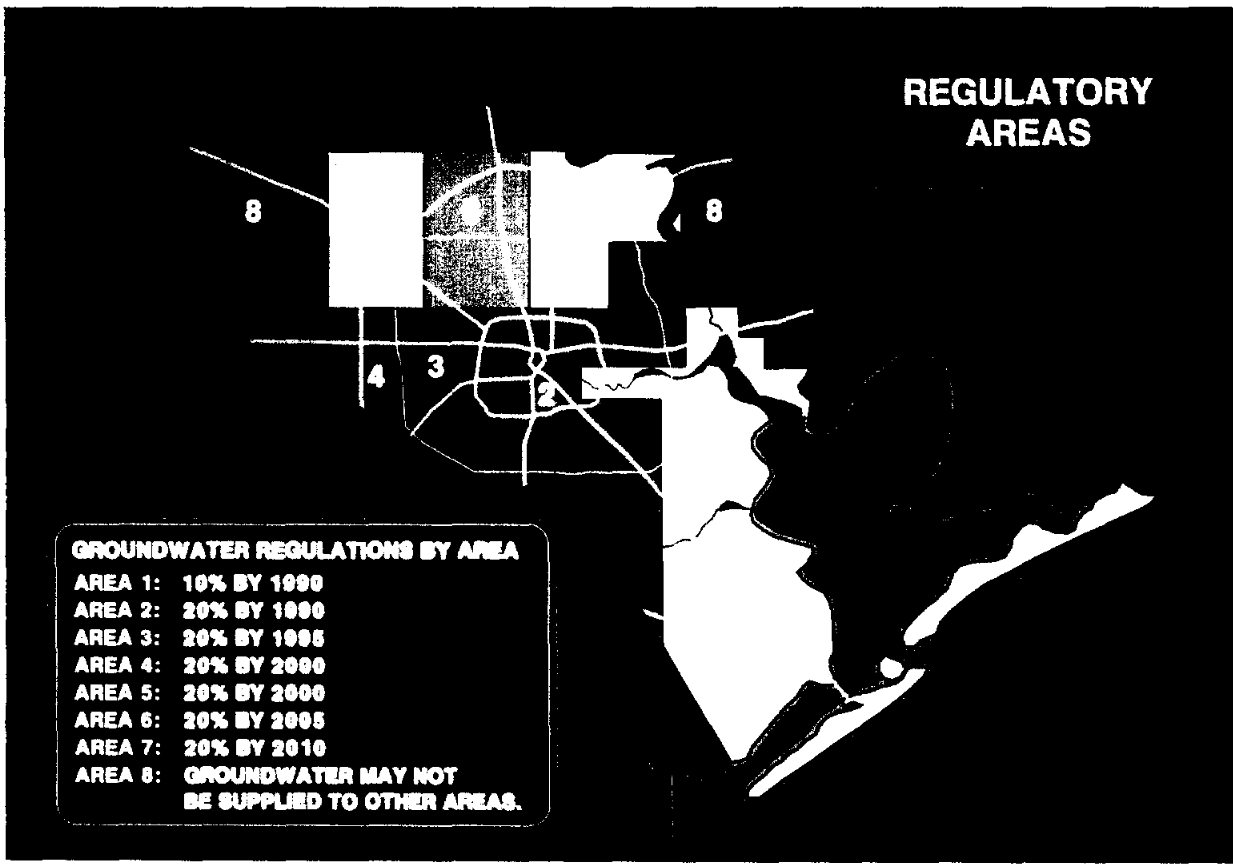
Rapid growth in the Houston area has resulted in significant growth in West Harris County. According to estimates by the year 2030 West Harris County will require 124 million gallons per day (MGD) of surface water to meet the Harris-Galveston Coastal Subsidence District Plan (HGCSD). The HGCSD's plan formulated in 1985 requires that portions of West Harris County have projects on line to allow 80% conversion to surface water by as early as 1995. Major surface water conversion projects require a development program of eight years or more and as a result project planning and development should begin as soon as possible.

As a result of the urgency associated with surface water conversion, the West Harris County Surface Water Supply Corporation (WHCSWSC) was formed. The WHCSWSC is a non-profit water supply corporation created by the Coastal Water Authority under Article 1434a, Vernon's Texas Civil Statutes.


SPRING CREEK
HARRIS COUNTY
US 290
FM 1960
SH 6
IH 10
WEST HARRIS COUNTY
SURFACE WATER
SUPPLY CORPORATION
SERVICE AREA

Plan Objective

The WHCSWSC plan objective is to accurately define the most practical and economical facilities needed to provide surface water to West Harris County in accordance with the Houston Water Master Plan (HWMP) and the HGCSD's plan.

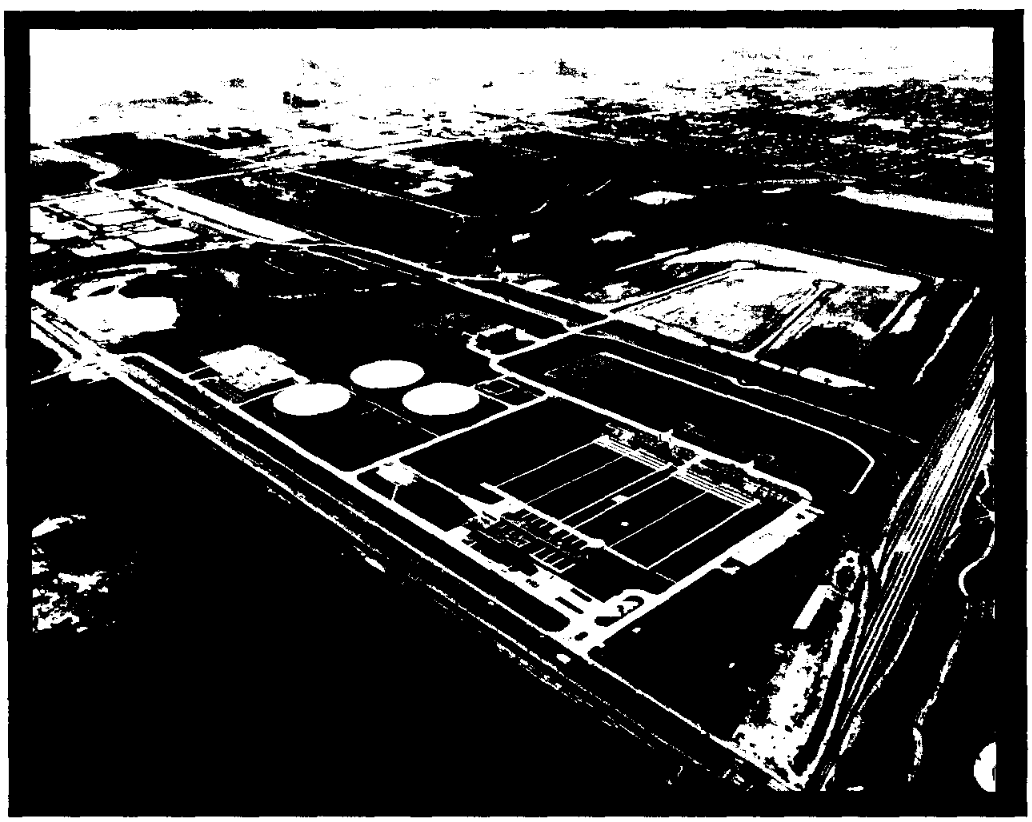


Plan Objective (Cont'd)

The plan is being accomplished in five appendices as shown below:

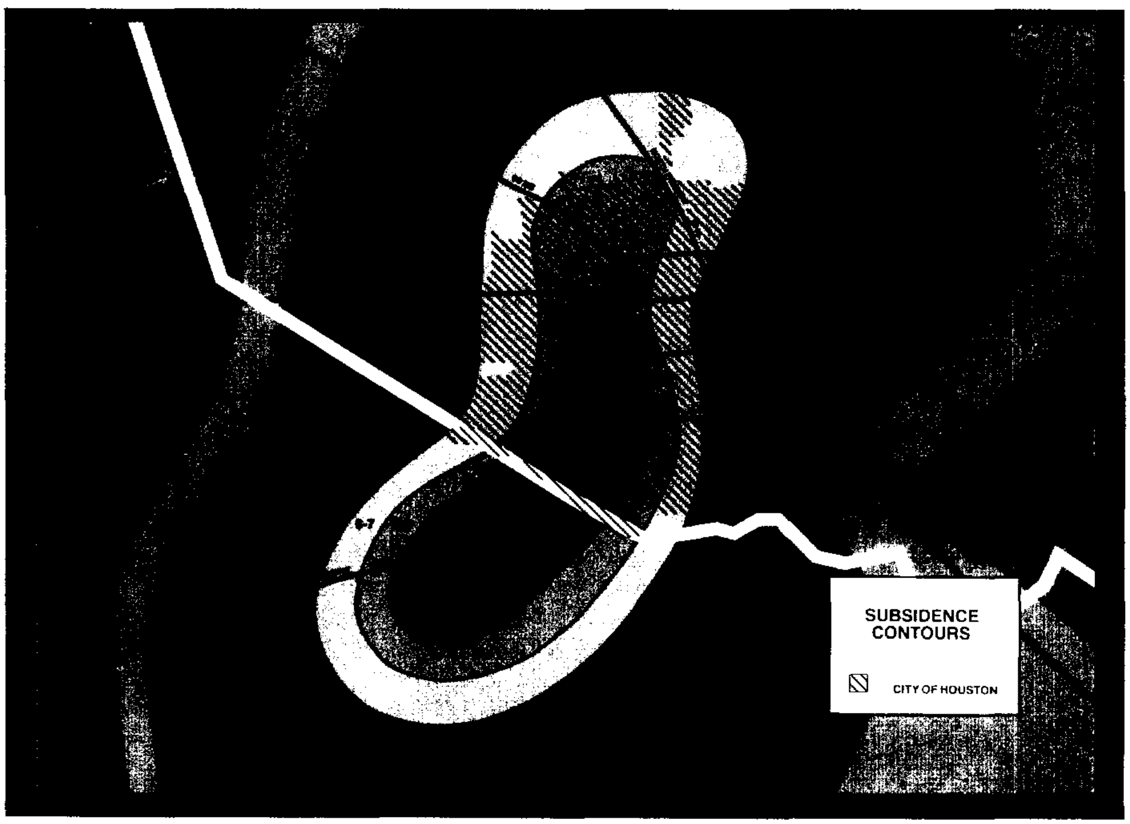
Appendix I:	*Water Conversion Plan*
Appendix II:	*Water Demand and Supply*
Appendix III:	*Supplement to Water Demand*
Appendix IV:	*Definition and Evaluation of Alternatives*
Appendix V:	*Detailed Evaluation of Selected Alternatives*

These five technical appendices are the foundation of the WHCSWSC Implementation Plan.



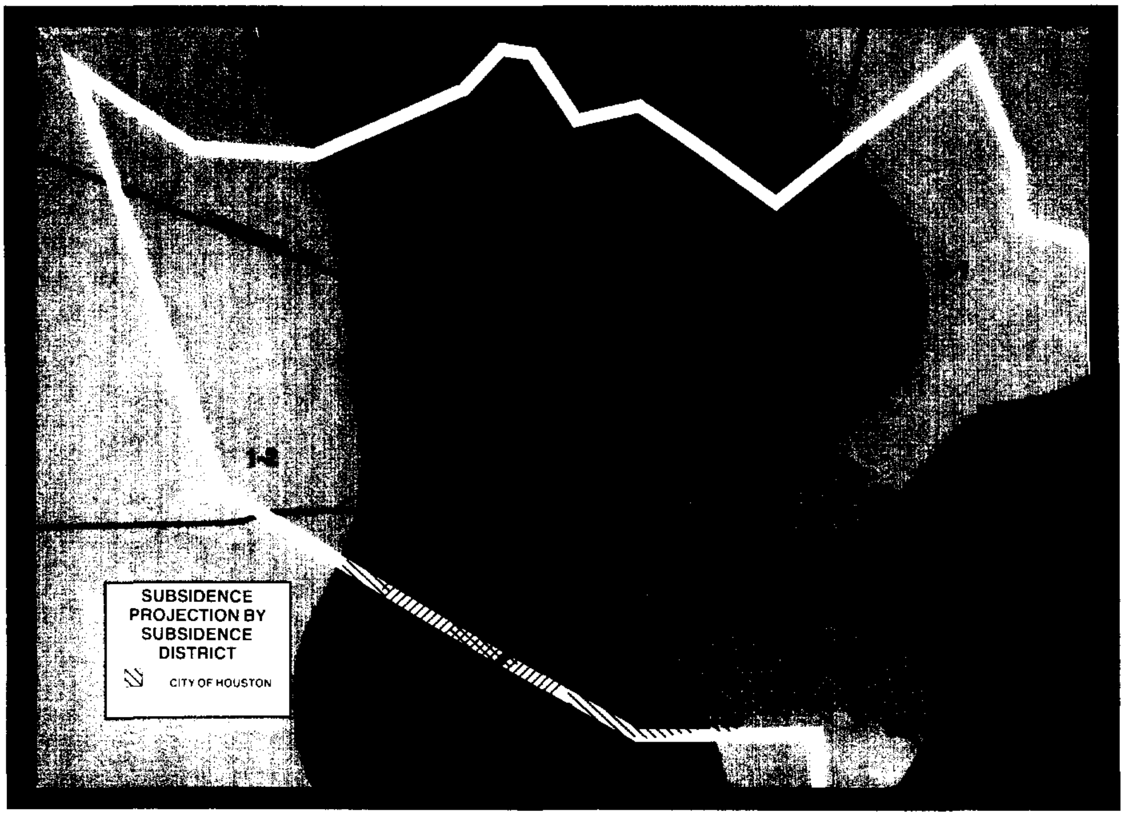
Subsidence

The WHCSWSC plan objective to bring surface water to West Harris County directly addresses one of the most pressing issues in the West Harris County area, SUBSIDENCE. Due to increased groundwater withdrawal, up to 9.0 feet of subsidence has occurred in the Baytown area since 1973. This subsidence has resulted in permanent flooding of certain inland areas. As a result an agressive surface water conversion plan in Southeast Harris County began resulting in a drastic reduction in the rate of subsidence in that part of the County. However, due to the explosive growth in West Harris County subsidence has continued to increase at an alarming rate. Presently no surface water supply system exists in West Harris County and according to recent studies if the HGCSD's plan is not implemented certain areas of West Harris County will experience 9.0 feet of subsidence by the year 2030.



Subsidence (Con't)

However, if surface water supplies are made available and surface water conversion is implemented in West Harris County by as early as 1995, then the projected rate of subsidence would be drastically minimized.

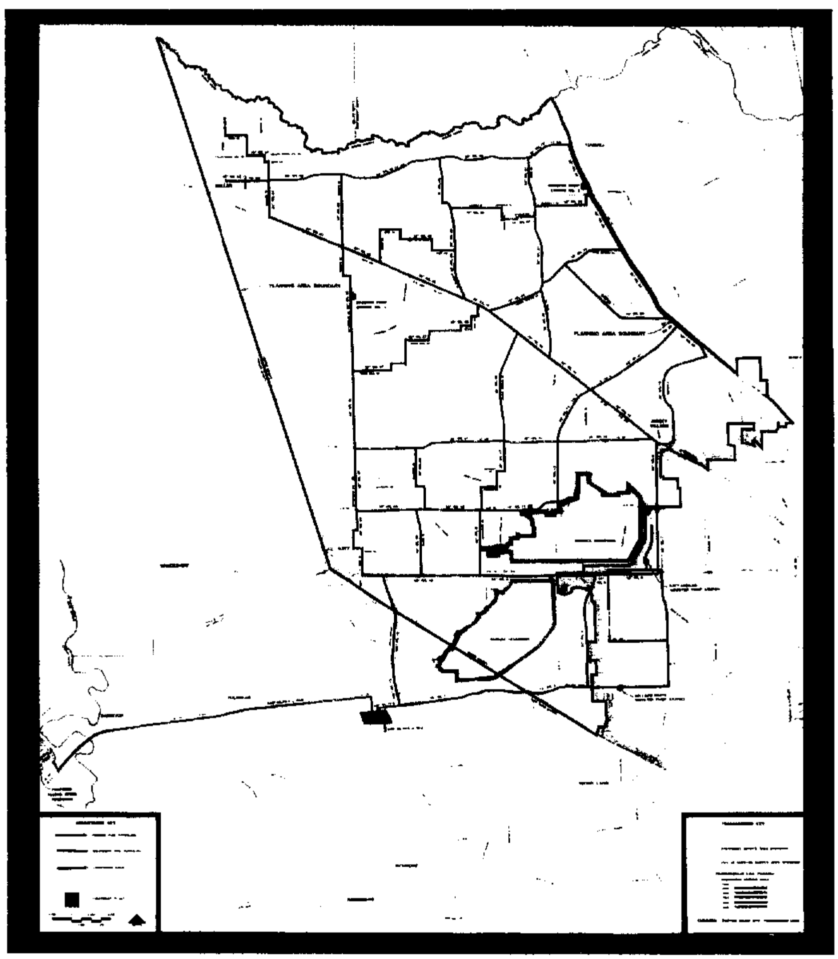


As shown above if conversion follows the HGCSD Plan, the subsidence will be reduced in certain areas by as much as 7.0 feet.

Facilities Plan

General

WHCSWSC's selected plan consists of developing a major southwest surface water supply system with an ultimate (2030) capacity of 150 MGD to serve the entire WHCSWSC's planning area with provisions to serve a portion of the City of Houston west of Fondren-Blalock as well as portions of Fort Bend County. The raw water supply source would be the Brazos River Basin utilizing both the Galveston County Water Authority (GCWA) canal and the Brazos River System proper.



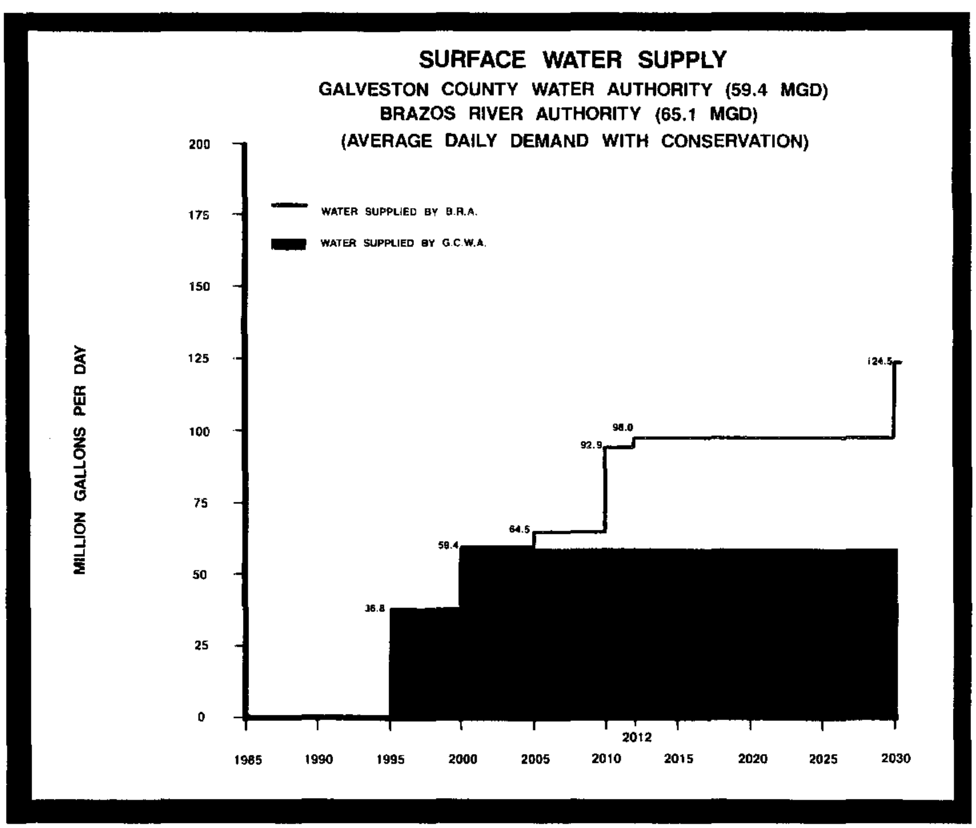
Facilities Plan (Con't)

Projected Surface Water Demand

Year	Phase	Surface Water Demand (MGD) With Conservation	Without Conservation
1995	I	36.8	38.0
2000	II	59.4	61.5
2005	III	64.5	66.9
2010	IV	92.9	97.0
2030	V	124.5	132.8

Projected Surface Water Supply

The surface water supply is projected to be supplied from a combination of Brazos River water from the GCWA canals and the Brazos River System proper.



Facilities Plan (Cont'd)

Plan Development Cost

The following development costs represent the total costs associated with the development of the facilities plan including raw water cost; capital costs and operational and maintenance cost. The annual cost per thousand gallons shown includes all costs associated with plan financing.

		Annual		
Phase	Period	Maximum Net Debt Service Cost ($1,000,000)	O & M Cost ($1,000,000) (1)	Maximum Cost per 1000 Gallons to Customers
I	1990-1995	6.4	1.2	(2)
II	1996-2000	10.7	5.2	1.26
III	2001-2005	12.3	8.6	1.26
IVA	2006-2010	19.2	10.5	1.26
IVB	2011-2012	32.8	10.5	1.26
V	2013-2030	37.8	16.4 (3)	1.45 (4)

(1) Raw water cost included in O & M.

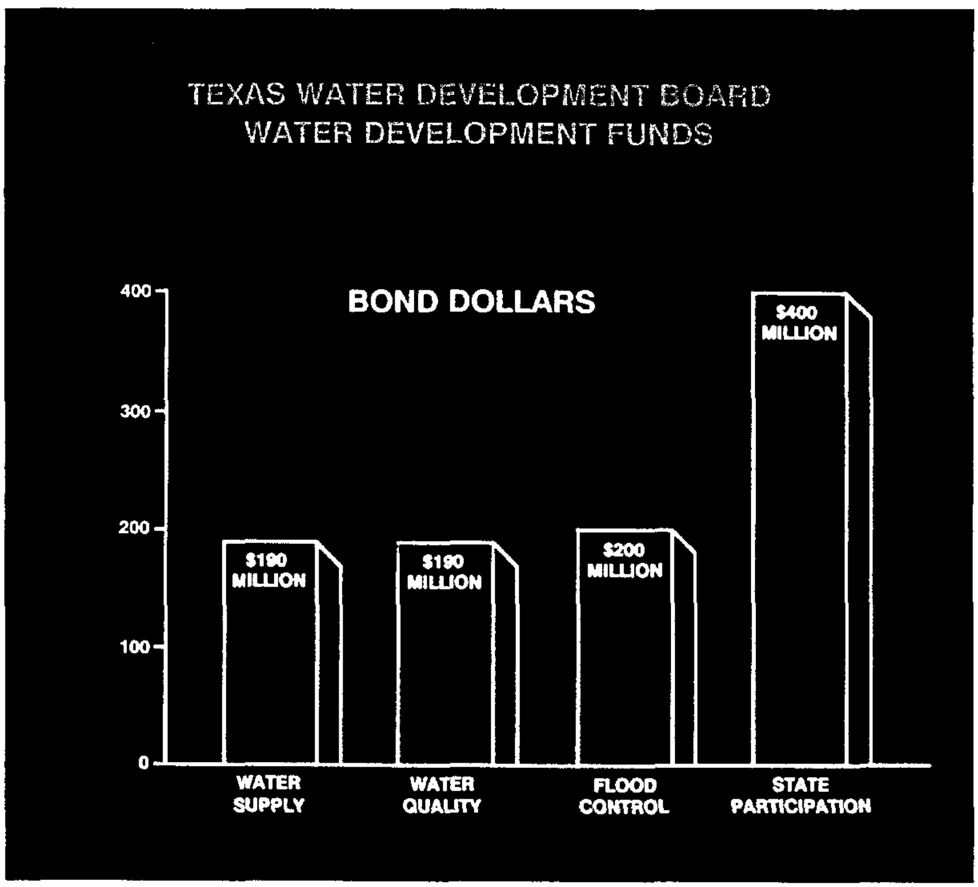
(2) The first year in which treated water is expected to be purchased by a customer of WHCSWSC is 1996. Costs incurred prior to that time are assumed to be passed through to the sole customer for Phase I service, the City of Houston. Total annual costs between 1990 and 1995 vary from $1.7MM to $7.6MM

(3) $23.4mm from 2031-2055

(4) Varies between $1.55 and $0.85 with a peak of $1.55/1000 gallons in 2013 through 2019.

Financing Method

Funds to finance the construction of WHCSWSC facilities will be obtained through the sale of tax exempt revenue bonds backed by water supply contracts with wholesale water suppliers in the planning area. It is noted that a distinct difference exists between Phases I and II and the balance of the phases. Phase I has as its sole customer the City of Houston, and the City of Houston is the principal customer for Phase II service. Phases III through V have as customers a mix of small municipalities other than the City of Houston and a large number of municipal utility districts. Since the City of Houston is the sole customer for Phase I service,it is assumed that all costs associated with Phase I are a straght pass-through to the City of Houston. It is also assumed that Phase I bonds will be sold to the Texas Water Development Board or some other State agency.



Phase I Plan - 1995

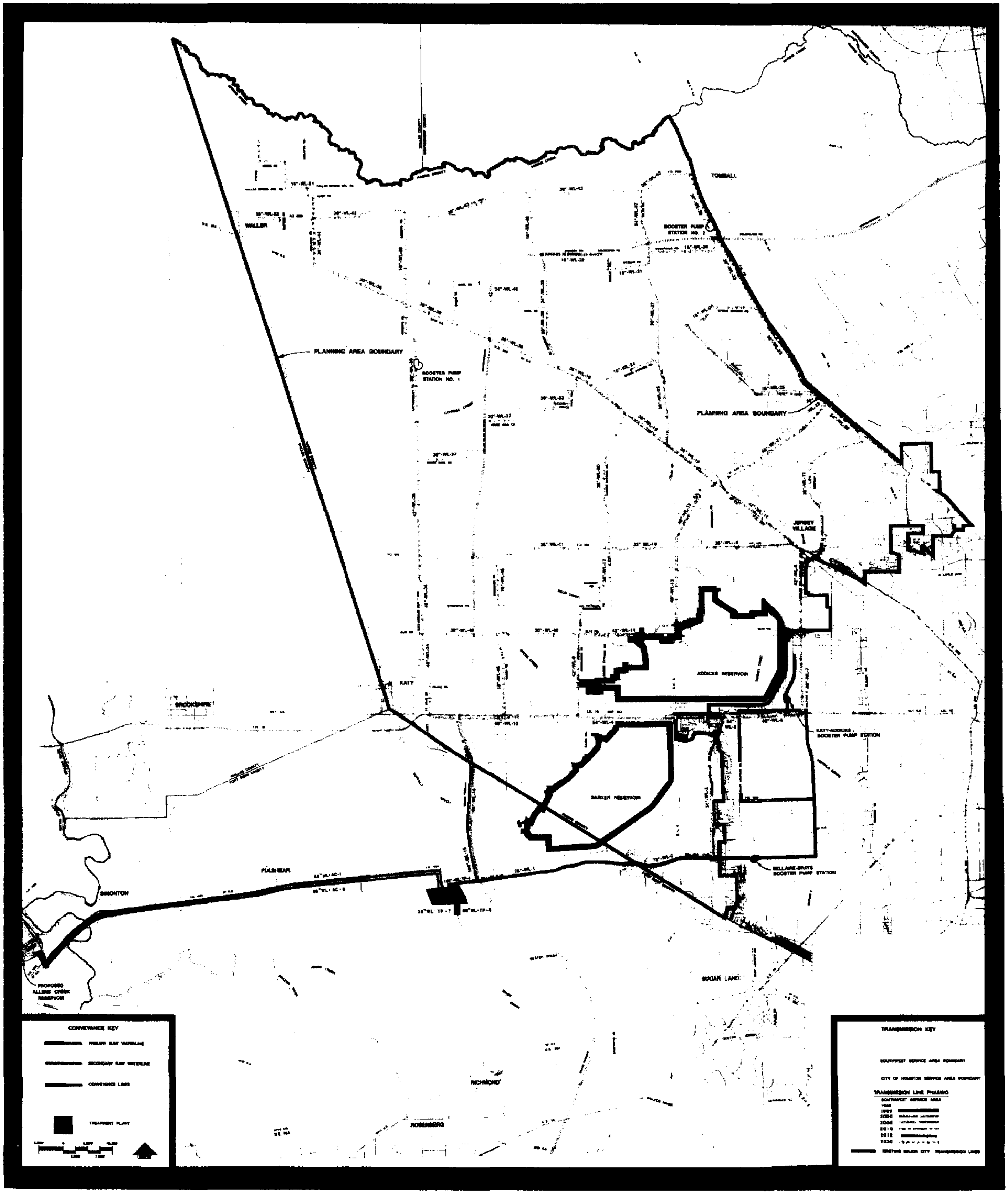
WHCSWSC's Phase I facilities plan is projected to be operational by late 1995 consisting of the development of surface water supply facilities with a capacity of 37.5 MGD.

PHASE I DEVELOPMENT COST

PHASE I
(Through 1995)

- First Delivery Year: 1996
- Annualized Cost (1996): *
- Available Capacity: (Average Daily) 37.5 MGD
- Projected Demands: (Average Daily) 36.8 MGD

* The first year in which treated water is expected to be purchased by a customer of WHCSWSC is 1996 at a cost $1.26/1000 gallons. Costs incurred prior to that time are assumed to be passed through to the sole customer for Phase I service, the City of Houston.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WALLER
BOOSTER PUMP STATION NO. 2
PLANNING AREA BOUNDARY
BOOSTER PUMP STATION NO. 1
PLANNING AREA BOUNDARY
JERSEY VILLAGE
KATY
BROOKSHIRE
ADDICKS RESERVOIR
KATY-ADDICKS BOOSTER PUMP STATION
BARKER RESERVOIR
FULSHEAR
SIMONTON
BELLAIRE-BRAYS BOOSTER PUMP STATION
SUGAR LAND
RICHMOND
ROSENBERG
CONVEYANCE KEY
TRANSMISSION KEY

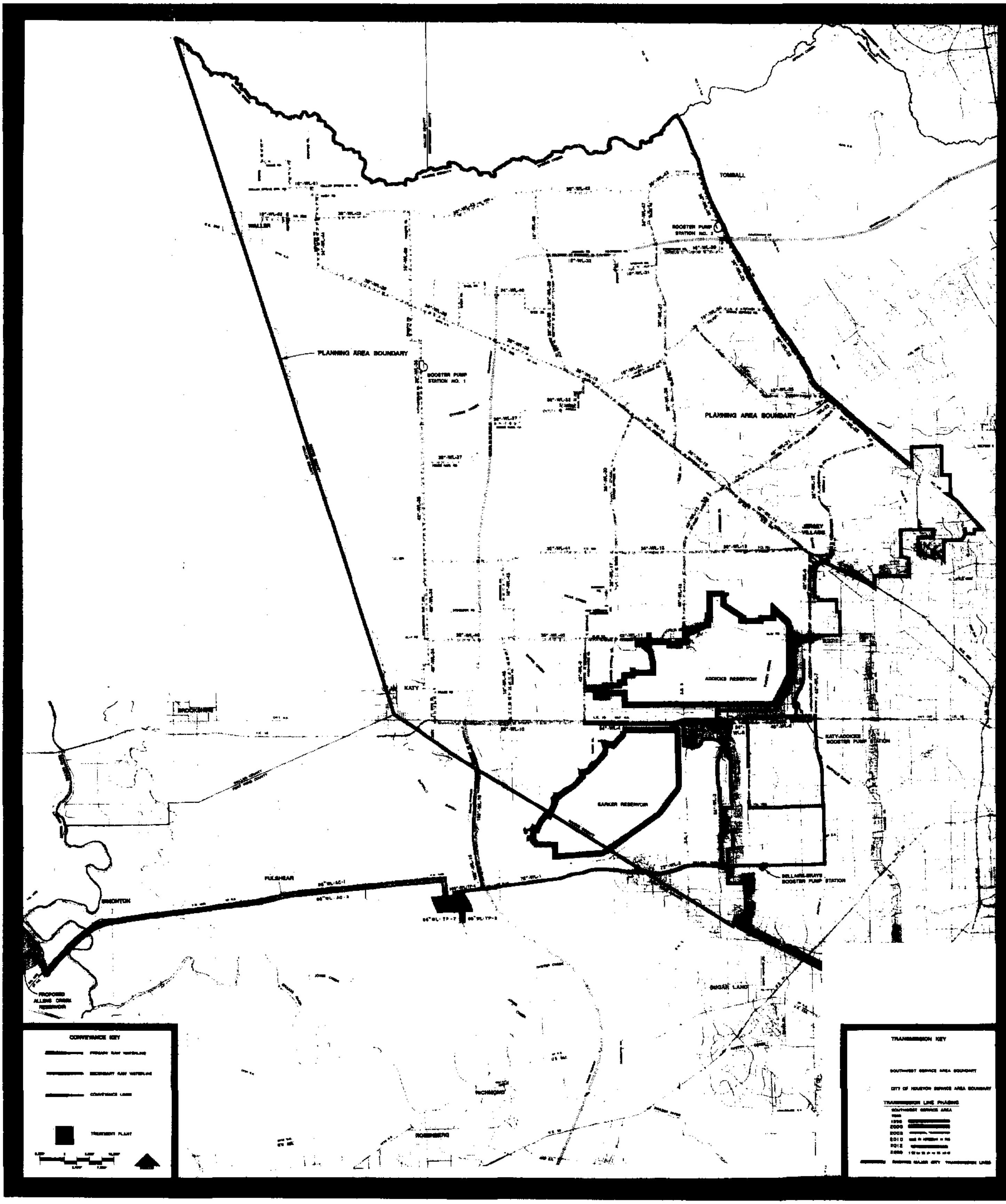
Phase II Plan - 2000

WHCSWSC's Phase II facilities plan is projected to be operational by late 2000 increasing the capacity to 62.5 MGD.

PHASE II DEVELOPMENT COST

PHASE II
(Through 2000)

° First Delivery Year:	2001
° Annualized Cost (2001):	$1.26/1000 Gallons
° Available Capacity: (Average Daily)	62.5 MGD
° Projected Demands: (Average Daily)	59.4 MGD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BOOSTER PUMP STATION NO. 2
JERSEY VILLAGE
ADDICKS RESERVOIR
KATY
BROOKSHIRE
KATY-ADDICKS BOOSTER PUMP STATION
BARKER RESERVOIR
FULSHEAR
SIMONTON
BELLAIRE-BRAYS BOOSTER PUMP STATION
PROPOSED ALLENS CREEK RESERVOIR
SUGAR LAND
RICHMOND
ROSENBERG
CONVEYANCE KEY
TRANSMISSION KEY

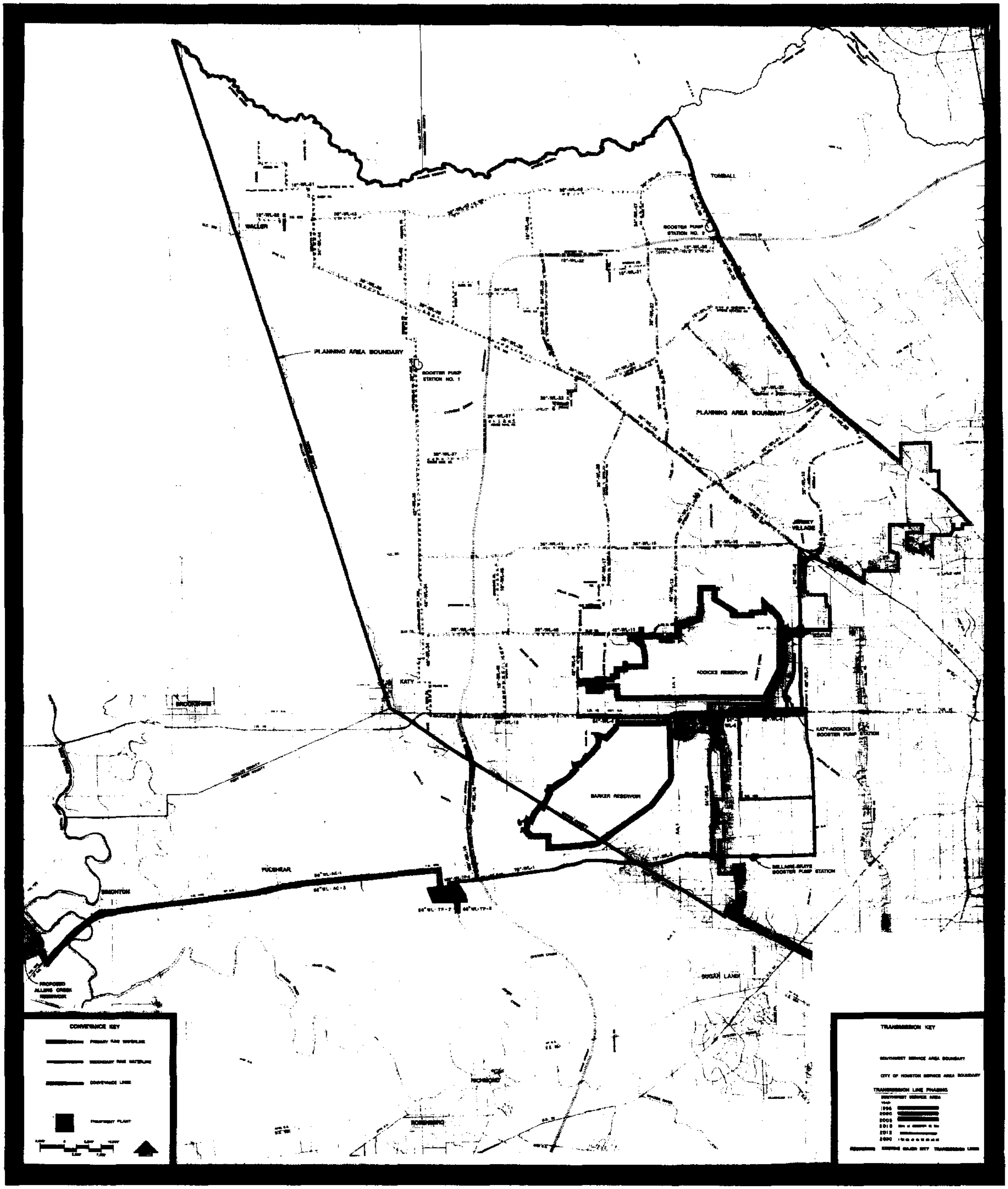
Phase III Plan - 2005

WHCSWSC's Phase III facilities plan is projected to be operational by late 2005 increasing the capacity to 75.0 MGD.

PHASE III DEVELOPMENT COST

PHASE III
(Through 2005)

°	First Delivery Year:	2006
°	Annualized Cost (2006):	$1.26/1000 Gallons
°	Available Capacity: (Average Daily)	75.0 MGD
°	Projected Demands: (Average Daily)	64.5 MGD



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PLANNING AREA BOUNDARY
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PLANNING AREA BOUNDARY
JERSEY VILLAGE
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FULSHEAR
SIMONTON
BELLAIRE-BRAYS BOOSTER PUMP STATION
SUGAR LAND
PROPOSED ALLENS CREEK RESERVOIR
CONVEYANCE KEY
TRANSMISSION KEY
RICHMOND
ROSENBERG

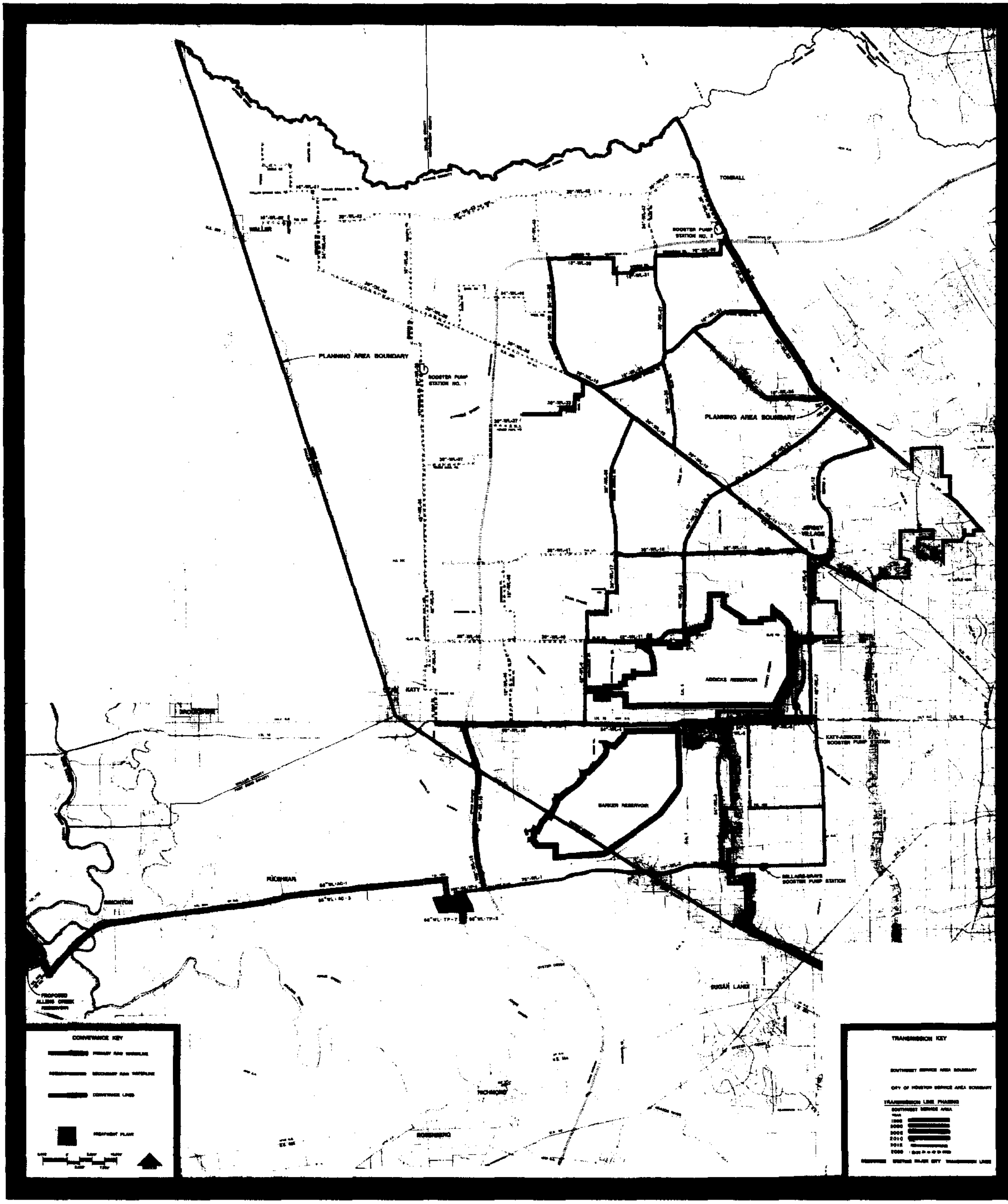
Phase IVA Plan - 2010

WHCSWSC's Phase IVA facilities plan is projected to be operational by late 2010 increasing the capacity to 100.0 MGD.

PHASE IVA DEVELOPMENT COST

PHASE IVA
(Through 2010)

- First Delivery Year: 2011
- Annualized Cost (2011): $1.45/1000 Gallons
- Available Capacity: (Average Daily) 100.0 MGD
- Projected Demands: (Average Daily) 92.8 MGD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ADDICKS RESERVOIR
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SIMONTON
SUGAR LAND
RICHMOND
ROSENBERG
CONVEYANCE KEY
TRANSMISSION KEY

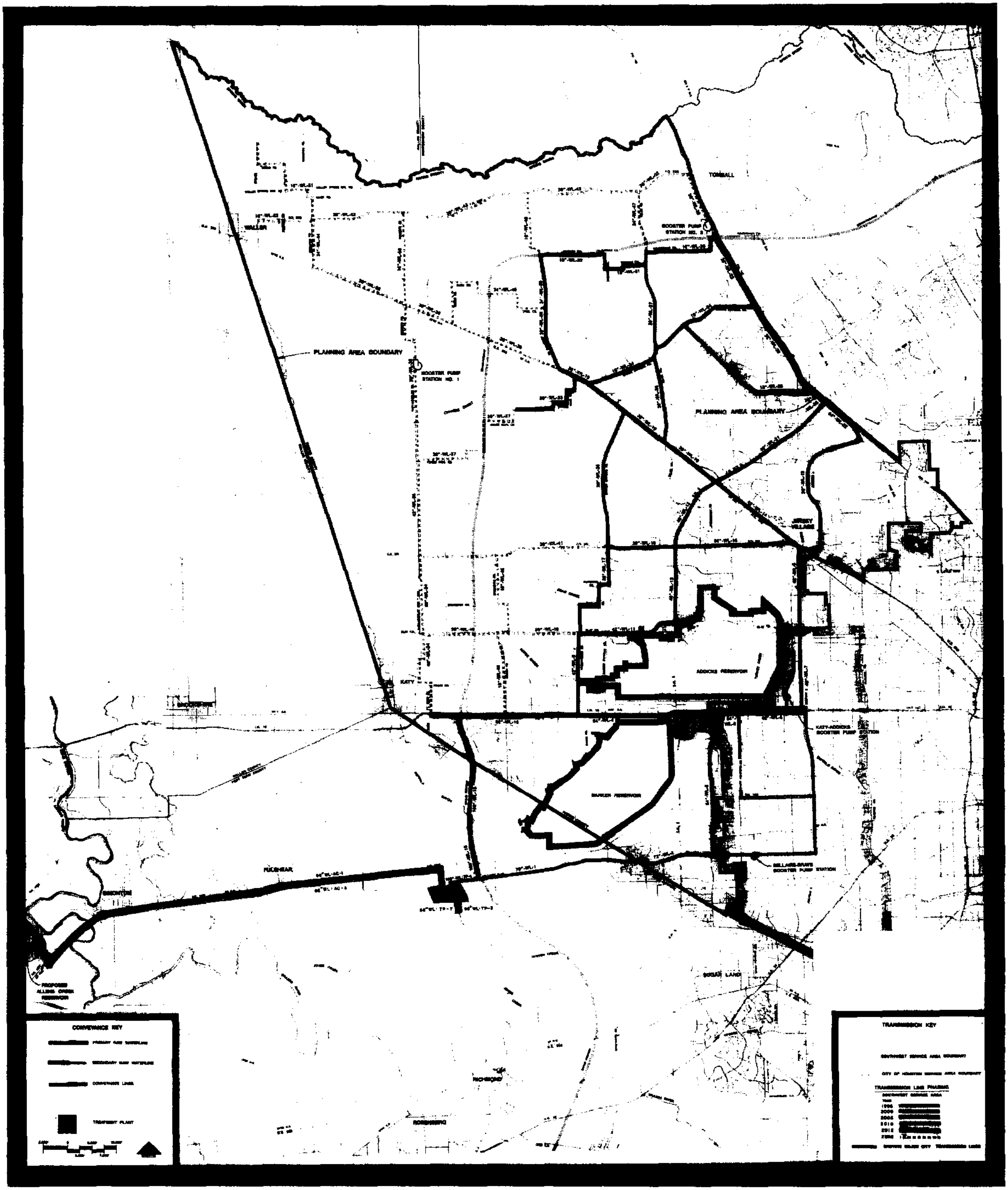
Phase IVB Plan - 2012

WHCSWSC's Phase IVB facilities plan is projected to be operational by late 2012 increasing the capacity to 100.0 MGD.

PHASE IVB DEVELOPMENT COST

PHASE IVB
(Through 2012)

° First Delivery Year:	2013
° Annualized Cost (2013):	$1.55/1000 Gallons
° Available Capacity: (Average Daily)	100.0 MGD
° Projected Demands: (Average Daily)	98.0 MGD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KATY
KATY-ADDICKS BOOSTER PUMP STATION
BARKER RESERVOIR
BELLAIRE-BRAYS BOOSTER PUMP STATION
FULSHEAR
SUGAR LAND
RICHMOND
ROSENBERG
CONVEYANCE KEY
TREATMENT PLANT
TRANSMISSION KEY

Phase V Plan - 2030

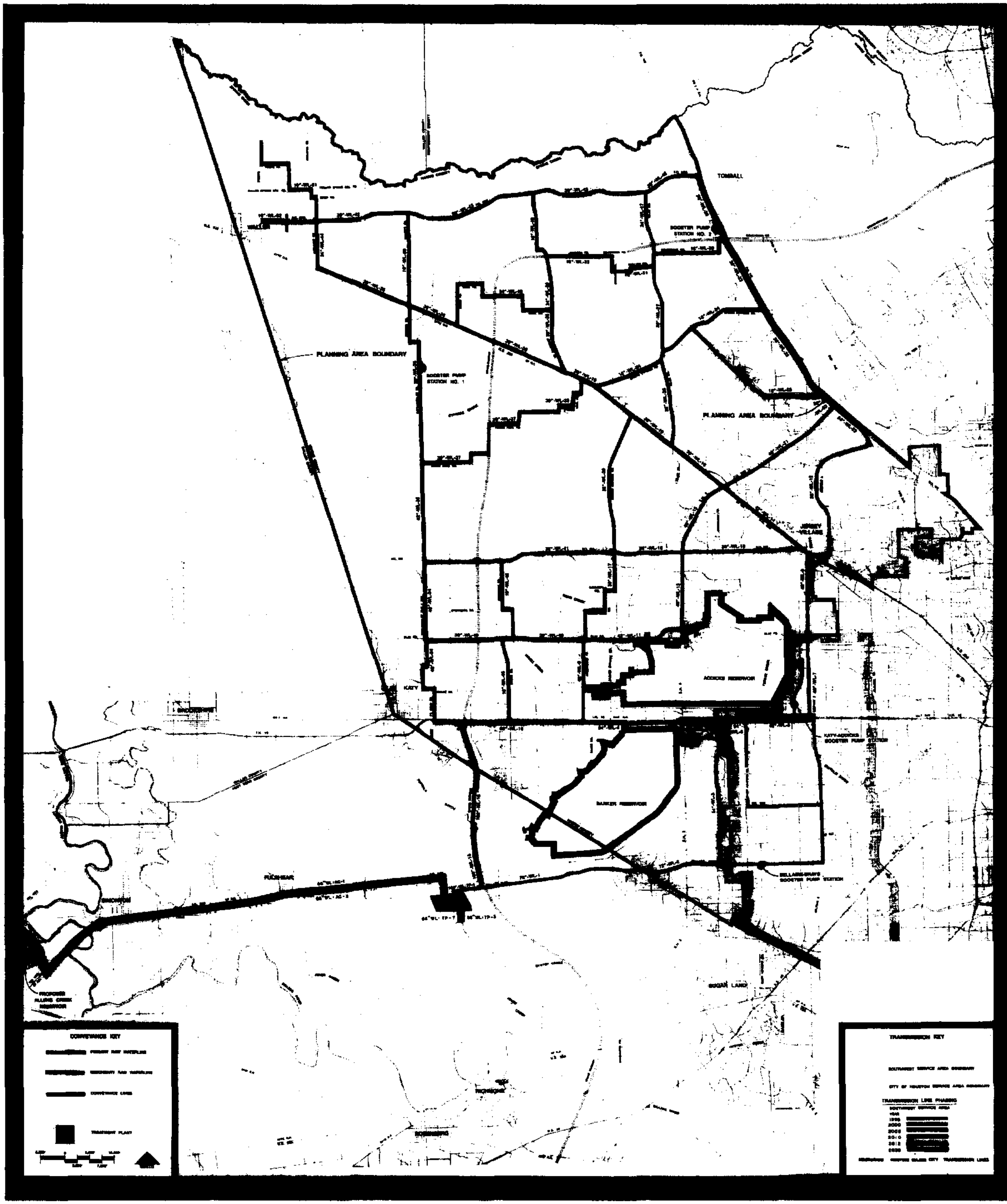
WHCSWSC's Phase V facilities plan is projected to be operational by late 2030 increasing the capacity to 150.0 MGD.

PHASE V DEVELOPMENT COST

PHASE V
(Through 2030)

°	First Delivery Year:	2031
°	Annualized Cost (2031):	*$1.37/1000 Gallons
°	Available Capacity: (Average Daily)	150.0 MGD
°	Projected Demands: (Average Daily)	124.5 MGD

*Varies between $1.55 and $1.37 with a peak of $1.55/1000 gallons in 2013 through 2019. In the year 2034, the cost reduces to $1.01/1000 gallons, and in the year 2040, it reduces further to $0.89/1000 gallons.


TOMBALL
PLANNING AREA BOUNDARY
PLANNING AREA BOUNDARY
KATY
ADDICKS RESERVOIR
BARKER RESERVOIR
SUGAR LAND

Acknowledgements

The success of surface water conversion for West Harris County is a very important issue and will require the cooperation of the general public as well as all agencies affected. As a result, the development of this plan has included the staff members and managers of many agencies. We would like to express our appreciation to the following agencies for their support and assistance throughout the planning period for without your support this plan could not have been successfully developed.

Association of Water Board Directors

Brazos River Authority

City of Houston

Coastal Water Authority

Corps of Engineers

Galveston County Water Authority

Harris-Galveston Coastal Subsidence District

Memorial Villages Water Authority

San Jacinto River Authority

Texas Water Commission

Texas Water Development Board

West Houston Association

Participants

(Through Monetary Participation Fee)

Harris-Galveston Coastal Subsidence District

Rolling Fork P.U.D.

Harris County MUD No. 188

Westpark MUD

Horsepen Bayou MUD

Harris County MUD No. 175

Spenser Road PUD

Emerald Forest UD

Chelford ONE MUD

Mission Bend MUD No. 2

Cimmaron MUD

Harris County MUD No. 158

Harris County MUD No. 170

Harris County MUD No. 81

Jack Rabbit Road P.U.D.

Renn Road MUD

Harris County MUD No. 23

Weston MUD

Morton Road MUD

Harris County MUD No. 69

City of Jersey Village

Harris County MUD No. 149

Windfern Forest UD

Harris County MUD No. 144

Harris County MUD No. 61

Fort Bend County MUD NO. 30

Harris County MUD No. 90

Harris County MUD No. 186

Harris County MUD No. 254

Memorial Village Water Authority

Green Trails MUD

Harris County MUD No. 286

Harris County MUD No. 223

West Harris County MUD No.7

Harris County MUD No. 163

Harris County MUD No. 162

Harris County MUD No. 183

Westlake MUD

West Harris County Surface Water Supply Corporation

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Ralph Rundle - Coastal Water Authority

Plan Consultants

Engineering

Dannenbaum Engineering Corporation

Legal / Bond Counsel

Vinson and Elkins

Co-Financial Advisors

Underwood Neuhaus & Co., Incorporated

Masterson & Company

SUMMARY OF MAJOR PROJECT DEVELOPMENT CRITERIA FOR EACH APPENDIX

A successful long range water resource plan has to be flexible to react with changing conditions and criteria. In developing this plan the West Harris County Surface Water Supply Corporation and its consultants have had to react to many new developments. These new developments have created changing criteria throughout the development of Appendices I through V. The following is a summary of the major criteria utilized to develop each appendix.

APPENDIX I - WATER CONSERVATION PLAN

- Develop a water conservation/water shortage contingency plan in accordance with Texas Water Development Board (TWDB) guidelines.
- Develop strategy to require contract customers to follow plan.
- Report possible reduction in water demands if plan is followed.
- Report possible delays in capital projects if plan is followed.

APPENDIX II - WATER DEMAND AND SUPPLY

Water Demands

- Historic and projected water demands within the planning area were determined and evaluated utilizing results from the City of Houston Water Master Plan (HWMP) as of February, 1988.
- Historic and projected surface water demand requirements were determined and evaluated as needed to meet the conversion requirements in the Harris Galveston Coastal Subsidence District (HGCSD) plan developed in 1985.
- Projected water demands were determined utilizing the modified growth projections by the HWMP which assumes no growth between 1985 through 1990.

- o Area 8 of the HGCSD's plan is assumed to convert to 80% surface water in the year 2030.

- o Utilize maximum daily projections for water demand requirements in accordance with the HWMP.

- o The effects of water conservation were not included in the demand projections to be consistent with the HWMP.

Surface Water Supply

- o Determine and evaluate surface water supplies available from the northeast surface water supply system (Houston Northeast Treatment Plant) and the Southwest Surface Water Supply System (Brazos River Basin).

- o Utilize average daily projections for surface water supply requirements to meet the projected surface water demands.

- o Southwest Surface Water Supply System consists of surface water available from the Brazos Basin and/or the Brazos Canal System both presently controlled by the Brazos River Authority (BRA).

APPENDIX III - SUPPLEMENT TO WATER SUPPLY - NORTH SYSTEM

- o Determine and evaluate surface water supplies available from the north system equivalent to the HWMP's western alternative, surface water in the Trinity/Brazos/San Jacinto River Basins.

- o All other criteria previously mentioned under Appendix II were, also, utilized in this Appendix.

APPENDIX IV - DEFINITION AND EVALUATION OF SELECTED ALTERNATIVE SYSTEMS

- Develop and evaluate various alternates using either or both of the Southwest and Northeast Supply Systems.

- The North System was eliminated from further evaluation by the WHCSWSC Board to be consistent with the HWMP.

- The surface water source for the Northeast Supply System will be supplied from the proposed City of Houston Northeast Water Treatment Plant.

- The surface water source for the Southwest Supply System will be supplied from the Brazos Basin presently controlled by the Brazos River Authority including the Brazos River Canal System.

- After evaluation, the results of Appendix IV were based on a Southwest Water Supply being supplied from the Brazos Basin System outlined in the BRA offer to WHCSWSC dated January 11, 1988.

- The BRA canal water rights were not considered in the final alternates. These rights were reserved by WHCSWSC for users in Fort Bend County.

- Maximum daily demands were used to size treatment plants, conveyance systems and transmission systems.

- Raw water sources were evaluated based on average daily demands.

- The final alternates were evaluated and selected utilizing conveyance and transmission facilities that were sized for maximum daily demands.

APPENDIX V - DETAILED EVALUATION OF SELECTED ALTERNATIVES

- A detailed evaluation was performed utilizing Service Area Alternate No. 7 (Appendix IV) which maximizes the Southwest Supply System providing southwest water to the entire service area.

- The water demands should be revised to include only average daily demands and these demands should be reduced by water conservation measures.

- The transmission system should maintain the flexibility to serve areas from FM 149 south to I-10 from the northeast supply system in future phases.

- Individual southwest water treatment plant sites were located, evaluated and ranked in the area west of the Grand Parkway/FM 1093 intersection west to the proposed Allens Creek Reservoir site.

- The southwest plant sites should be sized and evaluated at a capacity large enough to serve the entire WHCSWSC service area and possible outside areas.

- The conveyance and transmission systems including treatment plant should be sized and evaluated utilizing average daily demands including water conservation measures with the ability to treat and convey the maximum daily demands through increased storage, pumping and/or increased velocity requirements.

- The final conveyance system should be evaluated assuming the Southwest Supply System will utilize either the BRA System, the GCWA Canal System recently purchased from the BRA or a combination of both.

- The Southwest Conveyance System should utilize temporary onsite termination storage with ultimately the termination storage requirements being met or partially met by the proposed Allens Creek Reservoir.

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

IMPLEMENTATION PLAN

APPENDIX I

CONSERVATION AND WATER SHORTAGE PLAN

SEPTEMBER 1988

DANNENBAUM ENGINEERING CORPORATION
CONSULTING ENGINEERS
3100 WEST ALABAMA
HOUSTON, TEXAS 77098
(713) 622-8011

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1.0 INTRODUCTION

1.0 INTRODUCTION

Purpose and Planning

This report addresses the issues of water conservation and water shortages for the West Harris County Surface Water Supply Corporation (WHCSWSC). The water conservation and water shortage contingency plan has been prepared as Phase I of an implementation plan for a proposed surface water supply system to serve western Harris County. Formulation of the plan is required by the Texas Water Development Board and adoption of such a plan is needed prior to the sale of bonds backed by the State of Texas.

Though related, the issues of water conservation and water shortage are not identical. Water conservation is a continual program whose goal is to reduce water usage in day to day residential and commercial activities. A water shortage is usually short term and demands stricter conservation measures. This report describes typical water conservation and water shortage response plans with reference to expected conditions within the WHCSWSC service area, details the proposed plan, and outlines implementation procedures. It must be noted that at present the water supply system to be constructed is known only in its general form; therefore, this conservation and water shortage plan is largely conceptual. As the supply system details are finalized, the plan will be tailored to fit the needs of the WHCSWSC and its customers.

The water demands used in the following appendices of this implementation study have been reduced to account for the water conservation measures that will be enacted in the WHCSWSC service area. The reduction which will be outlined later in this Appendix translates into an approximate 7% reduction in water demands over the course of the study. WHCSWSC does not have authority to enact water conservation measures except through water supply contracts with users within the service area. Therefore, the reduction of water consumption through conservation will have to be on a voluntary basis or regulated through future water supply contracts. The following reduction in water demands are expected if the water conservation plan outlined in this Appendix is followed by the WHCSWSC customer base.

	Average Daily Projected Demand	
Year	With Conservation	Without Conservation
1995	36.8 MGD	38.0 MGD
2000	59.4 MGD	61.5 MGD
2005	64.5 MGD	66.9 MGD
2010	92.9 MGD	97.0 MGD
2012	98.0 MGD	103.6 MGD
2030	124.5 MGD	132.8 MGD

The 7% reduction in water demand due to water conservation is not expected to significantly affect the phasing of facility expansion. However, the economic benefits to WHCSWSC's customer base is expected to be realized by significant reduction in operating cost (power cost) due to the reduction in peak demands. Another advantage would be the increased water pressure experienced during peak demands that would be realized without increasing the pumping cost.

2.0 CONSERVATION PLAN

2.0 CONSERVATION PLAN

A water conservation plan is an ongoing program designed to reduce water use and wastage. Reductions in water use ranging from 5% to 15% have been achieved in communities which have implemented conservation methods. If WHCSWSC becomes the implementing agency, then the Corporation will set a goal to try to reduce the Corporation's overall water consumption by 10% through enacting certain water conservation measures, however, it is expected that the real reduction will only amount to approximately 7%. The City of Houston Water Master Plan estimates a savings of approximately 7%.

Water conservation options fall into two categories: supply management and demand management. Supply management is concerned with improving efficiency and reducing waste in the treatment and distribution process upstream of the customer's meter. Demand management seeks to reduce water usage by the consumer through providing education and incentives. Several strategies in each category are described below.

Supply Management

Supply management attempts to increase the efficiency of the treatment and distribution system by reducing losses. Losses from the system can be attributed to leaks, street washing, flushing of water mains, and unauthorized or unmetered water use. Appendix C of the Houston Water Master Plan found that unaccounted-for water in the City of Houston ranged as high as 30% during

1980 to 1985, and concluded that 15% to 20% losses could be expected in the system in future years. Billed versus pumped data is available for 86 of the approximately 200 utility districts within the WHCSWSC service area. Of these districts, 14 had losses of more than 30% during 1986, with the average losses being about 17%.

Possible areas of emphasis for supply management, including water reuse and lowered pressure as well as loss reduction, are discussed in the following paragraphs:

- Leak Detection and Repair

While major leaks are usually spotted immediately and repaired, smaller ones can escape notice for some time, causing substantial water losses. To find these leaks, a continuous program should be followed which includes visual and electronic sonic checks as well as annual water accounting and audits. Sources of unaccounted-for water, once located, should be corrected immediately. Leak detection may have high labor costs but leads to significantly lower operating costs.

The WHCSWSC proposes to construct a major water supply and distribution system to serve West Harris County. A leak detection and repair program will be enacted providing each customer with leak detection and water audit material and if practical provide sonic leak detection equipment or other appropriate equipment for loan. The program will, also, require each customer to conduct annual water audits determining levels of unaccounted water. Each customer served by WHCSWSC will handle leak detection and repair within their local boundaries. If WHCSWSC becomes the implementing agency, then the Corporation will recommend that each customer within their boundaries enact an aggressive leak detection program and if practical WHCSWSC will assist individual customers in performing local water audits.

- Universal Metering and Repair of Meters

When all water uses are not metered, an annual water audit can never be accurate, making identification of losses more difficult. The water source as well as all of the customers of a utility should be metered, and all meters should be regularly tested and replaced.

Proposed full metering of the water used in the WHCSWSC service area should begin at the surface water source. Sales of water to the customers served should be metered as well. The wells currently used for water supply are metered to comply with the regulations of the Harris-Galveston Coastal Subsidence District (HGCSD). It is not known what proportion of water used in the service area is presently being metered; however, metering of 100% of the water used should be accomplished as soon as possible. If WHCSWSC becomes the implementing agency, then the Corporation will commit to forming a program to assure that all master meters under WHCSWSC's jurisdiction be tested for accuracy on a regular basis. WHCSWSC will, also, require all customers to practice universal metering.

- Pressure Reduction

Water pressure is sometimes reduced to decrease losses resulting from leakage and line breaks within a system. Sufficient pressures and flows must be maintained if this option is used. System pressures of 60 to 65 psi are usual in recently developed areas, while the Texas Department of Health requires 20 psi as a minimum.

The transmission lines proposed by WHCSWSC will have pressures ranging from 45 to 90 psi. Each wholesale customer will be required to pressurize its own distribution system to the retail customer base it serves.

- Recycling and Reuse of Water

Water recycling and reuse can take many forms, not all of which will apply to any given area. For industrial applications, cooling water is commonly recycled or reused. Treated effluent is often used for irrigation of parks and golf courses. The costs of small scale recycling and reuse programs prohibit their implementation except when there is significant need to reduce water use.

This report does not present specific opportunities for effective water recycling or reuse. However, the water districts and cities which will be served by the WHCSWSC should investigate this option. A conservation plan should encourage recycling and reuse of any industrial or municipal water which could replace an existing use of potable water from the supply system.

Demand Management

Demand management is aimed at the consumers of water. Water demand is reduced through education, promotion of less wasteful water use practices and installation of water-saving devices. Reduced water usage can result in savings to the consumers in water and energy costs as well as savings to the district in wastewater treatment costs. However, one result of demand management is that water revenues tend to decrease, often offsetting treatment and distribution savings.

The following options are available to reduce water use through demand management practices:

- Education of Consumers

Numerous ways to decrease water consumption in and around the home or office exist. Typically, indoor water use accounts for 65% of the total residential demand. By not running faucets when standing water will do, washing only full loads of clothes and dishes, testing for leaking toilets, faucets and pipes and similar practices, household water use can be reduced. Outdoors, water can be conserved by watering landscaping and lawns less frequently and at cooler times of the day.

New water use habits must be created for effective water conservation. The more the public is informed and educated regarding the importance of conservation and ways to achieve it, the more likely such habits are to be formed. Possible means of information and education include television and radio public service announcements, newspaper articles, pamphlets included with water bills, talks to civic groups and poster campaigns. The Texas Water Development Board, the American Water Works Association and the American Public Works Association provide publications and materials for information and education programs.

An education and information program is essential to a successful demand management strategy. No conservation plan can ignore the benefits of public support. It should be noted that interest tends to wane as time passes, and water use habits tend to revert to wasteful ones. Therefore, the education process must be considered a continual one. Direct communications with the water users should foster the greatest cooperation with the proposed conservation plan. If WHCSWSC becomes the implementing agency, then the Corporation will commit to instituting an educational program that at a minimum will include providing individual utility districts with water conservation information packets obtained from the Texas Water Development Board. The Corporation will, also, commit to maintaining an ample supply of conservation literature that can be referenced by the individual districts.

- Water-Saving Fixtures in New Construction

Several types of water-saving plumbing fixtures exist. The ones usually installed cost no more than standard fixtures. If a plumbing code requiring the installation of water-saving fixtures is adopted, a large reduction in water usage can result over the years as they are used in a greater percentage of structures. Enforcement of such a regulation will affect the level of conservation achieved.

It is not known whether the districts in the WHCSWSC service area currently require water-saving fixtures. Since much of the area is not yet developed, plumbing codes that call for these fixtures could have a greater effect on the total water demand than in an established area. The major obstacle to a uniform plumbing code in the service area is the large number of political subdivisions that would need to adopt it.

The WHCSWSC has no authority to enforce an amendment to the established building codes for use thru-out the Corporation's service area. Also, a portion of the entities providing water are private water supply corporations who have no jurisdiction in the enforcement of building code requirements. As a result, WHCSWSC can not require users within the Corporation's service area to adopt building code amendments.

However, the Corporation will require through water supply contracts that its customer cities of 5,000 population or more to amend their individual plumbing code to include Texas Water Development Board's water conservation provisions for all types of fixtures.

- Retrofit Programs for Existing Consumers

To reduce water demand immediately, a program to install watersaving devices in existing residences may be used. These devices include lowflow shower heads and toilet dams to reduce the volume of water in the tank. Since showers and toilets make up the largest portion of typical residential usage, a retrofit program can be highly effective. Savings of about 13 gpcd for each home installing retrofit devices were predicted by the City's Water Master Plan. The extent of the program can include supplying the public with information about the need for and sources of the devices, making retrofit kits with instructions available to the public, or installing the devices in homes.

Since portions of the WHCSWSC service area are undeveloped, the need for retrofitting is somewhat reduced. In most areas, supplying information and making a kit available for purchase would probably be the greatest expense that the resulting water savings would justify.

- Water Rate Structures to Encourage Conservation

There are several water rate structures designed to promote water conservation. The most common is the increasing block structure, but seasonal rates, excess use charges and other rate structures may also be used. Separate rate structures may be used for residential, commercial and industrial customers.

Water rate information on approximately 100 water districts within the WHCSWSC service area is available. Of these, 19% currently increase the charge per 1000 gallons as water use increases. Another 25% of the districts have a high minimum charge followed by lower but increasing costs per 1000 gallons for larger users. Both of these rate structure types will promote water conservation. The other 56% of the districts have flat rates or ones which decrease with increased water use. If WHCSWSC becomes the implementing agent, then the Corporation will attempt to require through water sales contracts or by other means as available, that no customer utility use declining block or similar non-conservation oriented water rate structures.

- Reducing Water Use in Landscaping

The highest water demand days in Houston are frequently hot, dry periods in the summer when landscaping and lawn watering reach a peak. The City of Houston Water Master Plan suggests a plan of sprinkling reduction from May through September. In it, lawn sprinkling would not occur between 7:00 a.m. and 7:00 p.m., and only 20% of homes and businesses would water each day. The Master Plan estimates that if these guidelines were voluntary, a reduction in maximum day pumpage of 1% to 2%

could be expected, while a 9% to 10% reduction would result from mandatory restrictions. Further, it states that no plants would be permanently injured by this program, although drought-sensitive ones such as azaleas, roses and nandinas might wilt. The success of such a program could be enhanced by encouraging the use of landscape plants requiring little water.

Recommended Conservation Plan

The conservation approach for the WHCSWSC service area must take into account the need to address the concerns of as many as two hundred separate entities. While the WHCSWSC will probably assume a coordinating role in the execution of the plan, it will have no direct contact with the end users of the water. This contact will be possible only through the districts and cities supplied by WHCSWSC. For this reason, supply management alternatives are stressed somewhat in the suggested conservation plan described below and summarized in Table 1.

If WHCSWSC becomes the implementing agency, then aggressive leak detection, repair, and educational programs will be instituted in the WHCSWSC service area. Universal metering will make water accounting easier and aid in identifying sources of lost water. Water reuse and recycling will be considered where applicable. Several demand management options will be used, including education of consumers. Also, a conservation information packet, including recommendations for retrofit devices, will be prepared and provided to the customers by the districts buying water from the WHCSWSC. This will be followed periodically with additional reminders. Other methods of reaching the public, such as the media, will be given consideration. A plumbing code requiring water-saving fixtures seems to be a dependable demand management method. The Corporation will recommend that all entities adopt and enforce a water conservation plumbing code amendment consistent with the T.W.D.B. guidelines, however, the WHCSWSC does not have the authority to enforce building code requirements. WHCSWSC will also recommend and require that all customer utilities utilize conservation oriented water rate structures. Extensive retrofit programs and sprinkling regulations will be investigated by each water district where applicable.

Implementation of Conservation Plan

The WHCSWSC will most likely assume the task of coordinating water conservation efforts within its service area. This will be complicated by the large number of political subdivisions involved and the City of Houston's annexation policies. All water districts and cities will be urged to adopt this conservation plan or a similar one. The plan should include a water-saving plumbing code and conservation-oriented rate structure. Costs of administering this plan will be passed on to the districts.

TABLE 1

PROPOSED CONSERVATION PLAN

CONSERVATION OPTION	LEVEL OF EMPHASIS
SUPPLY MANAGEMENT	
Leak Detection & Repair	Strong (Aggressive program throughout service area)
Universal Metering	Strong (Regular testing and repair of all meters)
Pressure Reduction	Minimal (As feasible)
Recycling & Reuse	Moderate (Investigate all possible applications)
DEMAND MANAGEMENT	
Education of Consumers	Strong (Provide packets to customers, regular updates)
Water-Saving Fixture Codes	Strong (Adoption and enforcement by all WHCSWSC customers)
Retrofit Programs	Moderate (Provide information and make kits available)
Water Rate Structures	Strong (All WHCSWSC customers use conservation structure)
Sprinkling Restrictions	Minimal (At discretion of water districts and cities)

3.0 WATER SHORTAGE CONTINGENCY PLAN

3.0 WATER SHORTAGE CONTINGENCY PLAN

During a water shortage, the water available for distribution is nearly equal to or less than the amount needed to meet normal demands and required fire flows. A situation of this kind is most often the result of drought conditions, but it may also be brought on by failure of a water treatment and distribution system or a natural disaster. When water demand meets or exceeds supply, an effective means of controlling water use is needed to ensure that essential activities are not interrupted. Some criteria must be established to determine when action should be taken. These are dependent on the characteristics of the supply and distribution system and the magnitude of the shortage.

Constraints on Supply and Distribution System

The limitations and constraints on the water supply systems are affected by concerns over ground subsidence. The Harris-Galveston Coastal Subsidence District (HGCSD) has developed a plan of groundwater usage control for western Harris County. About three-quarters of the political subdivisions in the WHCSWSC service area will be required to use at least 80% surface water by the years 2000 - 2010. Thereafter, they will not be permitted to decrease surface water use. In this water shortage contingency plan, it is assumed that WHCSWSC will supply the average daily water demand to its customers. Higher demands will be met with available groundwater. Average daily demands with the ability to meet maximum daily demands will be used to size WHCSWSC treatment facilities, major transmission lines, pumping equipment and storage facilities.

Groundwater currently makes up the entire water supply for the water districts and cities within the WHCSWSC service area. When surface water becomes available to the districts, the HGCSD is expected to reduce the amount of permitted groundwater withdrawal. However, the districts will retain the existing groundwater pumping capability. Short term interruptions in the surface water supply may be met with groundwater withdrawals, so long as the annual permitted amount is not exceeded. Surface water supply failures of longer duration would necessitate conservation measures and permission from the HGCSD to exceed permitted withdrawals. If surface water supply is not reduced, a district should be able to meet temporary increases in demand by increased pumping, provided its distribution system is adequate.

Levels of Water Shortage

Depending on how close water demand is to the total supply, a water shortage may be classified as mild, moderate, severe or critical. Each district will have to determine when a reduction in surface water supply or an increase in water demand constitutes a shortage. The method described here provides guidelines for how this may be accomplished. The level of water shortage in a district is computed as follows:

DEMAND =Three-Day Average Water Demand (mgd)

G.W.S. = Groundwater Supply Available to the District (mgd)

%SWS = Percent of Usual Surface Water Supply Available

S.W.S. = Usual Surface Water Supply (mgd)

PERM = Permitted Groundwater Withdrawal (mgd)

PUMP = Annual Amount of Groundwater Pumped to Date (mgd)

T.S. = Total Water Supply Available to the District

T.S. = S.W.S. x %SWS + G.W.S.

LEVEL OF SHORTAGE	DEFINITION	
Mild	DEMAND = 0.80 x T.S.	
Moderate	DEMAND = 0.90 x T.S.	and/or PUMP = 0.90 x PERM
Severe	DEMAND = T.S.	and/or PUMP = PERM
Critical	DEMAND PERM	and/or PUMP PERM

Further study may reveal a need for some districts to vary the proportion of total supply which demand must reach to define a shortage level. Note that the danger of a district exceeding its permitted amount of groundwater withdrawal is classified as a shortage.

The WHCSWSC will, also, have to specify trigger conditions that will be required when WHCSWSC's surface water supply has been reduced by the City of Houston to a point where the supply has fallen below the demands requested by the entities within the Corporation's service area. If this happens, the WHCSWSC may have the authority under contract with receiving entities to enact emergency rationing measures as deemed necessary.

Water Shortage Response

Once some level of water shortage has been determined to exist, steps should be taken to reduce water use or increase supply to prevent worsening of the situation. Many water shortages may be limited to a few districts, in which case additional water supplies might be available through either WHCSWSC or nearby districts. If not, conservation measures will be needed. Responses to the shortage will be more drastic as the level of water shortage increases. Each level is discussed here and the conclusions are summarized in Table 2.

- Mild Water Shortage

Voluntary use reductions will be employed to lower water demand. Residential customers should be informed of the situation and of possible ways to cut down on excessive water use. During the summer, this would include sprinkling only 20% of the lawns on any given day as discussed in the conservation plan. Insulating pipes rather than running water to keep pipes from freezing would be suggested in the winter. Major commercial customers should be contacted individually and asked to restrict water use. All customers should check for dripping faucets, running toilets and hidden leaks.

- Moderate Water Shortage

For a moderate water shortage, all actions taken for a mild shortage would apply with the exception that sprinkling restrictions would be mandatory rather than voluntary. In addition, some nonessential outdoor water uses would be limited or forbidden. Public outdoor water uses which would be restricted include street washing, flushing fire hydrants, watering parks and filling pools. Targeted private outdoor activities would be the washing of cars, windows or pavement. A careful check should be kept on whether groundwater withdrawals are nearing the amount permitted by the HGCSD.

- Severe Water Shortage

When a severe level of shortage is reached, the same household and commercial restrictions mentioned for lesser shortages would be requested. Additionally, all outdoor water use would be prohibited, and penalties would be imposed, if possible, on any customer using excess water. If the total groundwater pumpage reaches the amount permitted by the HGCSD, the subsidence district should be contacted for permission to exceed the permitted amount.

- Critical Water Shortage

In a critical shortage, water demand exceeds the total water supply. It is important to maintain adequate water supply and pressure for essential activities. To ensure this, water would be rationed or cut off to selected users, if possible. Industrial and institutional users would have lowest priority, followed by commercial users, then residential users, and finally by public health and safety facilities. In addition to these drastic measures, substantial emphasis would be placed on voluntary indoor reductions, and outdoor water use would be prohibited. Again, if the allowable groundwater withdrawal has been exceeded, the HGCSD would be notified and petitioned for appropriate increases in allowable groundwater withdrawal.

Implementation of Water Shortage Contingency Plan

With the numerous political subdivisions in the WHCSWSC service area, it will be virtually impossible to determine solely from the water demand on the WHCSWSC system whether an isolated shortage exists within the service area. Due to differences in pumping capacities, groundwater supply availabilities, and what portion of the daily water requirements are purchased from WHCSWSC, each district or city will have a unique situation. Each entity will need to use the foregoing suggestions to decide when a given level of shortage exists. The WHCSWSC will attempt to handle shortages in a fair manner among its customers by increasing water supplies, if possible, to those who have the highest level of shortage.

It will be the responsibility of each district or city to enforce any water use restrictions placed on its residents. The WHCSWSC will have the power to impose surcharges on any customer which withdraws excess water from the distribution system, creating water shortages for other customers.

WHCSWSC will be responsible for determining when the water supply received from the City of Houston is insufficient to meet the demands due to a reduction in WHCSWSC's supply allocations. The Corporation will develop its own contingency plan and notify each utility of the Corporation's procedures for handling shortages caused by a reduction in water supply from the City of Houston.

TABLE 2

PROPOSED WATER SHORTAGE CONTINGENCY PLAN

LEVEL OF SHORTAGE	DEFINITION	RESPONSE
Mild	DEMAND = 0.80 x T.S.	Voluntary indoor and outdoor use reductions
Moderate	DEMAND = 0.90 x T.S. and/or PUMP = 0.90 x PERM	Voluntary indoor reductions, mandatory outdoor restrictions
Severe	DEMAND = T.S. and/or PUMP = PERM	Voluntary indoor reductions, no outdoor use, penalty for excess use
Critical	DEMAND T.S. and/or PUMP PERM	Voluntary indoor reductions, no outdoor use, ration or cut off use

Note:

DEMAND = Three-Day Average Water Demand

T.S. = Total Water Supply Available to the District

PUMP = Annual Amount of Groundwater Pumped to Date

PERM = Permitted Groundwater Withdrawal

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.0 CONCLUSIONS AND RECOMMENDATIONS

A tentative plan for water conservation and water shortage response has been outlined in this report. While details of the operation of the WHCSWSC are not yet final, the plan seems to be workable. It is clear that the greatest obstacle to a single plan for the entire WHCSWSC service area is the large number of political subdivisions which would need to agree to it. For this reason, the plan which has been recommended in this report is broad in nature. Items which are considered to be most important will be stressed for adoption by all WHCSWSC customers, while others will be left to the discretion of the utility districts and cities themselves.

5.0 ACKNOWLEDGEMENTS

ACKNOWLEDGMENTS:

Prior reports and studies dealing with the City of Houston and surrounding counties were utilized as needed in preparing this study. Reports and studies reviewed during the course of this appendix are as follows:

1. Houston Water Master Plan, Appendices A thru M, August 1985 to March 1987, by Metcalf and Eddy.

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

IMPLEMENTATION PLAN

APPENDIX II

WATER DEMAND AND SUPPLY

OCTOBER 1987

DANNENBAUM ENGINEERING CORPORATION
CONSULTING ENGINEERS
3100 WEST ALABAMA
HOUSTON, TEXAS 77098
(713) 622-8011

EXECUTIVE SUMMARY

Purpose and Scope

The purpose of this study, undertaken by the West Harris County Surface Water Supply Corporation (WHCSWSC), is to produce an implementation program that will provide a reliable, long-term surface water supply to west Harris County. This implementation program is an extension of the Houston Water Master Plan (HWMP) which is a comprehensive look at water supplies and demands for the Houston region through the year 2030. The results of this Appendix has been modified to include the February, 1988 revisions to the City of Houston Water Master Plan.

The scope of work for this phase of the implementation plan deals with water supplies and demands for the WHCSWSC study area. Current demand information for municipal and public utility districts, cities and private industries will be used to supplement the information provided in the HWMP to arrive at present and future water requirements for the area. Three potential surface water supply sources, the Northeast System, the North System and the Southwest System will be evaluated and service areas will be defined.

Study Area

The WHCSWSC study area encompasses the majority of western Harris County. Approximate boundaries are Spring Creek on the north, the Harris County line on the west and south, the City of Houston city limits on the east and F.M. 149 on the northeast.

Background

Area growth has resulted in a substantial increase in groundwater withdrawal which, in turn, has caused a decline in the area water table, partial or complete capacity loss of a number of wells, intrusion of contaminates and land subsidence.

Efforts to reduce subsidence have called for shifts from groundwater use to surface water. The Harris-Galveston Coastal Subsidence District was created in 1975 to regulate groundwater pumpage and has developed a plan to address the subsidence problem in eight regulatory areas. The HGCSD has the power to amend or revoke well permits and require conservation measures be taken.

Population growth and associated increases in water demand are expected to occur in the WHCSWSC study area between the present and 2030. Much of this study area falls within one of the HGCSD regulatory areas requiring conversion to surface water. Currently, there are no surface water supplies available to serve the demands of the area. An implementation program defining timing and costs to develop a surface water source, treatment facilities, and transmission networks is therefore needed.

WATER DEMANDS

Data Sources and Collection

Data was collected from the HWMP and the HGCSD to determine historic and future water demands within the WHCSWSC study area. The study area was divided into six municipal demand areas (MDAs) comprised of a number of contiguous census tracts with similar land use characteristics. Historic and future water demands were determined for each MDA to establish a total demand required by the WHCSWSC study area. Data relative to the overall Houston area was derived from the HWMP while data on the individual users within the WHCSWSC was obtained from the HGCSD and the users themselves. The data used in this appendix is consistent with the February, 1988 revisions to the HWMP. Water conservation was not included in the water demands evaluation in the Appendix.

The existing water users within the WHCSWSC study area consist primarily of conservation and reclamation districts such as municipal utility districts, water control and improvement districts and fresh water supply districts, and a few small cities. These users presently rely on groundwater as their sole source of water supply.

Existing Water Use

The WHCSWSC study area is divided into six MDAs similar to those used in the HWMP. The WHCSWSC study area contains all of MDAs 31 and 32 and portions of MDAs 24, 25, 26 and 33. The four partial MDAs, which will be called MDAs 24W, 25W, 26W and 33W, consist of portions of the HWMP MDAs which fall inside the WHCSWSC planning boundaries.

Groundwater pumpage records were obtained for each municipal utility district, city and industry for a seven year period from 1980 to 1986. This data was compiled to determine water pumpage for each of the six WHCSWSC MDAs. Table ES-1 presents this historical data.

TABLE ES-1

AVERAGE DAILY WATER PUMPAGE IN WHCSWSC PLANNING AREA, 1980 - 1986

	AVERAGE DAILY PUMPAGE (MGD)						
	1980	1981	1982	1983	1984	1985	1986
MDA 24W	1.77	2.56	4.15	4.32	5.53	5.97	6.12
MDA 25W	1.70	2.02	2.91	3.18	3.87	4.57	4.29
MDA 26W	3.30	3.76	5.08	5.08	6.17	6.79	6.66
MDA 31	5.51	6.19	8.46	8.88	10.28	11.32	10.39
MDA 32	2.03	2.33	2.99	3.19	3.91	4.20	4.25
MDA 33W	1.83	1.84	2.61	2.82	3.30	3.49	4.09
TOTAL WHCSWSC	16.14	18.70	26.20	27.47	33.06	36.34	35.80

Projected Water Demands

Projected water demands were computed in the HWMP by determining gallons per capita (or per employee) per day use criteria, assigning these demand criteria to each MDA, and multiplying them by the projected population and employment figures for each MDA. An econometric model developed by Rice Center was selected in the HWMP to project future growth.

Maximum day demands were used to determine required treated water supply systems and were computed by multiplying the average daily demands by a peak day factor which ranged from 1.6 to 2.0. Table ES-3 presents projected maximum daily demands within the WHCSWSC study area.

TABLE ES-2

PROJECTED MAXIMUM DAILY WATER USAGE BY MDA

	MAXIMUM DAILY USAGE (MGD)					
MDA	1985	1990	2000	2010	2020	2030
24W	7.52	7.52	11.82	15.60	16.90	16.73
25W	10.52	10.52	15.37	20.16	24.19	27.58
26W	12.48	12.57	18.18	24.80	29.55	33.31
31	16.05	16.05	28.77	46.88	64.96	79.70
32	8.34	8.34	14.41	21.96	30.09	38.18
33W	6.12	6.12	9.51	14.25	18.03	20.33
TOTAL WHCSWSC	61.03	61.03	98.06	143.65	183.72	215.83

SURFACE WATER SUPPLY

Area River Basins

A number of surface water sources are available for use by the WHCSWSC. The WHCSWSC planning area is located in the San Jacinto River Basin, however, major rivers and reservoirs within the adjacent Trinity and Brazos River Basins were also considered as potential sources.

Northeast Supply System

The Northeast Supply System consists of raw water from the San Jacinto River Basin supplemented by water from the Trinity and Sabine River Basins as outlined in the HWMP. The City of Houston has indicated that they propose to build a Northeast Water Purification Plant near Lake Houston. Preliminary sizing of this plant ranges from 425 MGD to 625 MGD ultimate maximum daily capacity (year 2030).

Southwest Supply System

The Southwest Supply System consists of raw water taken from the Brazos River Basin. The Brazos River and/or Canals A and B would supply a proposed Southwest Purification Plant located south of F.M. 1093 and north of the Brazos River. Preliminary sizing of this plant indicates approximately 100 MGD ultimate maximum daily capacity (year 2030). Allen's Creek Reservoir, originally proposed by Houston Lighting and Power Company to supply cooling water for a proposed power plant, is also a potential source of surface water. The BRA has offered the WHCSWSC a permanent average daily supply of water up to 133 MGD (226 MGD - maximum daily) is available upon construction of this reservoir and recapturing water previously committed to HL&P by the Brazos River Authority.

North Supply System

The North Supply System consists of surface water from the Trinity, Brazos and San Jacinto River Basins. Development of Lake Millican and Bedias Reservoir and raw water conveyance systems to Lake Conroe would be part of this supply system. The proposed location of a Northwest Water Purification Plant would be south of Lake Conroe with an ultimate maximum daily capacity of 350 MGD (year 2030).

ALTERNATE SERVICE AREAS

Approach and Methods

Five alternate service areas were investigated to determine surface water supply versus demand relationships and also availability to meet the conversion dates outlined in the HGCSD Plan. The alternate service areas were divided as follows:

Alternate No. 1	-	Southwest System Service South of Highway 290 Northeast System Service North of Highway 290
Alternate No. 2	-	Southwest System Service South of F.M. 529 Northeast System Service North of F.M. 529
Alternate No. 3	-	Southwest System Service South of Clay Road Northeast System Service North of Clay Road
Alternate No. 4	-	Southwest System Service South of I.H. 10 Northeast System Service North of I.H. 10
Alternate No. 5	-	Southwest System Service South of Clay Road North System Service North of Clay Road

Table ES-3 presents a summary of surface water requirements for each alternate from 1985 to 2030. For purposes of computing surface water requirements in 2030, it was assumed that HGCSD regulatory area eight will be given a conversion requirement of 80% in that year. All surface water demands are in terms of maximum daily demands while all surface water supplies are in terms of average daily flows.

TABLE ES-3

SUMMARY OF SURFACE WATER REQUIREMENTS BY ALTERNATE (MAXIMUM DAILY DEMANDS)

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST* (MGD)	TOTAL ALL AREAS (MGD)
ALTERNATE 1 - BOUNDARY AT U.S. 290					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.96	0.00	105.96
2005	89.82	16.14	105.96	9.66	115.62
2010	89.82	44.76	134.58	36.18	170.76
2012	101.17	44.76	145.93	36.18	182.11
2020	101.17	44.76	145.93	36.18	182.11
2030**	101.17	86.25	187.42	43.85	231.27
ALTERNATE 2 - BOUNDARY AT F.M. 529					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.96	0.00	105.96
2005	89.82	16.14	105.96	9.66	115.62
2010	89.82	39.25	129.07	41.69	170.76
2012	101.17	39.25	140.42	41.69	182.11
2020	101.17	39.25	140.42	41.69	182.11
2030**	101.17	76.29	177.46	53.80	231.26
ALTERNATE 3 OR 5 - BOUNDARY AT CLAY ROAD					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	15.74	105.56	0.41	105.97
2005	89.82	15.74	105.56	10.06	115.62
2010	89.82	15.74	105.56	65.21	170.77
2012	101.17	15.74	116.91	65.21	182.12
2020	101.17	15.74	116.91	65.21	182.12
2030**	101.17	38.79	139.96	91.30	231.26
ALTERNATE 4 - BOUNDARY AT I.H. 10					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	12.49	102.31	3.66	105.97
2005	89.82	12.49	102.31	13.31	115.62
2010	89.82	12.49	102.31	68.46	170.77
2012	101.17	12.49	113.66	68.46	182.12
2020	101.17	12.49	113.66	68.46	182.12
2030**	101.17	19.79	120.96	110.30	231.26

*In Alternate 5, the Northeast System is replaced by the North System.

**Harris-Galveston Coastal Subsidence District plan for surface water use ends at 2020. Required surface water for 2030 was estimated assuming that Area 8 will be required to convert to 80% surface water in that year.

Comparison of Alternates

Considerations of supply adequacy were based on the minimum surface water required to meet the HGCSD conversion plan. The minimum requirements climb in a stair-step fashion rather than linearly, however, the minimum requirements for the City of Houston Southwest Supply System and the total for the WHCSWSC supply area do not vary between alternates.

The total average daily supply available from the SWWPP is assumed to be 133 MGD (226 maximum daily) which is adequate to supply the projected Southwest Service Areas in all alternates.

Some consideration must be given to the timing of the availability of the surface water. In the Southwest service area, the first conversion requires 65 MGD in 1995. This is the same for all alternates. It may be estimated that the SWWPP will take around six years to bring on-line from design to completion which if started by 1989 will allow the first phase of the Southwest plant to produce water in time to meet the 1995 HGCSD conversion date.

Timing issues are more complex in the North and Northeast service areas. Alternates 1 and 2 both require about 10 MGD at 2005. Alternates 3 and 5 call for 0.5 MGD in 2000, and Alternate 4 requires 4 MGD in 2000. The quantities of surface water needed in 2000 or 2005 for any alternate are small and it is likely that this area would be supplied from the Southwest Supply System until 2005 or 2010, when most of the northern area will then convert to surface water. The WHCSWSC has been asked to provide the City with an amount of surface water needed from the NEWPP so that it can be designed for the additional capacity. The amount of maximum daily surface water demand required from the proposed plant for Alternative 1 and 2 would be approximately 36 MGD and 41 MGD respectively by the year 2010. For Alternative No. 3 and 4 in the year 2010 the amount would be 65 MGD and 68 MGD respectively.

For Alternate 5, the North Supply System must be considered. The NWWPP is proposed to have a capacity of 350 MGD in 2030. However, the majority of the surface water for this plant is to originate in two proposed reservoirs, Lake Millican and Bedias Reservoir. Construction of these sources would probably take about thirty years, yielding a completion date of 2018. Using this alternate, it would be unlikely to meet the HGCSD conversion dates for regulatory areas six and seven. The areas could be temporarily supplied from the Southwest System.

CONCLUSIONS

The Southwest Supply System will be adequate to meet the projected Southwest Service Area surface water demands in all of the alternatives. As a result, the available surface water will not be the deciding factor in determination of service area boundaries. However, the phasing of the service areas during interim conditions will influence the decision of service area boundaries. The remaining major factor in service area boundary determination will be the cost analysis all of which will be evaluated and reported later in Appendix IV.

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1.0 INTRODUCTION

1.0 INTRODUCTION

Purpose and Scope

The purpose of this study is to produce an implementation program that will provide a reliable, long-term surface water supply to West Harris County. This proposed implementation program is an extension of the Houston Water Master Plan (the "HWMP") which has been three years in the making. The Houston Water Master Plan is a comprehensive study of water demands and supplies for the region through the year 2030 and provides a realistic look at the limits of groundwater availability and a conceptual plan for conversion to surface water. In order to bring this plan to reality, careful consideration must be given to specific details of a workable implementation program. To this extent, the West Harris County Surface Water Supply Corporation (the "WHCSWSC") intends to refine the HWMP for its specified study area and provide the details necessary for implementation.

The project scope of work for this phase of the implementation program deals with water demands and supplies. Evaluation of water demands for West Harris County will entail identifying current demands for municipal and public utility districts, incorporated municipalities, and private industries. This demand information will be used to supplement the information provided in the HWMP and its February 1988 revisions, which will be the primary planning documents for this effort. All demands and projections presented in the HWMP will be compared with historic data for the WHCSWSC study area for general agreement. Water conservation reductions were not included in this Appendix to be consistent with the HWMP as formulated in February, 1988.

Evaluation of water supplies for West Harris County will involve investigation of three potential sources of surface water. The first is purchasing water from a future City of Houston Northeast Water Purification Plant (the "Northeast System"). The second is from the Brazos River out of a future Southwest Water Purification Plant (the "Southwest System"). The third is from a Trinity/Brazos/San Jacinto System as described in the western alternative of the HWMP (the "North System"). The evaluation of the North Water Supply System will be accomplished under Phase III of this study, which will allow the City of Houston time to decide if a western alternative is to be selected for the HWMP.

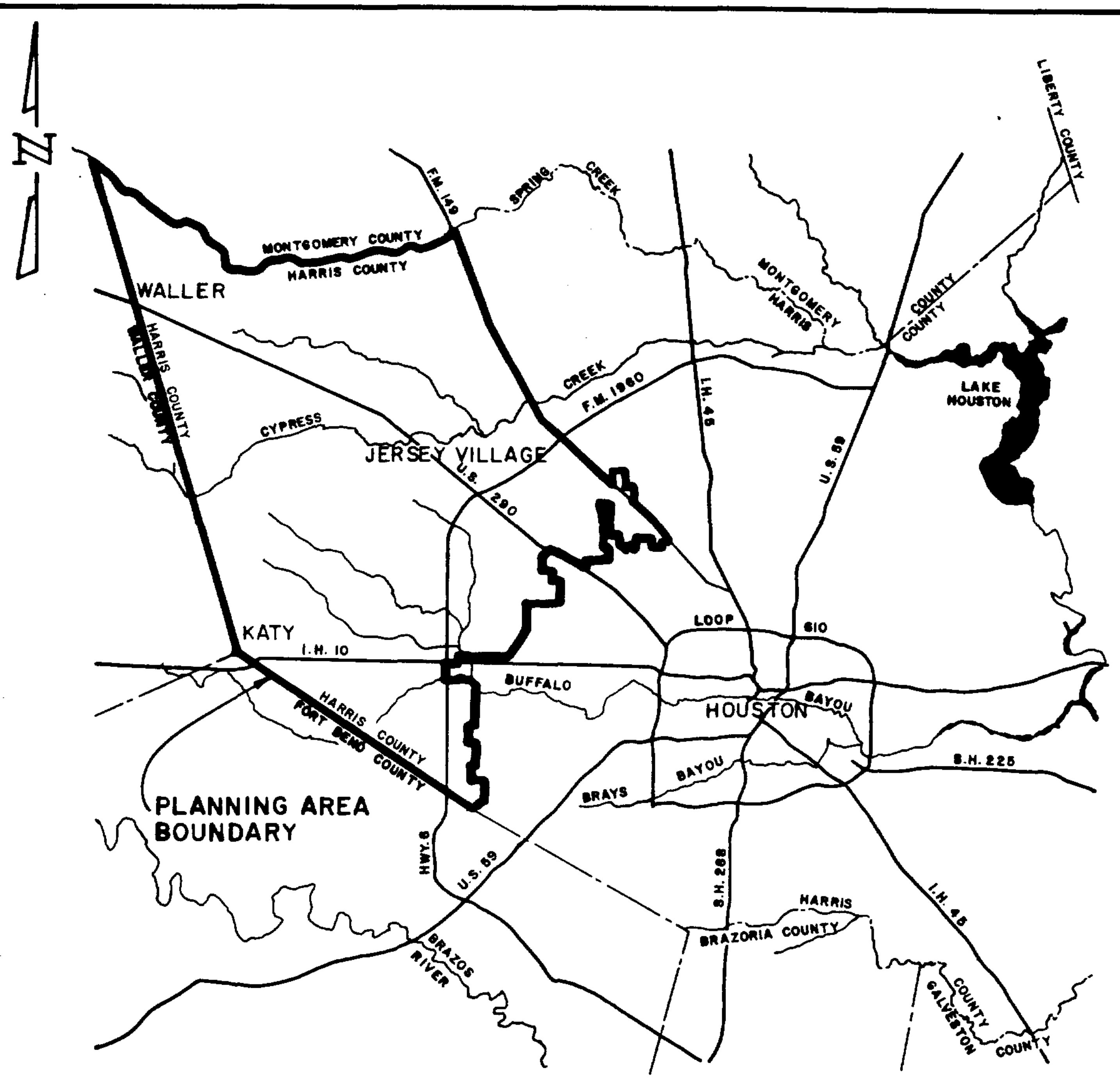
Several alternate service areas will be defined and evaluated based on water demands and timing for each of the supply systems. The service areas will be investigated with regard to the long-term conversion plans as designated by the Harris-Galveston Coastal Subsidence District (the "HGCSD").

Study Area

The geographical area for the WHCSWSC implementation program consists of a large portion of West Harris County. The approximate boundaries are Spring Creek on the north, Harris County boundary line on the west and south, the City of Houston current City limits on the east and F.M. 149 on the northeast, as shown on Figure 1. Approximately 443 square miles (283,500 acres) comprise the planning area with the majority located within the City of Houston's extraterritorial jurisdiction. Smaller portions of the planning area encompass either the City limits or a portion of the extraterritorial jurisdiction of Jersey Village, Waller and Katy. Approximately 200 conservation and reclamation districts fall within the planning area. These are listed on Table 1. The planning boundaries were selected to allow regional surface water planning to be accomplished on a large scale, which will help to reduce the cost to individual users.

The planning boundaries to the north and northeast were located to eliminate overlaps with studies presently being done by the North Harris County Water Supply Corporation and to minimize any overlap with the San Jacinto River Authority. The boundaries on the south and southeast were located to coincide with the City of Houston city limits, therefore eliminating any duplication of studies being done within the city limits of Houston.

FIGURE 1



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

PLANNING AREA

TABLE 1

PLANNING AREA CONSERVATION AND RECLAMATION DISTRICTS

No.	Name of District
1.	Addicks U.D.
2.	Barker-Cypress MUD
3.	Beechnut MUD
4.	Bissonet MUD
5.	Braes U.D.
6.	Camfield MUD
7.	Castlewood MUD
8.	Chelford City MUD
9.	Chelford One MUD
10.	Chimney Hill MUD
11.	Cimarron MUD
12.	Cinco MUD 3
13.	Cinco MUD 5
14.	Cinco MUD 6
15.	Cinco MUD 9
16.	Clay Road MUD
17.	Cornerstone MUD
18.	Cypress Creek U.D.
19.	Cypress Hill MUD 1
20.	Cypress Hill MUD 2
21.	Emerald Forest U.D.
22.	Faulkey Gully MUD
23.	Fry Road MUD
24.	Grant Road PUD
25.	Green Trails MUD
26.	Harris County FWSD 61
27.	Harris County MUD 6
28.	Harris County MUD 18
29.	Harris County MUD 23
30.	Harris County MUD 25
31.	Harris County MUD 29
32.	Harris County MUD 52
33.	Harris County MUD 61
34.	Harris County MUD 62
35.	Harris County MUD 63
36.	Harris County MUD 64
37.	Harris County MUD 65
38.	Harris County MUD 69
39.	Harris County MUD 70
40.	Harris County MUD 71
41.	Harris County MUD 81
42.	Harris County MUD 90
43.	Harris County MUD 102
44.	Harris County MUD 105
45.	Harris County MUD 107
46.	Harris County MUD 118
47.	Harris County MUD 119
48.	Harris County MUD 120
49.	Harris County MUD 127
50.	Harris County MUD 130
51.	Harris County MUD 136
52.	Harris County MUD 137
53.	Harris County MUD 144
54.	Harris County MUD 147
55.	Harris County MUD 149
56.	Harris County MUD 155
57.	Harris County MUD 156
58.	Harris County MUD 157
59.	Harris County MUD 158
60.	Harris County MUD 162
61.	Harris County MUD 163
62.	Harris County MUD 165
63.	Harris County MUD 166
64.	Harris County MUD 167
65.	Harris County MUD 168
66.	Harris County MUD 170
67.	Harris County MUD 172
68.	Harris County MUD 173
69.	Harris County MUD 175
70.	Harris County MUD 177
71.	Harris County MUD 179
72.	Harris County MUD 183
73.	Harris County MUD 185
74.	Harris County MUD 186
75.	Harris County MUD 188
76.	Harris County MUD 190
77.	Harris County MUD 194
78.	Harris County MUD 195
79.	Harris County MUD 196
80.	Harris County MUD 197
81.	Harris County MUD 199
82.	Harris County MUD 208

TABLE 1 (Cont'd)

PLANNING AREA CONSERVATION AND RECLAMATION DISTRICTS

No.	Name of District	No.	Name of District
83.	Harris County MUD 216	125.	Harris County U.D. 6
84.	Harris County MUD 222	126.	Harris County WCID 113
85.	Harris County MUD 223	127.	Harris County WCID 133
86.	Harris County MUD 225	128.	Harris-Ft. Bend MUD 1
87.	Harris County MUD 229	129.	Harris-Ft. Bend MUD 3
88.	Harris County MUD 230	130.	Harris-Ft. Bend MUD 4
89.	Harris County MUD 237	131.	Harris-Ft. Bend MUD 5
90.	Harris County MUD 238	132.	Horsepen Bayou MUD
91.	Harris County MUD 239	133.	Interstate MUD
92.	Harris County MUD 240	134.	Jackrabbit Road PUD
93.	Harris County MUD 243	135.	Kingsbridge MUD
94.	Harris County MUD 246	136.	Lake Forest U.D.
95.	Harris County MUD 247	137.	Langham Creek U.D.
96.	Harris County MUD 248	138.	Longhorn Town U.D.
97.	Harris County MUD 250	139.	Malcomson Road U.D.
98.	Harris County MUD 252	140.	Mason Creek U.D.
99.	Harris County MUD 255	141.	Mayde Creek MUD
100.	Harris County MUD 256	142.	Memorial MUD
101.	Harris County MUD 257	143.	Mills Road MUD
102.	Harris County MUD 259	144.	Mission Bend MUD 1
103.	Harris County MUD 261	145.	Mission Bend MUD 2
104.	Harris County MUD 263	146.	Morton Road MUD
105.	Harris County MUD 264	147.	Northwest Freeway MUD
106.	Harris County MUD 268	148.	NW Harris County MUD 5
107.	Harris County MUD 272	149.	NW Harris County MUD 9
108.	Harris County MUD 273	150.	NW Harris County MUD 10
109.	Harris County MUD 276	151.	NW Harris County MUD 12
110.	Harris County MUD 277	152.	NW Harris County MUD 15
111.	Harris County MUD 280	153.	NW Harris County MUD 16
112.	Harris County MUD 281	154.	NW Harris County MUD 25
113.	Harris County MUD 282	155.	NW Harris County MUD 27
114.	Harris County MUD 283	156.	NW Harris County MUD 29
115.	Harris County MUD 284	157.	Northwest Park MUD
116.	Harris County MUD 286	158.	Nottingham Country MUD
117.	Harris County MUD 287	159.	Park Ten MUD
118.	Harris County MUD 288	160.	Pecan Park MUD
119.	Harris County MUD 289	161.	Reid Road MUD 1
120.	Harris County MUD 306	162.	Reid Road MUD 2
121.	Harris County MUD 317	163.	Remington MUD 1
122.	Harris County MUD 318	164.	Remington MUD 2
123.	Harris County MUD 319	165.	Remington MUD 3
124.	Harris County MUD 325	166.	Renn Road MUD

TABLE 1 (Cont'd)

PLANNING AREA CONSERVATION AND RECLAMATION DISTRICTS

No.	Name of District
167.	Ricewood MUD
168.	Rolling Creek U.D.
169.	Rolling Fork PUD
170.	Spencer Road PUD
171.	Timberlake I.D.
172.	West Harris County MUD 1
173.	West Harris County MUD 2
174.	West Harris County MUD 4
175.	West Harris County MUD 5
176.	West Harris County MUD 6
177.	West Harris County MUD 7
178.	West Harris County MUD 8
179.	West Harris County MUD 9
180.	West Harris County MUD 10
181.	West Harris County MUD 11
182.	West Harris County MUD 14
183.	West Harris County MUD 15
184.	West Harris County MUD 16
185.	West Harris County MUD 17
186.	West Harris County MUD 20
187.	West Memorial MUD
188.	Westlake MUD 1
189.	Weston MUD
190.	Westpark MUD
191.	Westway U.D.
192.	White Oak Bend MUD
193.	White Oak/1960 MUD
194.	Willow Chase MUD
195.	Windfern Forest U.D.

Background

Development of surface water supply sources to supplement groundwater supplies has been an ongoing process by the City of Houston since 1966 when Phase I of a three-phase Water Master Plan was completed. Since that time, numerous revisions and updates to this plan have been initiated with the latest effort being the comprehensive Houston Water Master Plan (HWMP) by Metcalf and Eddy. The HWMP represents a detailed study of water demands and supplies for the entire eight county region surrounding the City of Houston. The HWMP also provides a realistic look at the limits of groundwater availability in the region and addresses a conceptual plan for conversion to surface water. The HWMP has been recently revised (February, 1988) to account for the economic slow down in the Greater Houston Area. The population projections and water demands were revised to assume no growth between 1985 through 1990. After 1990 the growth pattern was assumed to resume as previously projected. However, at the time of the development of this Appendix, water conservation reductions were not included in the HWMP projections.

The existing users within the WHCSWSC planning area consist primarily of conservation and reclamation districts, such as municipal utility districts, water control and improvement districts and fresh water supply districts, and a few small incorporated cities. These users presently rely on ground water as their sole source of water supply. Water supply for municipal use has been facilitated in the past by the abundance and excellent quality of regional groundwater. Wells yielding quality water requiring only chlorination could be easily drilled virtually anywhere at fairly low cost. For this reason, the municipal water system has developed as a series of wells and distribution pump stations with each individual well and distribution system supplying a specific subdivision or area of a city.

As a result of heavy groundwater withdrawal, the area water table has substantially declined over the last several years, causing partial or complete capacity loss in a number of wells. A portion of the wells in operation have experienced a serious intrusion of natural gas causing increased treatment costs. Contamination from radiation and other trace elements presently regulated by the State Department of Health has occurred in a smaller portion of the existing wells. Continued increased pumpage will likely lower the water table further and increase the chances of well contamination, eventually producing a shortage of potable water in the planning area.

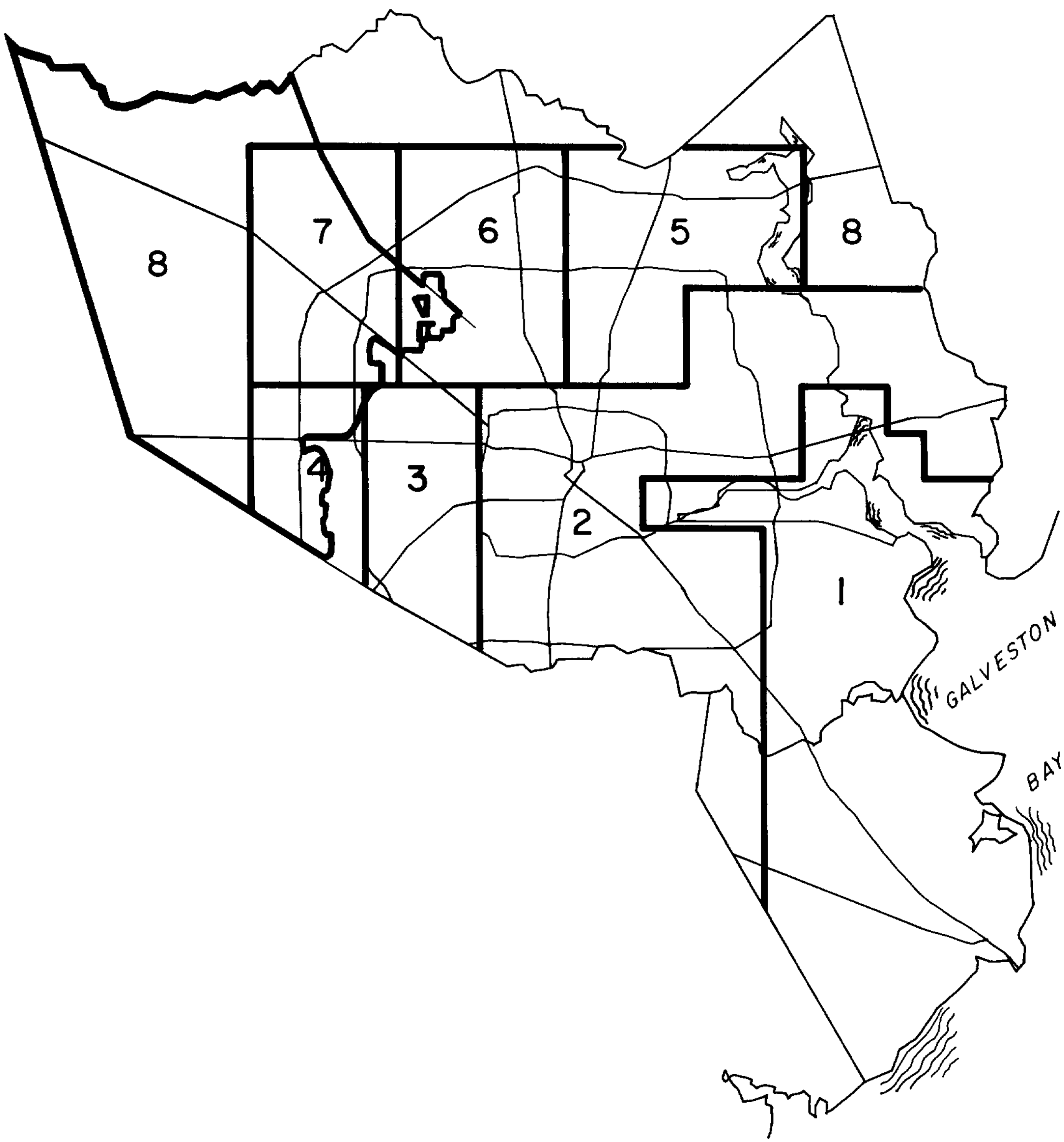
Land subsidence, caused by the pumping of groundwater, has also been a problem in the Houston area. By 1975, land subsidence had reached a critical state with nearly nine feet of elevation lost in southeast Houston and over one foot lost in the majority of Harris and Galveston Counties. Efforts to reduce or eliminate subsidence have called for shifts by municipal and industrial users from groundwater to surface water. The dramatic decreases in subsidence realized in southeast Houston are the direct result of reducing groundwater withdrawal. Recently a shift in the location of greatest subsidence has occurred from the eastern coastal region to west and southwest Houston where between 1978 and 1983 over one foot of elevation was lost.

Projections have indicated the possibility of up to 12 feet of elevation loss between now and 2020 if a surface water source is not developed in southwest Houston.

With the creation of the Harris-Galveston Coastal Subsidence District in 1975, the reality of conversion to surface water has come into focus. As a result of growth and increased groundwater withdrawal, the HGCSD has developed an eight regulatory area plan to address subsidence through 2020 (see Attachment 2). Figure 2 shows the boundary lines of the eight regulatory areas as determined by the HGCSD. Regulatory areas which overlap with the WHCSWSC study planning boundaries are Areas 3, 4, 6, 7 and 8. Table 2 lists a summary of the HGCSD plan requirements. Basically, Areas 3 thru 7 will be limited by the HGCSD to using not more than 20% groundwater at certain conversion years. The conversion dates fall between the years 1995 to 2010, and increases in groundwater use above 20% will be permitted thereafter only as long as surface water use does not decrease. In Area 8 increases in groundwater withdrawal may be permitted through 2020, however, supplying areas outside of the boundaries of Area 8 would be prohibited. For the purpose of this study, Area 8 was assumed to have a conversion date of 2030, when not more than 20% groundwater withdrawal will be permitted. The HGCSD has the power to amend or revoke permits as well as requiring conservation measures as a condition on certain well permits.

Population is expected to grow in all eight surrounding counties of the Houston region between the present and 2030. The highest growth is forecast for Harris County, with a net change of approximately 2,300,000 persons.

FIGURE 2



HARRIS - GALVESTON COUNTY SUBSIDENCE DISTRICT
REGULATORY AREAS

TABLE 2 (Cont'd)

SUMMARY OF HGCSD PLAN REQUIREMENTS BY SUB-AREA

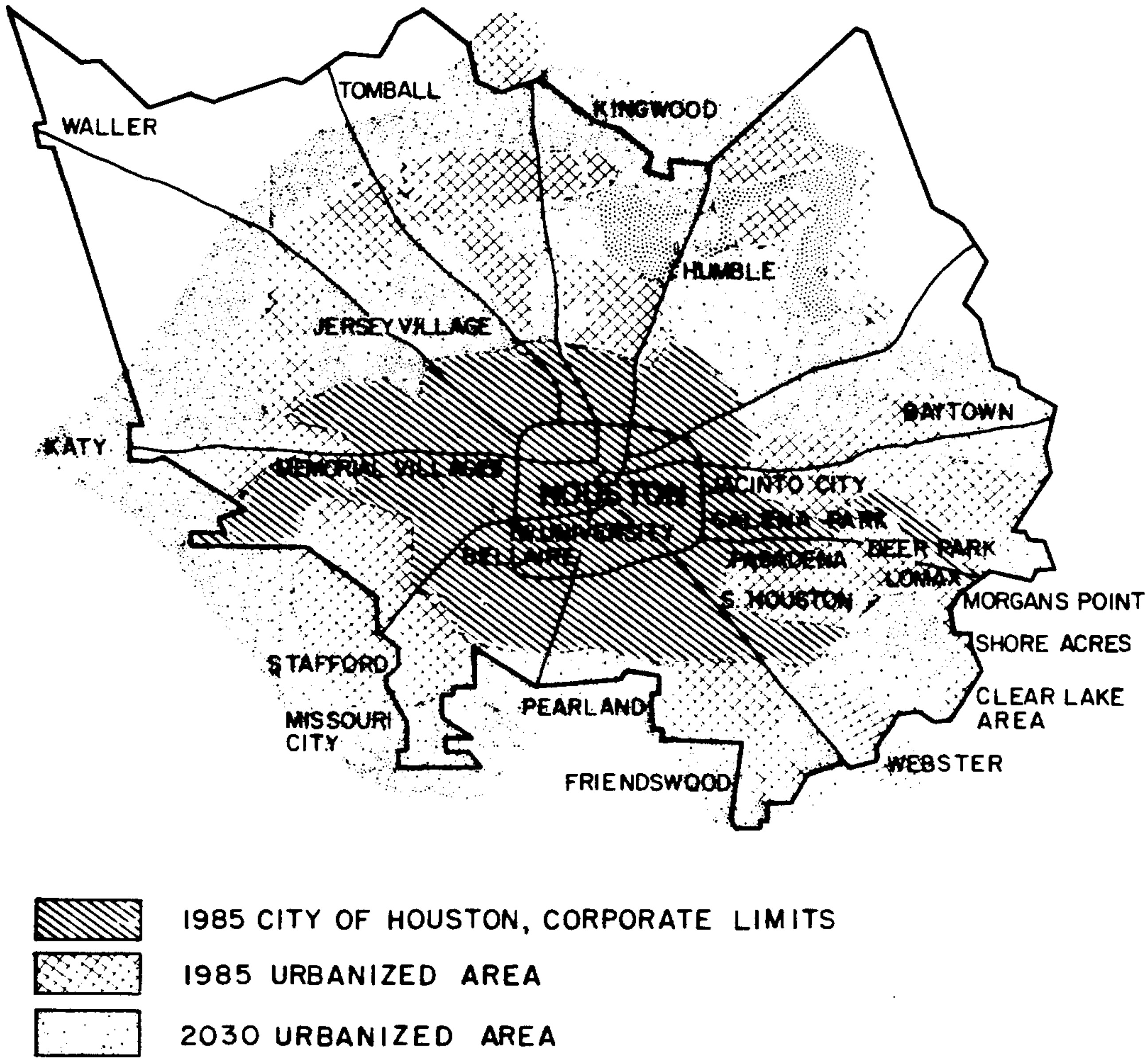
	REQUIREMENTS AND YEAR IN WHICH THEY TAKE EFFECT			
SUB-AREA	CURRENT-1990	1990-2000	2000-2010	2010-2020
Eight	Increases in groundwater permitted; Groundwater withdrawn in this area may not be supplied to areas outside boundaries.	Same as prior period.	Same as prior period.	Same as prior period.

Previous studies have indicated that within Harris County itself, the western portions of the county will experience the majority of the projected municipal growth. Figures 3 and 4 are reproduced directly from Appendix D of the HWMP and graphically show the extent of future Houston urbanization and population change between 1985 and 2030.

Along with this expected future growth will come a steady increase in water demand. For the WHCSWSC planning area, the maximum daily water demand is projected to remain at 61 MGD from 1985 through 1990. After 1990 it is projected to increase to 216 MGD by the year 2030. At present virtually 100% of the water demands of the area are supplied by groundwater.

As previously presented, much of the WHCSWSC planning area falls within one of the HGCSD regulatory areas requiring conversion to surface water. Subsidence monitors located in southwest Houston and Addicks indicate a continuing land subsidence of approximately one and a half inches per year. To reduce this loss of elevation will require reduction in groundwater pumpage and the delivery of surface water to the area. Currently, there are no existing surface water supplies available in West Harris County to serve the present or future demands of the area. The majority of alternative surface water supplies mentioned in prior studies for the City of Houston are located to the northeast of the City. This will result in a substantial long-term cost of transporting water across the City to areas in West Harris County where the greatest future municipal demand is expected. Clearly, a surface water source, treatment facilities, and transmission networks are needed to serve the West Harris County area and comply with the existing HGCSD regulations.

FIGURE 3

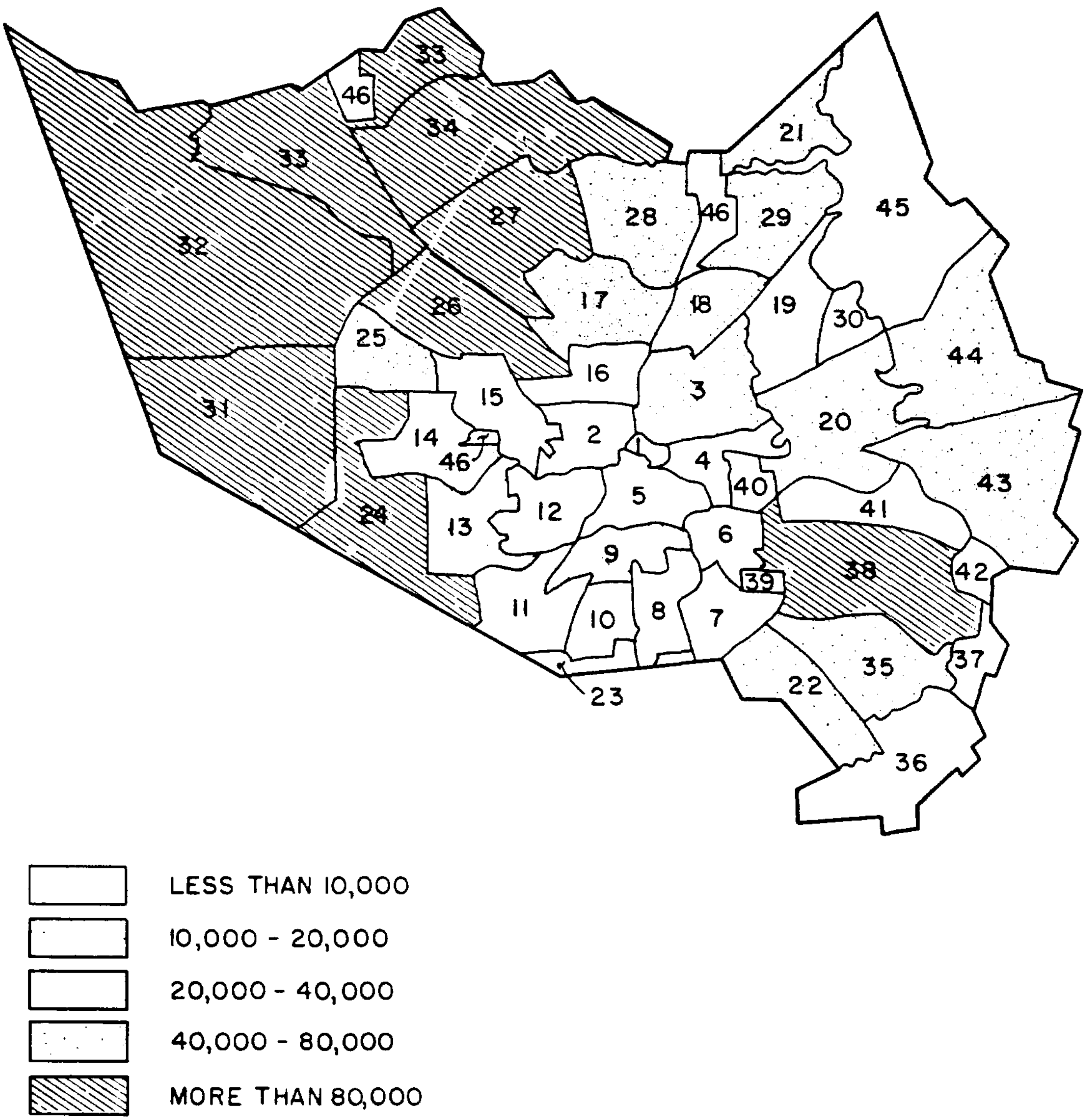


REPRODUCED FROM FIGURE I-4, HOUSTON WATER MASTER PLAN, APPENDIX D

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

EXTENT OF HOUSTON URBANIZED AREA

FIGURE 4



REPRODUCED FROM FIGURE 4-26, HOUSTON WATER MASTER PLAN, APPENDIX D - REVISED BY W.H.C.S.W.S.C.

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

POPULATION CHANGE, 1985 - 2000

Lead time and revenue are necessary to provide new surface water supplies and the associated treatment and transmission facilities. An implementation program accurately defining timing and costs of a new surface water supply is therefore a necessity.

Authorization:

This implementation plan was authorized by contract between the Texas Water Development Board and the West Harris County Surface Water Supply Corporation dated July 29, 1987.

Fifty percent of the costs associated with the implementation plan will be funded by Texas Water Development Board Planning and Research Grant funds with the remaining fifty percent being funded by the West Harris County Surface Water Supply Corporation.

2.0 WATER DEMANDS

2.0 WATER DEMANDS

Approach and Methods

It is the goal of the WHCSWSC to provide surface water for West Harris County in a timely and efficient manner. Existing and future water demands are the most important pieces of information needed to formulate a plan to accomplish this goal. While historic water use data is fairly easy to obtain, projections of future water use are affected by numerous factors which make estimating difficult. Economic growth is the driving force behind these factors. The City of Houston Water Master Plan examined three projections of economic growth for Houston and the surrounding areas, covering the years 1985 to 2030. Of the three, an econometeric model developed by Rice Center was selected to form projections of population, employment and water demands. The projections were revised to include the areas recent economic downturn. The revised HWMP projections were used to compute future water demands for the service area of WHCSWSC. Water demand reductions due to water conservation measures were not included to be consistent with the HWMP as reported in February, 1988. To better understand the potential customers of the WHCSWSC and to confirm the projections in the HWMP, detailed knowledge of the types of water use currently in the study area was gathered. This data was compiled into a Lotus 1-2-3 database for easy reference and handling.

Data Sources and Collection

Data was collected from a variety of sources to build a complete picture of historical and future water use in the proposed study area of the WHCSWSC. This data falls into two broad categories: information relative to large areas derived from the HWMP, and information obtained on the individual water users in the WHCSWSC study area. The following paragraphs explains the sources of data used to formulate water demand projections and the types of data obtained.

Data from the Houston Water Master Plan

The City of Houston Water Master Plan thoroughly addresses the question of projected water demand in three appendices. They are Appendix C, "Current Water Uses," Appendix D, "Population and Growth Projections," and Appendix H, "Water Demands."

Appendix C provides an inventory of current water uses during the period from 1980 to 1984. This is limited to the City of Houston and to the Coastal Water Authority. Water use is not broken down by location, but trends of water demand by user category are examined for the five years.

Population and growth projections from the Rice Center econometric model of Houston's economic growth are the topic of Appendix D of the HWMP. For a breakdown of the projected variables by location, census tracts were used. The tracts were grouped into 46 Municipal Demand Areas (MDAs) within Harris County and 19 in the seven surrounding counties. Each MDA is contiguous and has fairly similar land use characteristics. Projections for population, employment, housing and land use were prepared for each census tract in the HWMP study area, and the data was presented in the appendix for each MDA. The Rice Center econometric model yielded consistently higher forecasts than did other projection scenarios thereby producing a prudent basis for water demand projections. These projections were revised by the City of Houston's Master Plan Consultant in February of 1988. The revisions were made to account for the Greater Houston's Area economic slow down between the years 1985 through 1990. The projections were assumed flat through these five years. After 1990 it was assumed the growth would continue as projected by the Rice Center econometric model. These revised projections were used in developing this report.

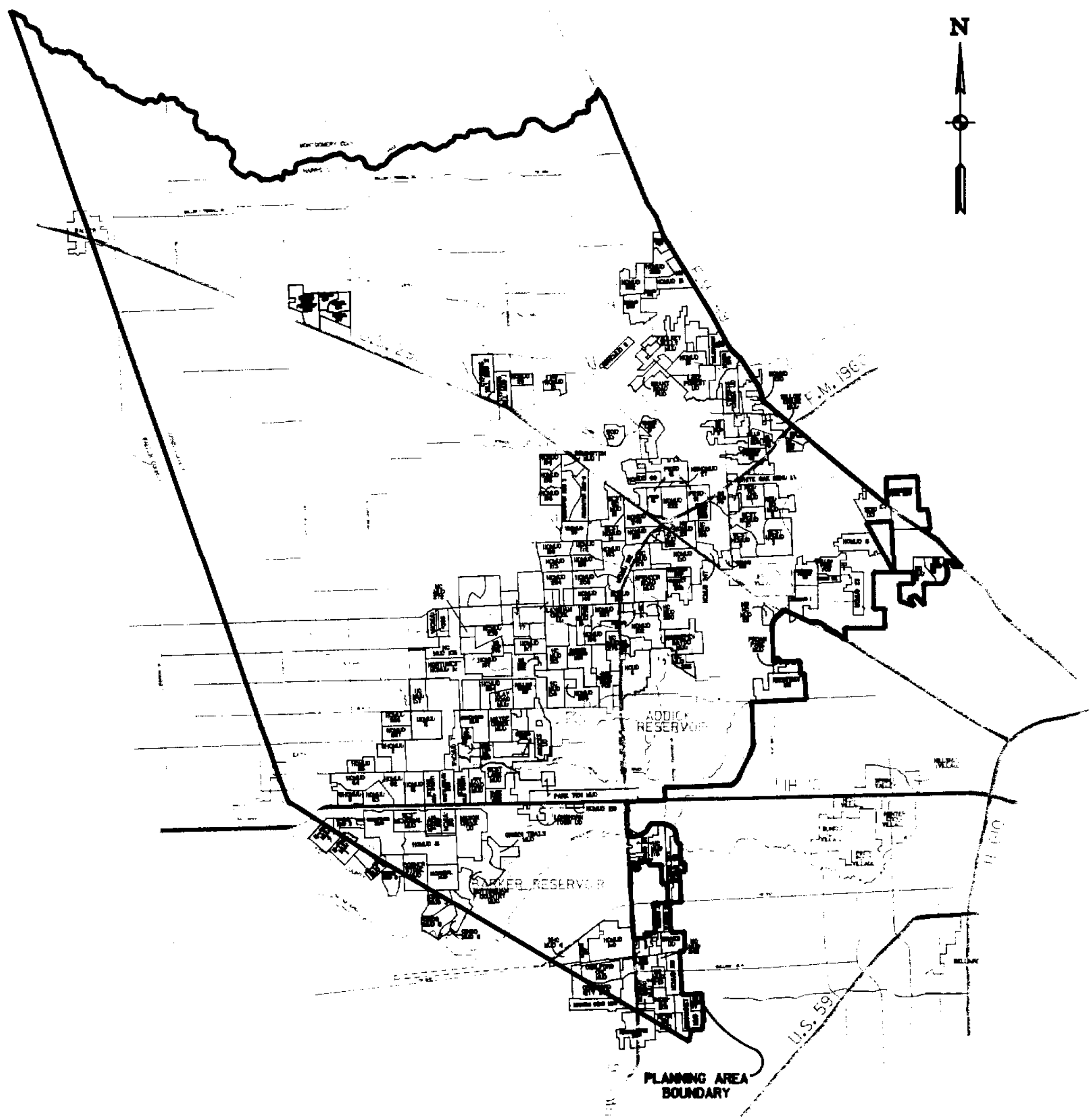
Appendix H of the HWMP and its revisions combined the information amassed in Appendix D and its revisions with a one year record of water billing in the City of Houston to calculate per capita and per employee water demands throughout the City. These numbers were used to project water demand during the time period of the study. As in Appendix D, computations were performed on a census tract level and reported by MDA.

All water demand projections in the HWMP are for consumer use only and do not include unaccounted-for water in the system. Predictions of water needs in the WHCSWSC study area were taken from Appendix H and its revisions. For greater accuracy when dealing with partial MDAs, a listing of water demands by census tract was obtained from Metcalf and Eddy, the consultant for the HWMP.

Data on Specific WHCSWSC Water Users

To aid in the deeper understanding of water needs, a list of the water users in the WHCSWSC study area was compiled. These users are principally municipal utility districts and the cities of Jersey Village, Katy and Waller, although there are some commercial and industrial users present. An alphabetical listing of the municipal districts within the study area was previously presented in Table 1. This list of utility districts has two sources. The names of districts in the study area were taken from a municipal utility district map published by the Houston City Planning Commission in 1984, updated to December 30, 1986. In addition, a complete listing of active utility districts within Harris County, as of January 1987, was obtained from the Texas Water Commission. This list was used to eliminate districts which had been dissolved, consolidated, annexed, or become inactive; and to add districts which had been created recently. Districts within the WHCSWSC planning area boundary are shown on Figure 5. All deleted districts have been removed from the figure and all but five new districts have been added. No boundary map could be obtained for the omitted districts; however, none of these had begun pumping water by 1986.

FIGURE 5



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

TABLE 3

INDUSTRIAL AND COMMERCIAL WATER USERS HAVING WELL PERMITS

NO.	NAME OF INDUSTRY
1.	Baker Service Tools
2.	Baker Tubular Services
3.	Bear Creek Golf World
4.	Britmore Utility Company
5.	Cameron Iron Works
6.	Enchanted Valley Water Supply
7.	Gifford-Hill & Company
8.	Hearthstone Country Club
9.	National Steel Products
10.	Northwest Water Systems, Inc.
11.	Peek Road Utilities
12.	Tall Pines Utility
13.	Texas Instruments
14.	Tower Oak Bend Water Supply
15.	Treeline Golf Club, Inc.
16.	Trumix Concrete Company
17.	Trunkline Gas Company

Industrial and commercial water users having their own wells with yearly consumptions greater than approximately three million gallons are listed in Table 3. This list was compiled using well permit data available from the HGCSD. The list of industrial users is not intended to be a complete list of all significant industries in the area, since many industries and businesses buy their water from cities and water districts. It was compiled to account for additional water use in the study area.

The most important information needed to evaluate projected water demands is the historic demand of all users. A time frame from 1980 to 1986 was chosen to overlap the time frame in Appendix C of the HWMP, 1980 to 1984. Since no surface water is currently used in western Harris County, groundwater pumpage reports form a nearly complete record of water use within the service area. The HGCSD proved to be the most convenient source of pumping data. Each owner of a well six inches or greater in diameter is required to submit to HGCSD a yearly report indicating groundwater pumpage by month. Copies of these reports were obtained for each utility district in the study area having a well permit. An annual summary of these reports was provided for each city and business of interest. Only the annual pumpage totals were included in the water user database. The pumpage includes water billed as well as unaccounted-for water.

In a few instances, water for a district is purchased from another district, the City of Houston, or imported from Fort Bend County, where the HGCSD has no authority. In these cases, the operators of the water plants for the districts in question were asked to provide pumpage records for the period of study. Where one district supplies water for another, the water use was divided among them when the split could be determined, especially if the water was consumed in different MDAs.

Additional data for many characteristics of the utility districts in the study area was sought from the district operators in the WHCSWSC study area. Each operator was asked to supply information on current number of connections, amounts of ground and elevated storage, primary and booster pumping capacities, water rates, billed versus pumped percentages, well permits and water analysis reports. Not all districts have operators, and not all of this information was readily available to each operator, but much of it was received and tabulated in database form. Of the 195 districts, some or all the information was available on approximately 132 districts. This data was useful not only in evaluating water demands but also in providing insights into the types of water users in the WHCSWSC study area.

To gather information on future development, the local office of the Texas Water Commission was visited in order to make copies of portions of bond issue and creation reports containing projected types of development and build-out schedules. These reports were available for 136 of the districts in the WHCSWSC study area. This general information was helpful in resolving questions of water sources for the districts as well as describing likely development trends.

Existing Water Use

Two sources of data on existing water usage were available for this study. The first, groundwater pumpage information collected from the HGCSD, provides the most useful evidence of water consumption trends in the study area. Water demand can be broken out by location to better understand growth patterns. The second source, Appendix C of the HWMP, is concerned only with City of Houston billed water use. This information is not directly applicable to the WHCSWSC study area; however, general trends found in the City will be compared to those in western Harris County. This section examines the data from both sources, compares them, and makes conclusions about current water uses.

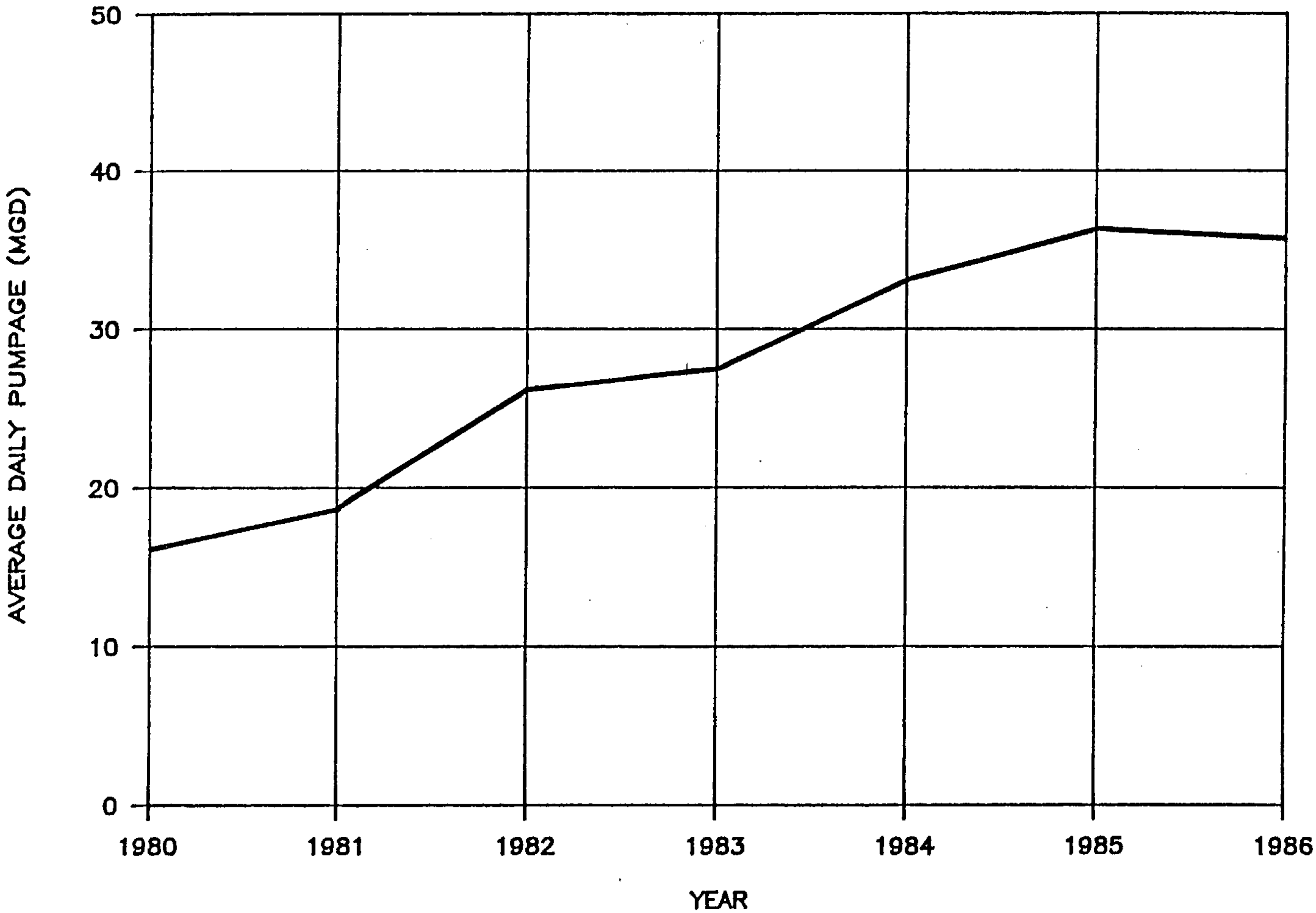
Groundwater Pumpage in the WHCSWSC Study Area

Groundwater pumpage records for each municipal utility district, city and industry were obtained for the period from 1980 to 1986. In order to determine the daily water supply needed, the annual pumpage of each water user was divided by 365 to yield an average daily demand. These demands were added to give the total average daily demand for each MDA. Since small wells are not required to have permits, the total computed is slightly smaller than the actual groundwater used. The total groundwater pumpage during the 1980 to 1986 period is plotted on Figure 6.

FIGURE 6

HISTORIC GROUNDWATER PUMPAGE

IN THE WHCSWSC SERVICE AREA

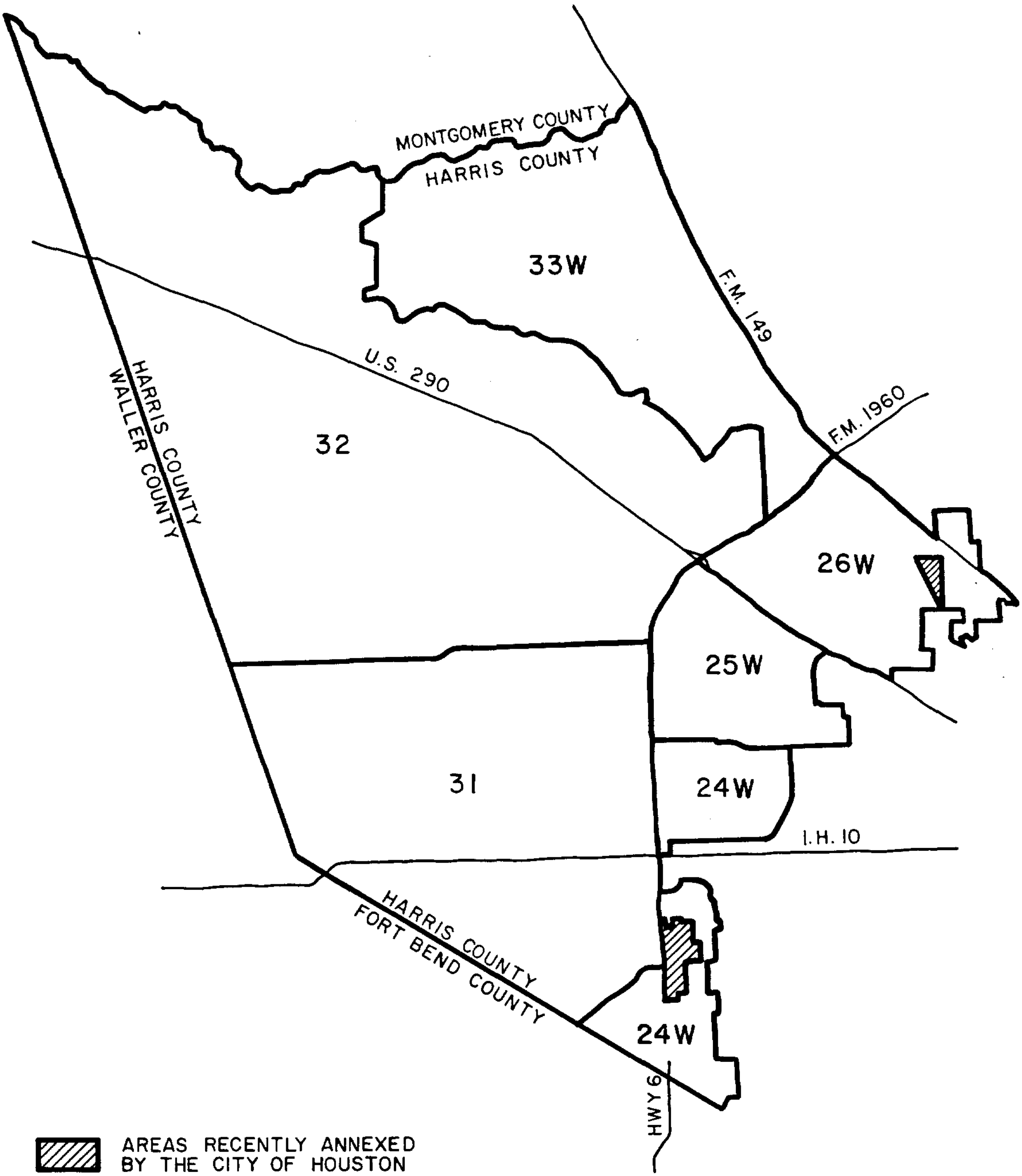


The WHCSWSC study area contains all of MDAs 31 and 32, and portions of MDAs 24, 25, 26 and 33. The four partial MDAs, hereinafter called MDAs 24W, 25W, 26W and 33W are not identical to those in the HWMP, but consist of the portions of the HWMP MDAs which fall inside the WHCSWSC planning area. Figure 7 shows the WHCSWSC MDAs. Table 4 lists the census tracts which make up the WHCSWSC MDAs. When the planning area boundary did not coincide with a census tract boundary, the percentage of land within the WHCSWSC study area was computed.

Historic water pumpages in the WHCSWSC study area have been calculated for each of the six WHCSWSC MDAs. Table 5 shows a breakdown per year of average daily pumpage and Figure 8 graphically presents these results. Examination of the data reveals pumpage trends for each MDA. Note that all six MDAs experienced rapid growth during the seven year period. Water pumpage in MDA 24W more than tripled while water pumpage in the other areas at least doubled. In general, groundwater pumpage grew steadily except during 1983, when it slowed somewhat in all MDAs, and in 1986, when MDAs 25W, 26W and 31W actually recorded drops in water usage. The leveling off or reduction from 1985 through 1990 reinforces the revisions to the Rice econometric model and to the HWMP performed in February of 1988. The leveling off was projected through 1990 where the growth was projected to increase as previously mentioned.

Groundwater pumpage records were obtained in monthly and annual form. Therefore, no analysis of maximum daily or peak hourly demands could be performed. It was also impossible tc break down the pumpage reported for a city or district into user categories such as commercial or single-family residential, since no billing records were obtained.

FIGURE 7



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

MUNICIPAL DEMAND AREAS

TABLE 4

COMPARISON OF 1980 CENSUS TRACTS TO MUNICIPAL DEMAND AREAS

MDA 24 W	
CENSUS TRACT	PERCENT INCLUDED
437.01	100%
437.02	66%
438.01	39%
438.06	31%
448.00	100%

MDA 25 W	
CENSUS TRACT	PERCENT INCLUDED
542.01	100%
542.02	88%
543.00	100%

MDA 26 W	
CENSUS TRACT	PERCENT INCLUDED
530.01	100%
530.02	5%
530.03	50%
540.01	80%
540.02	64%
541.00	100%

MDA 31	
CENSUS TRACT	PERCENT INCLUDED
449.00	100%
450.00	100%
451.01	100%
451.02	100%
452.01	100%
452.02	100%

MDA 32	
CENSUS TRACT	PERCENT INCLUDED
544.00	100%
545.01	100%
545.02	100%
546.00	100%
547.00	100%
548.00	100%
549.00	100%

MDA 33 W	
CENSUS TRACT	PERCENT INCLUDED
550.00	100%
551.01	100%
551.02	100%
552.00	100%

TABLE 5

AVERAGE DAILY WATER PUMPAGE IN WHCSWSC PLANNING AREA, 1980 - 1986

	AVERAGE DAILY PUMPAGE (MGD)						
	1980	1981	1982	1983	1984	1985	1986
MDA 24W	1.77	2.56	4.15	4.32	5.53	5.97	6.12
MDA 25W	1.70	2.02	2.91	3.18	3.87	4.57	4.29
MDA 26W	3.30	3.76	5.08	5.08	6.17	6.79	6.66
MDA 31	5.51	6.19	8.46	8.88	10.28	11.32	10.39
MDA 32	2.03	2.33	2.99	3.19	3.91	4.20	4.25
MDA 33W	1.83	1.84	2.61	2.82	3.30	3.49	4.09
TOTAL WHCSWSC	16.14	18.70	26.20	27.47	33.06	36.34	35.80
WHCSWSC Industry*	0.61	0.81	0.75	0.67	0.74	0.80	0.66

*Available total for industrial and commercial consumers.

FIGURE 8

HISTORIC GROUNDWATER PUMPAGE

IN MDA 24W

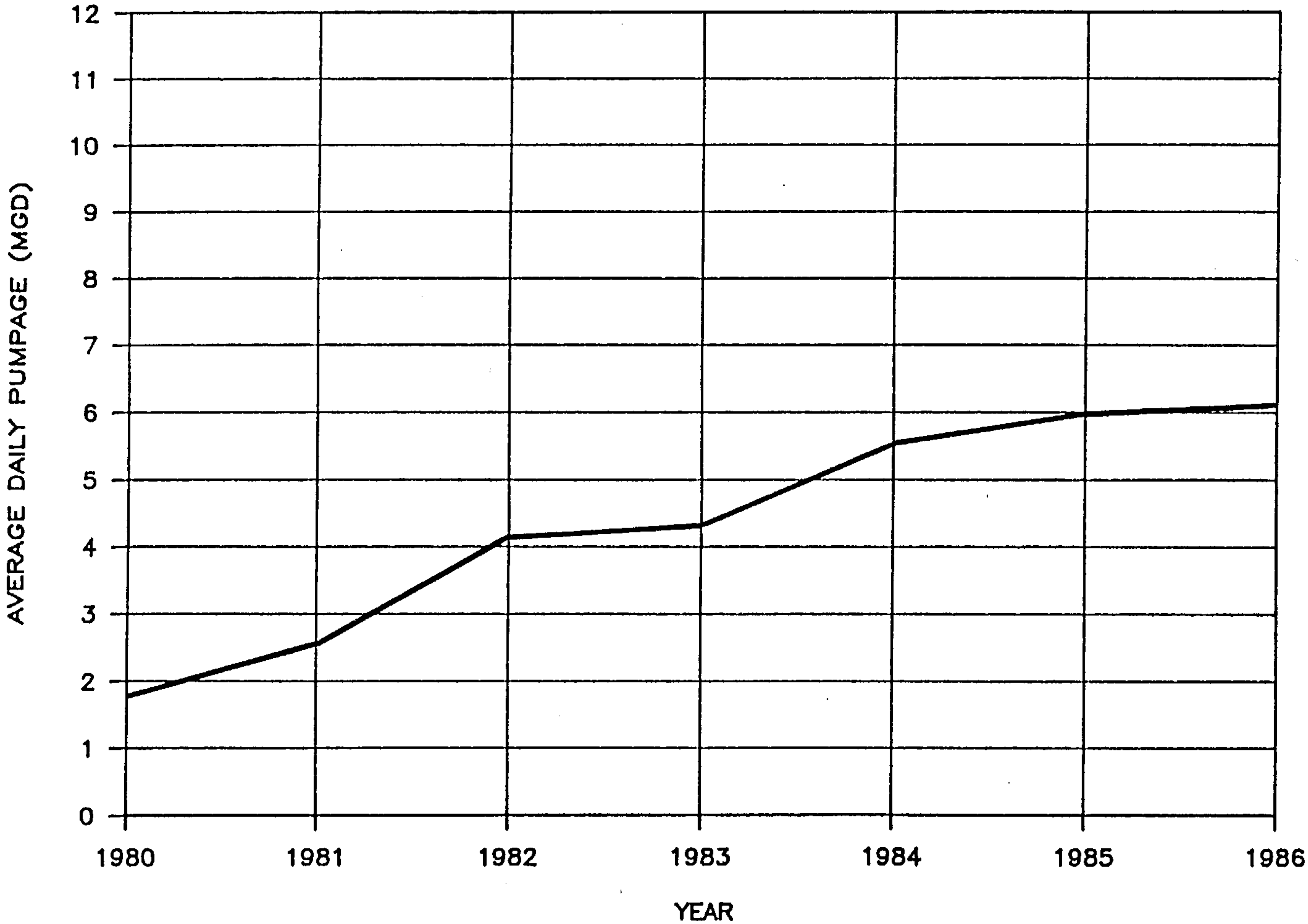


FIGURE 8
(CONT.)
HISTORIC GROUNDWATER PUMPAGE
IN MDA 25W

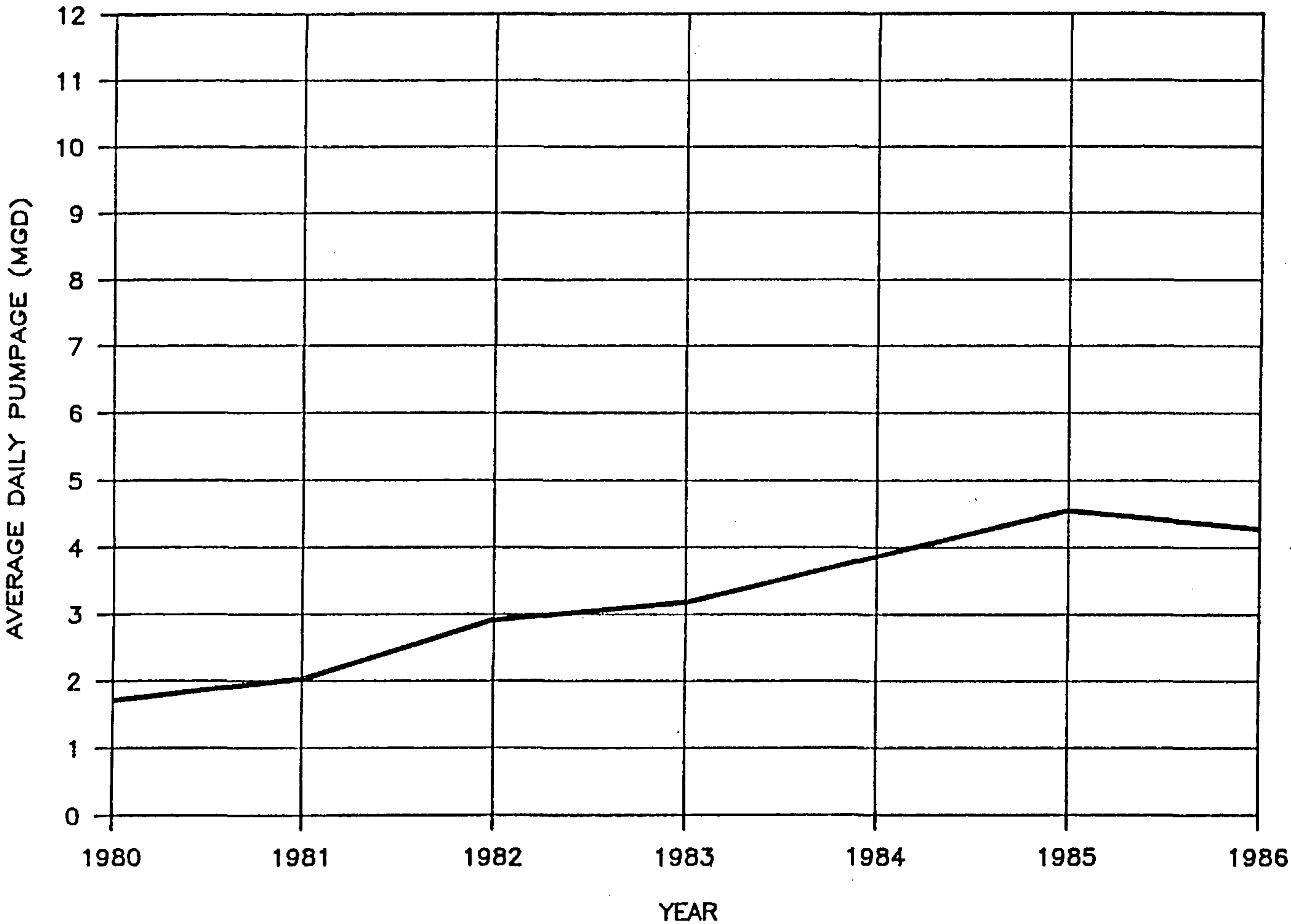


FIGURE 8
(CONT.)
HISTORIC GROUNDWATER PUMPAGE
IN MDA 26W

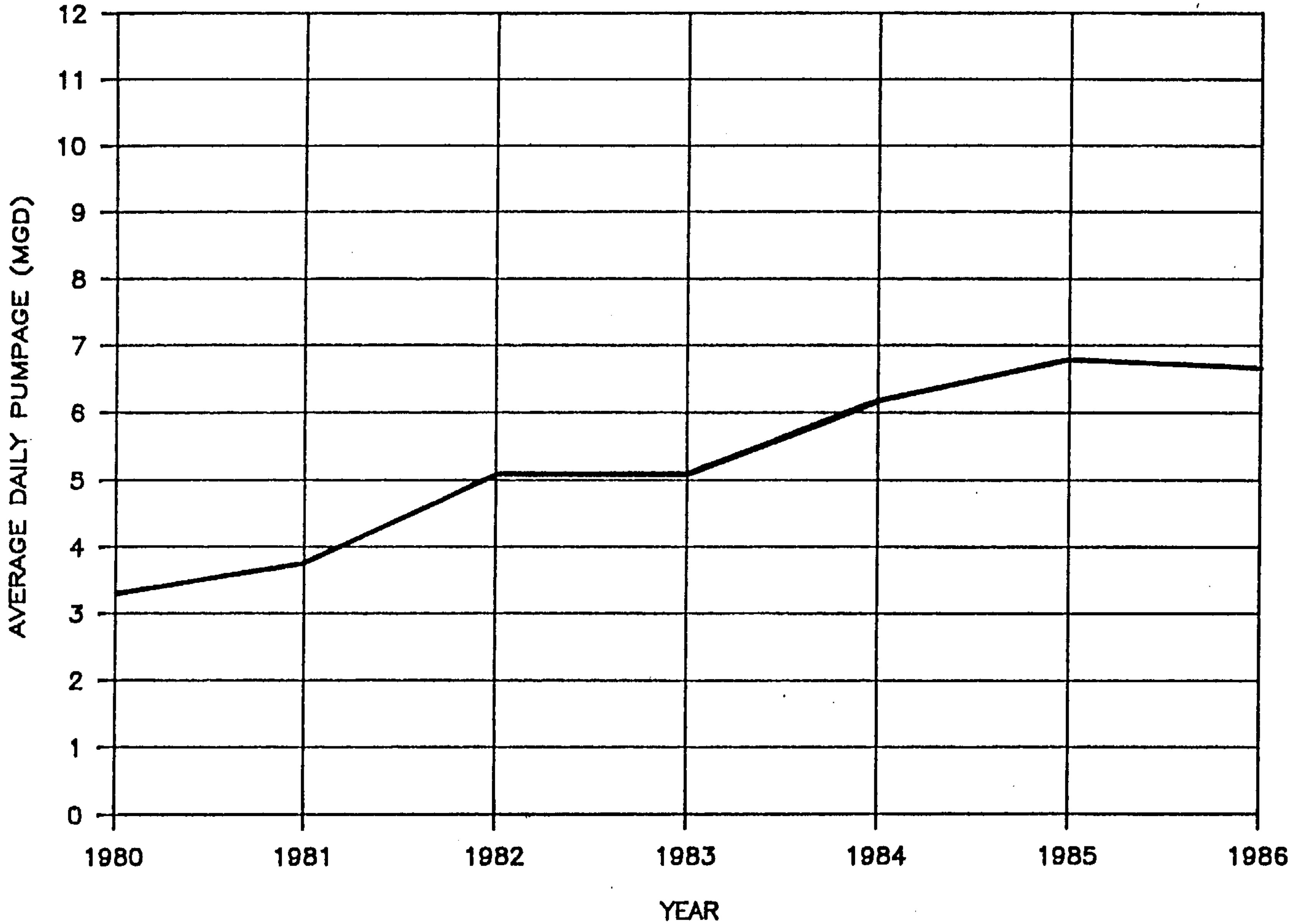


FIGURE 8
(CONT.)
HISTORIC GROUNDWATER PUMPAGE
IN MDA 31

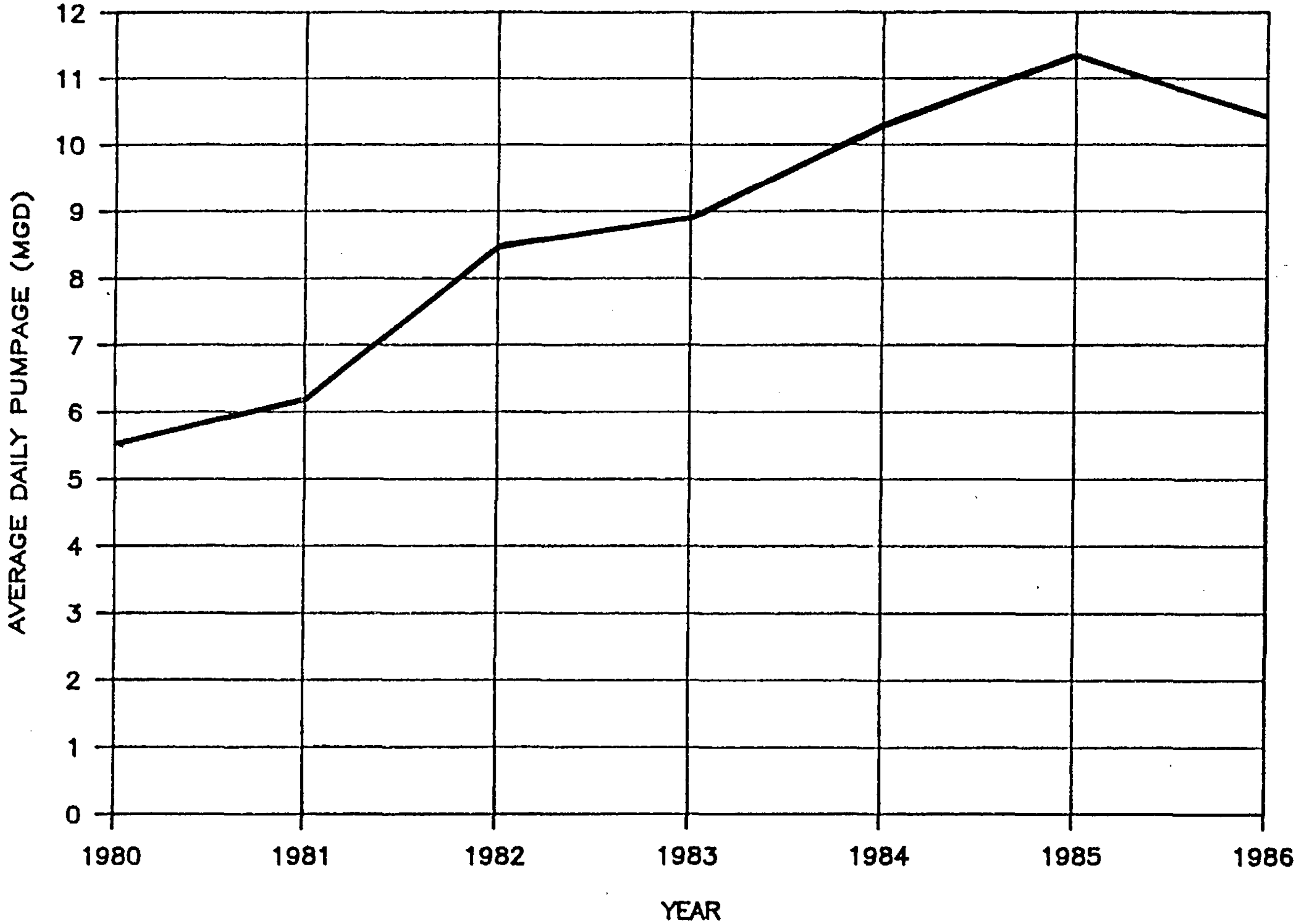


FIGURE 8
(CONT.)
HISTORIC GROUNDWATER PUMPAGE
IN MDA 32

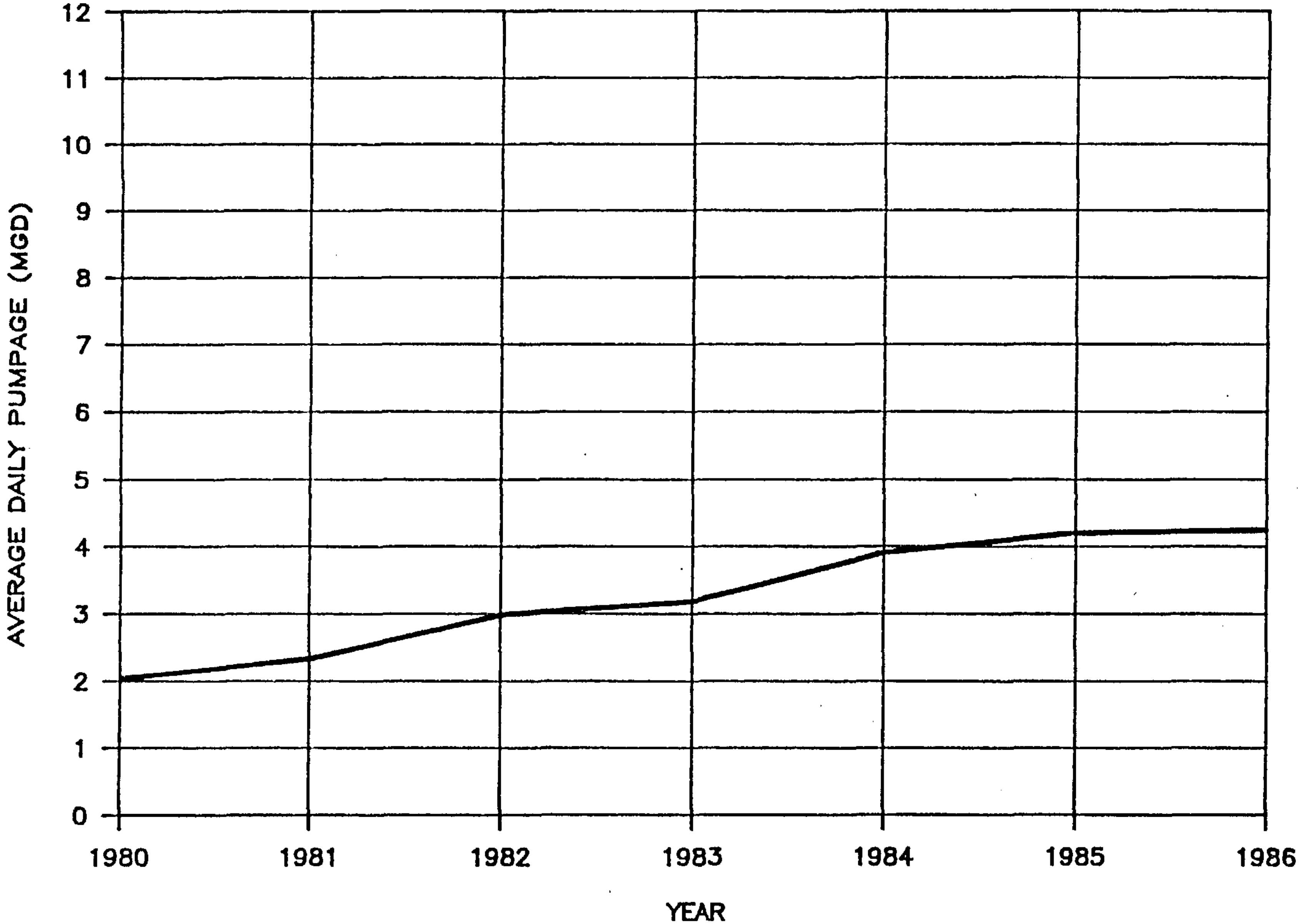
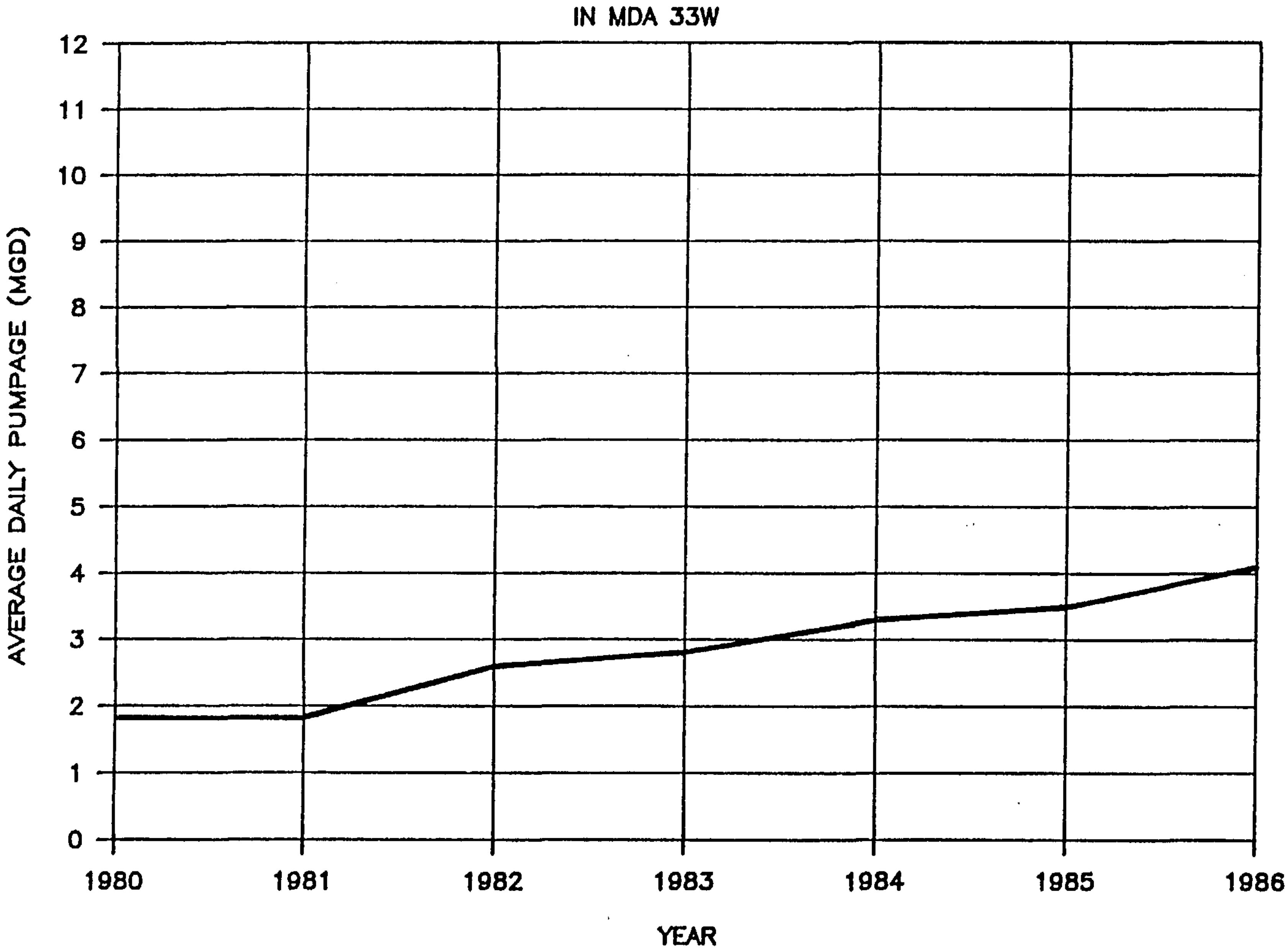


FIGURE 8
(CONT.)
HISTORIC GROUNDWATER PUMPAGE



A complete list of industrial and commercial water users within the WHCSWSC service area cannot be compiled, but a list exists of 17 users that have well permits but are neither municipal utility districts nor cities. Of these, six are utilities providing municipal water supply. If these are eliminated, eleven industries and commercial users remain. Water pumpage trends in this group are shown on previously presented Table 5. Pumpage increased from 1980 to 1981, then fell until 1983. In 1984, water pumpage began to increase, and this continued through 1985. In 1986, water use dropped nearly to 1980 levels.

Water Usage in the City of Houston and CWA

The City of Houston serves mainly residential and commercial customers, while CWA supplies raw water to the City of Houston for supplying raw water to the industries along the Ship Channel. Table 6 shows the average daily water demands for the City of Houston and CWA and Figure 9 graphs the total demands of the two entities. During the time frame of Appendix C of the HWMP, 1980 to 1984, the total water billed by the City of Houston and by CWA varied by only 7%, so water demand was fairly steady. Combined demands peaked at 490 MGD in 1982, followed in 1983 by the low value of 453 MGD. Demand began to rise by 1984. When only the City of Houston is considered, the same pattern of increase and decrease is noted as for the combined Houston and CWA usage. However, the decline in demand in 1983 is not so severe. When CWA water demands are examined, a different sequence is observed. Beginning in 1982, demand for CWA declined, leveling off somewhat by 1984.

TABLE 6

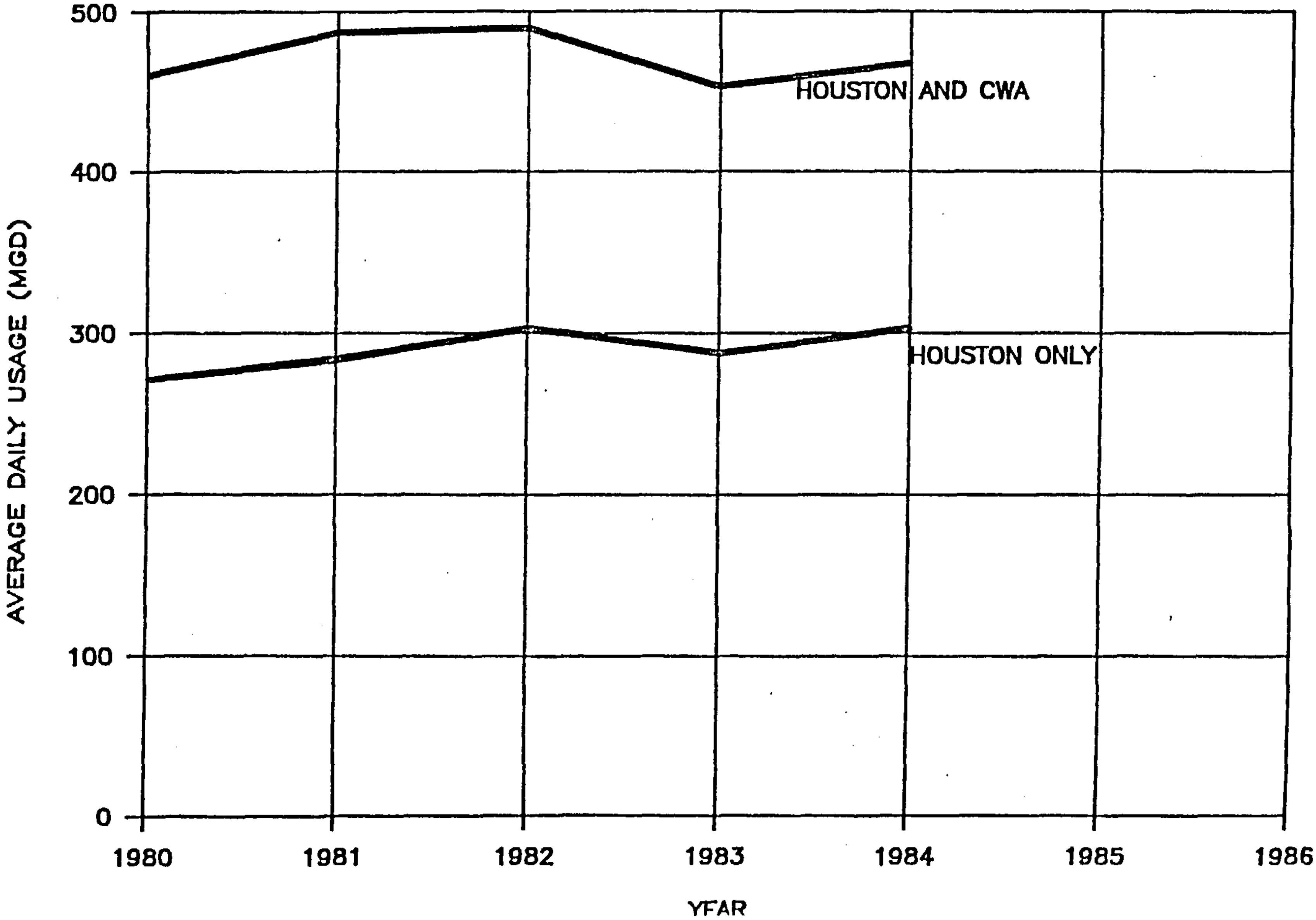
AVERAGE DAILY WATER USAGE IN HOUSTON, 1980 - 1984

	AVERAGE DAILY USAGE (MGD)				
	1980	1981	1982	1983	1984
Houston	271.31	285.08	302.96	287.36	303.24
CWA	189.96	202.88	187.34	165.68	164.48
TOTAL HOUSTON	461.27	487.96	490.30	453.04	467.72

FIGURE 9

HISTORIC WATER USAGE IN HOUSTON

BASED ON BILLING RECORDS



It is interesting to compare water demands in the City of Houston with those in the WHCSWSC study area. Since West Harris County has little heavy industry compared to the total Houston system, it might be expected that historic usage in the WHCSWSC area would more closely resemble that of Houston without CWA. A comparison of Figures 6 and 9 and of Tables 5 and 6 shows this to be true. The City of Houston use showed growth in all years except 1983. In the western region, no demand reductions occurred between 1980 and 1984. Instead, the WHCSWSC study area shows decreased demand growth in 1983. With two additional years of data for the WHCSWSC service area, it is seen that in 1986 demand actually decreased by 1.5%. However, over the seven year period, the water demand in the WHCSWSC service area increased an average of 17% annually. The City demand without CWA increased about 2.4% annually, while during the same period total City use increased by only 1% over five years.

From Appendix C of the HWMP it is evident that industrial water use suffered larger declines and experienced less growth than other uses. Although the historical WHCSWSC data on industrial and commercial users is limited, the figures on Table 5 may be compared to the CWA totals on Table 6. It is seen that years of growth and decline coincide until 1984 when CWA use held steady while WHCSWSC demands increased. From these comparisons it is clear that while WHCSWSC water use trends mirror those in Houston to a degree, municipal growth in the western portions of the county is faster and steadier than in the City.

Projected Water Demands

Appendix H of the HWMP and its revisions gives average daily, maximum daily and peak hour water demands for each MDA at ten year intervals from 1990 to 2030. The following describes the process used to calculate projected water demands and compare them to historic data to evaluate their accuracy.

To compute projected demands, the HWMP required three separate steps. First, demand criteria in gallons per capita (or per employee) per day were determined. Inside the City of Houston, billing records for September 1984 through August 1985 were used along with 1985 populations to compute these criteria for several user categories, including single-family residential, multi-family residential, commercial and light industrial, and heavy industrial. These demand criteria are not consistent, but vary in each MDA. Next, demand criteria were assigned to the MDAs outside the city limits based on similarity of land usage. Table 7 summarizes the criteria used for the WHCSWSC MDA's. Finally, the population and employment figures from Appendix D and its revisions were used as the basis of projecting total average daily water demands for each MDA. Maximum daily and peak hour demands were computed by multiplying the average daily demands by the appropriate factors.

In the MDAs outside the city limits, the accuracy of the HWMP projections depends on the assignment of correct demand criteria. Since the WHCSWSC service area is entirely outside of the City of Houston, with the exception of Addicks and Barker Reservoirs, this is an important consideration. The HWMP

TABLE 7

DEMAND CRITERIA USED IN WHCSWSC PLANNING AREA

MDA	Single-Family Residential (GPCD)	Multi-Family Residential (GPCD)	Commercial and Light Industrial (GPED)	Heavy Industrial (GPED)
24	105	80	70	3500
25	100	75	70-140*	3500
26	95	75	70-140*	3500
31	105	80	70-140*	3500
32	105	80	70-140*	3500
33	105	80	70	3500

*70 GPCD in 1985, increasing linearly to 140 GPCD in 2030.

Reproduced from Appendix H, Table 3-1 of the HWMP.

made no comparisons with existing water use for the outer MDAs. Therefore, groundwater pumpage records from 1980 to 1986 were checked against the HWMP projections in this study. Direct comparison of the average daily water demand projections developed in Appendix H of the HWMP with groundwater pumpage records in the WHCSWSC service area is not possible for two reasons. First, four of the MDAs used in the HWMP did not fall completely within the planning boundaries of the WHCSWSC; namely, MDAs 24, 25, 26 and 33. Second, the water useage projections used in the HWMP did not include losses (unaccounted-for water).

Both data inconsistencies were addressed so that the accuracy of the HWMP projections could be checked. In order to apply the water demand projections in Appendix H of the HWMP to the partial MDAs, the total demand for a given MDA was split based on the census tracts shown on previously presented Table 4. For each WHCSWSC MDA, the water demands for the included census tracts were multiplied by the percentage of the tract area in the MDA and added to yield a total MDA water demand. Adjustments were made to the WHCSWSC pumpage data in order to estimate water usage. Billed versus pumped information in 1986 for 79 utility districts in the planning area was obtained from district water plant operators. Average losses of 17% were computed from this data. Groundwater pumpages for the entire study period were reduced by 17% for comparison to the HWMP water usages. Table 8 gives the historic and projected data, while Figure 10 shows it graphically. The historic and projected data overlapped in 1985 and 1986. Table 9 compares the historic usage to the projected for these years. Note that the estimated historic water use is lower than the projected water use in half of the MDAs. This is to be

TABLE 8

REVISED DEMANDS
HISTORIC AND PROJECTED AVERAGE DAILY WATER USAGE BY MDA

YEAR	MDA 24 HISTORIC USAGE (MGD)	MDA 24 PROJECTED USAGE (MGD)	MDA 25 HISTORIC USAGE (MGD)	MDA 25 PROJECTED USAGE (MGD)	MDA 26 HISTORIC USAGE (MGD)	MDA 26 PROJECTED USAGE (MGD)
1980	1.47		1.41		2.74	
1981	2.12		1.68		3.12	
1982	3.44		2.42		4.22	
1983	3.59		2.64		4.22	
1984	4.59		3.21		5.12	
1985	4.96	4.38	3.79	5.48	5.64	6.95
1986	5.08	4.38	3.56	5.48	5.53	6.95
1990		4.38		5.48		6.95
1995		5.39		6.52		8.11
2000		6.87		8.00		10.11
2010		9.06		10.85		14.17
2020		9.82		13.37		17.25
2030		9.73		15.24		19.46

YEAR	MDA 31 HISTORIC USAGE (MGD)	MDA 31 PROJECTED USAGE (MGD)	MDA 32 HISTORIC USAGE (MGD)	MDA 32 PROJECTED USAGE (MGD)	MDA 33 HISTORIC USAGE (MGD)	MDA 33 PROJECTED USAGE (MGD)
1980	4.57		1.68		1.52	
1981	5.14		1.93		1.53	
1982	7.02		2.48		2.17	
1983	7.37		2.65		2.34	
1984	8.53		3.25		2.74	
1985	9.40	8.37	3.49	4.09	2.90	2.99
1986	8.62	8.37	3.53	4.09	3.39	2.99
1990		8.37		4.09		2.99
1995		11.32		5.64		3.61
2000		16.43		7.51		4.84
2010		27.26		11.84		7.41
2020		37.77		16.61		9.68
2030		48.22		21.70		11.22

NOTE:
1. Historic water usages computed based on average 1986 losses. 1986 projected usages determined by straight-line interpolation.
2. Projected water usages computed were based on the HWMP's February 1988 revisions.

FIGURE 10
AVERAGE WATER USAGE IN MDA 24W
HISTORIC AND PROJECTED

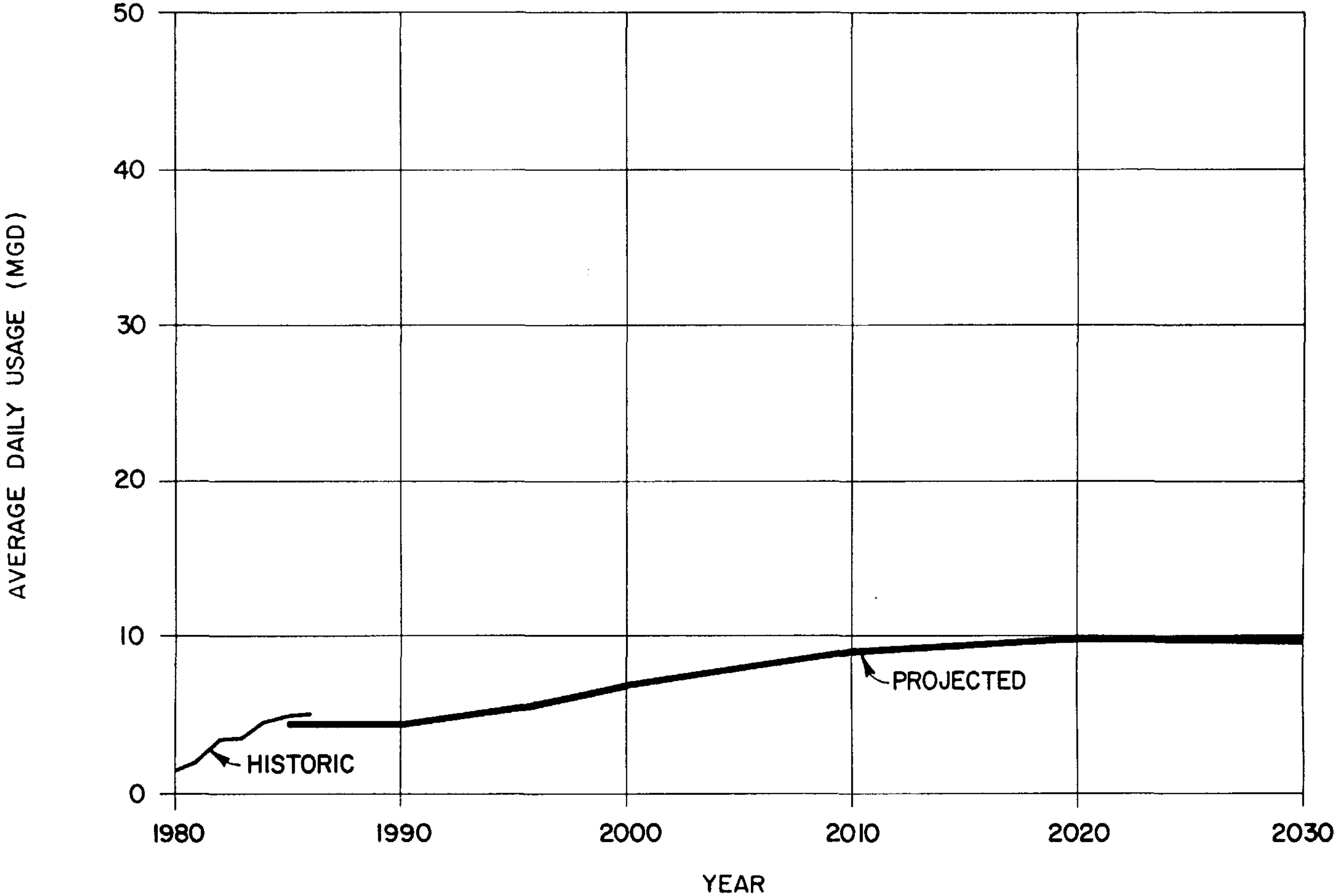


FIGURE 10
(CONT.)
AVERAGE WATER USAGE IN MDA 25W
HISTORIC AND PROJECTED

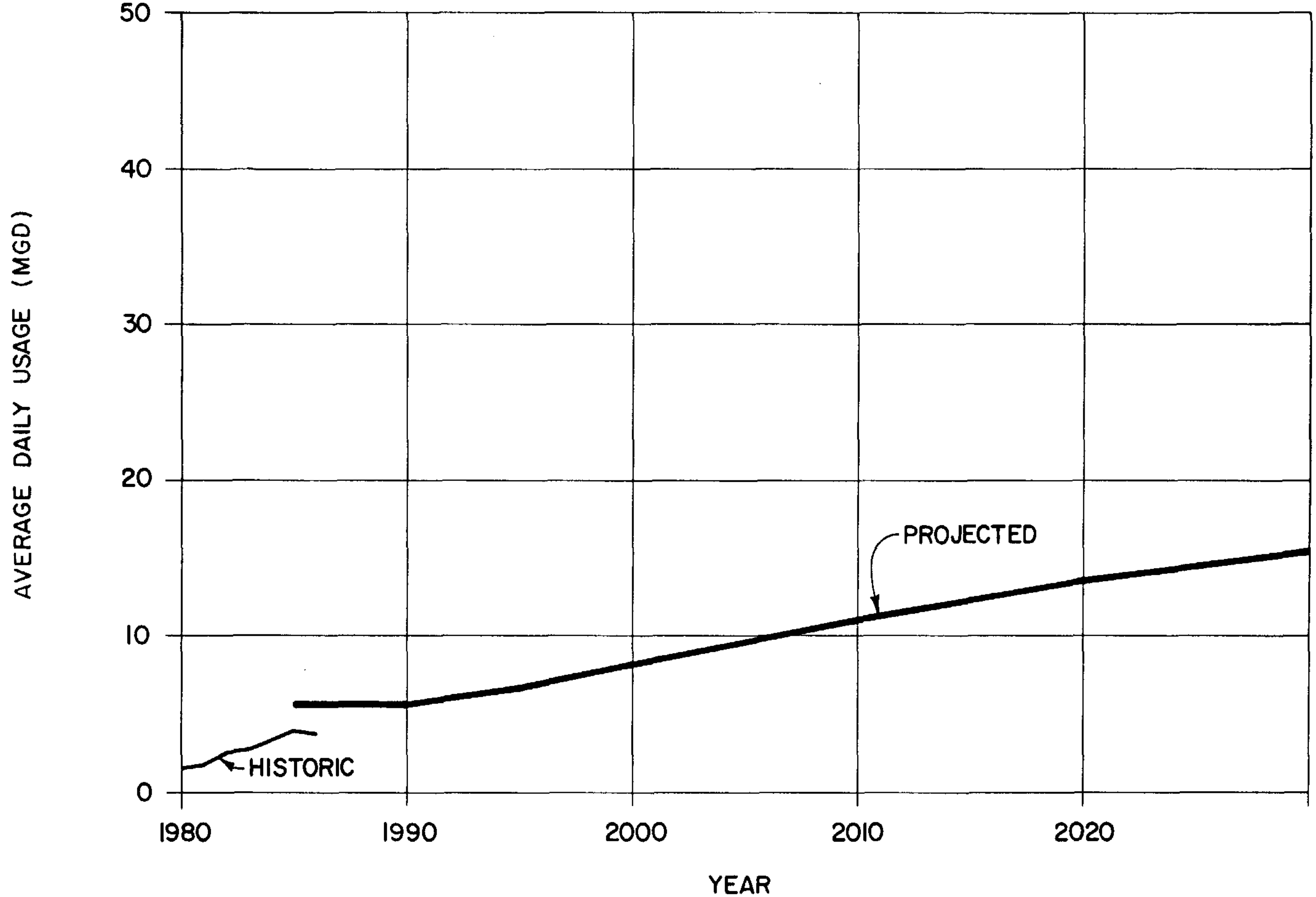


FIGURE 10
(CONT.)
AVERAGE WATER USAGE IN MDA 26W

HISTORIC AND PROJECTED

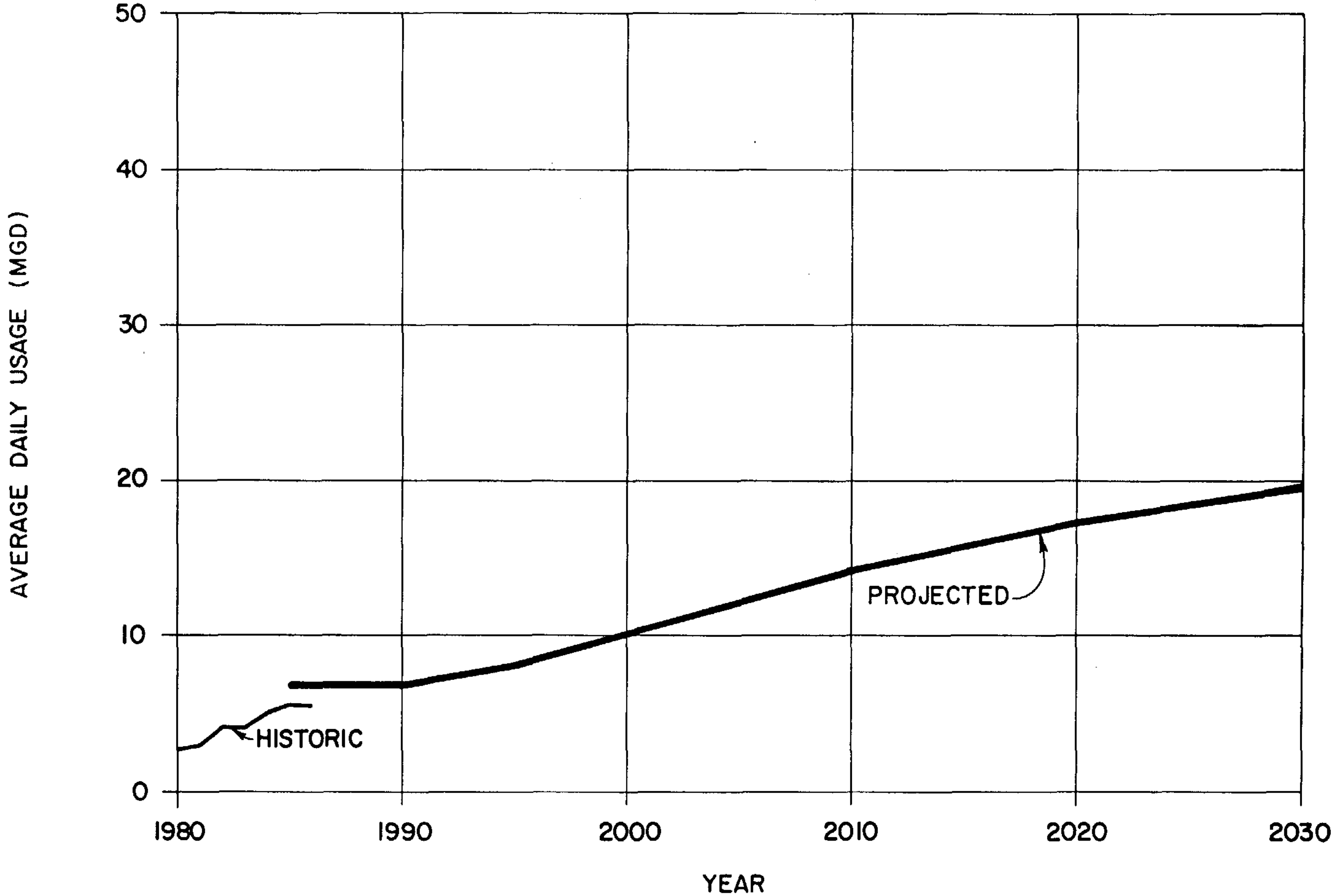


FIGURE 10
(CONT.)
AVERAGE WATER USAGE IN MDA 31
HISTORIC AND PROJECTED

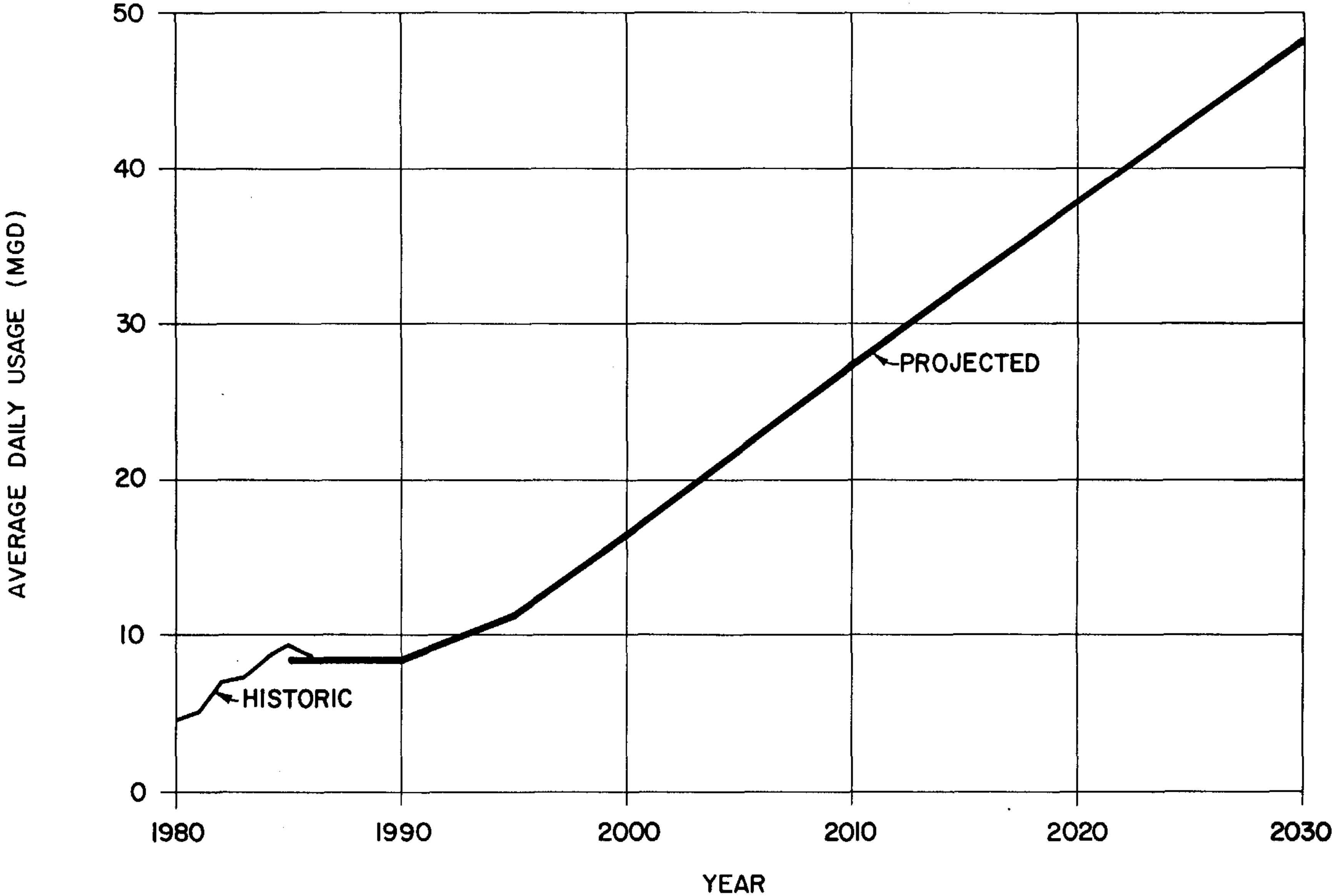


FIGURE 10
(CONT.)
AVERAGE WATER USAGE IN MDA 32
HISTORIC AND PROJECTED

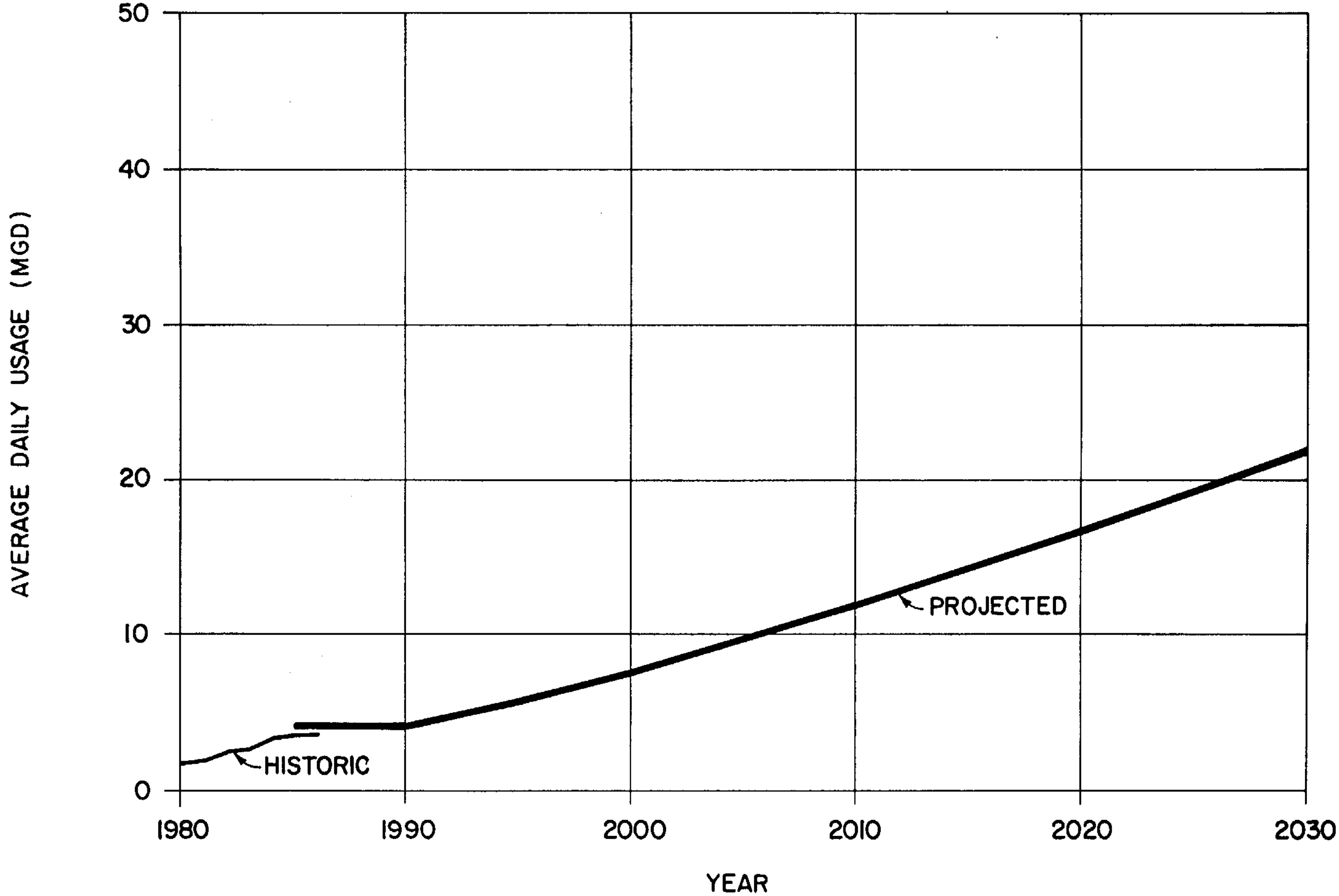


FIGURE 10
(CONT.)
AVERAGE WATER USAGE IN MDA 33W
HISTORIC AND PROJECTED

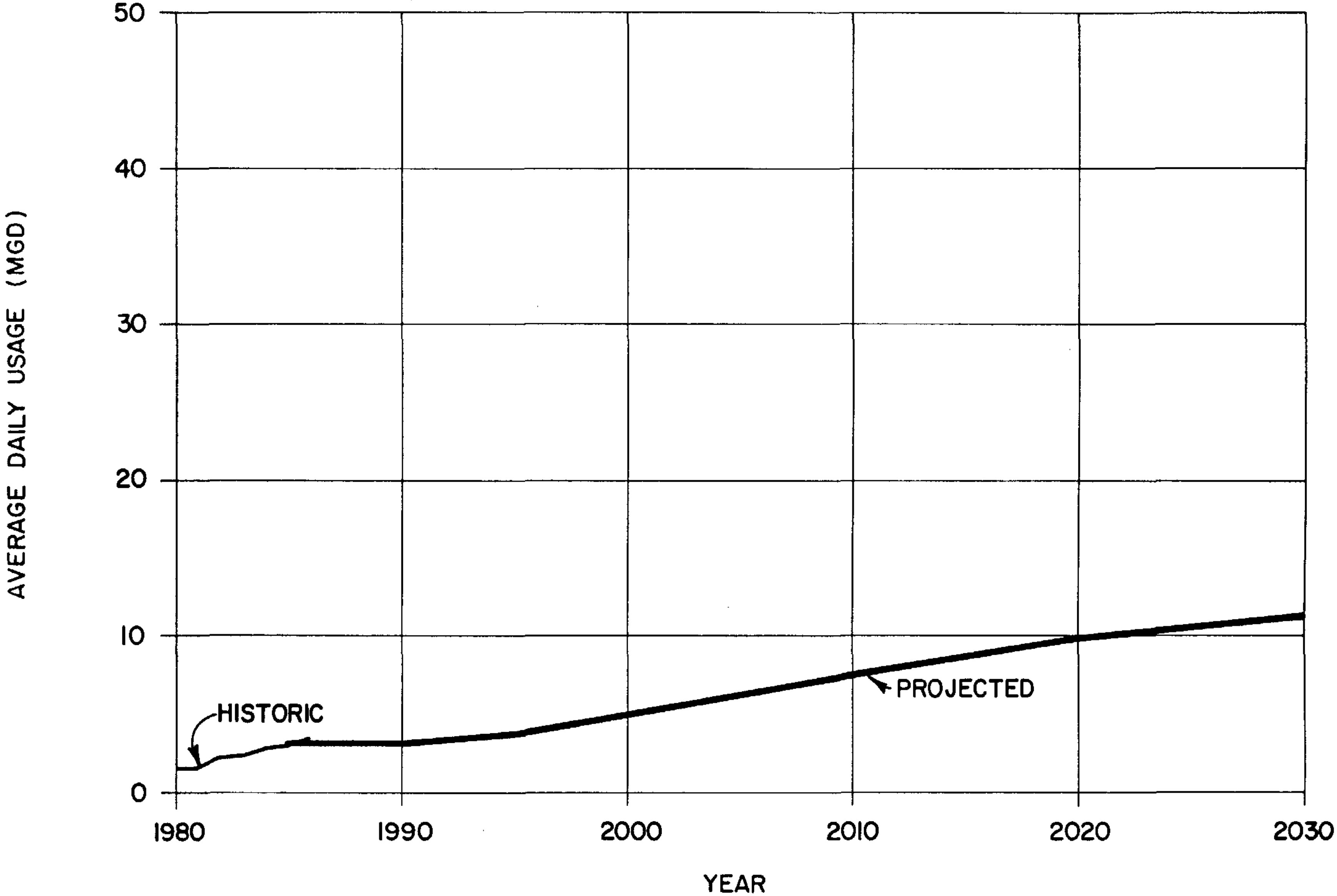


TABLE 9

COMPARISON OF HISTORIC TO PROJECTED WATER USE, 1985 - 1986
(AVERAGE DAILY USAGE)

	ACTUAL DIFFERENCE IN HISTORIC USE FROM PROJECTED USE (MGD)			PERCENT DIFFERENCE IN HISTORIC USE FROM PROJECTED USE (%)		
MDA	1985	1986	AVG	1985	1986	AVG
24W	0.58	0.70	0.64	13.1	16.0	14.5
25W	-1.69	-1.92	-1.80	-30.8	-35.0	-32.9
26W	-1.31	-1.42	-1.36	-18.9	-20.4	-19.65
31	1.03	0.25	0.64	12.3	3.0	7.6
32	-0.60	-0.56	-0.58	-14.8	-13.7	-14.3
33W	-0.09	0.40	0.16	-3.1	13.4	5.2

(-) Negative number indicates historic usage less than projected usage.

expected, considering that pumpage from wells smaller than six inches in diameter, agricultural wells, and commercial wells with annual pumpage less than three million gallons was excluded. Three MDAs have estimated water usage greater than projected, but the differences are small, 0.1 to 0.5 mgd, on the average. Examination of the graphs in Figure 10 reveals that the HWMP projections appear to be reasonable extensions of the historic water use. It should be mentioned that a best-fit line passed through the plot of historic data would fall above the HWMP projections for all MDAs except MDA 32 and 33W. In other words, the HWMP predicts rates of water demand growth slower than the historic rates for MDAs 24W, 25W, 26W, and 31. However, the estimated historic water usage data supports the HWMP projections overall and justifies the use of the higher growth scenario as presented in Appendix D of the HWMP and its revisions. This also indicates that demand criteria were accurately assigned to the six WHCSWSC MDAs and that the supply system for the area may safely be planned using the HWMP water demand projections and its recent February 1988 revisions.

Using computed demands for residential, commercial and industrial user categories, the HWMP presents per capita average daily demands. These were obtained by dividing total demand for a category by total population in the eight county study area. Although they were not used by the HWMP to calculate total demands, it is interesting to consider them. For residential and commercial demands combined, per capita demands of 140-146 GPCD were reported. When industrial water demands were included, per capita figures rose to 243-254 GPCD. However, these amounts apply to a large region, not specifically to any area.

Per capita figures were computed for each of the six MDAs overlapping the WHCSWSC study area throughout the study period. This was accomplished by dividing the total MDA average daily demand by its projected population. The results are given on Table 10. Note that since the HWMP does not provide a breakdown of total demand by user categories, only the total per capita demand could be computed. These average 121-145 GPCD, lower than the total per capita demands computed by the HWMP and somewhat lower than even the combined residential and commercial per capita demands given by the HWMP. Since there is not a great deal of heavy industry in the WHCSWSC supply area, the per capita values would not be expected to be as high as the totals including industrial for the entire eight county region.

The HWMP used maximum day demands to size required water treatment and transmission systems and average daily demand for water supply systems. The WHCSWSC study will use the same criterion. Projected maximum daily demands for the study period are found in Table 11. The maximum demands for the four partial MDAs were computed by adding the maximum daily demands of the included census tracts. The HWMP computed the maximum daily demands for each tract by multiplying the average daily demand for each census tract by a peak day factor. This factor was constant for each individual MDA and varied between MDAs depending on the amount of the average daily demand for the entire MDA. The source of the peak day factor was a regression curve based on data from numerous cities and utility districts, which showed that the peak day factor decreases with increasing average daily demand. In the WHCSWSC study area, this factor ranges from about 1.6 to 2.0, decreasing through time. For

TABLE 10

COMPUTATION OF AVERAGE DAILY PER CAPITA DEMANDS

	MDA 24	MDA 25	MDA 26	MDA 31	MDA 32	MDA 33	TOTAL
1985							
Avg. Daily Use	24	5.8	11	8	4	3	56.4
Population	190693	25292	93899	68466	32630	30096	441076
Per Capita Use	123	228	120	122	125	110	128
1990							
Avg. Daily Use	27	6.9	13	11	6	4	68.1
Population	240618	36843	114334	86863	44183	38741	561582
Per Capita Use	113	186	112	130	127	104	121
2000							
Avg. Daily Use	32	8.4	15	16	8	5	84.8
Population	273521	49179	138493	125432	58261	51811	696697
Per Capita Use	115	171	111	130	128	104	122
2010							
Avg. Daily Use	38	11.4	21	27	12	8	117.7
Population	325229	71697	185084	204426	89031	79448	954915
Per Capita Use	117	158	110	133	132	105	123
2020							
Avg. Daily Use	42	14.0	24	38	17	11	145.4
Population	348213	88955	216103	274051	118540	104148	1150010
Per Capita Use	119	157	112	137	140	105	126
2030							
Avg. Daily Use	43	16.0	27	48	22	13	168.3
Population	348653	97753	233035	331963	145193	121519	1278116
Per Capita Use	122	164	115	145	149	106	132

TABLE 11

PROJECTED MAXIMUM DAILY WATER USAGE BY MDA

	MAXIMUM DAILY USAGE (MGD)					
MDA	1985	1990	2000	2010	2020	2030
24W	7.52	7.52	11.82	15.60	16.90	16.73
25W	10.52	10.52	15.37	20.16	24.19	27.58
26W	12.48	12.48	18.18	24.80	29.55	33.31
31	16.05	16.05	28.77	46.88	64.96	79.70
32	8.34	8.34	14.41	21.96	30.09	38.18
33W	6.12	6.12	9.51	14.25	18.03	20.33
TOTAL WHCSWSC	61.03	61.03	98.06	143.65	183.72	215.83

instance, in MDA 24W, the average daily demands computed remain relatively steady throughout the study period, and the peak day factor stays about 1.7. In MDA 31, where explosive growth was predicted, the peak day factor decreases from 1.9 to 1.6 from 1985 to 2030. It is important to observe that even the lowest peak day factor results in a maximum day water supply that is more than adequate to meet average daily demands plus estimated losses of 15% to 20%.

Overall, the estimated historic water usage data supports the HWMP projections and its revisions. Therefore, planning for the WHCSWSC supply system utilized the HWMP projections of maximum daily water usage.

3.0 SURFACE WATER SUPPLY

3.0 SURFACE WATER SUPPLY

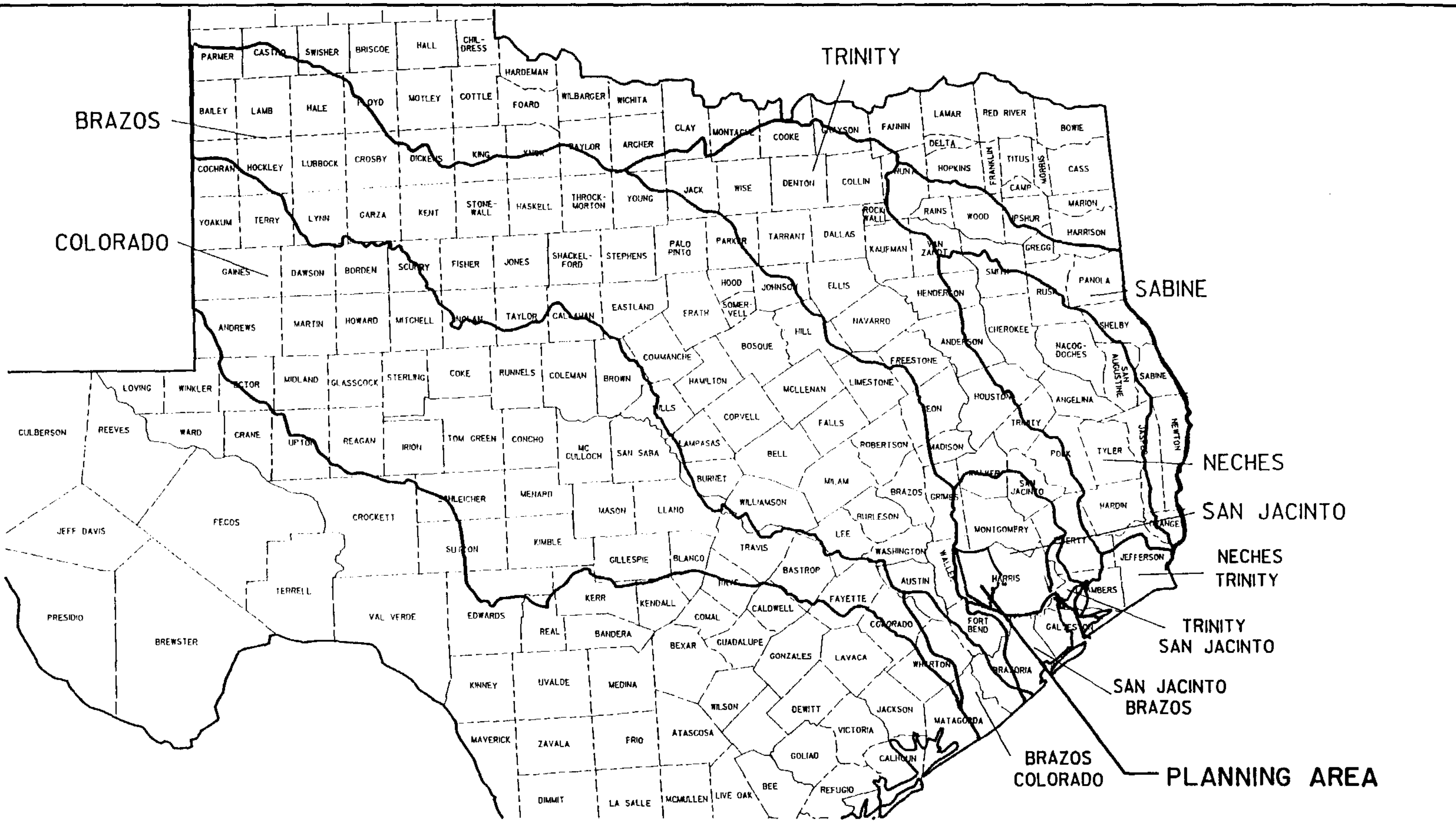
Area River Basins

Numerous surface water supply sources are potentially available for use by the WHCSWSC. Three river basins: namely, the Brazos River Basin, the Trinity River Basin and the San Jacinto River Basin; along with two coastal basins, the Trinity-San Jacinto Coastal Basin and the San Jacinto-Brazos Coastal Basin, are in close proximity to the planning area as shown on Figure 11. The WHCSWSC planning area is located within the San Jacinto River Basin which is situated in the upper Gulf Coast region. The San Jacinto River Basin is bounded on the north and northeast by the Trinity River Basin and on the southeast by the Trinity-San Jacinto Coastal Basin. The San Jacinto-Brazos Coastal Basin borders the basin on the south, and on the west it is bordered by the Brazos River Basin. The major rivers and reservoirs within these basins are shown on Figure 12.

San Jacinto River Basin

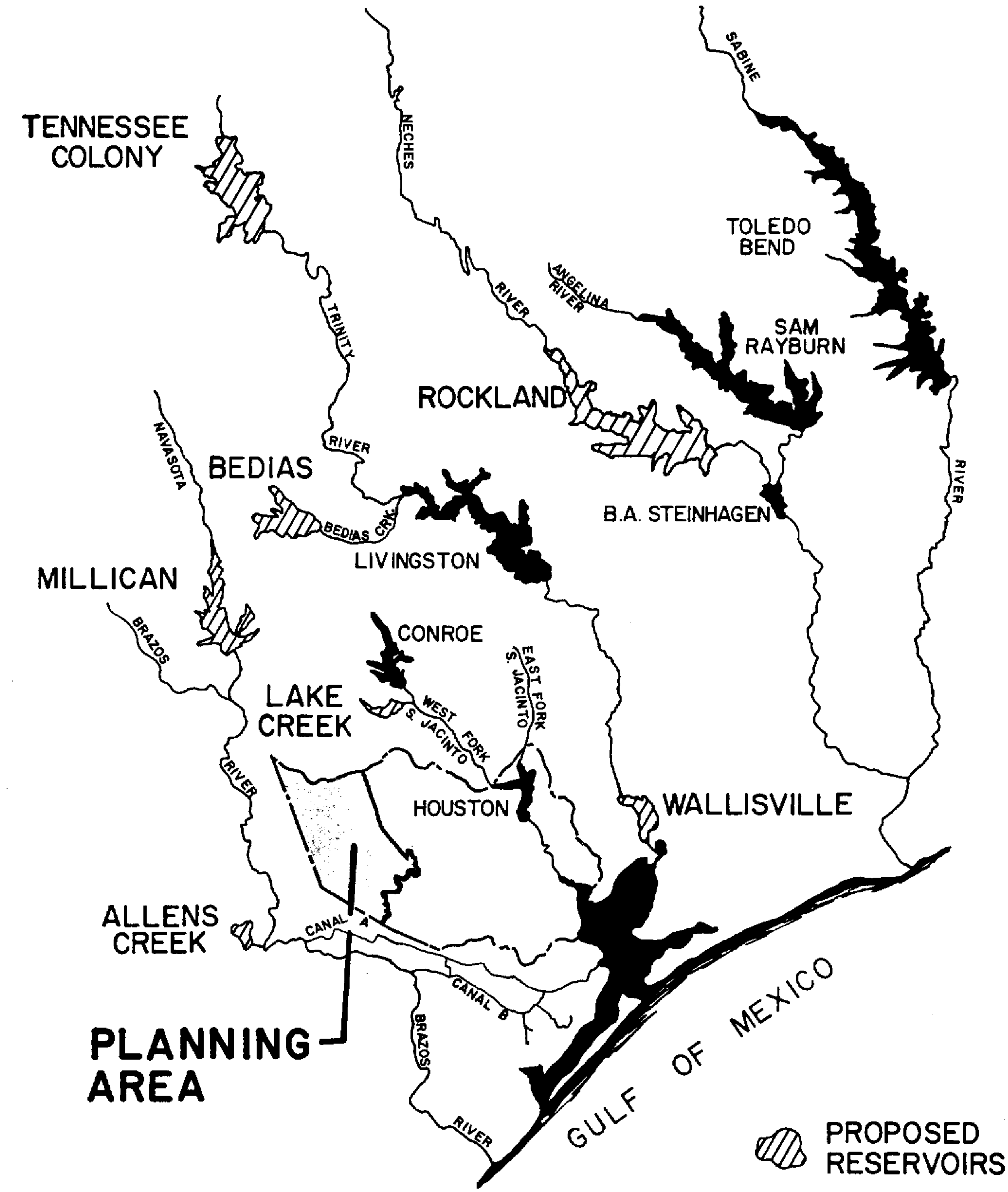
The San Jacinto River Basin is approximately 85 miles long with an average width of 50 miles. In Harris County, the east and west forks of the river converge to form Lake Houston. The San Jacinto River discharges into the upstream end of the Houston Ship Channel. The total drainage area of the San Jacinto River Basin is approximately 5600 square miles.

FIGURE 11



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION
PLANNING AREA RIVER BASINS

FIGURE 12



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

PLANNING AREA – RIVERS & RESERVOIRS

Physical and chemical quality of the water within the basin is quite good based on water quality characteristics of the two existing reservoirs, Lake Conroe and Lake Houston. As the San Jacinto River flows downward to the Ship Channel, the water quality is poorer due to industrial and sewage treatment plant discharges. The San Jacinto River Authority (SJRA) is a co-owner of Lake Conroe along with the City of Houston and the Texas Water Development Board. The SJRA also owns water rights in Lake Houston equal to the low flow yield of the San Jacinto River at the Lake Houston dam site prior to its construction in 1952. The City of Houston owns and operates Lake Houston. The two existing reservoirs, Lake Conroe and Lake Houston, have an available yield of 100,600 acre-feet (90 MGD) and 199,300 acre-feet (178 MGD) respectively. Table 12 is a summary of water rights and available water in the San Jacinto River Basin. One additional smaller reservoir, Lake Creek, is proposed south of Lake Conroe with an estimated safe yield of approximately 55,100 acre-feet per year (48 MGD).

Trinity River Basin

The Trinity River Basin covers all or parts of 37 counties including the Dallas-Fort Worth area. The total drainage area of the basin is approximately 18,000 square miles. Bedias Creek and the Trinity River converge to form Lake Livingston, approximately 50 miles north of the City of Houston. The general overall quality of water in the Trinity River Basin is good. The quality of water in Lake Livingston has been a concern in the past because of the effluent dominated upstream watercourses; however,

TABLE 12

SAN JACINTO RIVER BASIN WATER RIGHTS AND AVAILABLE WATER

	TOTAL PERMITS (MGD)	ALLOCATED (MGD)	UNCOMMITTED (MGD)	AVAILABLE YIELD (MGD)	
Lake Conroe	90				
City of Houston		59	0	59	
					90
SJRA		22	9	31	
Lake Houston	199				
City of Houston		150	0	129*	
					178
SJRA		49	0	49	
				268 MGD	

*Estimated safe yield.

measures are underway to improve the river basin quality through improvements to area wastewater treatment plants. The southern portion of the Trinity River Basin is affected by salt water intrusion from the Gulf of Mexico during periods of low flow. Flushing water is periodically released from Lake Livingston to minimize this problem. The Trinity River Authority (TRA) owns 30% of the water rights in Lake Livingston with the City of Houston owning the remaining 70%.

Lake Livingston total storage capacity is 1,750,000 acre-feet (1563 MGD) with a safe yield of approximately 1,538,000 acre-feet (1374 MGD). The actual available yield for municipal use is complicated due to fixed downstream water rights obtained prior to construction of the reservoir in 1968 and the need to release water to control upstream salt water intrusion during periods when water is being withdrawn from the reservoir for irrigation. Table 13 is a summary of water rights and available water in the Trinity River Basin. Two smaller reservoirs are proposed in the area - Bedias Reservoir with an estimated yield of 109,758 acre-feet (98 MGD) and Wallisville Reservoir with an estimated yield of up to 320 MGD.

TABLE 13

TRINITY RIVER BASIN WATER RIGHTS AND AVAILABLE WATER

	TOTAL PERMITS (MGD)	ALLOCATED (MGD)	SALTWATER INTRUSION CONTROL (MGD)	UNCOMMITTED (MGD)	AVAILABLE YIELD (MGD)
Lake Livingston	1,374				
City of Houston		806	-126	0	680 *
TRA		314	-54	0	260 *
Downstream Commitments					
Dayton Canal Company		35	0	0	35
Chambers-Liberty Co. Navigation District		127	0	0	127
Denvers Canal System		52	0	0	52
Barbers Hill Canal		40	0	0	40
					1194

*A combined total of 180 MGD is required to control saltwater intrusion.

Brazos River Basin

The Brazos River Basin is the second largest river basin in the state with a total drainage area of 45,573 square miles. The basin is over 600 miles long and varies in width from 110 miles around Waco to only about 1 mile at its mouth at the Gulf of Mexico. The quality of water in the Brazos River Basin varies considerably along the extent of the basin. Currently, there are no existing reservoirs adjacent to the WHCSWSC study area. Future plans call for a proposed reservoir on the Navasota River, Lake Millican. Safe yield of Lake Millican has been estimated to be 252,000 acre-feet (225 MGD). Allen's Creek Reservoir, originally proposed by HL&P as a cooling water supply, is also planned on the Brazos River. This smaller reservoir will have an estimated safe yield of 75,000 acre-feet (67 MGD). The Brazos River Authority (BRA) has permits for the diversion of 236,936 acre-feet (212 MGD) from the Brazos River through two canals called Canal A and Canal B. Municipal, industrial and irrigation commitments total 164 MGD, leaving 48 MGD presently uncommitted.

The BRA has recently made a offer to the WHCSWSC for a permanent average daily supply of water from the Brazos River Basin totaling approximately 133 MGD by the year 2030. The BRA offer consists of the complete yield from the proposed Allen's Creek Reservoir, uncommitted water presently existing in the Brazos River Basin, recaptured water from H.L. & P. and partial yield from the proposed South Bend Reservoir. Refer to Attachment 4 for details on the mentioned BRA offer.

WHCSWSC's Northeast Supply System

Northeast Water Purification Plant

The City of Houston has indicated that their intentions are to build a Northeast Water Purification Plant. The proposed location for the plant will be adjacent to existing Lake Houston near the proposed Beltway 8. Raw water supply for this plant will be from Lake Houston, supplemented by water from the Trinity and Sabine River Basins as outlined in the HWMP. The HWMP presents two "eastern water" and one "western water" alternative to be considered for development of a future water supply for the City of Houston. In these alternatives, the ultimate capacity of a Northeast Water Treatment Plant ranges from 625 MGD maximum day capacity (eastern alternative) to 425 MGD maximum day capacity (western alternative). The WHCSWSC will present its surface water demand to the City of Houston which if appropriate may size the Northeast Water Purification Plant to accommodate this requirement.

WHCSWSC's Southwest Supply System

Brazos River

The headwaters of the Brazos River originate in New Mexico at an elevation of approximately 4,700 feet above mean sea level. From there, the river travels approximately 800 miles in a southeast direction to empty into the Gulf of Mexico near Freeport. The Brazos River is the only existing surface water source in close proximity to the WHCSWSC study area. Advantages of utilizing this source is that major conveyance systems can be eliminated and pumping across the City from east side treatment plants can be reduced.

Brazos River Authority Canals

The Brazos River Authority (BRA) owns and operates a dual canal system which flows southeast through Fort Bend County to Galveston and Brazoria Counties. Canal A draws water from the Brazos River near Fulshear through a 353 MGD capacity pumping station. From there, water flows through Jones and Oyster Creeks to just south of River Bend where it is pumped into the System A canal. Canal B draws water from the Brazos River six miles west of Arcola through a 302 MGD capacity pump station. Water then flows southeast along Highway 6. Canals A and B are interconnected at two locations, the first near Manvel and the second west of Santa Fe. Canal B presently supplies the Galveston County Water Authority's reservoir and 16 MGD treatment plant. The

BRA has permits for the diversion of 212 MGD from the Brazos River into these canals. Municipal, industrial and irrigation commitments total 164 MGD leaving 48 MGD available for use. The Galveston County Water Authority is in the process of purchasing Canals A and B from the BRA. Acquisition of these canals should be complete in 1-1/2 to 2 years.

Allen's Creek Reservoir

Allen's Creek is a reservoir originally proposed by Houston Lighting and Power to supply cooling water for a proposed power plant. The proposed location of the reservoir is approximately 25 miles west of Houston with an estimated yield of 70,000 acre-feet (63 MGD). Water rights and property for the reservoir have been purchased by HL&P; however, a re-evaluation of future power needs in the service area has postponed indefinitely the project and enabled this proposed reservoir to become a potential surface water source.

Under contracts which have been in place for several years, the Brazos River Authority has committed a substantial amount of water to HL&P that can be diverted from the Brazos River at any desired location downstream of the mouth of the Navasota River. Much of this water was to be used as make-up water for the planned Allen's Creek Reservoir. HL&P, after re-evaluation of area power needs, has recently offered the BRA a proposal including both the Allen's Creek Reservoir site along with the opportunity to recapture up to 87,400 acre-feet (78 MGD) of water presently contracted to HL&P from Lake Limestone. The opportunity to recapture this water now committed to HL&P and to acquire the Allen's Creek reservoir site, places the BRA in a position to offer a permanent average daily raw water supply of Brazos River water up to an estimated 150,000 acre-feet (133 MGD). Of the estimated 150,000 acre-feet (133 MGD), approximately 75,000 acre-feet (67 MGD) is available for immediate diversion from the Brazos River; 45,000 acre-feet (40 MGD) available upon completion of the Allen's Creek Reservoir and 30,000 acre-feet (27 MGD) available upon construction of South Bend Reservoir. This offer by BRA will provide an ample supply of water for the Southwest System for all of the service area alternatives that will be investigated later in this appendix.

Southwest Water Purification Plant

The HWMP includes a proposed location of a Southwest Water Purification Plant would be in the vicinity of Highway 6 and U.S. Highway 90A near the Fort Bend-Harris County line. This plant would treat raw water taken from the Brazos River and/or the BRA canal system. The HWMP gives an estimated ultimate capacity of the plant as 100 MGD. Final ultimate capacity of the plant could be as much as 200 MGD depending on negotiations with the Brazos River Authority and/or the Galveston County Water Authority. Early indications from the WHCSWSC study shows that the southwest plant should be located south of F.M. 1093 and north of the Brazos River.

North Supply System

Trinity/Brazos/San Jacinto River Supply

This supply system consists of surface water from the Trinity, Brazos and San Jacinto River Basins. The development of two water supply sources, Lake Millican and Bedias Reservoir, would be a vital part of this supply system along with conveyance systems from these sources to Lake Conroe. Present available uncommitted water at the Lake Conroe is 9 MGD. Evaluation of the North Water Supply System will be accomplished under Phase III of this study which will allow the City of Houston time to decide if a western alternative is to be selected for the HWMP.

Northwest Water Purification Plant

Upon selection of a western alternative and development of Lake Millican and Bedias Reservoir and conveyance systems to Lake Conroe, the City of Houston proposes construction of a Northwest Water Purification Plant. The proposed location of this plant would be just south of Lake Conroe from which it will get its raw water supply. Preliminary sizing of this plant as presented in the HWMP is 350 MGD at ultimate capacity.

4.0 ALTERNATE SERVICE AREAS

4.0 ALTERNATE SERVICE AREAS

Approach and Methods

This section examines the possibilities for supplying the WHCSWSC study area with surface water from the sources discussed in Section 3.0. Several alternative service areas are proposed, and each is evaluated in terms of water demand versus supply and the possibility of meeting the conversion schedule as outlined in the HGCSD Plan. The alternates will be further tested for economic feasibility in Appendix IV of this study.

All three water supply scenarios considered by the HWMP include the Northeast Water Purification Plant (NEWPP) at Lake Houston and the Southwest Water Purification Plant (SWWPP) near the Brazos River. Only one, the western alternative, proposes a water treatment facility at Lake Conroe, the Northwest Water Purification Plant (NWWPP). Since the SWWPP and the NEWPP are included in all scenarios of the HWMP, they are used in four of the five alternates addressed in this study. The North Supply System can only be used if Houston elects to bring water from the west, and is included in only one alternate.

Evaluation of the adequacy of surface water supplies is based on the minimum surface water required to meet the HGCSD conversion goals, not the full maximum daily requirements. It is unlikely that surface water conversion will take place before the HGCSD target dates unless water production problems

The surface water required by the HGCSD conversion plan was calculated as follows. First, the total service area demands were broken out by HGCSD regulatory area by adding census tract demands as described above. Since only extremely small portions of regulatory areas three and six are included in the study area, they were lumped with areas four and seven, respectively. Next, for each regulatory area, the amount needed at the conversion date, 80% of the total average daily demand, was computed. Next 80% of the total average daily water demand was multiplied by the appropriate peak day factor ranging from 1.6 to 1.7 to determine maximum daily demands. The regulatory areas will not be required to increase surface water usage unless another conversion date is reached, so the previously calculated amount was maintained until that time or the end of the study in year 2030. When the totals for all regulatory areas in a service area were added at each conversion date, a stair-step pattern was revealed. Note that at no time does the required surface water total 80% of the total for a service area, since regulatory areas do not have the same conversion dates.

The HGCSD plan ends at 2020, with the latest conversion date at 2015, while the WHCSWSC investigated conditions to 2030. It is probable that as subsidence trends become better known, the HGCSD will extend its surface water conversion plan, adding conversion dates beyond 2015. The only regulatory area currently not required to utilize surface water is area eight. For purposes of computing surface water requirements in 2030, it was assumed in this study that area eight will be given a conversion requirement of 80% in that year.

Alternate Service Areas

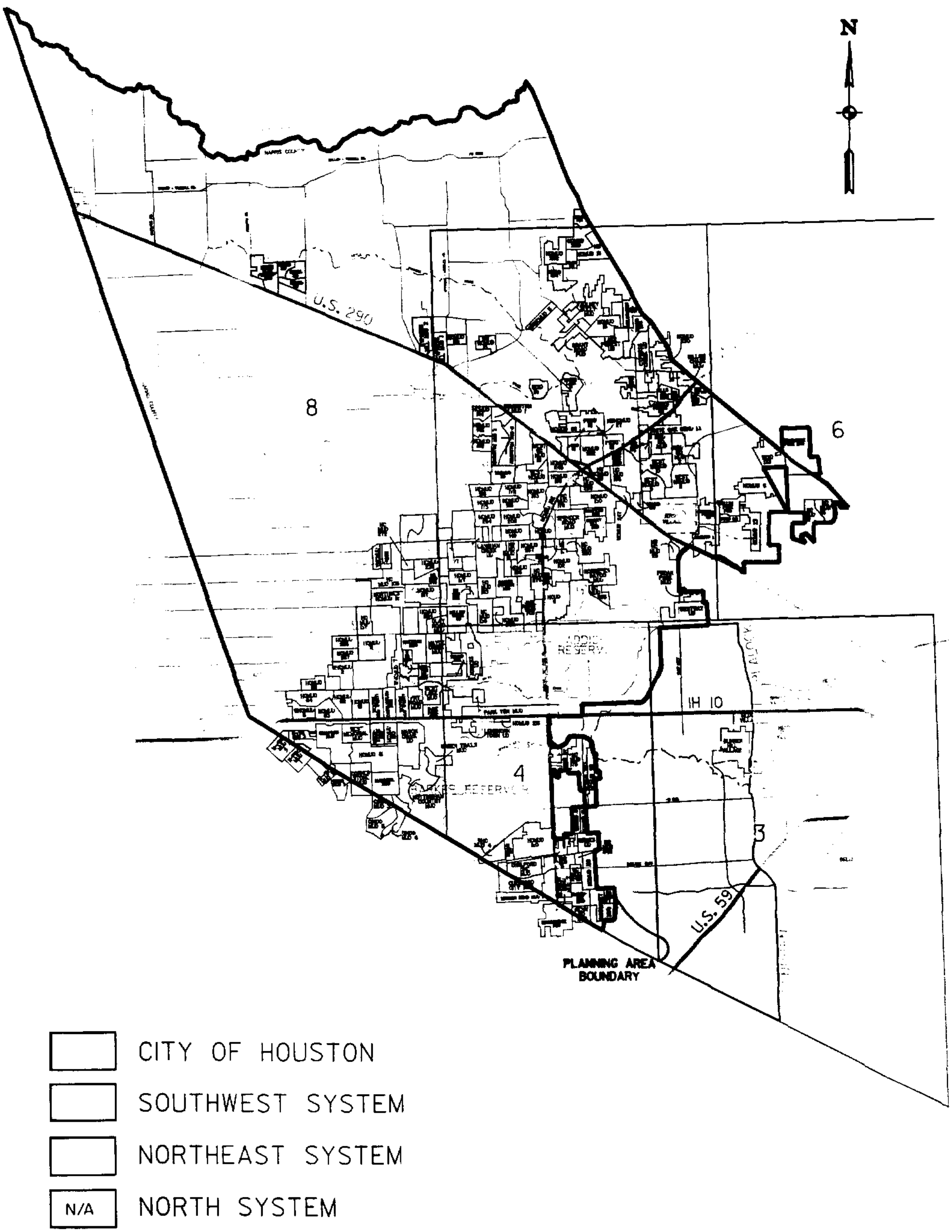
Five alternate service areas are detailed below. Two criteria are applied to each. First, the supply is compared to the HGCSD surface water requirements at each conversion date. Second, consideration is given to whether the water sources will be available in time to meet the conversion dates. Three tables are provided for reference in this section. Table 14 gives total maximum daily usage for both systems in each alternate. Table 15 details the calculation of surface water requirements described above, and Table 16 summarizes this information. It should be noted that both the water supply available and the water demands projected have been shown in maximum daily units for consistency. This should not be interpreted to mean the water supplies needed will be based on maximum daily demands.

Alternate No. 1

In Alternate 1, the portion of the WHCSWSC planning area south of U.S. 290 would be served by the Southwest Supply System, while the remainder of the planning area would be supplied from the Northeast Supply System. Figure 13 shows the service area boundaries for this alternate.

The HGCSD minimum maximum daily surface water requirements on Table 16 reveals that the City of Houston will require 65 MGD from the Southwest System in 1995. WHCSWSC has no mandate in 1995. In the year 2000, the Southwest System will require a total of 106 MGD, or 90 MGD for Houston and 16 MGD for the WHCSWSC. In the year 2030, the Southwest System will

FIGURE 13



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

ALTERNATE 1 SERVICE AREAS

require a total of 187 MGD, or 101 MGD for Houston and 86 MGD for the WHCSWSC. The BRA offer made to the WHCSWSC of 133 MGD of average daily supply (226 MGD maximum daily) is adequate to supply the needs for Alternate No. 1 throughout the planning period (2030).

The Northeast Supply System has three conversion dates for this alternate: 2005, 2010 and 2030. At the first conversion date of 2005, 10 MGD will be required. Beginning in 2010, 36 MGD will be needed, remaining constant until 2030. At that time it is considered that HGCSD regulatory area eight will require conversion to surface water, increasing the Northeast System requirements to 44 MGD.

Alternate No. 2

In Alternate 2, the portion of the WHCSWSC planning area south of F.M. 529 from the western boundary of Harris County to Highway 6, then northeast along Highway 6 to U.S. 290 would be served by the Southwest Supply System, while the remainder of the planning area would be supplied from the Northeast Supply System. Figure 14 shows the service area boundaries for this alternate.

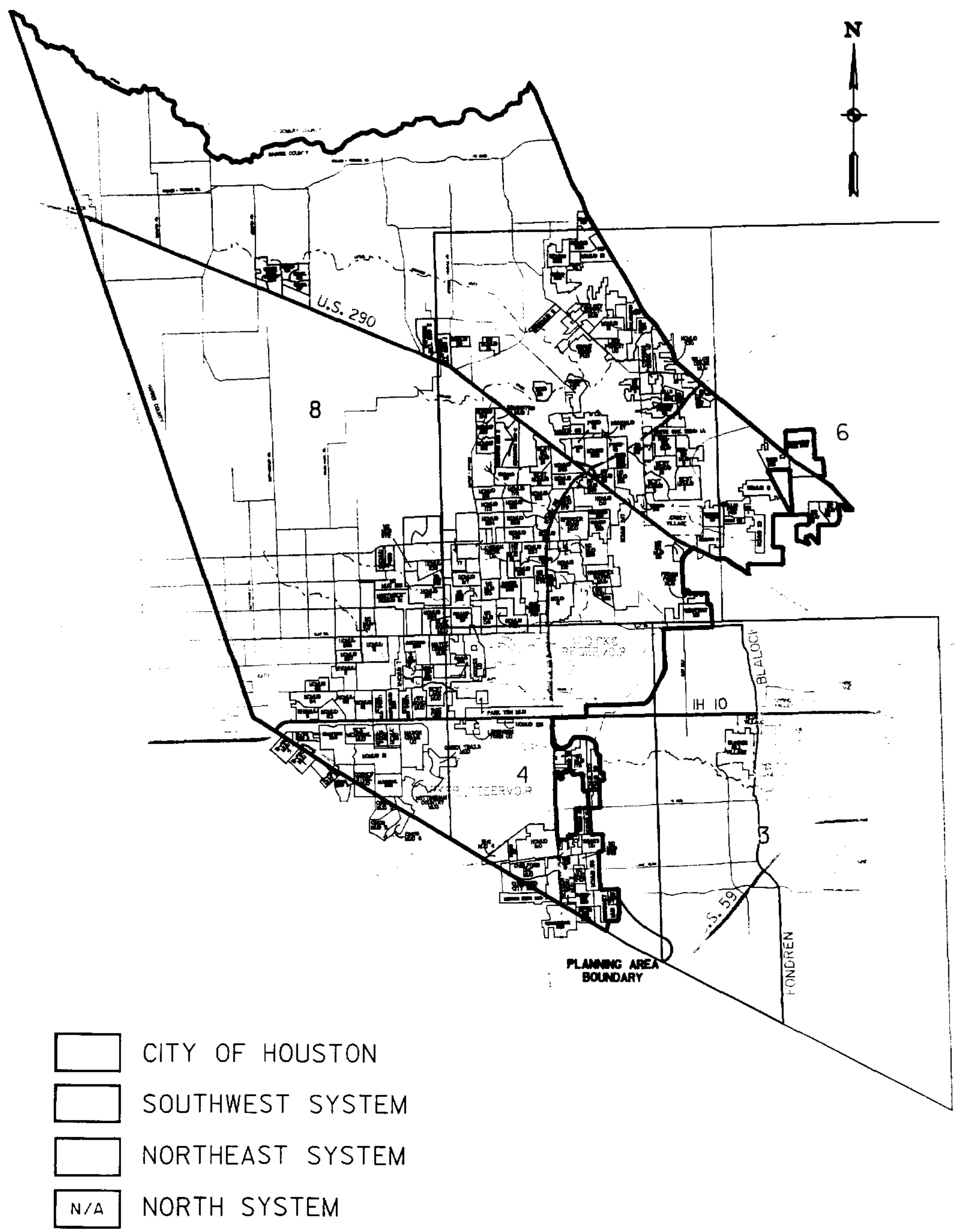
The HGCSD minimum maximum daily surface water requirements on Table 16 reveals that the City of Houston will require 65 MGD from the Southwest System in 1995.

WHCSWSC has no mandate in 1995. In the year 2000, the Southwest System will require a total of 106 MGD, or 90 MGD for Houston and 16 MGD for the WHCSWSC. In the year 2030, the Southwest System will require a total of 187 MGD, or 101 MGD for Houston and 86 MGD for the WHCSWSC. As in Alternate No. 1, the BRA offer will be sufficient to meet the 2030 demands.

The Northeast Supply System has three conversion dates for this alternate: 2005, 2010 and 2030. At the first conversion date of 2005, 10 MGD will be required. Beginning in 2010, 42 MGD will be needed, remaining constant until 2030. At that time it is considered that HGCSD regulatory area eight will require conversion to surface water, increasing the Northeast System requirements to 54 MGD.

Alternate No. 3

In Alternate 3, the portion of the WHCSWSC planning area south of Clay Road would be served by the Southwest Supply System, while the remainder of the planning area would be supplied from the Northeast Supply System. Figure 15 shows the service area boundaries for this alternate.



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

ALTERNATE 3 SERVICE AREAS

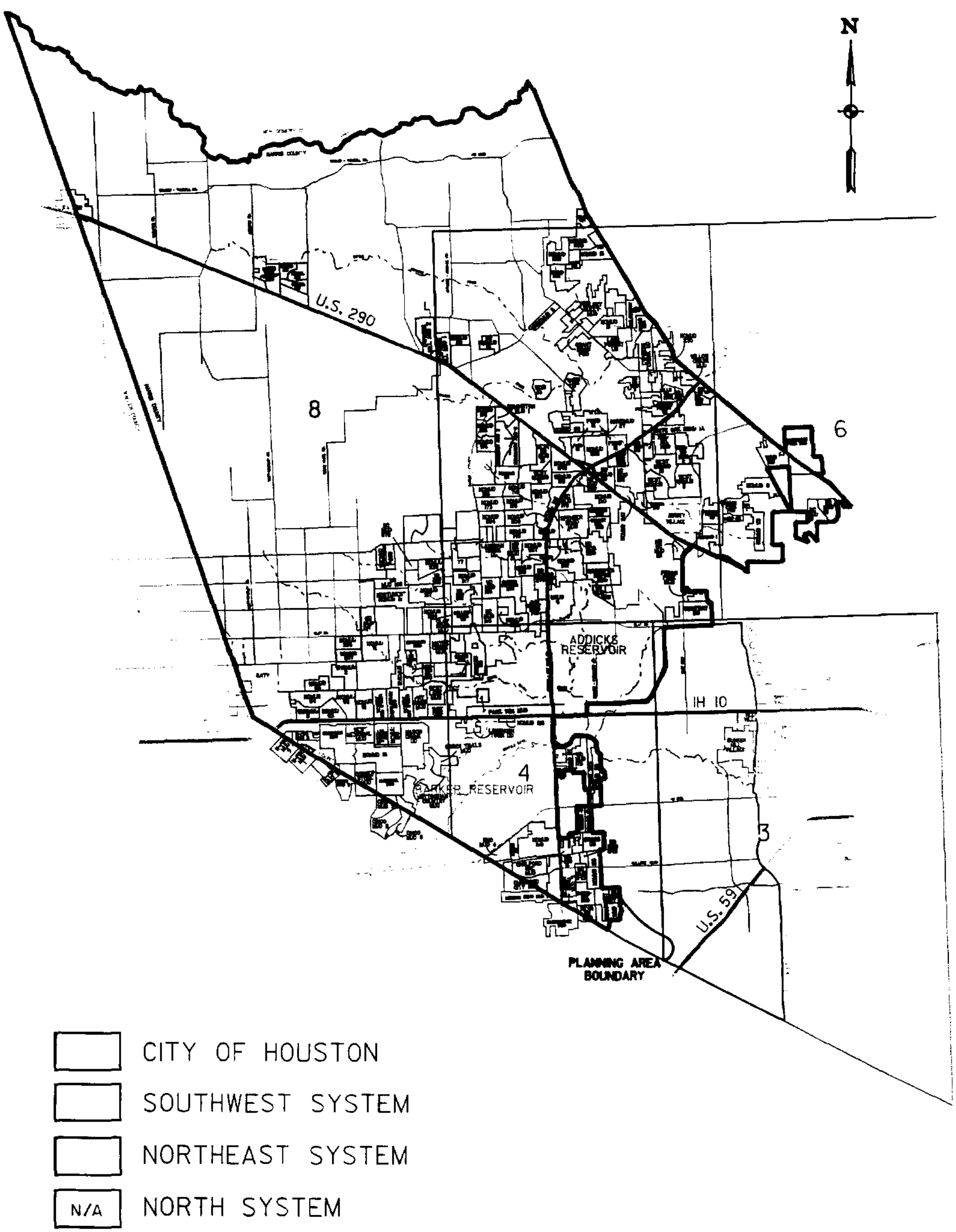
The HGCSD minimum surface water requirements on Table 16 reveals that the City of Houston will require 65 MGD from the Southwest System in. 1995. WHCSWSC has no mandate in 1995. In the year 2000, the Southwest System will require a total of 106 MGD, or 90 MGD for Houston and 16 MGD for the WHCSWSC. The Southwest System average daily yield of 133 MGD (226 MGD maximum daily) would be adequate throughout the planning period (2030), when 177 MGD of maximum daily surface water would be required. Of this total, 101 MGD would be used by the City of Houston, while WHCSWSC would need 76 MGD. As in previous alternatives, the BRA proposal is sufficient to meet the Southwest System demands.

The Northeast Supply System has four conversion dates for this alternate: 2000, 2005, 2010 and 2030. The earliest conversion date is 2000, when 0.4 MGD would be necessary for a portion of HGCSD regulatory area four. At the next conversion date of 2005, 10 MGD would be required. Beginning in 2010, 65 MGD would be needed, remaining constant until 2030. At that time it is considered that HGCSD regulatory area eight will require conversion to surface water, increasing the Northeast System requirements to 91 MGD.

Alternate No. 4

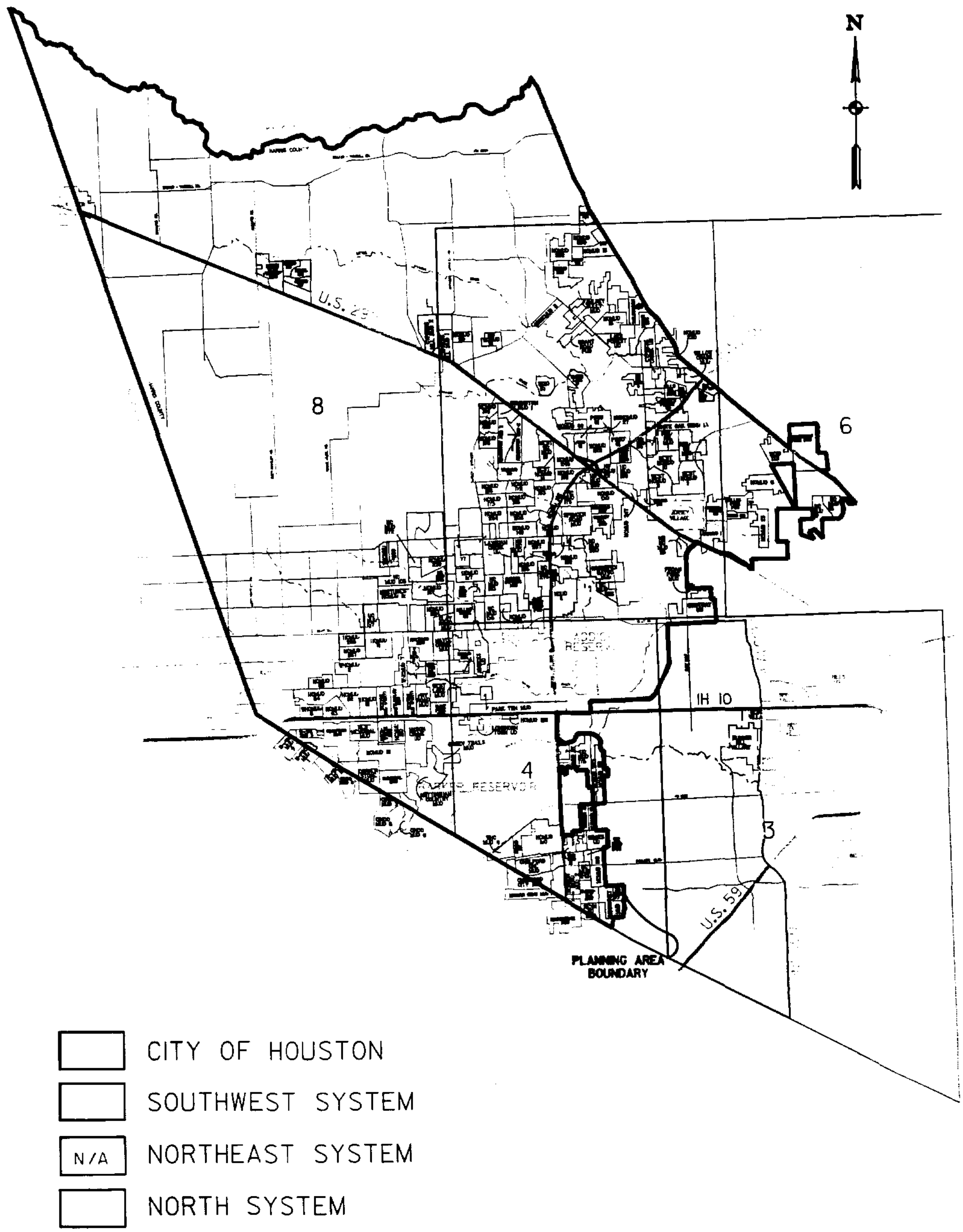
In Alternate 4, the portion of the WHCSWSC planning area south of I.H. 10 would be served by the Southwest Supply System, while the remainder of the planning area would be supplied from the Northeast Supply System.

FIGURE 16



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

FIGURE 17



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

ALTERNATE 5 SERVICE AREAS

of the planning area would be supplied from the North Supply System. Figure 17 shows the service area boundaries for this alternate. Using these boundaries, 30% of the total WHCSWSC maximum daily demand is located in the Southwest Service area throughout the study period.

The HGCSD minimum surface water requirements on Table 16 reveals that the City of Houston will require 65 MGD from the Southwest System in 1995. WHCSWSC has no mandate in 1995. In the year 2000, the Southwest System will require a total of 106 MGD, or 90 MGD for Houston and 16 MGD for the WHCSWSC. The Southwest System average daily yield of 133 MGD (226 MGD maximum daily) would be adequate through 2030, when 141 MGD of surface water would be required. Of this total, 101 MGD would be used by the City of Houston, while WHCSWSC would need 40 MGD. As in the previous alternatives, the BRA offer is sufficient to meet the Southwest System needs.

The North Supply System has four conversion dates for this alternate: 2000, 2005, 2010 and 2030. The earliest conversion date is 2000, when 0.4 MGD would be necessary for a portion of HGCSD regulatory area four. At the next conversion date of 2005, 10 MGD would be required. Beginning in 2010, 65 MGD would be needed, remaining constant until 2030. At that time it is considered that HGCSD regulatory area eight will require conversion to surface water, increasing the North System requirements to 91 MGD.

TABLE 14

MAXIMUM DAILY WATER DEMANDS BY ALTERNATE

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST* (MGD)	TOTAL ALL AREAS (MGD)
ALTERNATE 1 - BOUNDARY AT U.S. 290					
1985	99.59	35.96	135.55	25.10	160.65
1990	99.59	35.96	135.55	25.10	160.65
1995	108.36	45.83	154.19	29.18	183.37
2000	117.37	61.25	178.62	36.81	215.42
2005	126.38	76.66	203.04	44.43	247.47
2010	131.37	91.82	223.19	51.78	274.96
2012	133.37	97.88	231.25	54.71	285.96
2020	139.17	119.97	259.14	63.97	323.11
2030	144.18	142.83	287.01	72.93	359.94
ALTERNATE 2 - BOUNDARY AT F.M. 529					
1985	99.59	34.10	133.69	26.96	160.65
1990	99.59	34.10	133.69	26.96	160.65
1995	108.36	42.28	150.64	32.74	183.38
2000	117.37	55.96	173.33	42.10	215.43
2005	126.38	69.64	196.02	51.45	247.47
2010	131.37	82.63	214.00	60.97	274.97
2012	133.37	87.83	221.20	64.77	285.97
2020	139.17	106.04	245.21	77.60	322.81
2030	144.18	124.01	268.19	91.74	359.93
ALTERNATE 3 OR 5 - BOUNDARY AT CLAY ROAD					
1985	99.59	17.95	117.54	43.10	160.64
1990	99.59	17.95	117.54	43.10	160.64
1995	108.36	22.37	130.73	55.66	183.39
2000	117.37	29.64	147.01	68.43	215.43
2005	126.38	36.90	163.28	84.19	247.47
2010	131.37	44.12	175.49	99.48	274.97
2012	133.37	47.01	180.38	105.59	285.97
2020	139.17	56.56	195.73	127.08	322.81
2030	144.18	65.61	209.79	150.15	359.94
ALTERNATE 4 - BOUNDARY AT I.H. 10					
1985	99.59	12.33	111.92	48.73	160.65
1990	99.59	12.33	111.92	48.73	160.65
1995	108.36	14.73	123.09	60.30	183.39
2000	117.37	19.21	136.58	78.85	215.43
2005	126.38	23.69	150.07	97.40	247.47
2010	131.37	27.34	156.71	116.25	274.96
2012	133.37	28.80	162.17	123.79	285.96
2020	139.17	32.94	172.11	150.70	322.81
2030	144.18	35.45	179.63	180.30	359.93

*In Alternate 5, the Northeast System is replaced by the North System.

TABLE 15 (Cont'd)

SURFACE WATER REQUIREMENTS PER HGCSD PLAN
TOTAL WHCSWSC
(MAXIMUM DAILY DEMANDS)

ALTERNATE 3 OR 5 - SUPPLY TO CLAY ROAD

Regulatory Area	1985	Surface Water (MGD) 2000	2005	2010	2030
SOUTHWEST SYSTEM					
4	0.00	15.74	15.74	15.74	15.74
8	0.00	0.00	0.00	0.00	23.06
SOUTHWEST TOTAL	0.00	15.74	15.74	15.74	38.79
NORTHEAST SYSTEM					
4	0.00	0.41	0.41	0.41	0.41
6	0.00	0.00	9.66	9.66	9.66
7	0.00	0.00	0.00	55.14	55.14
8	0.00	0.00	0.00	0.00	26.09
NORTHEAST TOTAL	0.00	0.41	10.06	65.21	91.30
ALT. No. 3 OR 5 TOTAL	0.00	16.14	25.80	80.94	130.09

ALTERNATE 4 - SUPPLY TO I.H. 10

Regulatory Area	1985	Surface Water (MGD) 2000	2005	2010	2030
SOUTHWEST SYSTEM					
4	0.00	12.49	12.49	12.49	12.49
8	0.00	0.00	0.00	0.00	7.30
SOUTHWEST TOTAL	0.00	12.49	12.49	12.49	19.79
NORTHEAST SYSTEM					
4	0.00	3.66	3.66	3.66	3.66
6	0.00	0.00	9.66	9.66	9.66
7	0.00	0.00	0.00	55.14	55.14
8	0.00	0.00	0.00	0.00	47.12
NORTHEAST TOTAL	0.00	3.66	13.31	68.46	110.30
ALT. No. 4 TOTAL	0.00	16.14	25.80	80.94	130.09

TABLE 16

SUMMARY OF SURFACE WATER REQUIREMENTS BY ALTERNATE
PER HGCSD REQUIREMENTS
(MAXIMUM DAILY DEMANDS)

YEAR	CITY OF HOUSTON SOUTHWEST	WHCSWSC SOUTHWEST	TOTAL SOUTHWEST	TOTAL NORTHEAST*	TOTAL ALL AREAS
ALTERNATE 1 - BOUNDARY AT U.S. 290					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.96	0.00	105.96
2005	89.82	16.14	105.96	9.66	115.62
2010	89.82	44.76	134.58	36.18	170.76
2012	101.17	44.76	145.93	36.18	182.11
2020	101.17	44.76	145.93	36.18	182.11
2030**	101.17	86.25	187.42	43.85	231.27
ALTERNATE 2 - BOUNDARY AT F.M. 529					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.96	0.00	105.96
2005	89.82	16.14	105.96	9.66	115.62
2010	89.82	39.25	129.07	41.69	170.76
2012	101.17	39.25	140.42	41.69	182.11
2020	101.17	39.25	140.42	41.69	182.11
2030**	101.17	76.29	177.46	53.80	231.26
ALTERNATE 3 OR 5 - BOUNDARY AT CLAY ROAD					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	15.74	105.56	0.41	105.97
2005	89.82	15.74	105.56	10.06	115.62
2010	89.82	15.74	105.56	65.21	170.77
2012	101.17	15.74	116.91	65.21	182.12
2020	101.17	15.74	116.91	65.21	182.12
2030**	101.17	38.79	139.96	91.30	231.26
ALTERNATE 4 - BOUNDARY AT I.H. 10					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	12.49	102.31	3.66	105.97
2005	89.82	12.49	102.31	13.31	115.62
2010	89.82	12.49	102.31	68.46	170.77
2012	101.17	12.49	113.66	68.46	182.12
2020	101.17	12.49	113.66	68.46	182.12
2030**	101.17	19.79	120.96	110.30	231.26

*In Alternate 5, the Northeast System is replaced by the North System.

**Harris-Galveston Coastal Subsidence District plan for surface water use ends at 2020. Required surface water for 2030 was estimated assuming that Area 8 will be required to convert to 80% surface water in that year.

Comparison of Alternates

In this section, the five alternates will be compared on the basis of the previous discussion. No alternates will be eliminated, since only the questions of supply versus required surface water and timing of water availability have been considered. However, general conclusions can be made after this preliminary investigation.

Total Maximum Daily Demands

An examination of the total maximum daily water demands on Table 14 reveals several things. Three factors remain constant for each alternate. First, the City of Houston Southwest service area total demand increases from about 100 MGD in 1985 to 146 MGD in 2030. Second, the total WHCSWSC demand grows from 61 MGD to 230 MGD during the study period. Third, for all areas combined, the total demand is 161 MGD in 1985 and 377 MGD in 2030. The variable figures are the WHCSWSC portion of the Southwest System and the Northeast or North maximum daily water demands, which depend on the placement of the service area boundaries. For Alternate 1, the Southwest service area contains most of the total WHCSWSC demand, and the percentage increases throughout the study period. The reverse is true of Alternate 4, in which the Northeast service area holds an increasing majority of the total demand. For Alternates 2, 3 and 5, the demand split remains fairly constant during the period of interest. A summary of the demand proportions is found in Table 17.

TABLE 17

COMPARISON OF ALTERNATES

	ALTERNATE 1	2	3	4	5
Southwest Demand (% of Total WHCSWSC)	59-66*	57	30	20-16*	30
Northeast or North Demand (% of Total WHCSWSC)	41-34*	43	70	80-84*	70
Year Southwest Supply** Deficit Begins	2012	2030	None	None	None
Southwest Supply Surplus (Deficit) Year 2030 (MGD)	39	49	86	105	86
Year of First Southwest Conversion	1995	1995	1995	1995	1995
Amount of First Southwest Conversion (MGD)	65	65	65	65	65
Year of First Northeast or North Conversion	2005	2005	2000	2000	2000
Amount of First Northeast or North Conversion (MGD)	10	10	0.4	4	0.4

*1985 Percentage Increasing or Decreasing to 2030 Percentage.

**Based on an Available Southwest Supply of 133 MGD (Average Daily Demand) (226 MGD Maximum Daily Demand)

All Demands are Based on Maximum Daily Requirements.

Total Available Surface Water Supply

All considerations of supply adequacy were based on the minimum surface water required to meet the HGCSD conversion plan, previously shown on Table 15. As opposed to the total maximum daily demands, the minimum requirements climb in a stair-step fashion rather than linearly. However, the minimum requirements for the City of Houston Southwest Supply System, the total for the WHCSWSC supply area and the overall totals do not vary by alternate.

The total maximum daily treated surface water supply available from the SWWPP is assumed to be 226 MGD. This is based on an maximum average daily supply of 133 MGD of raw water supply from the BRA offer. As shown above, the Southwest Supply System is sufficient to meet the ultimate (2030) surface water demands as projected in all five of the alternatives. As a result, the available Southwest surface water supply will not be the controlling factor in determining which service area alternate is chosen.

Feasibility of Meeting HGCSD Plan

Some consideration must be given to the timing of the availability of the surface water and whether it would be possible to meet the HGCSD conversion plan with the five alternatives. In the Southwest service area, the first conversion requires 65 MGD in 1995. This is the same for all alternates since the area which is required to convert to surface water is in HGCSD regulatory area three in the City of Houston. It may be estimated that the SWWPP will take around six years to bring on-line from design to completion; therefore it is possible to meet the first Southwest conversion date of 1995.

Timing issues are more complex in the North and Northeast service areas. The first conversion date is either 2000 or 2005. Alternates 1 and 2 both require about 10 MGD at 2005. Alternates 3 and 5 call for 0.4 MGD in 2000, and Alternate 4 requires 4 MGD at the same date. The quantities of surface water needed in 2000 or 2005 for any alternate are small. In addition, the regulatory area using surface water at these dates is area four, which is in the most southern part of the service area. It is likely that this regulatory area would be supplied from the Southwest Supply System until 2005 or 2010, when most of the northern area will then convert to surface water. If the NEWPP is completed in six years, it seems certain that water could be provided by either 2000 or 2005, so the early conversion dates could be met from either system. The WHCSWSC has been asked to provide the City with an amount of surface water needed from the NEWPP so that it can be designed for the additional capacity. As shown in Table 16, the amount of surface water required from the proposed Northeast Plant would be approximately 35 MGD to 40 MGD by 2010 if Alternate 1 or Alternate 2 is chosen, and 65 to 70 MGD if one of the other alternates is considered. While the NEWPP can be completed in time to provide these substantial water requirements, it is not clear whether the City of Houston will have sufficient water availability from Lake Houston. The HWMP appendices currently available do not address the subject of construction phasing.

The preceding discussion has dealt with the Northeast Supply System. For Alternate 5, the North Supply System must be considered. As mentioned in the description of Alternate 5, the NWWPP is proposed to have a capacity of 350 MGD in 2030, easily enough to supply the needs of the North Supply System and the surrounding areas. However, the majority of the surface water for this plant is to originate in two proposed reservoirs, Lake Millican and Bedias Reservoir. Construction of these sources would probably take about thirty years, yielding a completion date of 2018. Using this alternate, it would be unlikely to meet the HGCSD conversion dates for regulatory areas six and seven. The areas could be temporarily supplied from the Southwest System, since the total average daily demand does not exceed 133 MGD beginning in 2010.

5.0 CONCLUSIONS

5.0 CONCLUSIONS

Several conclusions may be drawn from the previous comparisons. The most apparent is that all of the service area alternatives are feasible when considering the available raw water supply in the southwest from the Brazos River Basin. In fact, if the northeast water supply becomes delayed, the southwest supply would be adequate to serve all of WHCSWSC's service area. However, it is readily apparent that the transmission cost savings is non-existent when pushing southwest water north of Highway 290. The main objective to any alternative raised is that water from the North System in Alternate 5 may not be available in time to meet HGCSD target dates. A cost analysis of the major sources and transmission systems will be necessary before any alternate can be eliminated. This will be described later in Appendix IV.

ATTACHMENTS

ATTACHMENT 1

ACKNOWLEDGEMENTS:

Prior reports and studies dealing with water demands and supplies in the City of Houston and surrounding areas were utilized as needed in preparing this study. Materials reviewed during the course of this project are as follows:

1. Houston Water Master Plan, Appendices A through M, August 1985 to March 1987, by Metcalf and Eddy, Inc.

2. District Plan, Adopted November 1985, by Harris-Galveston Coastal Subsidence District.

3. Subsidence '87, February 1987 by Harris-Galveston Coastal Subsidence District.

4. Utility District Listing, Creation and Bond Issue Reports, Texas Water Commission Records, January 1987.

5. Yearly Groundwater Pumpage Records, Harris Galveston Coastal Subsidence District.

ATTACHMENT 2

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT
PROPOSED DISTRICT PLAN
JULY 16, 1985

Area One

a. Through 1989, as a general rule, increases in groundwater withdrawal will not be permitted.

b. Beginning in 1990 groundwater withdrawal must be reduced so that no more than 10% of the total water use is from groundwater.

Area Two

a. Through 1989, as a general rule, increases in groundwater withdrawal may be permitted so long as surface-water use is not reduced.

b. In 1990 groundwater withdrawal must be reduced so that no more than 20% of the total water use is from groundwater.

c. Thereafter through 1998 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased. Then in 1999 groundwater withdrawal again must be reduced so that no more than 20% of the total water use is from groundwater.

d. Thereafter through 2006 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased. Then in 2007 groundwater withdrawal again must be reduced so that no more than 20% of the total water use is from groundwater.

e. Thereafter through 2014 increases in groundwater withdrawal may be permitted so long as surface water use is not decreased. Then in 2015 groundwater withdrawal again must be reduced so that no more than 20% of the total water use is from groundwater.

f. Thereafter through 2020 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased.

Area Three

a. Through 1994, as a general rule, increases in groundwater withdrawal may be permitted.

b. In 1995 groundwater withdrawal must be reduced so that no more than 20% of total water use is from groundwater.

c. Thereafter through 2011 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased. Then in 2012 groundwater withdrawal again must be reduced so that no more than 20% of the total water use is from groundwater.

d. Thereafter through 2020 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased.

Area Four

a. Through 1999, as a general rule, increases in groundwater withdrawal may be permitted.

b. In 2000 groundwater withdrawal must be reduced so that no more than 20% of the total water use is from groundwater.

c. Thereafter through 2020 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased.

Area Five

a. Through 1999, as a general rule, increases in groundwater withdrawal may be permitted.

b. In 2000 groundwater withdrawal must be reduced so that no more than 20% of the total water use is from groundwater.

c. Thereafter through 2020 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased.

Area Six

a. Through 2004, as a general rule, increases in groundwater withdrawal may be permitted.

b. In 2005 groundwater withdrawal must be reduced so that no more than 20% of the total water use is from groundwater.

c. Thereafter through 2020 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased.

Area Seven

a. Through 2009, as a general rule, increases in groundwater withdrawal may be permitted.

b. In 2010 groundwater withdrawal must be reduced so that no more than 20% of the total water use is from groundwater.

c. Thereafter through 2020 increases in groundwater withdrawal may be permitted so long as surface-water use is not decreased.

Area Eight

a. As a general rule, increases in groundwater withdrawal may be permitted.

b. Groundwater withdrawal in this area shall not be supplied to areas outside of the boundaries of Area Eight except for compelling reasons as determined by the District.

ATTACHMENT 3

ANNUAL GROUNDWATER PUMPAGE IN MILLIONS OF GALLONS

NO.	NAME OF DISTRICT	MDA	1980 PUMPAGE	1981 PUMPAGE	1982 PUMPAGE	1983 PUMPAGE	1984 PUMPAGE	1985 PUMPAGE	1986 PUMPAGE	MAXIMUM PUMPAGE	1986 LOSSES
1	ADDICKS UD	31	20.681	25.819	37.393	38.614	45.373	46.000	46.643	46.643	11.0%
2	BARKER-CYPRESS MUD	31	0.000	0.000	0.000	0.000	0.000	40.469	55.544	55.544	3.0%
3	BEECHNUT MUD	24	0.000	0.000	0.000	1.718	27.600	35.500	44.266	44.266	>30%
4	BISSONET MUD	24	65.033	78.110	101.646	104.155	125.903	142.857	169.407	169.407	<30%
5	BRAES UD	24	0.517	24.041	54.833	49.524	36.906	69.274	52.204	69.274	<30%
6	CAMFIELD MUD	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
7	CASTLEWOOD MUD	31	0.000	0.272	9.344	27.045	52.182	37.701	27.229	52.182	6.3%
8	CHELFORD CITY MUD	24	250.000	275.000	300.000	352.827	302.443	409.807	316.620	409.807	
9	CHELFORD ONE MUD	24	52.900	112.192	84.633	129.958	226.438	227.221	208.721	227.221	
10	CHIMNEY HILL MUD	25	57.562	90.851	121.274	136.824	141.802	114.891	115.128	141.802	
11	CIMARRON MUD	31	0.000	0.000	84.242	105.789	75.405	76.158	86.047	105.789	16.9%
12	CINCO MUD 3	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
13	CINCO MUD 5	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
14	CINCO MUD 6	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
15	CINCO MUD 9	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
16	CLAY ROAD MUD	31	11.650	29.252	67.566	77.396	88.871	88.161	85.573	88.871	4.6%
17	CORNERSTONE MUD	31	0.120	28.496	59.602	59.339	55.050	85.186	62.740	85.186	23.0%
18	CYPRESS CREEK UD	33	144.033	137.625	156.773	98.173	158.337	141.707	218.686	218.686	
19	CYPRESS HILL MUD 1	32	0.000	0.000	0.000	0.000	0.119	13.156	14.651	14.651	
20	CYPRESS HILL MUD 2	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
21	EMERALD FOREST UD	33	86.346	114.498	189.837	155.768	165.870	180.431	179.764	189.837	18.5%
22	FAULKEY GULLY MUD	33	18.046	28.378	46.215	57.967	82.398	97.549	102.975	102.975	
23	FRY ROAD MUD	31	0.015	29.000	58.326	80.035	100.755	91.832	128.977	128.977	39.5%
24	GRANT RD. PUD	33	0.000	0.000	0.000	9.375	22.913	21.825	23.814	23.814	
25	GREEN TRAILS MUD	31	1.500	5.171	28.088	41.633	46.017	53.657	59.330	59.330	16.0%
26	HARRIS CO. FWSD 61	32	376.250	386.411	431.494	296.644	296.514	335.310	313.717	431.494	
27	HARRIS CO. MUD 006	26	145.594	163.987	184.445	171.540	169.982	152.636	185.852	185.852	<30%
28	HARRIS CO. MUD 018	33	71.436	58.338	110.000	142.461	195.970	192.551	205.639	205.639	
29	HARRIS CO. MUD 023	26	63.624	76.057	107.059	119.665	141.195	149.292	136.097	149.292	
30	HARRIS CO. MUD 025	26	28.541	33.249	58.396	46.812	44.895	41.588	37.267	58.396	18.9%
31	HARRIS CO. MUD 029	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
32	HARRIS CO. MUD 052	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
33	HARRIS CO. MUD 061	31	62.761	118.162	141.930	156.232	196.105	199.580	199.654	199.654	3.8%
34	HARRIS CO. MUD 062	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
35	HARRIS CO. MUD 063	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
36	HARRIS CO. MUD 064	31	82.509	59.156	107.555	72.294	75.001	61.188	57.779	107.555	15.4%
37	HARRIS CO. MUD 065	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
38	HARRIS CO. MUD 069	32	0.000	0.000	0.000	134.033	151.286	162.189	148.927	162.189	
39	HARRIS CO. MUD 070	32	11.218	10.168	18.093	38.631	37.667	57.248	33.374	57.248	13.5%
40	HARRIS CO. MUD 071	31	3.735	7.603	14.782	26.198	30.232	41.061	41.194	41.194	30.6%
41	HARRIS CO. MUD 081	31	307.784	374.258	379.076	315.529	454.059	480.434	441.234	480.434	10.1%
42	HARRIS CO. MUD 090	24	1.845	14.275	122.330	131.453	157.465	125.723	127.069	157.465	3.5%
43	HARRIS CO. MUD 102	25	41.498	50.269	114.338	129.204	143.733	174.234	167.450	174.234	
44	HARRIS CO. MUD 105	31	28.672	19.089	20.462	28.258	44.306	38.075	32.722	44.306	
45	HARRIS CO. MUD 107	24	64.863	60.375	101.018	41.496	86.799	84.209	76.570	101.018	26.3%
46	HARRIS CO. MUD 118	26	0.000	0.000	0.000	156.141	188.737	176.172	174.250	188.737	27.1%
47	HARRIS CO. MUD 119	26	120.268	174.722	229.328	165.573	132.980	177.639	171.246	229.328	6.4%
48	HARRIS CO. MUD 120	24	67.144	111.306	221.690	168.566	129.239	158.353	249.553	249.553	15.6%
49	HARRIS CO. MUD 127	31	0.000	0.000	0.000	0.000	14.415	29.370	28.411	29.370	13.0%
50	HARRIS CO. MUD 130	25	0.000	0.000	0.000	0.000	22.091	39.610	31.465	39.610	4.8%

ANNUAL GROUNDWATER PUMPAGE IN MILLIONS OF GALLONS

NO.	NAME OF DISTRICT	MDA	1980 PUMPAGE	1981 PUMPAGE	1982 PUMPAGE	1983 PUMPAGE	1984 PUMPAGE	1985 PUMPAGE	1986 PUMPAGE	MAXIMUM PUMPAGE	1986 LOSSES
51	HARRIS CO. MUD 136	31	95.345	94.696	156.008	139.917	113.345	122.080	106.959	156.008	5.2%
52	HARRIS CO. MUD 137	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
53	HARRIS CO. MUD 144	31	15.469	26.216	26.800	24.160	35.979	38.046	28.303	38.046	0.0%
54	HARRIS CO. MUD 147	24	51.358	54.672	111.712	80.967	89.147	74.242	69.592	111.712	10.3%
55	HARRIS CO. MUD 149	32	46.891	59.498	97.506	107.656	109.578	142.927	131.562	142.927	13.3%
56	HARRIS CO. MUD 155	32	0.000	0.000	0.000	0.000	0.000	10.549	18.156	18.156	22.7%
57	HARRIS CO. MUD 156	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
58	HARRIS CO. MUD 157	31	3.463	9.169	18.737	45.966	46.982	36.138	34.601	46.982	26.5%
59	HARRIS CO. MUD 158	24	5.000	17.134	29.662	26.960	61.000	66.392	75.356	75.356	12.6%
60	HARRIS CO. MUD 162	32	46.544	60.896	138.813	134.087	196.099	140.551	83.861	196.099	45.8%
61	HARRIS CO. MUD 163	32	0.000	0.000	0.000	0.000	0.000	0.000	190.330	190.330	7.6%
62	HARRIS CO. MUD 165	32	0.000	0.000	0.000	3.500	15.710	31.423	24.354	31.423	0.5%
63	HARRIS CO. MUD 166	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
64	HARRIS CO. MUD 167	31	0.000	0.000	0.000	0.000	0.000	2.120	6.630	6.630	70.6%
65	HARRIS CO. MUD 168	26	7.836	10.459	62.193	104.894	193.662	234.326	213.074	234.326	4.4%
66	HARRIS CO. MUD 170	26	0.000	8.000	47.605	59.154	42.869	48.745	56.623	59.154	8.0%
67	HARRIS CO. MUD 172	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
68	HARRIS CO. MUD 173	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
69	HARRIS CO. MUD 175	24	0.000	0.000	0.000	0.000	8.586	19.118	27.787	27.787	15.1%
70	HARRIS CO. MUD 177	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
71	HARRIS CO. MUD 179	25	0.000	0.000	6.538	92.956	48.237	71.717	67.424	92.956	16.6%
72	HARRIS CO. MUD 183	31	0.000	0.000	0.000	14.294	69.481	72.527	69.868	72.527	15.2%
73	HARRIS CO. MUD 185	25	1.550	14.000	49.830	44.583	74.983	96.573	100.384	100.384	
74	HARRIS CO. MUD 186	25	0.000	0.000	0.000	0.000	138.356	155.410	147.242	155.410	64.3%
75	HARRIS CO. MUD 188	32	0.000	0.000	1.288	53.200	71.185	80.733	72.666	80.733	9.2%
76	HARRIS CO. MUD 190	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
77	HARRIS CO. MUD 194	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
78	HARRIS CO. MUD 195	32	0.000	0.000	0.000	0.000	0.000	0.000	0.735	0.735	
79	HARRIS CO. MUD 196	32	0.000	0.000	0.000	0.000	5.400	3.000	1.840	5.400	
80	HARRIS CO. MUD 197	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
81	HARRIS CO. MUD 199	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.0%
82	HARRIS CO. MUD 208	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
83	HARRIS CO. MUD 216	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
84	HARRIS CO. MUD 222	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
85	HARRIS CO. MUD 223	24	0.000	0.000	0.000	0.000	9.261	29.138	39.272	39.272	13.0%
86	HARRIS CO. MUD 225	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
87	HARRIS CO. MUD 229	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
88	HARRIS CO. MUD 230	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
89	HARRIS CO. MUD 237	26	0.000	0.000	0.000	0.000	0.000	0.830	1.576	1.576	41.8%
90	HARRIS CO. MUD 238	31	0.000	0.000	0.000	0.000	0.000	12.348	11.858	12.348	41.4%
91	HARRIS CO. MUD 239	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	73.3%
92	HARRIS CO. MUD 240	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
93	HARRIS CO. MUD 243	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
94	HARRIS CO. MUD 246	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
95	HARRIS CO. MUD 247	26	0.000	0.000	0.000	0.000	0.500	6.501	10.270	10.270	
96	HARRIS CO. MUD 248	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
97	HARRIS CO. MUD 250	25	0.000	0.000	0.000	0.000	1.770	9.889	13.013	13.013	35.5%
98	HARRIS CO. MUD 252	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
99	HARRIS CO. MUD 255	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
100	HARRIS CO. MUD 256	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%

ANNUAL GROUNDWATER PUMPAGE IN MILLIONS OF GALLONS

NO. NAME OF DISTRICT	MDA	1980 PUMPAGE	1981 PUMPAGE	1982 PUMPAGE	1983 PUMPAGE	1984 PUMPAGE	1985 PUMPAGE	1986 PUMPAGE	MAXIMUM PUMPAGE	1986 LOSSES
101 HARRIS CO. MUD 257	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
102 HARRIS CO. MUD 259	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
103 HARRIS CO. MUD 261	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
104 HARRIS CO. MUD 263	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
105 HARRIS CO. MUD 264	32	0.000	0.000	0.000	0.000	0.000	0.000	35.964	35.964	10.3%
106 HARRIS CO. MUD 268	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
107 HARRIS CO. MUD 272	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
108 HARRIS CO. MUD 273	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
109 HARRIS CO. MUD 276	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
110 HARRIS CO. MUD 277	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
111 HARRIS CO. MUD 280	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
112 HARRIS CO. MUD 281	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
113 HARRIS CO. MUD 282	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
114 HARRIS CO. MUD 283	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
115 HARRIS CO. MUD 284	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
116 HARRIS CO. MUD 286	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
117 HARRIS CO. MUD 287	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
118 HARRIS CO. MUD 288	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
119 HARRIS CO. MUD 289	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
120 HARRIS CO. MUD 306	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
121 HARRIS CO. MUD 317	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
122 HARRIS CO. MUD 318	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
123 HARRIS CO. MUD 319	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
124 HARRIS CO. MUD 325	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
125 HARRIS CO. UD 6	25	255.584	243.110	323.494	332.844	362.402	453.849	448.946	453.849	15.8%
126 HARRIS CO. WCID 113	32	35.560	35.346	39.759	35.002	40.899	40.034	35.712	40.899	
127 HARRIS CO. WCID 133	26	257.409	209.398	254.884	187.730	207.763	215.430	231.920	257.409	
128 HARRIS-FT. BEND MUD 1	31	0.000	0.000	0.000	0.000	0.000	4.728	5.970	5.970	8.0%
129 HARRIS-FT. BEND MUD 3	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
130 HARRIS-FT. BEND MUD 4	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
131 HARRIS-FT. BEND MUD 5	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
132 HORSEPEN BAYOU MUD	25	0.000	3.932	24.826	39.610	70.873	89.698	103.811	103.811	
133 INTERSTATE MUD	31	0.000	0.000	0.000	0.000	2.713	44.032	42.405	44.032	22.9%
134 JACKRABBIT ROAD PUD	31	350.548	339.197	407.277	396.467	416.830	419.323	376.378	419.323	
135 KINGSBRIDGE MUD	24	0.000	0.000	0.000	17.908	116.781	146.220	135.880	146.220	12.2%
136 LAKE FOREST UD	33	61.492	67.310	75.395	85.292	96.545	116.830	121.095	121.095	
137 LANGHAM CREEK UD	31	27.078	59.347	147.946	149.324	160.827	160.049	150.004	160.827	10.6%
138 LONGHORN TOWN UD	31	0.000	0.000	0.000	0.000	1.867	15.500	30.975	30.975	12.0%
139 MALCOMSON ROAD UD	33	143.482	157.056	175.921	199.014	225.270	272.603	282.556	282.556	
140 MASON CREEK UD	31	200.843	211.474	261.051	304.784	395.372	418.282	349.537	418.282	
141 MAYDE CREEK MUD	31	1.501	7.166	31.106	48.271	82.999	59.093	27.590	82.999	
142 MEMORIAL MUD	31	0.030	7.124	14.900	14.835	13.763	17.037	15.685	17.037	23.0%
143 MILLS ROAD MUD	33	75.092	37.774	107.202	164.464	119.101	95.598	132.183	164.464	
144 MISSION BEND MUD 1	24	1.928	91.324	101.044	92.519	232.264	148.333	148.253	232.264	
145 MISSION BEND MUD 2	24	29.069	50.800	129.132	107.589	209.043	216.673	258.338	258.338	
146 MORTON ROAD MUD	31	8.933	24.489	50.133	59.974	66.627	62.423	50.314	66.627	0.6%
147 NORTHWEST FREEWAY MUD	32	34.476	34.151	66.594	70.440	80.083	71.374	56.272	80.083	0.0%
148 NORTHWEST PARK MUD	26	162.405	168.157	227.170	128.683	278.609	296.660	286.120	296.660	
149 NOTTINGHAM COUNTRY MUD	31	0.000	0.000	0.000	0.000	0.000	13.129	35.158	35.158	27.6%
150 NW HARRIS CO. MUD 05	33	31.021	30.000	33.881	35.678	36.290	33.485	32.768	36.290	3.0%

ANNUAL GROUNDWATER PUMPAGE IN MILLIONS OF GALLONS

NO.	NAME OF DISTRICT	MDA	1980 PUMPAGE	1981 PUMPAGE	1982 PUMPAGE	1983 PUMPAGE	1984 PUMPAGE	1985 PUMPAGE	1986 PUMPAGE	MAXIMUM PUMPAGE	1986 LOSSES
151	NW HARRIS CO. MUD 09	32	17.545	18.642	33.629	45.648	126.095	145.448	105.889	145.448	10.5%
152	NW HARRIS CO. MUD 10	32	0.000	19.191	19.000	19.000	19.852	20.068	20.664	20.664	37.8%
153	NW HARRIS CO. MUD 12	31	0.534	3.263	9.632	16.382	24.722	38.728	20.285	38.728	
154	NW HARRIS CO. MUD 15	33	4.554	5.760	5.921	14.791	28.972	40.777	31.155	40.777	11.6%
155	NW HARRIS CO. MUD 16	31	15.392	18.572	23.151	22.074	29.910	31.009	27.808	31.009	14.8%
156	NW HARRIS CO. MUD 25	25	0.000	0.000	4.730	0.026	3.275	6.500	10.875	10.875	
157	NW HARRIS CO. MUD 27	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
158	NW HARRIS CO. MUD 29	26	0.000	0.000	0.000	0.000	0.000	31.653	39.370	39.370	93.1%
159	PARK TEN MUD	31	99.117	107.559	135.311	146.278	206.517	219.476	230.855	230.855	11.2%
160	PECAN PARK MUD	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
161	REID ROAD MUD 1	26	0.000	96.013	103.606	125.000	148.178	191.501	209.091	209.091	11.0%
162	REID ROAD MUD 2	26	0.000	0.000	0.000	3.773	51.663	40.282	35.939	51.663	5.0%
163	REMINGTON MUD 1	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
164	REMINGTON MUD 2	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
165	REMINGTON MUD 3	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
166	RENN ROAD MUD	24	0.000	2.085	76.127	121.218	64.222	64.148	62.776	121.218	7.5%
167	RICEWOOD MUD	31	0.000	0.000	0.000	0.000	0.000	64.647	70.970	70.970	33.0%
168	ROLLING CREEK UD	31	0.000	0.000	0.000	0.000	0.000	11.679	5.443	11.679	
169	ROLLING FORK PUD	26	91.681	72.940	82.851	75.926	87.150	113.675	85.219	113.675	12.7%
170	SPENCER ROAD PUD	25	118.165	118.492	177.058	147.677	142.474	170.009	146.262	177.058	
171	TIMBERLAKE ID	32	84.044	88.645	109.857	98.248	121.379	129.632	132.520	132.520	
172	WEST HARRIS CO. MUD 01	26	28.541	33.249	58.396	46.812	44.895	41.588	37.267	58.396	
173	WEST HARRIS CO. MUD 02	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
174	WEST HARRIS CO. MUD 04	24	0.000	0.000	7.200	46.140	29.960	27.000	23.977	46.140	15.3%
175	WEST HARRIS CO. MUD 05	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
176	WEST HARRIS CO. MUD 06	24	18.916	28.368	48.492	57.246	62.752	77.266	75.097	77.266	28.7%
177	WEST HARRIS CO. MUD 07	31	0.000	0.000	0.000	0.000	0.000	31.023	25.667	31.023	
178	WEST HARRIS CO. MUD 08	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
179	WEST HARRIS CO. MUD 09	26	0.000	3.044	40.819	75.724	103.087	52.152	57.320	103.087	2.8%
180	WEST HARRIS CO. MUD 10	26	0.000	0.000	0.000	0.000	5.508	97.915	88.152	97.915	5.4%
181	WEST HARRIS CO. MUD 11	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
182	WEST HARRIS CO. MUD 14	32	0.000	0.000	4.559	0.000	0.000	0.000	0.000	4.559	
183	WEST HARRIS CO. MUD 15	32	0.000	0.000	0.000	25.259	28.500	32.450	29.899	32.450	23.5%
184	WEST HARRIS CO. MUD 16	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
185	WEST HARRIS CO. MUD 17	31	0.000	0.000	0.000	4.028	15.560	15.328	16.650	16.650	34.9%
186	WEST HARRIS CO. MUD 20	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0%
187	WEST MEMORIAL MUD	31	226.257	170.010	214.766	171.705	217.654	216.423	184.018	226.257	8.4%
188	WESTLAKE MUD 1	31	88.274	114.324	161.501	132.830	150.432	134.070	164.431	164.431	16.3%
189	WESTON MUD	31	57.134	62.442	67.948	66.094	58.923	98.505	42.225	98.505	6.8%
190	WESTPARK MUD	31	0.000	0.418	5.785	23.000	42.608	90.454	43.432	90.454	8.0%
191	WESTWAY UD	25	33.970	55.375	92.670	97.489	113.171	126.389	104.567	126.389	
192	WHITE OAK BEND MUD	26	25.217	31.993	47.987	57.895	64.653	62.793	58.773	64.653	3.0%
193	WHITE OAK/1960 MUD	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
194	WILLOW CHASE MUD	33	0.000	0.487	7.340	25.398	26.958	27.495	47.833	47.833	
195	WINDFERN FOREST UD	26	40.454	52.675	77.123	75.997	85.969	86.851	56.071	86.851	10.6%
196	JERSEY VILLAGE	26	218.7	224.4	262.8	244.6	250.6	247.7	249.1	262.8	
197	KATY, CITY OF	31	301.9	307.3	346.8	427.8	311.8	304.3	258.6	427.8	
198	BAKER SERVICE TOOLS	26	13.4	15.8	11.1	6.9	8.0	10.9	11.9	15.8	
199	BAKER TUBULAR SERVICS	25	7.8	9.2	11.2	7.1	5.0	6.9	7.8	11.2	
200	BEAR CREEK GOLF WORLD	24	39.2	16.0	25.4	44.9	41.3	59.0	72.1	72.1	

ANNUAL GROUNDWATER PUMPAGE IN MILLIONS OF GALLONS

NO.	NAME OF DISTRICT	MDA	1980 PUMPAGE	1981 PUMPAGE	1982 PUMPAGE	1983 PUMPAGE	1984 PUMPAGE	1985 PUMPAGE	1986 PUMPAGE	MAXIMUM PUMPAGE	1986 LOSSES
201	BRITMORE UTILITY CO	25	33.1	35.1	40.9	50.9	62.3	58.1	56.9	62.3	
202	CAMERON IRON WORKS	32	45.7	85.6	73.2	57.4	59.7	40.1	35.5	85.6	
203	ENCHANTED VALLEY W/S	33	10.3	9.2	15.1	11.0	8.8	14.4	75.9	75.9	
204	GIFFORD-HILL & CO	25	17.2	13.5	20.6	9.8	11.9	12.4	22.2	22.2	
205	HEARTHSTONE COUNTRYCLUB	25	34.9	75.6	57.2	57.2	63.6	76.8	17.8	76.8	
206	NATIONAL STEEL PRODUCTS	25	20.1	26.3	18.5	14.4	6.4	5.7	5.3	26.3	
207	N.W. WATER SYSTEMS, INC	33	17.2	15.8	18.8	17.1	17.2	15.8	15.3	18.8	
208	PEEK ROAD UTILITIES	31	0.0	0.0	0.0	3.4	8.8	8.9	6.7	8.9	
209	TALL PINES UTILITY	33	6.4	8.5	10.5	8.9	9.6	9.2	9.2	10.5	
210	TEXAS INSTRUMENTS	32	24.0	35.6	30.1	26.7	43.9	50.8	38.3	50.8	
211	TOWER OAK BEND WAT.SUP.	32	0.1	0.0	0.0	2.0	7.0	12.1	11.6	12.1	
212	TREELINE GOLF CLUB, INC	33	0.0	0.0	0.0	4.0	12.0	14.0	15.8	15.8	
213	TRUMIX CONCRETE COMPANY	32	3.3	2.5	5.5	4.8	2.1	0.8	0.5	5.5	
214	TRUNKLINE GAS COMPANY	32	16.2	14.8	20.5	12.5	15.3	12.8	15.3	20.5	

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

IMPLEMENTATION PLAN

APPENDIX III

SUPPLEMENT TO WATER SUPPLY
NORTH SUPPLY SYSTEM

October 1987

DANNENBAUM ENGINEERING CORPORATION
CONSULTING ENGINEERS
3100 West Alabama
Houston, Texas 77098
(713) 622-8011

EXECUTIVE SUMMARY

Purpose and Scope

This phase of the implementation plan deals with evaluation of a north surface water supply system from the Trinity/Brazos/San Jacinto River Basins and is intended to be a supplement to Appendix II. This supply system is described in the western alternative of the Houston Water Master Plan (HWMP).

Water Demands

Existing and Projected Water Demands

Existing and projected water demands used in this Appendix are based on data previously presented in Appendix II, Water Demand and Supply. Maximum daily demands were used to determine required treated water supply systems.

Surface Water Supply

Northeast and Southwest Supply Systems

The Northeast and Southwest Supply Systems used in this Appendix are discussed in detail in Appendix II, Water Demand and Supply.

North Supply System

This supply system consists of surface water from the Trinity, Brazos and San Jacinto River Basins as outlined in the western alternative of the HWMP. Development of Lake Millican, Bedias Reservoir and possibly Lake Creek would be necessary along with major conveyance systems from these sources. The HWMP western water alternative calls for two proposed treatment plants, a 150 MGD ultimate capacity Northwest Water Purification Plant and a 200 MGD ultimate capacity Waller Water Purification Plant. If Lake Creek were developed the ultimate capacity of the Northwest Water Purification Plant could be increased to 200 MGD.

Alternate Service Areas

Approach and Methods

Alternate service areas were investigated to determine surface water supply versus demand relationship and also availability to meet the conversion dates outlined in the HGCSD plan. In addition to the five alternate service areas presented in Appendix II, the following alternate was investigated:

Alternate No. 6 - Southwest System Service South of Clay Road
Northeast System Service East of Barker-Cypress
North System Service West of Barker-Cypress

Table ES-1 presents a summary of surface water requirements for Alternate 6 from 1985 to 2030. For purposes of computing surface water requirements in 2030, it was assumed that HGCSD regulatory area eight will be given a conversion requirement of 80% in that year. All surface water requirements are in terms of maximum day demands.

TABLE ES-1

SUMMARY OF SURFACE WATER REQUIREMENTS BY ALTERNATE
(MAXIMUM DAILY DEMANDS)

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST (MGD)	TOTAL NORTH (MGD)	TOTAL ALL AREAS (MGD)
ALTERNATE 6 - S.W. BOUNDARY AT CLAY ROAD; N.E. BOUNDARY AT BARKER-CYPRESS						
1985	0.00	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	0.00	65.27
2000	89.82	15.74	105.96	0.28	0.14	105.98
2005	89.82	15.74	105.96	9.94	0.14	115.64
2010	89.82	15.74	105.96	60.88	4.33	170.77
2012	101.17	15.74	116.91	60.88	4.33	182.12
2020	101.17	15.74	116.91	60.88	4.33	182.12
2030	101.17	38.79	139.96	60.88	30.42	231.26

Comparison of Alternate No. 6

Considerations of supply adequacy were based on the minimum surface water required to meet the HGCSD conversion plan. The minimum requirements climb in a stair-step fashion rather than linearly, however, the minimum requirements for the City of Houston Southwest and total WHCSWSC supply areas do not vary between alternates.

The total maximum daily treated water supply available from the Southwest Water Purification Plant (SWWPP) is assumed to be 226 MGD which is based on a average daily raw water supply of 133 MGD from the BRA. The total available ultimate supplies from the Northeast, Northwest and Waller treatment plants as proposed in the HWMP would be adequate to meet the Alternate 6 service area needs.

Some consideration must be given to the timing of the availability of the surface water and whether it would be possible to meet the HGCSD conversion plan. In the Southwest service area, the first conversion requires 65 MGD in 1995. If an estimate of six years is used to bring the SWWPP on-line, then it can be reasonably assumed that the first southwest conversion date of 1995 is feasible.

Timing issues are more complex in the North and Northeast service areas. The quantities of surface water for these areas in 2000 or 2005 are small for Alternate 6 and it is likely that they will be supplied from the Southwest Supply System until 2010 when most of the northern area will then convert to surface water. The amount of water required from the Northeast Water Purification Plant (NEWPP) for Alternate 6 would be 61 MGD by 2010. The City has stated that the initial design of the plant could accommodate this additional requirement.

The North Supply System proposes two water plants, the Northwest Water Purification Plant (NWWPP) and the Waller Water Purification Plant (WWPP), both with ultimate capacities adequate to meet the needs of the service area. However, the majority of raw surface water for these plants originates in proposed reservoirs which may not be completed in time to meet the HGCSD conversion dates. These northern areas could be temporarily supplied from a Southwest System with the North System providing treated water by the year 2030.

Conclusions

In Alternate No. 6, the Southwest Supply System will be adequate to meet the projected Southwest Service Area. However, it is very likely that the water from the North Supply System may not be available in time to meet HGCSD target dates. A cost analysis of the major sources and transmission systems will be necessary before any service area alternate can be eliminated. This will be described later in Appendix IV.

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1.0 INTRODUCTION

1.0 INTRODUCTION

__Purpose and Scope__

The project scope of work for this phase of the implementation program deals with evaluation of a North Surface Water Supply System from the Trinity/Brazos/San Jacinto river basins (the "North System"). This supply system is described in the western alternative of the Houston Water Master Plan (HWMP). This appendix is intended to be a supplement to Appendix II which dealt with water supplies and demands.

Evaluation of water supplies for West Harris County involves investigation of three potential sources of surface water. The first two, purchasing water from a future City of Houston Northeast Water Purification Plant (the "Northeast System") and from the Brazos River out of a future Southwest Water Purification Plant (the "Southwest System") were addressed previously in Appendix II, Water Demand and Supply. The third potential source from the Trinity/Brazos/San Jacinto river basins (the North System) is the topic of this Appendix.

2.0 WATER DEMANDS

2.0 WATER DEMANDS

Existing and Projected Water Demands

The alternate service area water demands formulated in this Appendix are based on the existing and projected water demands as previously defined in Appendix II, Water Demand and Supply. Existing water demands were obtained from groundwater pumpage records for each municipal utility district, city and industry within the defined alternate service area. Projected water demands, as presented in the HWMP, were determined by assigning demand criteria to population and employment projections developed by Rice Center for each census tract and MDA within the alternate service area. Maximum daily demands were used to determine required water treatment and transmission facilities. All raw water supply facilities will be based on average daily demands.

3.0 SURFACE WATER SUPPLY

3.0 SURFACE WATER SUPPLY

Northeast and Southwest Supply Systems

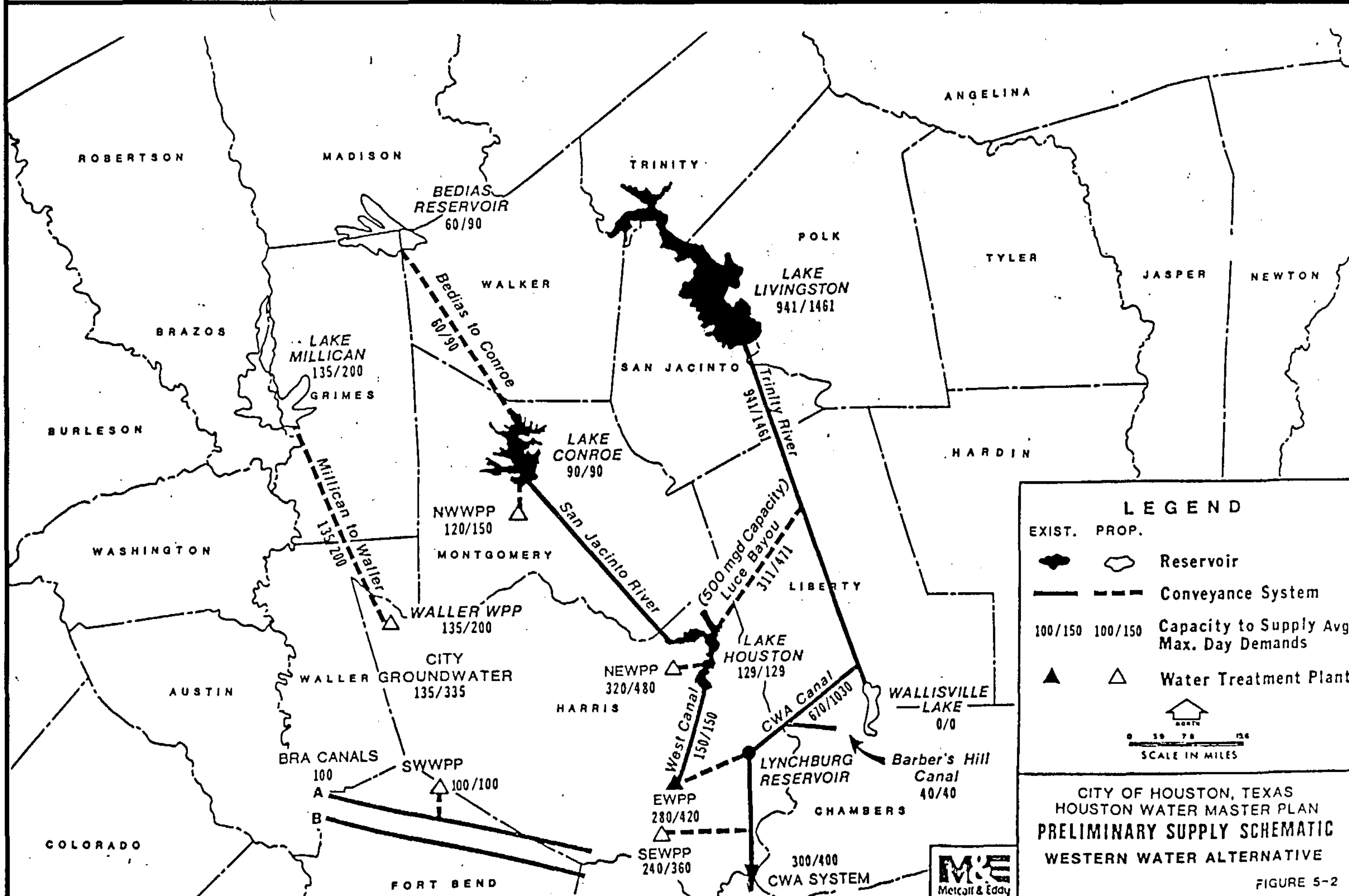
The Northeast and Southwest suface water supplies used in formulating alternate service areas in this Appendix are discussed in Appendix II, Water Demand and Supply.

North Supply System

Trinity/Brazos/San Jacinto River Supply Excluding Lake Creek

This supply system consists of surface water from the Trinity, Brazos and San Jacinto River Basins as outlined in the western water alternative of the HWMP. The development of two water supply sources, Lake Millican and Bedias Reservoir, would be a vital part of this supply system along with conveyance systems from these sources. Figure 1, reproduced directly from Appendix M of the HWMP, presents the most recent preliminary supply schematic for the western water alternative of the HWMP. This latest refinement of the HWMP western water alternative calls for a reduction in capacity of the Northwest Water Purification Plant south of Lake Conroe from 350 MGD to 150 MGD and the addition of a 200 MGD water purification plant near Waller. A raw water conveyance system from proposed Lake Millican would be routed to this plant at Waller rather than to Lake Conroe as previously mentioned in Appendix II.

FIGURE I


ROBERTSON
MADISON
TRINITY
ANGELINA
BEDIAS RESERVOIR
60/90
WALKER
POLK
TYLER
JASPER
NEWTON
LAKE LIVINGSTON
941/1461
Bedias to Conroe
60/90
BRAZOS
LAKE MILLICAN
135/200
GRIMES
SAN JACINTO
Trinity River
941/1461
BURLESON
LAKE CONROE
90/90
HARDIN
Millican to Waller
135/200
NWWPP
120/150
San Jacinto River
(500 mgd Capacity)
Luce Bayou
311/471
WASHINGTON
MONTGOMERY
LIBERTY
WALLER WPP
135/200
LAKE HOUSTON
129/129
CITY GROUNDWATER
135/335
WALLER
NEWPP
320/480
AUSTIN
HARRIS
West Canal
150/150
CWA Canal
670/1030
WALLISVILLE LAKE
0/0
BRA CANALS
100
A
B
SWWPP
100/100
LYNCHBURG RESERVOIR
Barber's Hill Canal
40/40
EWPP
280/420
CHAMBERS
COLORADO
SEWPP
240/360
300/400
CWA SYSTEM
FORT BEND
LEGEND
EXIST.
PROP.
Reservoir
Conveyance System
100/150
100/150
Capacity to Supply Avg./Max. Day Demands
Water Treatment Plant
NORTH
SCALE IN MILES
M&E
Metcalf & Eddy
CITY OF HOUSTON, TEXAS
HOUSTON WATER MASTER PLAN
PRELIMINARY SUPPLY SCHEMATIC
WESTERN WATER ALTERNATIVE
FIGURE 5-2

Trinity/Brazos/San Jacinto River Supply Including Lake Creek

This supply system is identical to the system described above except for requiring the development of three rather than two water supply sources , namely Lake Millican, Bedias Reservoir and Lake Creek Reservoir. A recently released planning report and draft environmental statement, prepared by the Bureau of Reclamation and sponsored by the SJRA presents alternative plans to develop additional surface water supplies within the San Jacinto River Basin. The recommended alternative selected was the Lower Lake Creek site located on Lake Creek in Montgomery County about 5 miles south of Lake Conroe. The development of Lake Creek Reservoir would make available an additional 56 MGD which could be treated by the proposed Northwest Water Purification Plant.

Northwest Water Purification Plant

Upon selection of a western alternative and the development of Bedias Reservoir and a conveyance system to Lake Conroe, the City of Houston proposes construction of a Northwest Water Purification Plant. The proposed location of this plant would be just south of Lake Conroe from which it will get its raw water supply. Preliminary sizing of this plant as presented in the HWMP is 150 MGD at ultimate capacity (year 2030). If Lake Creek Reservoir were also developed, the Northwest Water Purification Plant could possibly be increased in size to 200 MGD ultimate capacity (year 2030).

Waller Water Purification Plant

Upon selection of a western alternative and the development of Lake Millican, the City of Houston proposes to construct a Waller Water Purification Plant in northwest Harris County near the Waller County line. A conveyance system from Lake Millican to the Waller treatment plant is also proposed. Preliminary sizing of this plant as presented in the HWMP is 200 MGD at ultimate capacity (year 2030).

4.0 ALTERNATE SERVICE AREAS

Approach and Methods

This section is a supplement to Section 4.0 of Appendix II and examines supplying the WHCSWSC study area with surface water from sources from the North, Northeast and Southwest. Each alternate service area is evaluated in terms of water demand versus supply and the possibility of meeting the conversion schedule as outlined in the HGCSD Plan. The alternates presented in this Appendix as well as Appendix II will be further tested for economic feasibility in Appendix IV of this study.

All water supply scenarios considered by the HWMP include the Northeast Water Purification Plant (NEWPP) at Lake Houston and the Southwest Water Purification Plant (SWWPP) near the Brazos River. The North System (HWMP western alternative), proposes a water treatment facility at Lake Conroe, the Northwest Water Purification Plant (NWWPP) and a water treatment facility in northwest Harris County, the Waller Water Purification Plant (WWPP). The North Supply System can only be used if the City of Houston elects to bring water from the west.

Evaluation of the adequacy of surface water supplies is based on the minimum surface water required to meet the HGCSD conversion goals, not the full maximum daily requirements.

The following alternate consists of three sources of supply: The Southwest System combined with a Northeast and North System. The Southwest System will supply surface water to portions of the City of Houston as well as the WHCSWSC service area as far north as Clay Road. The City of Houston's portion of the Southwest System is bounded by Fondren and Blalock Roads on the east, Clay Road on the north, the Houston City Limits on the west and the Harris County boundary on the south.

For the following alternate, the boundaries of the service area and the projected water demands were defined as mentioned in Appendix II, Section 4.0.

Alternate No. 6

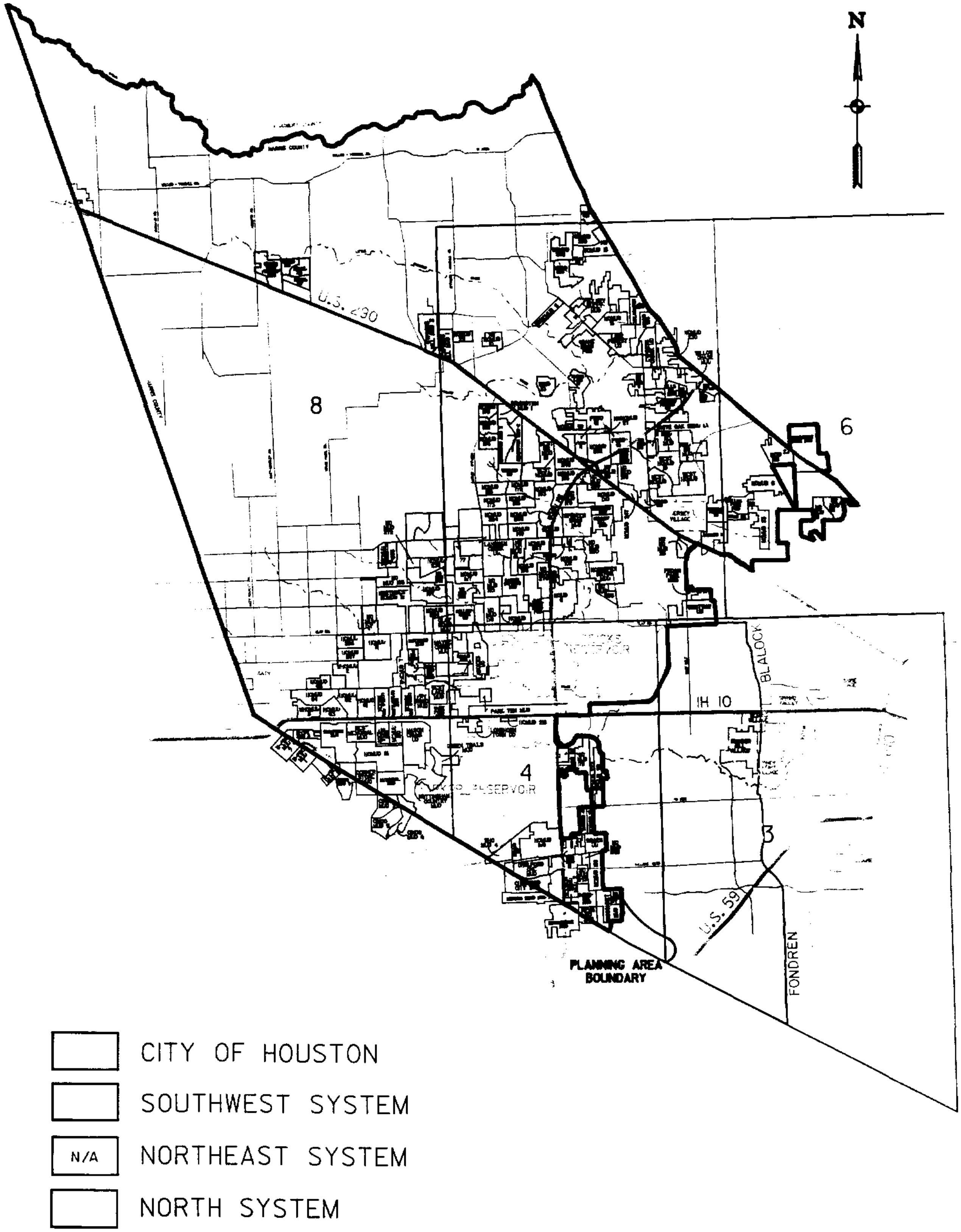
Two criteria are applied to Alternate No. 6 described below. First, the supply is compared to the HGCSD surface water requirements at each conversion date and second, consideration is given to whether the water sources will be available in time to meet the HGCSD conversion dates. Table 1 gives total maximum daily usage for each system in Alternate 6. Table 2 details the calculation of surface water requirements per HGCSD requirements, and Table 3 is a summary of this information.

In Alternate 6, the portion of the WHCSWSC planning area south of Clay Road would be served by the Southwest Supply System, while the remainder of the planning area would be supplied from a combination of the Northeast Supply System and the North Supply System. The boundary line between the Northeast and North Supply Systems runs north along Barker-Cypress Road from Clay Road to U.S. 290 then northwest along U.S. 290 to Spring-Cypress Road then northeast along Spring-Cypress Road to F.M. 149. Figure 2 shows the service area boundaries for this alternate.

The HGCSD surface water requirements on Table 3 reveal that the City of Houston will require 65 MGD from the Southwest System in 1995. The WHCSWSC has no mandate in 1995. In the year 2000, the Southwest System will require a total of 106 MGD, or 100 MGD for the City of Houston and 16 MGD for the WHCSWSC. The Southwest System average daily yield of 133 MGD (226 MGD maximum daily) would be adequate throughout the planning period.

The Northeast Supply System has three conversion dates for this alternate: 2000, 2005, and 2010. The earliest conversion date is 2000, when 0.3 MGD would be needed for a portion of HGCSD regulatory area four. At the next conversion date of 2005, 10 MGD will be required. Beginning in 2010, 61 MGD will be needed, remaining constant until 2030.

The North Supply System also has three conversion dates for Alternate 6: 2000, 2010 and 2030. At the first conversion date of 2000, 0.2 MGD will be required. At the next conversion date of 2010, 4 MGD will be needed. In 2030 it is assumed that HGCSD regulatory area eight will require conversion to surface water, increasing the North Supply System requirements to 30 MGD.



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

ALTERNATE 6 SERVICE AREAS

TABLE 1

TOTAL WATER DEMANDS BY ALTERNATE
(MAXIMUM DAILY)

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST (MGD)	TOTAL NORTH (MGD)	TOTAL ALL AREAS (MGD)
ALTERNATE 6 - S.W. BOUNDARY AT CLAY ROAD; N.E. BOUNDARY AT BARKER-CYPRESS						
1985	99.59	17.95	117.54	36.45	6.66	160.64
1990	99.59	17.95	117.54	36.45	6.66	160.64
1995	108.36	22.37	130.73	43.68	8.97	183.39
2000	117.37	29.64	147.01	55.48	12.94	215.43
2005	126.38	36.90	163.28	67.27	16.91	247.47
2010	131.37	44.12	175.49	77.55	21.93	274.97
2012	133.37	47.01	180.38	81.65	23.93	285.97
2020	139.17	56.56	195.73	95.18	31.91	322.81
2030	144.18	65.61	209.79	107.90	42.25	359.94

TABLE 2

SURFACE WATER REQUIREMENTS PER HGCSD PLAN
TOTAL WHCSWSC ONLY
(MAXIMUM DAILY DEMANDS)

ALTERNATE 6
Surface Water (MGD)

Regulatory Area	1985	2000	2005	2010	2030
SOUTHWEST SYSTEM					
4	0.00	15.74	15.74	15.74	15.74
8	0.00	0.00	0.00	0.00	23.06
SOUTHWEST TOTAL	0.00	15.74	15.74	15.74	38.79
NORTHEAST SYSTEM					
4	0.00	0.28	0.28	0.28	0.28
6	0.00	0.00	9.66	9.66	9.66
7	0.00	0.00	0.00	50.94	50.94
NORTHEAST TOTAL	0.00	0.28	9.94	60.88	60.88
NORTH SYSTEM					
4	0.00	0.14	0.14	0.14	0.14
7	0.00	0.00	0.00	4.19	4.19
8	0.00	0.00	0.00	0.00	26.09
NORTH TOTAL	0.00	0.14	0.14	4.33	30.42
ALT. No. 6 TOTAL	0.00	16.16	25.82	80.95	130.09

TABLE 3

SUMMARY OF SURFACE WATER REQUIREMENTS BY ALTERNATE
(MAXIMUM DAILY DEMANDS)

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST (MGD)	TOTAL NORTH (MGD)	TOTAL ALL AREAS MGD)
ALTERNATE 6 - S.W. BOUNDARY AT CLAY ROAD; N.E. BOUNDARY AT BARKER-CYPRESS						
1985	0.00	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	0.00	65.27
2000	89.82	15.74	105.96	0.28	0.14	105.98
2005	89.82	15.74	105.96	9.94	0.14	115.64
2010	89.82	15.74	105.96	60.88	4.33	170.77
2012	101.17	15.74	116.91	60.88	4.33	182.12
2020	101.17	15.74	116.91	60.88	4.33	182.12
2030**	101.17	38.79	139.96	60.88	30.42	231.26

**Harris-Galveston Coastal Subsidence District plan for surface water use ends at 2020. Required surface water for 2030 was estimated assuming that Area 8 will be required to convert to 80% surface water in that year.

Comparison of Alternate No. 6

In this section, Alternate 6 will be compared on the basis of supply versus required surface water and timing of water availability in a similar manner to the five alternates previously presented in Appendix II. No alternates will be eliminated at this time, however, some general conclusions can be made.

Total Maximum Daily Water Demands

Three factors remain constant for each alternate previously presented in Appendix II along with Alternate 6 presented herein. First, the City of Houston Southwest service area total demand increases from about 100 MGD in 1985 to 144 MGD in 2030. Second, the total WHCSWSC demand grows from 61 MGD to 216 MGD during the study period. Third, for all areas combined, the total demand is 161 MGD in 1985 and 360 MGD in 2030. The variable figures are the WHCSWSC portion of the Southwest System and the Northeast and North maximum daily water demands, which depend on the placement of the service area boundaries. Examination of Table 1 shows that for Alternate 6, the total Southwest System maximum daily water demand increases from 118 MGD in 1985 to 210 MGD in 2030, while during the same period the total Northeast System maximum daily water demand increases from 36 MGD to 108 MGD and the North System increases from 7 MGD to 42 MGD.

Total Available Surface Water Supply

All considerations of supply adequacy were based on the minimum surface water required to meet the HGCSD conversion plan, previously shown on Table 2 and Table 3. As opposed to the total maximum daily demands, the HGCSD conversion requirements climb in a stair-step fashion rather than linearly.

The total maximum daily treated water supply available from the SWWPP is assumed to be 226 MGD based on an available 133 MGD of average daily raw water supply from the Brazos River Basin.

Although the SWWPP has sufficient capacity to serve the entire WHCSWSC service area, it has been assumed that due to the added transmission cost the Southwest Service Area's northern boundary will be Clay Road. Please refer to Table 3 for a detailed breakdown of water demands between the three service areas.

Feasibility of Meeting HGCSD Plan

Some consideration must be given to the timing of the availability of surface water and whether it would be possible to meet the HGCSD conversion plan. In the Southwest service area, the first conversion requires 65 MGD in 1995. This is the same for the alternates previously presented in Appendix II along with Alternate 6 presented herein. The above mentioned area which is required to convert in 1995 to surface water is in HGCSD regulatory area three in the City of Houston. If an estimate of six years is used to bring the SWWPP on-line, then meeting the first southwest conversion date of 1995 is possible through development of the SWWPP.

Timing issues are more complex in the North and Northeast service areas. The first conversion date is 2000 for Alternate 6 when the Northeast service area would require .3 MGD and the North service area would require .2 MGD. The next conversion date would be 2005 when 10 MGD is required by the Northeast service area and .2 MGD is required by the North service area. The quantities of surface water needed in 2000 or 2005 for Alternate 6 are small. The regulatory area using surface water at these dates is area four, which is in the most southern part of the service area. This regulatory area most likely would be supplied from the Southwest Supply System until 2005 or 2010, when most of the northern area will then convert to surface water.

The WHCSWSC has been asked to provide the City with an amount of surface water needed from the NEWPP so that it can be designed for the additional capacity. It appears from Table 3 that the amount of surface water required from the proposed Northeast Plant for Alternate No. 6 would be approximately 61 MGD by 2010.

As mentioned in the description of the North Supply System a NWWPP is proposed near Lake Conroe with an ultimate capacity of 150 MGD. The WWPP is proposed near Waller with an ultimate capacity of 200 MGD. Although the ultimate capacities of these plants are adequate to easily meet the needs of the area, the majority of the raw surface water supply originates in three proposed reservoirs, Lake Millican, Lake Creek and Bedias Reservoir. Construction of these sources could take up to 30 years, yielding completion dates past the required HGCSD conversion dates.

5.0 CONCLUSIONS

Several conclusions may be drawn from the previous comparisons. The most apparent is that all of the service area alternatives as mentioned in Appendix II and III are feasible when considering the available raw water supply in the Southwest from the Brazos River Basin. In fact, if the North or Northeast Water Supply becomes delayed, the Southwest Supply would be adequate to serve all of WHCSWSC's service area. However, it is readily apparent that the transmission cost savings is non-existent when pushing Southwest water north of Highway 290. The main objective to any alternative raised is that water from the North System in Alternate No. 5 and 6 may not be available in time to meet HGCSD target dates. A cost analysis of the major sources and transmission systems will be necessary before any alternate can be eliminated. This will be described later in Appendix IV.

ATTACHMENTS

ATTACHMENT 1

ACKNOWLEDGEMENTS:

Prior reports and studies dealing with water demands and supplies in the City of Houston and surrounding areas were utilized as needed in preparing this study. Materials reviewed during the course of this project are as follows:

1. Houston Water Master Plan, Appendices A through M, August 1985 to March 1987, by Metcalf and Eddy, Inc. (Including February 1988 Revisions)

2. District Plan, Adopted November 1985, by Harris-Galveston Coastal Subsidence District.

3. Subsidence '87, February 1987 by Harris-Galveston Coastal Subsidence District.

4. Utility District Listing, Creation and Bond Issue Reports, Texas Water Commission Records, January 1987.

5. Yearly Groundwater Pumpage Records, Harris Galveston Coastal Subsidence District.

6. Planning Report/Draft Environmental Statement, September 1987, by United States Department of the Interior Bureau of Reclamation.

7. West Harris County Surface Water Supply Corporation Implementation Plan, Appendix II - Water Demand and Supply, October 1987, by Dannenbaum Engineering Corporation. (Revised February 1988)

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

IMPLEMENTATION PLAN

APPENDIX IV

DEFINITION AND EVALUATION OF ALTERNATIVE SYSTEMS

MARCH 1988

DANNENBAUM ENGINEERING CORPORATION
CONSULTING ENGINEERS
3100 WEST ALABAMA
HOUSTON, TEXAS 77098
(713) 622-8011

Treatment Processes

Northeast System

According to the City of Houston's Water Quality Section, the treatment process needed for the Northeast Plant will be very similar to the process presently used by the City in the East and Southeast Treatment Plants. As a result, operations cost for the proposed Northeast Plant should approximate the operations cost at the City's existing treatment plants.

Southwest System

Raw water from the Brazos River System has been successfully treated in the past by industry and municipalities. The Galveston County Water Authority (GCWA) began treatment of Brazos River water in 1983 and is currently producing approximately 12 MGD of finished water. According to operation reports from GCWA, the costs of operation and treatment is expected to approximate the operation and treatment costs at the City's existing treatment plants.

Conveyance Systems

- **Raw Water Conveyance**

  Raw water conveyance lines are those facilities required to pump and transfer raw water from the source to the treatment plant site.

- **Termination Storage/Pumping**

  The termination storage required at each of the alternate Southwest Treatment Plant general locations was based on a desired water quality which would limit chloride concentrations in the raw water to less than 240 mg/l. Assuming a usable depth of 16.0 feet, the volume of termination storage varied from 658 acres to 424 acres for Alternate Service Areas No. 1 to No. 4, respectively and was sized at 808 acres for Alternate Service Area No. 7.

- **Treatment Facilities**

  Northeast System

  This study utilized the City of Houston proposed Northeast Treatment Plant. The WHCSWSC will present its surface water demand to the City of Houston which, if practical, will size the Northeast Treatment Plant to accommodate this requirement.

Year	Demand
1995	65.27
2000	105.97
2005	115.62
2010	170.77
2030	231.26

Surface Water Sources

Northeast Supply System

The assumed surface water source for the Northeast System is Lake Houston which is comprised of existing raw water from the San Jacinto and Trinity River System and future developed raw water from the Sabine River System. For the purposes of this study, it is assumed that the HWMP Alternate 4 will be developed.

Southwest Supply System

The assumed surface water source for the Southwest System is the Brazos River, the proposed Allen's Creek Reservoir and/or the Brazos River Canal System. The WHCSWSC will be required to obtain permission to transfer Brazos River Basin water to the San Jacinto River Basin which presently encompasses the entire WHCSWSC service area. Both the Brazos River and San Jacinto River Authorities have agreed in principal to the mentioned transfer, therefore, this requirement is not perceived to affect the viability of this implementation plan.

Raw Water Characteristics

The raw water from the Brazos River System which would be used to supply the WHCSWSC service area compares favorably with other regional water sources such as Lake Conroe or the Trinity River.

Raw water quality conditions of the Brazos River itself have been monitored over the past 20 years by the USGS at its gauging station near Richmond, Texas. Of importance with respect to raw water supply and treatment are the amount of dissolved solids, chlorides and sulfates monitored in the raw water. In 95% of the samples taken the total dissolved solids were less than or equal to 730.0 milligrams per liter (mg/l), chlorides were equal to or less than 240.0 mg/l and sulfates were equal to or less than 130.5 mg/l.

Southwest Conveyance Systems

The components of the Southwest Conveyance System consist of a raw water pump station drawing from the Brazos River System, a raw water conveyance line from the source to the plant site, termination storage facilities for the raw water, a proposed Southwest Treatment Plant, ground storage and distribution pumping capabilities, and a treated water conveyance line to transport treated water from the plant site to the WHCSWSC boundary. A specific site for a proposed Southwest Treatment Plant will be recommended and further detailed in Phase V. However, this Appendix does evaluate and recommend a siting area for the Plant. In this Appendix, the following five different locations resulting in six different alternatives have been identified and evaluated.

Site 1.	Oyster Creek/Dairy Ashford Conveyance System
Site 2.	Brazos River/Highway 6 Conveyance System
Site 3.	Oyster Creek/Highway 6 Conveyance System
Site 4A.	Jones Creek/Grand Parkway Conveyance System
Site 4B.	Allens Creek/Grand Parkway Conveyance System
Site 5.	Allens Creek/F.M. 1093 Conveyance System

The above Sites 1, 2, 3 and 4A require termination storage facilities. Sites 4B and 5 do not require termination storage and utilize the proposed Allens Creek Reservoir.

Transmission Systems

The transmission system for the WHCSWSC study area was analysed using the following alternate service areas defined previously in Appendix II, "Water Demand and Supply":

- o Alternate No. 1 - Boundary at Highway 290
- o Alternate No. 2 - Boundary at F.M. 529
- o Alternate No. 3 - Boundary at Clay Road
- o Alternate No. 4 - Boundary at I.H. 10
- o Alternate No. 7 - Entire Service Area Served by Southwest Supply System

Phasing of these Alternate Service Area Transmission Systems was accomplished in accordance with the time frame and regulatory areas as outlined by the HGCSD surface water conversion plan.

Figures 3 through 6A show the specific details of the Alternate Service Area Transmission Systems.

Southwest System

The Southwest Treatment Plant will be located within one of five general locations presented later in this report. The raw water supply for this plant would be from the Brazos River Basin as mentioned previously. The estimated ultimate capacity of the Southwest Treatment Plant will be from 150 MGD to 250 MGD (maximum daily capacity); however, if the Fort Bend County area agrees to participate the ultimate capacity could increase to 300 MGD.

- **Treated Water Storage/Pumping**

  Treated water storage and pumping facilities are those facilities located at the treatment plant used to store the treated water and distribute it into the conveyance system.

- **Treated Water Conveyance**

  Treated water conveyance lines are those facilities required to transport water from the treatment plant to the boundary of the WHCSWSC study area. All treated water conveyance lines were sized to handle the maximum daily demands of their respective service areas.

<u>Transmission Systems</u>

The Transmission System for the WHCSWSC study area will be a delivery system which will supply wholesale treated surface water in the vicinity of groups of political subdivisions within the study area. The individual political subdivisions will be responsible for organizing and constructing the facilities needed to transport treated surface water from WHCSWSC transmission system to each individual political subdivision existing ground storage facility resulting in little or no disruptions during implementation.

<u>Northeast Conveyance Systems</u>

The Northeast Conveyance System, as referred to in this implementation plan, is comprised of the following components: a shared portion of the proposed City of Houston Northeast Treatment Plant, a shared portion of distribution pumping capacity capable of delivering treated water into a proposed WHCSWSC ground storage facility and pump station, and the WHCSWSC shared portion of the treated water conveyance line from the treatment plant to the ground storage facilities located at the WHCSWSC boundary line.

This study evaluated the following Northeast Conveyance Systems:

- Beltway 8 Route
- NHCWSC Route
- F.M. 1960 Route

Capital Cost Estimates

Northeast Conveyance System

The Northeast Conveyance System capital costs varied from $96,578,000 to $232,048,000 depending on the route and service area alternate investigated.

Southwest Conveyance System

Capital costs for the Southwest Conveyance System varied from $285,408,000 to $355,253,000 depending on the route and service area investigated.

Service Area Alternate Transmission System

The total capital costs associated with the Service Area Alternate Transmission Systems varied from $353,684,000 to $380,662,000 depending on the service area alternates investigated.

Annualized Cost Analysis

The annualized cost for each alternate was determined by adding capital cost amortized at 8% over 30 years with the associated annual operation and maintenance cost. The annual cost was further refined into annual cost per thousand gallons of water delivered by dividing the annual cost by the maximum daily water delivered for each phase of conversion. This final refinement will place the alternates on a comparable basis independent of the amount of water delivered by the phased developments.

Annualized costs for the Northeast Conveyance System ranged from $1.31/1000 gallons to $6.21/1000 gallons.

Annualized costs for the Southwest Conveyance System ranged from $1.24/1000 gallons to $1.58/1000 gallons.

Annualized costs for the Service Area Alternates including Conveyance and Transmission Systems varied from $1.54/1000 gallons to $1.77/1000 gallons at the end of the study (Year 2030).

Present Worth Analysis

The present worth analysis presented in this study was calculated assuming the following assumptions:

- o Project capital cost have a 30 year life and are amortized at 8%.
- o Time period beginning 1988 and ending in 2030 (Study Period).

Cost Analysis

Considerations and Assumptions

- o Northeast raw water supply costs are based on the following:

Year	Raw Water Cost
1990-2009	$0.25/1000 Gallons
2010-2029	$0.38/1000 Gallons
2030-After	$0.32/1000 Gallons

- o Southwest raw water supply costs are based on the BRA offer consisting of $0.37/1000 gallons with additional capital costs resulting in an additional $0.09/1000 gallons.

- o Raw water pumping/conveyance costs are based on $0.05/kilowatt-hour using an 85% efficiency factor.

- o Termination storage costs for each site was based on water quality criteria aimed at limiting chlorides to 240 mg/l. Capital costs associated with termination storage include the construction cost to build such a facility plus the cost of the land required.

- o All treatment plant capital cost estimates were based on current construction costs for similar facilities in the Houston area and include land costs, engineering and contingencies.

- o The Northeast Treatment Plant capital cost used in this study was approximately $0.80 per gallon which increased to $1.08/gallon when adding land cost and site development cost. The Southwest Treatment Plant capital cost was based on $0.80 per gallon for actual treatment facilities. This figure was increased depending on the plant site alternate to include land cost and site development.

- o The costs of operations and treatment at the proposed Northeast Treatment Plant are estimated to be in the range of $0.40 to $0.50 per 1000 gallons. A figure of $0.40 per 1000 gallons was used for this study.

- o Operations and treatment costs at the proposed Southwest Treatment Plant are estimated to be $0.42 per 1000 gallons based on data received from the GCWA.

- o Treated water pumping/conveyance and transmission capital costs were based on current construction costs for similar facilities constructed in the Houston area and the associated operating costs were based on $0.05/kilowatt-hour with maintenance costs estimated at $0.04/1000 gallons.

Ranking of Alternates

Methodology

Previous Appendices along with the previous sections of this Appendix have identified three Northeast Conveyance System Alternates, six Southwest Conveyance System Alternates and seven Service Area Alternates. At the request of the WHCSWSC Board, Service Area Alternates No. 5 and No. 6 were deleted from further consideration before beginning Appendix IV. Alternates 5 and 6 were deleted because of the lack of interest on the part of the city of Houston in developing the HWMP's "Western Alternative" which includes the WHCSWSC's North Supply System.

Since the majority of alternatives have both advantages and disadvantages when compared to one another, a systematic method of identifying the most feasible alternate must be developed. The method chosen to rank alternates in this Appendix will address the following general categories:

- Technical
- Environmental
- Community/Social
- Phasing
- Financial

Each set of Alternate Systems was evaluated and ranked in varying levels of detail within each of the general categories mentioned above.

Northeast Conveyance System Alternates

After detailed evaluation within the five general categories, it has been determined that the Beltway 8 Route is superior in all categories for the following reasons:

Technical

- Superior hydraulic characteristics producing a maximum of 16 psi more residual pressure at the WHCSWSC boundary than the other two routes.

- Reduced line lengths; 9 miles and 4 miles shorter than the F.M. 1960 and NHCWSC routes, respectively.

- Reduced possibility of needed land acquisitions outside existing street rights-of-way.

- Reduced possibility of problems during construction due to large rights-of-way, decreasing the construction time.

- o All present worth cost in 1988 dollars.

- o Operation and maintenance cost (O & M) are considered annually throughout study period.

- o O & M Costs are inflated at 10% per year.

- o The normalized present worth analysis was used for the Conveyance System Alternates by dividing the present worth by the million gallons per day (MGD) of maximum daily water delivered.

- o The actual present worth amounts were used when comparing Service Area Alternates (Through Year 2030) because the ultimate water delivered (231 MGD) was consistent for all Service Area Alternates.

- o Capital cost for each component was calculated as previously mentioned.

Normalized present worth for the Northeast Conveyance System ranged from $7.53/MGD to $8.99/MGD. For further details see Table 12 on Page 103.

Normalized present worth for the Southwest Conveyance System ranged from $10.46/MGD to $15.51/MGD. For further details see Table 13 on Page 104.

The normalized present worth for each Northeast or Southwest Conveyance System must be compared only within each Service Area Alternate. Comparing conveyance routes between Service Area Alternates or between the Northeast and the Southwest would not be valid due to the fact that all three components - Northeast Conveyance, Southwest Conveyance and Transmission System are needed in combination to serve the WHCSWSC demands.

The present worth in total dollars for the Service Area Alternates is shown below. The present worth analysis of the Service Area Alternates did not need normalizing since all of the alternates would ultimately deliver the same amount of treated water (231 MGD).

PRESENT WORTH
SERVICE AREA ALTERNATES
(Total Dollars)

SERVICE AREA ALTERNATES	SITE 4B	SITE 5
SERVICE AREA ALTERNATE 1	$2,980,823,000	$2,869,244,000
SERVICE AREA ALTERNATE 2	2,984,829,000	2,875,663,000
SERVICE AREA ALTERNATE 3	2,962,650,000	2,888,405,000
SERVICE AREA ALTERNATE 4	2,965,835,000	2,898,512,000
SERVICE AREA ALTERNATE 7	2,952,546,000	2,818,814,000

If the present worth costs were normalized using 231 MGD, then costs would range between $12.20/MGD in Service Area Alternate 7 to $12.90 in Service Area Alternate 4.

Ranking of Alternates

Methodology

Previous Appendices along with the previous sections of this Appendix have identified three Northeast Conveyance System Alternates, six Southwest Conveyance System Alternates and seven Service Area Alternates. At the request of the WHCSWSC Board, Service Area Alternates No. 5 and No. 6 were deleted from further consideration before beginning Appendix IV. Alternates 5 and 6 were deleted because of the lack of interest on the part of the city of Houston in developing the HWMP's "Western Alternative" which includes the WHCSWSC's North Supply System.

Since the majority of alternatives have both advantages and disadvantages when compared to one another, a systematic method of identifying the most feasible alternate must be developed. The method chosen to rank alternates in this Appendix will address the following general categories:

- o Technical
- o Environmental
- o Community/Social
- o Phasing
- o Financial

Each set of Alternate Systems was evaluated and ranked in varying levels of detail within each of the general categories mentioned above.

Northeast Conveyance System Alternates

After detailed evaluation within the five general categories, it has been determined that the Beltway 8 Route is superior in all categories for the following reasons:

Technical

- o Superior hydraulic characteristics producing a maximum of 16 psi more residual pressure at the WHCSWSC boundary than the other two routes.

- o Reduced line lengths; 9 miles and 4 miles shorter than the F.M. 1960 and NHCWSC routes, respectively.

- o Reduced possibility of needed land acquisitions outside existing street rights-of-way.

- o Reduced possibility of problems during construction due to large rights-of-way, decreasing the construction time.

After initial review and because of the importance attached to the selection of a Southwest Conveyance System, a very detailed ranking criteria and methodology has been developed within the confines of the previously mentioned five general ranking categories. Each of the general ranking categories were evaluated based on the sub-categories outlined in the Individual Ranking Form located in Attachment 1 of Appendix IV.

The final conveyance system rankings for individual raters; the final average ranking between raters and the final overall ranking of each system can be viewed in the chart below:

FINAL RANKING OF ALTERNATES
SOUTHWEST CONVEYANCE SYSTEM

RANKING COMMITTEE MEMBER	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
	SOUTHWEST CONVEYANCE ALTERNATES					
RATER NO. 1	6	4	5	3	1	2
RATER NO. 2	6	4	5	2	1	3
RATER NO. 3	6	5	4	3	1	2
RATER NO. 4	6	4	5	2	1	3
RATER NO. 5	6	4	5	2	2	1
RATER NO. 6	6	4	5	3	2	1
RATER NO. 7	6	5	4	3	2	1
FINAL AVERAGE RATING	6	4.3	4.7	2.6	1.4	1.9
FINAL RANKING	(6)	(4)	(5)	(3)	(1)	(2)

From the final ranking chart it can be concluded that Site 4B, the Allens Creek/Grand Parkway Alternate is the ranking committee's preferred Southwest Conveyance System alternate. Site 5, the Allens Creek/F.M. 1093 system was very close with Site 4A, the Jones Creek/Grand Parkway, a distant third. It can be concluded that Site 1 (Oyster Creek/Dairy Ashford); Site 2 (Brazos River/Highway 6); and Site 3 (Oyster Creek/Highway 6) are the least preferred.

It was concluded after reviewing the sensitivity of each of the five general ranking categories that the elimination of any one category would not affect the conclusion recommending Site 4B as the preferred Southwest Conveyance alternate.

Service Area Alternates

The Service Area Alternates considered for evaluation and ranking are described as follows:

- o Alternate No. 1 - Boundary at Highway 290
- o Alternate No. 2 - Boundary at F.M. 529
- o Alternate No. 3 - Boundary at Clay Road
- o Alternate No. 4 - Boundary at I.H.10
- o Alternate No. 7 - Entire Service Area Served by Southwest Supply System

It is apparent that the Service Area Alternate that follows the HGCSD Conversion Plan would be preferable. The HGCSD's earliest conversion dates of 1995 and 2000 are located in the southwest and the remaining conversion dates of 2005, 2010 and the assumed 2030 are located in the north and far northwest of the WHCSWSC study area. As a result, the Service Area Alternate that has its first phases in the southwest will be less expensive from a phasing standpoint. Service Area Alternate 7 which proposes to serve the study area from south to north produces the least cost from both an annualized and present worth analysis.

As a result of the above analogy, we recommend Alternate No. 7 as the preferred Service Area Alternate. However, this recommendation could be changed in future updates to this study without appreciable affecting the final ultimate cost of the entire transmission system.

Conclusions and Recommendations

Appendix IV concludes with the following recommendations:

- **o The Northeast Conveyance System should follow the Beltway 8 Route eliminating the NHCWSC and F.M. 1960 Routes from further study.**

- **o Eliminate the Southwest Conveyance System Alternates 1, 2, 3 and 4A from further study.**

- **o The Southwest Conveyance System Alternates No. 4B (Allens Creek/Grand Parkway) and No. 5 (Allens Creek/F.M. 1093) should be considered for further study.**

- **o Phase V should study in detail the possibility of locating a plant along F.M. 1093, in the area of the Grand Parkway/F.M. 1093 intersection, west to the proposed Allens Creek Reservoir site.**

- **o The Southwest Conveyance System plant site should be located to allow future development of an alternate and/or additional raw water source utilizing the available water rights in the BRA Canal System. This would enhance the possibility of surface water regionalization with entities in Fort Bend County.**

- The Southwest Conveyance System should obtain its raw water supply directly from Allens Creek Reservoir which will result in a higher quality water supply.

- Phase V should further study the Allens Creek Reservoir operational procedures required to limit chloride concentrations to 150 mg/l.

- The Southwest Conveyance System plant site should contain sufficient acreage to develop an ultimate plant capacity of approximately 300 MGD allowing the flexibility to meet demands due to possible Service Area modifications. This capacity is based on Service Area Alternate No. 7's ultimate capacity of 231 MGD, maximizing the water supply offer by the BRA, and the possibility of treating the available water rights of approximately 60 MGD from the BRA Canal System for possible wholesale to entities in Fort Bend County.

- Phase V should further study the ultimate transmission system utilizing the demands developed from either Service Area Alternate No. 7 or No. 4. This would maintain the flexibility required to meet future Service Area modifications at a increased cost of less than 5 percent of the total ultimate transmission system cost.

- WHCSWSC should request the BRA to upgrade its recent proposal based on the conclusions and recommendations outlined in this Appendix. The BRA proposal should include the construction of Allens Creek Reservoir by 1995.

- WHCSWSC should authorize the Engineer to begin Phase V - The Detail Evaluation of Selected Alternatives, as soon as possible.

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1.0 INTRODUCTION

1.0 INTRODUCTION

Purpose and Scope

The purpose of this study undertaken by the West Harris County Surface Water Supply Corporation (WHCSWSC), is to produce an implementation program that will provide a reliable long-term surface water supply to West Harris County. This proposed implementation program is an extension of the Houston Water Master Plan (HWMP) and will refine the HWMP, providing details necessary for implementation within the WHCSWSC study area.

The project scope of work for this phase of the implementation program deals with the definition and evaluation of alternative conveyance and transmission systems to serve the projected water demands of the WHCSWSC study area. The Northeast Conveyance System, as referred to in this implementation plan, is comprised of the following components: a shared portion of the proposed City of Houston Northeast Treatment Plant, a shared portion of distribution pumping capacity capable of delivering treated water into a proposed WHCSWSC ground storage facility and pump station, and the WHCSWSC shared portion of the treated water conveyance line from the treatment plant to the ground storage facilities located at the WHCSWSC boundary line. The Southwest Conveyance System is comprised of raw water pumping and conveyance facilities, termination storage facilities for the raw water, a proposed Southwest Treatment Plant, treated water ground storage and pumping facilities and treated water conveyance pipeline from the treatment plant to the WHCSWSC boundary line. The Transmission System is defined as the pipeline, ground storage facilities and booster pump stations required to deliver treated water from the conveyance systems to locations throughout the WHCSWSC service area. The demands used in this Appendix are the revised surface water requirements as previously defined in Appendix II, "Water Demand and Supply - Revision One". To satisfy these requirements with regard to the long-term conversion plan as outlined by the Harris-Galveston Coastal Subsidence District (HGCSD), a method of conveying surface water from sources located northeast and southwest of the WHCSWSC study area must be determined.

The northeast raw water supply source will be taken from Lake Houston. Three alternate Northeast Conveyance Systems will be defined and evaluated based on Technical, Environmental, Community/Social, Phasing and Financial criteria.

The southwest raw water supply source will be the Brazos River, the proposed Allen's Creek Reservoir and/or the Brazos River Canal System. Six alternate Southwest Conveyance Systems along with five general geographical areas have been identified and will be evaluated based on the previously mentioned criteria. Included in the evaluation of alternate Southwest Conveyance Systems will be the evaluation of a location for a proposed Southwest Water Treatment Plant.

The Transmission System required to deliver wholesale treated surface water from the previously defined conveyance systems to specific customers within the WHCSWSC study area will also be defined. Alternate Service Areas No. 1 through 4, as previously defined in Appendix II, and No. 7 will be evaluated based on capital and operational costs, and the phased construction of each alternate transmission system to satisfy HGCSD surface water conversion target dates. Alternative conveyance and transmission systems will be compared and rated with respect to each other. The highest rated systems will be further refined in Phase V, "Detailed Evaluation of Selected Alternatives".

2.0 DESIGN CONSIDERATIONS AND ASSUMPTIONS

2.0 DESIGN CONSIDERATIONS AND ASSUMPTIONS

Projected Water Demands

Table 1 presents a summary of alternate service area water requirements which are based on the revised projected water demands previously defined in Appendix II, "Water Supply and Demand - Revision One". The projected water demands were updated to be consistent with the recent revision to the water demands in the City of Houston Water Master Plan (HWMP). These revisions resulted in pushing back the projected water demands by five years after 1990. Also, included in the table is the projected water demands for an alternate that considers serving all of the WHCSWSC service area from the Southwest Supply, hereafter referred to as Alternate No. 7.

Projected water demands were determined by assigning demand criteria to population and employment projections developed by Rice Center for each census tract and Municipal Demand Area within the service area. The surface water supply requirements were based on using average daily water demands. To be consistent with the sizing criteria presented in the HWMP, the WHCSWSC study uses maximum day demands to size treatment plants, conveyance systems and transmission systems. Maximum daily demands were computed by multiplying average daily demands by a peak factor which ranged from 1.6 to 2.0. Refer to Exhibit 1 for a graphical representation of the WHCSWSC projected average daily demands and Exhibit 2 for the corresponding maximum daily demands.

The surface water required by the HGCSD conversion plan was calculated by using 80% of the total maximum daily demand within each of the HGCSD regulatory areas. The regulatory areas will not be required to increase surface water usage until another conversion date is reached and as a result the surface water requirements increase in a stair step fashion. The HGCSD plan ends in 2020, however, for purposes of computing surface water requirements for this study, it was assumed that HGCSD regulatory area eight will require 80% conversion to surface water in 2030. The HGCSD plan permits increases in groundwater withdrawal so long as surface water use is not decreased. Therefore, in this study it was assumed that the amount of surface water required at each regulatory area conversion date remained constant throughout the duration of the study. Increases in demand due to growth along with peak demands would be satisfied with available groundwater supplies.

The surface water requirements projected in this study have not been reduced to account for the enactment of a future water conservation plan. Any reduction experienced due to water conservation measures will only serve to postpone future phases. As a result for planning purposes the water conservation measures have been neglected to produce a worst case scenario. The water conservation measures will be reviewed when updating this plan for future expansions.

TABLE 1

SUMMARY OF SURFACE WATER DEMANDS BY ALTERNATE TO MEET HGCSD CONVERSION REQUIREMENTS (MAXIMUM DAILY DEMANDS)

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST (MGD)	TOTAL ALL AREAS (MGD)
ALTERNATE 1 - BOUNDARY AT U.S. 290					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.96	0.00	105.97
2005	89.82	16.14	105.96	9.66	115.62
2010	89.82	44.76	134.58	36.18	170.77
2012	101.17	44.76	145.93	36.18	182.11
2020	101.17	44.76	145.93	36.18	182.12
2030**	101.17	86.25	187.42	43.85	231.26
ALTERNATE 2 - BOUNDARY AT F.M. 529					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.96	0.00	105.96
2005	89.82	16.14	105.96	9.66	115.62
2010	89.82	39.25	129.07	41.69	170.76
2012	101.17	39.25	140.42	41.69	182.11
2020	101.17	39.25	140.42	41.69	182.11
2030**	101.17	76.29	177.46	53.80	231.26
ALTERNATE 3 - BOUNDARY AT CLAY ROAD					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	15.74	105.56	0.41	105.97
2005	89.82	15.74	105.56	10.06	115.62
2010	89.82	15.74	105.56	65.21	170.77
2012	101.17	15.74	116.91	65.21	182.12
2020	101.17	15.74	116.91	65.21	182.12
2030**	101.17	38.79	139.96	91.30	231.26

**Harris-Galveston Coastal Subsidence District Plan for surface water use ends at 2020. Required surface water for 2030 was estimated assuming that Area 8 will be required to convert to 80% surface water in that year.

TABLE 1 (CONT'D)

SUMMARY OF SURFACE WATER DEMANDS BY ALTERNATE
TO MEET HGCSD CONVERSION REQUIREMENTS
(MAXIMUM DAILY DEMANDS)

YEAR	CITY OF HOUSTON SOUTHWEST (MGD)	WHCSWSC SOUTHWEST (MGD)	TOTAL SOUTHWEST (MGD)	TOTAL NORTHEAST (MGD)	TOTAL ALL AREAS (MGD)
ALTERNATE 4 - BOUNDARY AT I.H. 10					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	12.49	102.31	3.66	105.97
2005	89.82	12.49	102.31	13.31	115.62
2010	89.82	12.49	102.31	68.46	170.77
2012	101.17	12.49	113.66	68.46	182.12
2020	101.17	12.49	113.66	68.46	182.12
2030**	101.17	19.79	120.96	110.30	231.26
ALTERNATE 7 - ENTIRE WHCSWSC AREA SERVED BY SOUTHWEST SYSTEM					
1985	0.00	0.00	0.00	0.00	0.00
1995	65.27	0.00	65.27	0.00	65.27
2000	89.82	16.14	105.97	0.00	105.97
2005	89.82	25.80	115.62	0.00	115.62
2010	89.82	80.95	170.77	0.00	170.77
2012	101.17	80.95	182.12	0.00	182.12
2020	101.17	80.95	182.12	0.00	182.12
2030**	101.17	130.09	231.26	0.00	231.26

**Harris-Galveston Coastal Subsidence District Plan for surface water use ends at 2020. Required surface water for 2030 was estimated assuming that Area 8 will be required to convert to 80% surface water in that year.

EXHIBIT NO. 1
SURFACE WATER REQUIREMENT
(AVERAGE DAILY DEMAND)

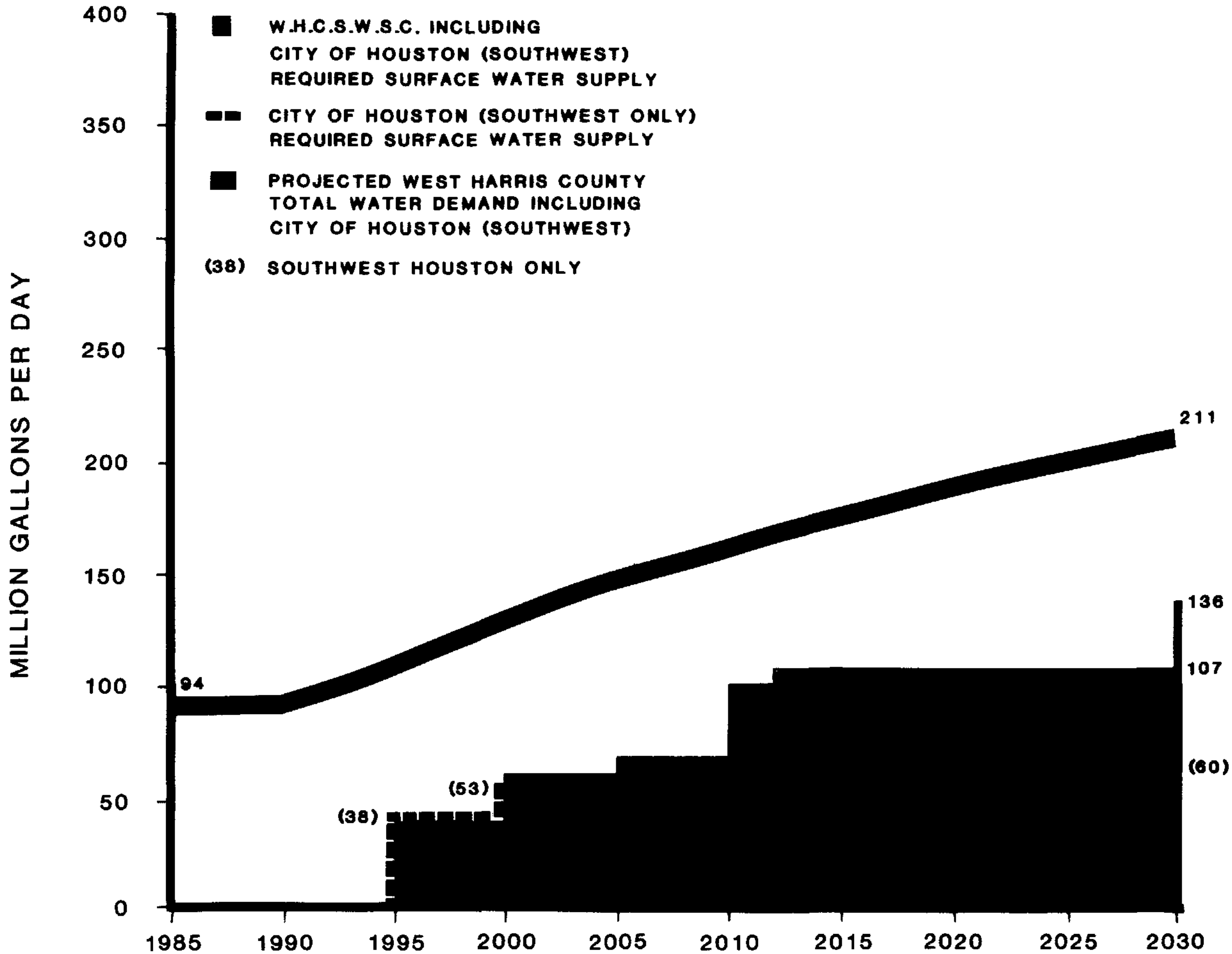
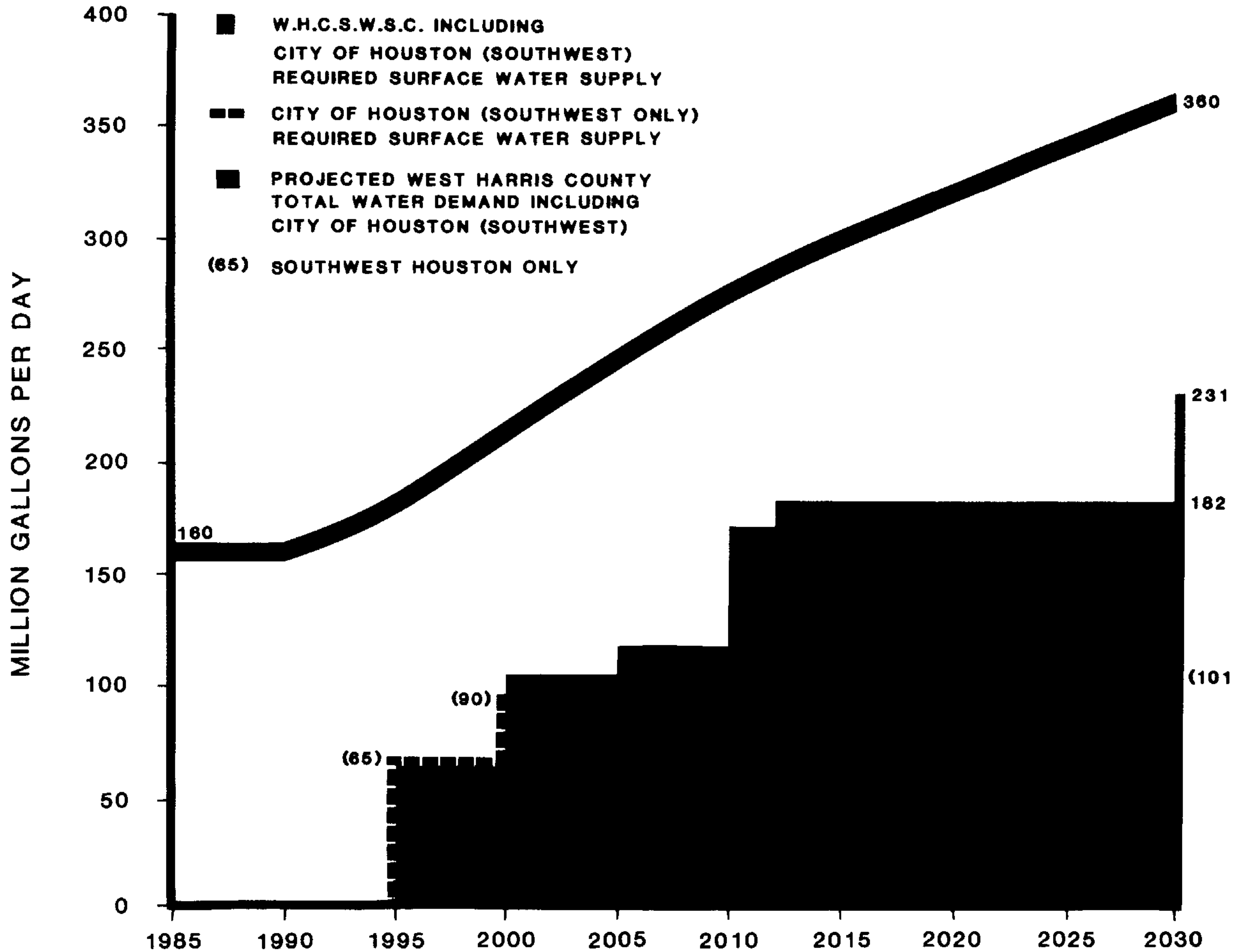


EXHIBIT NO. 2
SURFACE WATER REQUIREMENT
(MAXIMUM DAILY DEMAND)



Surface Water Sources

The assumed surface water source for the Northeast System is Lake Houston. Lake Houston is located approximately 20 miles east of the eastern boundary of the WHCSWSC study area and impounds San Jacinto River water. Lake Houston is owned and operated by the City of Houston and currently serves as a raw water source for the City. Various projects are underway or currently being investigated to bring additional water to Lake Houston from adjacent river basin systems which will assure a sufficient quantity of water available in Lake Houston to meet future demands.

The assumed surface water source for the Southwest System is the Brazos River, the proposed Allen's Creek Reservoir and/or the Brazos River Canal System which flows in a southeast direction approximately 4 miles southwest of the WHCSWSC study area boundary. The WHCSWSC will be required to obtain permission to transfer Brazos River Basin water to the San Jacinto River Basin which presently encompasses the entire WHCSWSC service area. Both the Brazos River and San Jacinto River Authorities have agreed in principal to the mentioned transfer, therefore, this requirement is not perceived to affect the viability of this implementation plan.

Correspondence received from the Brazos River Authority (BRA) outlines a proposal for an incrementally developed raw water source of up to 134 MGD (average daily supply) with the ability to meet the WHCSWSC maximum daily demands through operations of the entire Brazos River Basin. The initial increment of supply available immediately from existing sources is 67.0 MGD. The second increment of supply will come from the proposed Allen's Creek reservoir to be developed by the B.R.A. This second increment will increase the available supply of raw water to 107.2 MGD by the year 2000. The third increment is planned to be supplied by the proposed South Bend Reservoir Project. This supply will increase the available raw water supply to 134.0 MGD in 2030. However, the available raw water to WHCSWSC will only be a portion of the total available water which has been defined as current use water in the BRA proposal. The portion offered to WHCSWSC will be as follows:

Year	Cumulative Water Offered (MGD)
1995	40
2000	67
2005	72
2010	107
2015	116
2020	116
2025	116
2030	134

Table 2 presents a summary of supply source allocations for the WHCSWSC Southwest System. Exhibit 3 shows a graphical representation of the BRA proposal. Raw water sources were sized to handle the average daily demands of the alternate service areas with the ability to meet maximum daily demands as required. If the Southwest Conveyance System Alternate Site 4B or 5 is chosen, the WHCSWSC would need to request the BRA to construct Allens Creek Reservoir by the year 1995.

EXHIBIT NO. 3
SURFACE WATER SUPPLY
BRAZOS RIVER AUTHORITY
(AVERAGE DAILY DEMAND)

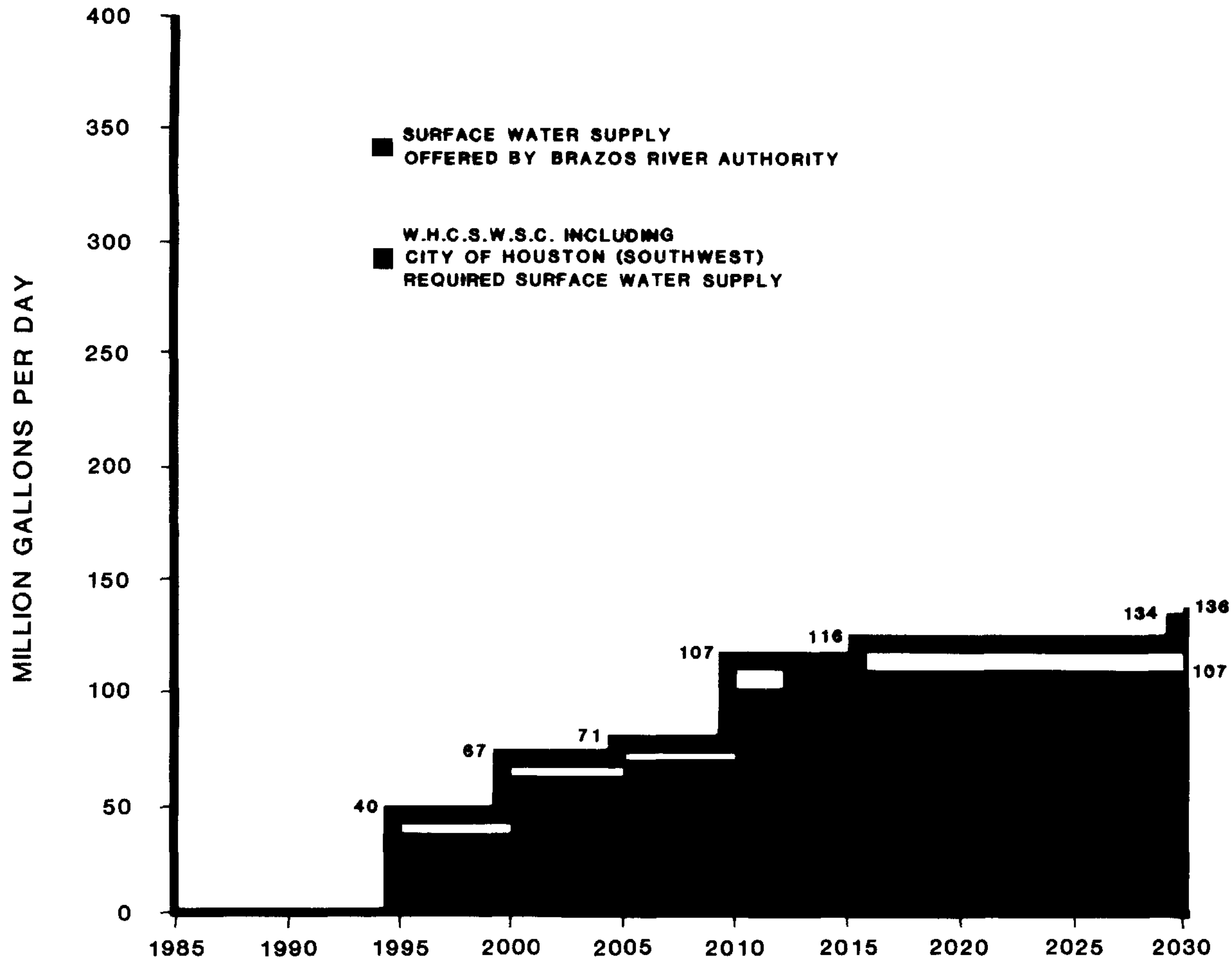


TABLE 2

WHCSWSC SOUTHWEST SYSTEM ALLOCATIONS FROM SOUTHWEST SUPPLY SOURCE (BRAZOS RIVER BASIN)

Supply Source	Supply Year Needed	Supply Source Amount (AF/YR)	Allocations* from Supply Source WHCSWSC (AF/YR)	Allocations* from Supply Source Option Grp (AF/YR)	Cumulative Total Allocated Supplies WHCSWSC (AF/YR)	Cumulative Total Allocated Supplies Option Grp (AF/YR)
Existing BRA Reservoir System	1988	90,000 (80.4) (mgd)	75,000 (67.0) (mgd)	15,000 (13.4) (mgd)	75,000 (67.0) (mgd)	15,000 (13.4) (mgd)
Allen's Creek	2000	70,000 (62.5) (mgd)	45,000 (40.2) (mgd)	25,000 (22.3) (mgd)	120,000 (107.2) (mgd)	40,000 (35.7) (mgd)
South Bend	2010	110,000 (98.2) (mgd)	30,000 (26.8) (mgd)	80,000 (71.5) (mgd)	150,000 (134.0) (mgd)	120,000 (107.2) (mgd)

*Each group would be allocated a total supply up to this amount. Water not designated Current Use Water for immediate use would be designated Future Use Water.

Raw Water Characteristics

The raw water from the Brazos River System which would be used to supply the WHCSWSC service area compares favorably with other regional water sources such as Lake Conroe or the Trinity River. Table 3 gives a summary comparison of Brazos River System water to these other supplies.

The Brazos River System contains the Brazos River and its reservoirs as well as the canal system which is comprised of portions of Jones Creek, Oyster Creek, and the manmade canal south of Missouri City which transfers raw water as far as the Texas City area. The head water flow of Oyster Creek originates as pumpage from the Brazos River at a pump station operated by the Brazos River Authority. From this pump station water flows into Jones Creek, which has been modified to flow into Oyster Creek. A second pump station delivers water out of Oyster Creek into Canal System A which serves Brazoria and Galveston Counties with irrigation and municipal water supply. Overflow of Dam No. 3 downstream of this second pumping station provides the only upstream flow to the lower part of Oyster Creek. The desired water uses for Oyster Creek as determined by the Texas Water Commission are contact recreation, high quality aquatic habitat, and domestic water supply.

TABLE 3

COMPARISON OF REGIONAL SURFACE WATER QUALITY[1/]

Parameter (Units)	Brazos River	Lake Conroe[2/] (San Jacinto River)	Benbrook Lake[2/] (Trinity River)
Turbidity (ntu)	16 - 111	N.A.[3/]	N.A.[3/]
Alkalinity (mg/l @ $CaCO_3$)	78 - 250	39 - 140	110-160
pH (units)	7.9 - 8.9	6.4 - 8.4	6.9 - 8.6
Fluoride (mg/l)	0.28 - 0.34	0.1 - 0.2	0.2 - 0.4
Calcium Hardness (mg/l @ $CaCO_3$)	128 - 140	37 - 85	97-155
Hardness (mg/l @ $CaCO_3$)	148 - 180	46 - 100	130-180
Zinc (mg/l)	N.A.[3/]	0.01 - 0.03	N.A.[3/]
Iron (mg/l)	2.7 - 3.8	0.01 - 8.3	0.01 - 0.79

1/ Source of Data: GCWA Monthly Reports, 1983 - 1985.
2/ Source of Data: U.S.G.S. Water Resources Data 1982.
3/ NA: Not Analyzed.

**Reproduced from G.C.W.A. Investigation of Potable Water Complaints in Dickinson, Texas by Malcolm Pirnie, May 1986.

The following numerical criteria have been established for the upper Oyster Creek segment to insure that the water quality will be maintained for the desired uses.

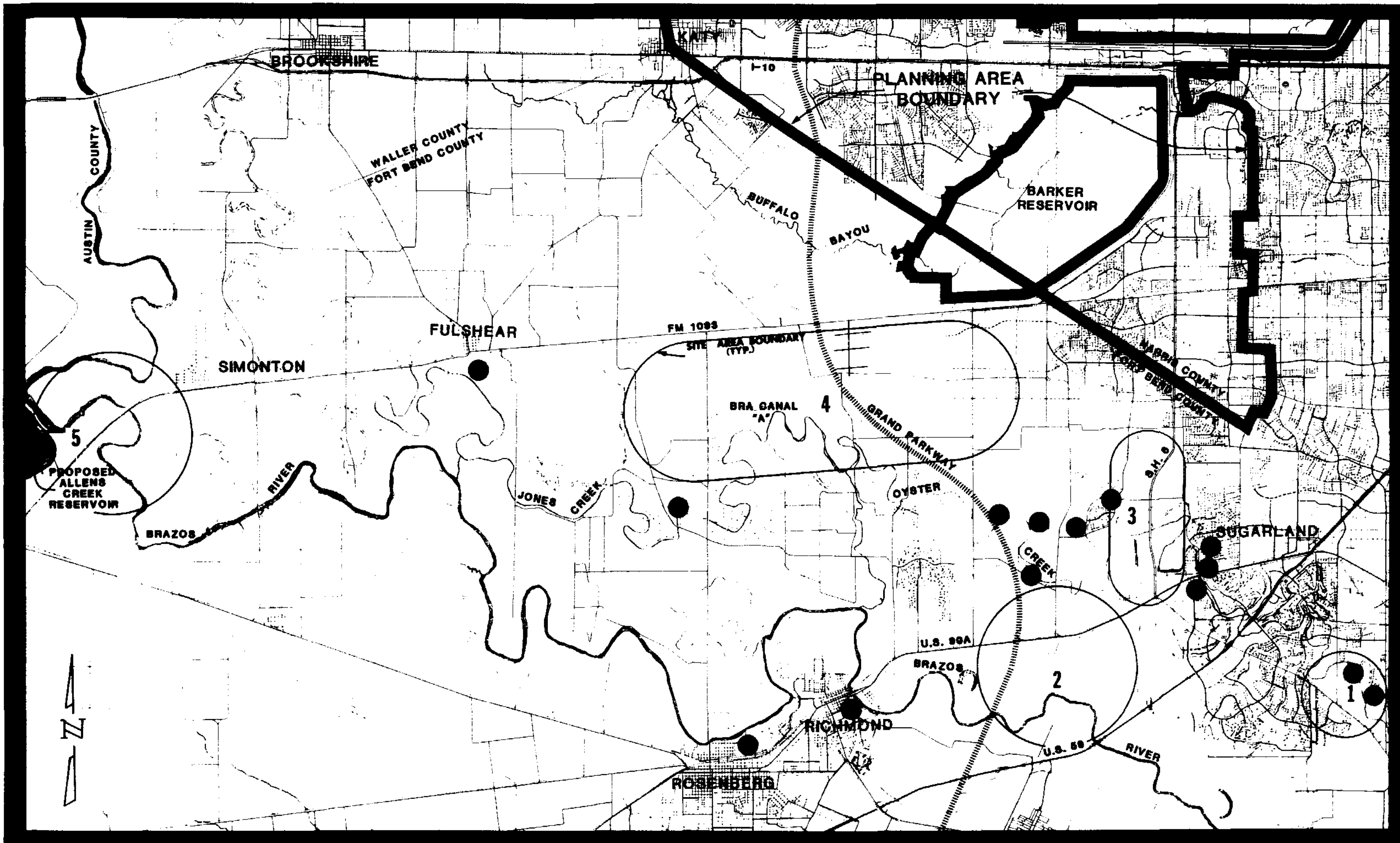
Parameter	Criteria
Dissolved Oxygen	Not less than 5.0 mg/l
pH	Not less than 6.5 nor more than 9.0
Temperature	Not to exceed 95^{o} F.
Chloride	Annual average not to exceed 140 mg/l
Sulfate	Annual average not to exceed 75 mg/l
Total Dissolved Solids	Annual average not to exceed 1070 mg/l
Fecal Coliform	30-Day geometric mean not to exceed 200 per 100 ml.

The Texas Water Commission maintains an active monitoring station of Oyster Creek at U.S. Highway 90A in Sugar Land. A draft report dealing with the wasteload evaluation for Upper Oyster Creek was published June 20, 1985. This document reports that data gathered over 4 years from the period of January 1, 1981 through December 31, 1984 indicate that water quality at this location is not meeting the state criteria for the following parameters: dissolved oxygen, temperature and pH. The average dissolved oxygen concentration for the period is 4.4 mg/l which is below the minimum allowable concentration of 5.0 mg/l. Maximum temperatures have been recorded up to 99^{o}F. which exceed the maximum allowable of

95^{o}F. The minimum pH observed was 6.1 which is less than the minimum criteria of 6.5. Recorded values for chlorides, sulfates, total dissolved solids and fecal coliform bacteria have been within the allowable criteria. Exhibit 4 shows the approximate locations of effluent discharge points into the Canal A system including Jones and Oyster Creeks.

Raw water quality conditions of the Brazos River itself have been monitored over the past 20 years by the USGS at its gauging station near Richmond, Texas. Table 4, taken from data prepared by the USGS, gives a description of water quality conditions in the Brazos River along with statistical and recurrence intervals for each criteria. Of importance with respect to raw water supply and treatment are the amount of dissolved solids, chlorides and sulfates monitored in the raw water. In 95% of the samples taken the total dissolved solids were less than or equal to 730.0 milligrams per liter (mg/l), chlorides were equal to or less than 240.0 mg/l and sulfates were equal to or less than 130.5 mg/l. Other criteria related to water quality of the Brazos River can also be seen in this table.

Raw water taken from the Brazos River System is characteristically high in color, with variable turbidity, high organic content, high iron and seasonally high algae content. The high algae and organic content of the raw water results in the potential for taste and odor problems to develop during treatment and distribution.



4 TREATMENT PLANT AREA

● WASTE DISCHARGE LOCATION

SOUTHWEST CONVEYANCE SYSTEM STUDY AREA

(WASTE DISCHARGE SURVEY)

EXHIBIT NO. 4

TABLE 4

STATISTICAL SUMMARY OF SELECTED WATER-QUALITY DATA

STATION NUMBER: 08114000 STATION NAME: BRAZOS RIVER AT RICHMOND, TEX.

LATITUDE: 293456 LONGITUDE: 0954527 COUNTY: FORT BEND DRAINAGE AREA: 45007.00 SQUARE MILES

SUMMARY OF SELECTED WATER QUALITY DATA COLLECTED AT PERIODIC INTERVALS FROM OCT 1967 TO AUG 1986

WATER-QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS				PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN				
	SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	95	75	MEDIAN 50	25	5
TEMPERATURE (DEG C)	300	33.50	3.50	20.35	30.50	26.00	20.00	15.00	8.00
STREAMFLOW, INSTANTANEOUS (CFS)	244	88100.00	120.00	10510.12	44979.96	12250.00	4969.00	1777.50	742.00
TURBIDITY (FTU)	55	890.00	0.40	140.97	556.00	200.00	74.00	20.00	2.54
COLOR (PLATINUMCOBALT UNITS)	61	180.00	5.00	45.70	158.00	50.00	25.00	10.00	5.00
SPECIFIC CONDUCTANCE (UMHOS)	315	1900.00	220.00	753.58	1298.00	936.00	725.00	517.00	334.40
OXYGEN, DISSOLVED (MG/L)	120	14.80	5.40	8.77	11.40	9.30	8.60	7.50	6.70
OXYGEN, DISSOLVED (PERCENT SATURATION)	119	150.00	66.00	93.17	119.00	104.00	97.00	91.00	76.00
OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	117	8.10	0.10	2.33	4.60	2.80	2.10	1.40	0.50
OXYGEN DEMAND, CHEMICAL (LOW LEVEL) (MG/	12	43.00	7.00	17.67	43.00	18.75	16.50	11.25	7.00
PH (UNITS)	302	8.60	6.20	7.73	8.30	8.00	7.80	7.50	7.10
ALKALINITY FIELD (MG/L AS CACO3)	293	243.00	75.00	136.29	190.00	153.50	135.00	115.00	89.00
CARBONATE FET-FLD (MG/L AS CO3)	251	9.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
SOLIDS, RESIDUE AT 105 DEG. C, SUSPENDED	62	2260.00	15.00	384.74	1636.50	539.50	136.50	41.25	20.15
SOLIDS, VOLATILE, SUSPENDED (MG/L)	57	2220.00	0.00	133.07	332.40	103.50	50.00	16.50	0.00
NITROGEN, ORGANIC TOTAL (MG/L AS N)	94	7.20	-0.03	0.85	1.75	1.10	0.75	0.45	0.13
NITROGEN, ORGANIC DISSOLVED (MG/L AS N)	12	1.20	0.37	0.70	1.20	0.87	0.65	0.52	0.37
NITROGEN, AMMONIA DISSOLVED (MG/L AS N)	42	0.18	0.00	0.05	0.14	0.08	0.05	0.03	0.00
NITROGEN, AMMONIA TOTAL (MG/L AS N)	103	1.10	0.00	0.06	0.22	0.08	0.05	0.02	0.00
NITROGEN, NITRITE DISSOLVED (MG/L AS N)	6	0.05	0.00	0.01	0.03	0.01	0.00	0.00	0.00
NITROGEN, NITRITE TOTAL (MG/L AS N)	39	0.25	0.00	0.02	0.13	0.02	0.01	0.00	0.00
NITROGEN, NITRATE DISSOLVED (MG/L AS N)	2	0.94	0.64						
NITROGEN, NITRATE TOTAL (MG/L AS N)	172	2.20	0.00	0.52	1.34	0.80	0.50	0.20	0.00
NITROGEN,AMMONIA + ORGANIC DIS. (MG/L AS	12	1.30	0.45	0.77	1.30	0.95	0.73	0.53	0.45
NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L A	75	7.30	0.01	1.09	1.95	1.20	0.93	0.72	0.45
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	76	1.50	0.00	0.40	1.10	0.62	0.41	0.02	0.00
NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	42	1.30	0.00	0.43	1.18	0.72	0.43	0.00	0.00
PHOSPHORUS, TOTAL (MG/L AS P)	111	0.95	0.03	0.24	0.66	0.31	0.19	0.11	0.07
PHOSPHORUS, DISSOLVED (MG/L AS P)	42	0.25	0.00	0.10	0.18	0.13	0.09	0.07	0.03
CARBON, ORGANIC TOTAL (MG/L AS C)	54	44.00	2.70	9.64	13.50	12.00	9.25	5.33	3.10
CARBON, ORGANIC DISSOLVED (MG/L AS C)	4	25.00	4.20						
CARBON, ORGANIC SUSPENDED TOTAL (MG/L AS	4	1.50	0.40						
HARDNESS (MG/L AS CACO3)	293	470.00	88.00	203.01	293.00	240.00	200.00	150.00	110.00
HARDNESS, NONCARBONATE (MG/L CACO3)	293	300.00	0.00	67.23	140.00	91.00	59.00	33.50	16.70
CALCIUM DISSOLVED (MG/L AS CA)	290	110.00	28.00	61.73	86.00	72.00	62.00	50.00	36.00
MAGNESIUM, DISSOLVED (MG/L AS MG)	290	71.00	3.20	11.67	20.00	15.25	12.00	7.77	4.45
SODIUM, DISSOLVED (MG/L AS NA)	130	240.00	9.50	77.54	169.00	110.00	69.50	40.00	16.05
SODIUM ADSORPTION RATIO	289	23.00	0.50	2.31	4.00	3.00	2.00	1.25	0.70
POTASSIUM, DISSOLVED (MG/L AS K)	142	7.50	1.30	4.59	5.89	5.10	4.50	4.10	3.40
CHLORIDE, DISSOLVED (MG/L AS CL)	295	370.00	11.00	111.01	240.00	150.00	96.00	53.00	22.00
SULFATE DISSOLVED (MG/L AS SO4)	294	220.00	13.00	71.40	130.50	92.00	67.00	46.00	21.50
FLUORIDE, DISSOLVED (MG/L AS F)	230	0.60	0.00	0.26	0.50	0.30	0.30	0.20	0.15
SILICA, DISSOLVED (MG/L AS SIO2)	294	40.00	0.30	8.19	11.00	9.50	8.40	6.97	3.63
COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML	42	7300.00	20.00	1107.00	6714.95	1175.00	535.00	137.50	41.50

TABLE 4 (CONT'D)

STATISTICAL SUMMARY OF SELECTED WATER-QUALITY DATA IN THE UPPER TRINITY RIVER BASIN, TEXAS

STATION NUMBER: 08114000 STATION NAME: BRAZOS RIVER AT RICHMOND, TEX.

LATITUDE: 293456 LONGITUDE: 0954527 COUNTY: FORT BEND DRAINAGE AREA: 45007.00 SQUARE MILES

SUMMARY OF SELECTED WATER QUALITY DATA COLLECTED AT PERIODIC INTERVALS FROM OCT 1967 TO AUG 1986

WATER-QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS: SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN: 95	75	MEDIAN 50	25	5
STREPTOCOCCI FECAL, KF AGAR (COLS. PER 1	42	9100.00	20.00	1374.33	8149.97	1100.00	240.00	130.00	32.60
PHENOLS (UG/L)	12	21.00	0.00	2.92	21.00	2.75	0.00	0.00	0.00
METHYLENE BLUE ACTIVE SUBSTANCE (MG/L)	16	0.05	0.00	0.01	0.05	0.01	0.00	0.00	0.00
SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED	42	915.00	135.00	495.50	906.95	674.25	456.00	314.75	159.75
SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (	290	1100.00	123.00	424.98	730.00	550.00	408.50	289.75	170.00
SED. SUSP. SIEVE DIAM. % FINER THAN .062	155	100.00	10.00	83.71	99.00	97.00	91.00	84.00	69.80
SEDIMENT, SUSPENDED (MG/L)	159	7360.00	12.00	1333.20	4820.00	1630.00	350.00	173.00	20.00
SEDIMENT, DISCHARGE, SUSPENDED (T/DAY)	159	600000.00	23.00	90910.31	495999.91	65400.00	12500.00	2010.00	56.00

Treatment Processes

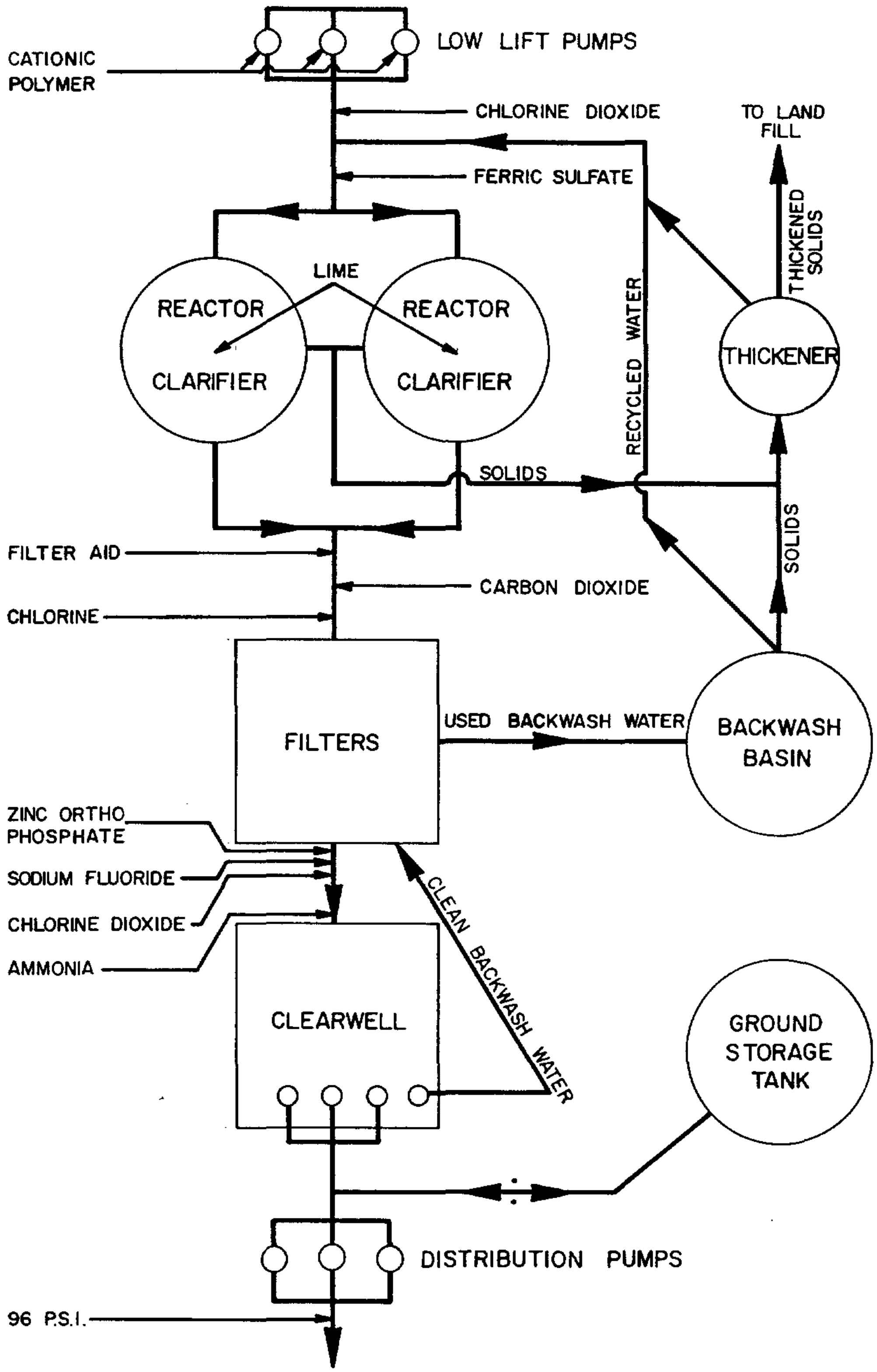
Northeast Supply (San Jacinto/Trinity/Sabine River Water)

The northeast raw water supply will originate from Lake Houston and will eventually be a mixture of San Jacinto, Trinity and Sabine River water. According to the City of Houston's Water Quality Section, the treatment process needed for the Northeast Plant will be very similar to the process presently used by the City in the East and Southeast Treatment Plants. As a result, operations cost for the proposed Northeast Plant should approximate the operations cost at the City's existing treatment plants.

Southwest Supply (Brazos River Water)

Raw water from the Brazos River System has been successfully treated in the past by industry and municipalities. The Galveston County Water Authority (GCWA) began treatment of Brazos River water in 1983 and is currently producing approximately 12 MGD of finished water. At the GCWA plant, low lift pumps raise the water from the inlet channel to a pair of reactor clarifiers. Cationic polymer is added as a coagulant which causes the particles suspended in the water to clump together and settle out, clearing the water. Chlorine dioxide is added to destroy algae, taste and odor. Lime is added for pH adjustment and water softening. Reactor clarifiers are used to clarify the raw water with flocculation, clarification and softening taking place in the same unit. Filter aid, chlorine and carbon dioxide are added prior to filtration. The filters consist of two feet of crushed anthracite coal, nine inches of sand and one foot of gravel. A clearwell holds the filtered water where post disinfection with chlorine dioxide takes place. Water from the clearwell also serves as backwash water for the filters. Transfer pumps, supply treated water to the ground storage facilities. Exhibit 5 shows a typical flow diagram for this treatment process using reactor clarifiers similar to the GCWA plant.

EXHIBIT NO. 5



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

WATER TREATMENT PLANT FLOW DIAGRAM

Conveyance Systems

Raw Water Conveyance

Raw water conveyance lines are those facilities required to pump and transfer raw water from the source to the treatment plant site. At sites requiring termination storage, raw water conveyance lines will pump and transfer water from the source into a termination storage facility and then into the treatment facility. Raw water conveyance lines were sized to handle the maximum daily demands of the alternate service areas. Maximum design velocities in the raw water conveyance systems were held to less than 7 feet per second (fps).

Termination Storage/Pumping

The termination storage required at each of the alternate Southwest Treatment Plant general locations was based on a desired water quality which would limit chloride concentrations in the raw water to less than 240 mg/l which is below the EPA recommended level of 250 mg/l. Historic water quality data previously presented in Table 4 shows that this is possible 95% of the time. Under this assumption raw water would need to be pumped from a termination storage facility rather than directly from the Brazos River System 5% of the time during the year. Termination storage facilities were sized for each alternate service area by using the maximum daily demand multiplied by the number of days required to satisfy the 5% limit. Assuming a usable depth of 16.0 feet, the volume of termination storage varied from 658 acres to 424 acres for Alternate

Service Areas No. 1 to No. 4, respectively and was sized at 808 acres for Alternate Service Area No. 7.

Treatment Facilities

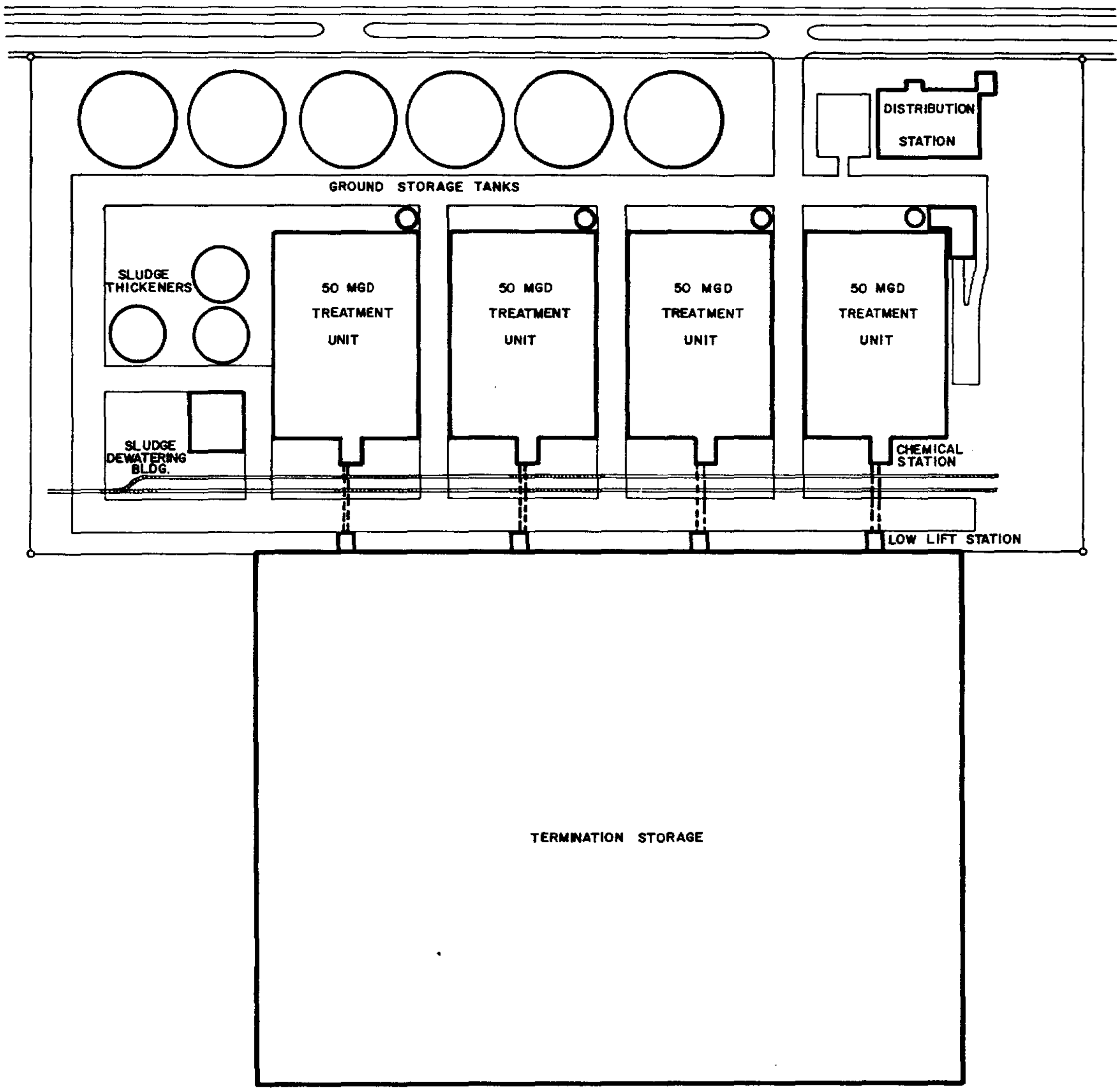
The City of Houston is currently proceeding with design and has purchased the site for a proposed Northeast Treatment Plant. The proposed plant would be located adjacent to Lake Houston near Beltway 8. The raw water supply for this plant would be Lake Houston. Correspondence recently received from the City of Houston indicates that initially the proposed Northeast Treatment Plant will have a nominal peak production capacity of 35 to 50 MGD and could be in operation as early as 1991. No firm schedule for future plant expansions currently exists, however, planning projections call for the ultimate capacity of the Northeast Treatment Plant to be up to 600 MGD.

Although, the final design of the Northeast Treatment Plant must be completed to establish the exact discharge pressures and pump operations, it is anticipated that the design will be similar to the existing Southeast Treatment Plant. The WHCSWSC will present its surface water demand to the City of Houston which, if practical, will size the Northeast Treatment Plant to accommodate this requirement.

The Southwest Treatment Plant will be located within one of five general locations presented later in this report. The raw water supply for this plant would be from the Brazos River Basin as mentioned previously. The estimated ultimate capacity of the Southwest Treatment Plant will be from 150 MGD to 250 MGD (maximum daily capacity); however, if the Fort Bend County area agrees to participate the ultimate capacity could increase to 300 MGD. Exhibits 6, 7 and 8 show three different water treatment plant site layouts which may occur depending on whether raw water is taken from a termination storage facility, directly out of the Allen's Creek Reservoir or from a raw water conveyance line. These exhibits are laid out using the City of Houston's present requirement of treatment trains instead of individual reactor clarifiers as previously presented. This configuration is usually more economical in larger plants because of the reduction in land needed for the plant site.

Treatment plants were sized to accommodate the maximum daily demands of their respective service areas. A discharge pressure of approximately 95 PSI was assumed for the alternatives examined, which is consistent with present discharge pressures for existing City of Houston treatment plants.

EXHIBIT NO. 6

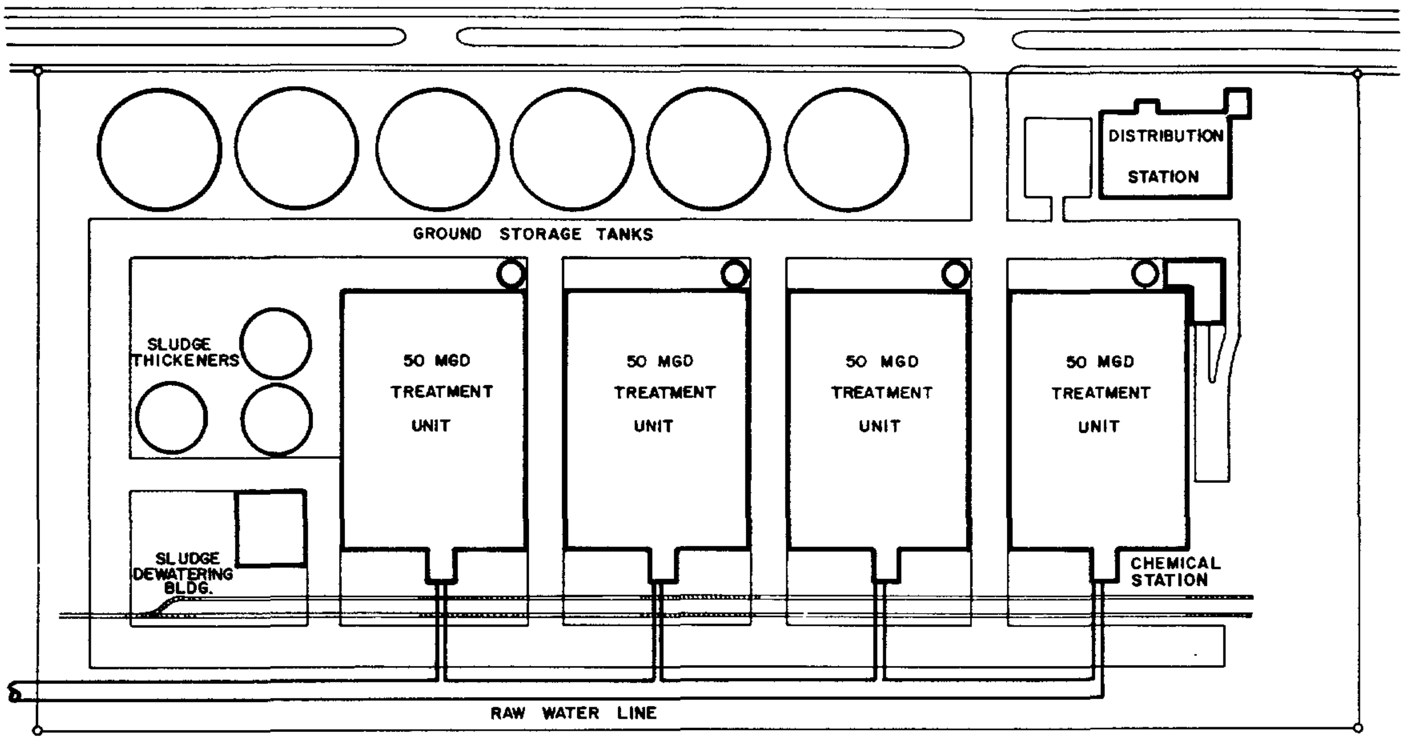


WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

TYPICAL WATER TREATMENT PLANT SITE LAYOUT

NO SCALE

EXHIBIT NO. 8



WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

TYPICAL WATER TREATMENT PLANT SITE LAYOUT

NO SCALE

Treated Water Storage/Pumping

Treated water storage and pumping facilities are those facilities located at the treatment plant used to store the treated water and distribute it into the conveyance system. Ground storage tanks were sized to provide 6 hour maximum daily demands for the alternate service areas. Distribution pumping capacity was also sized to handle the maximum daily demands of the alternate service areas.

Treated Water Conveyance

Treated water conveyance lines are those facilities required to transport water from the treatment plant to the boundary of the WHCSWSC study area. All treated water conveyance lines were sized to handle the maximum daily demands of their respective service areas. A minimum delivery pressure of 20 PSI was assumed for the Northeast Conveyance System which would be adequate to fill a ground storage tank at a booster pump station located at the WHCSWSC study area boundary. This requirement was set for estimating the WHCSWSC pro rata cost of the Northeast Conveyance System. It is understood that this conveyance system would be ultimately sized by the City of Houston and operate similar to the transmission systems to be discussed later.

The treated water conveyance lines in the Southwest Conveyance System will be designed based on the same criteria as outlined in the transmission systems discussed later in this appendix. The lines will be designed for maximum daily demands at a maximum velocity of 7 feet per second (fps).

Transmission System

Transmission Pipeline

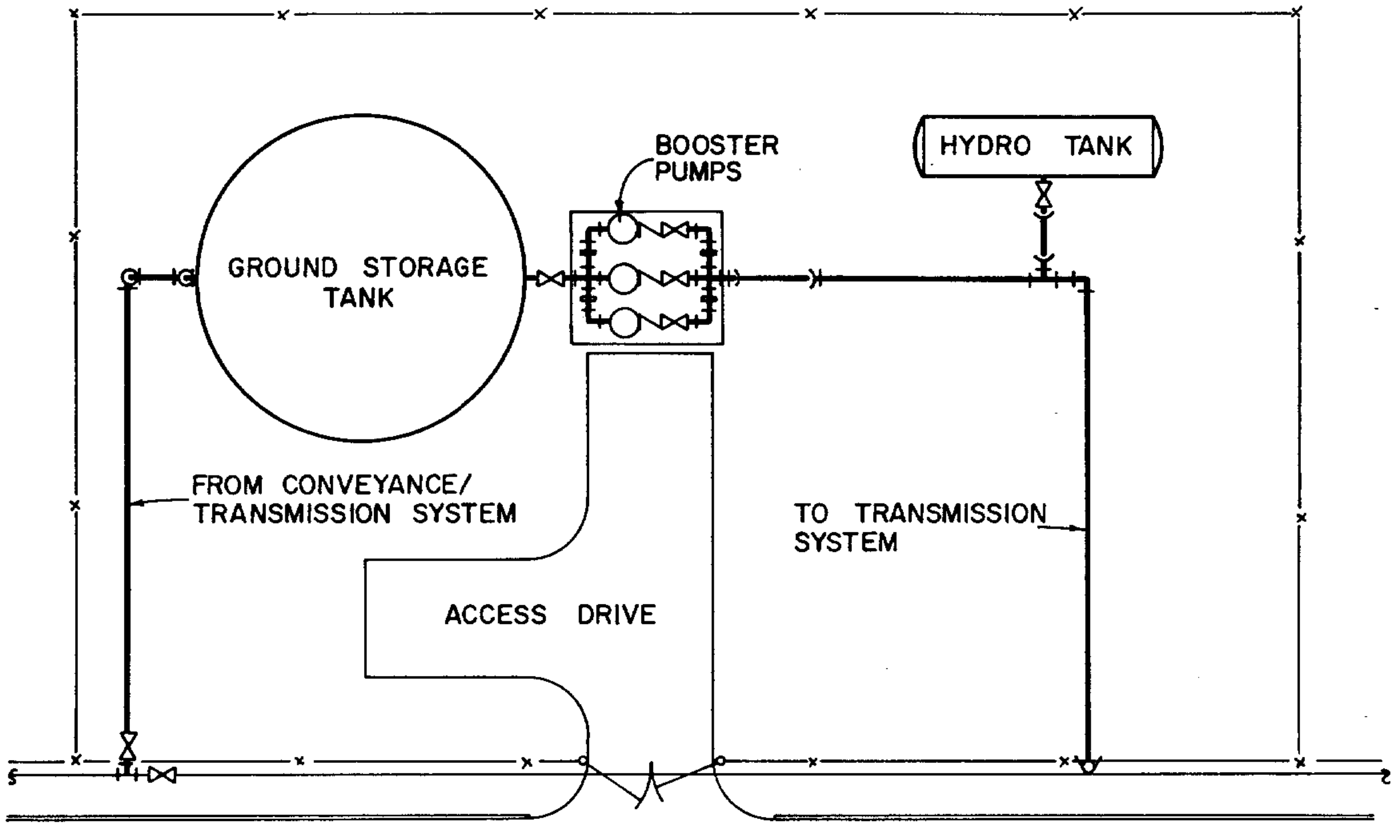
The Transmission System for the WHCSWSC study area will be a delivery system which will supply wholesale treated surface water in the vicinity of groups of political subdivisions within the study area. The individual political subdivisions will be responsible for organizing and constructing the facilities needed to transport treated surface water from WHCSWSC transmission system to each individual political subdivisions existing ground storage facility. Each subdivision will then utilize its existing water distribution system for distributing the treated water to retail customers. Under this assumption each political subdivision will be able to use its existing groundwater wells to supplement the surface water supply during peak hour periods or as an emergency supply back-up. As a result it is expected that little or no disruption in service will occur upon implementation of this plan.

The WHCSWSC Transmission System was sized to handle maximum daily demands with additional peak hour or fire flow demands being met by groundwater and/or stored water from each individual political subdivisions water system. A minimum pressure of 45 PSI was maintained throughout the system which will be adequate to deliver surface water to the various district ground storage tanks located within the study area. Maximum design velocities in the transmission system were held to less than 7 fps. The transmission system lines have been sized to allow comparisons of the alternatives and should not be construed as final. The recommended transmission system will be further evaluated in Phase V at which time a detailed plan will be recommended.

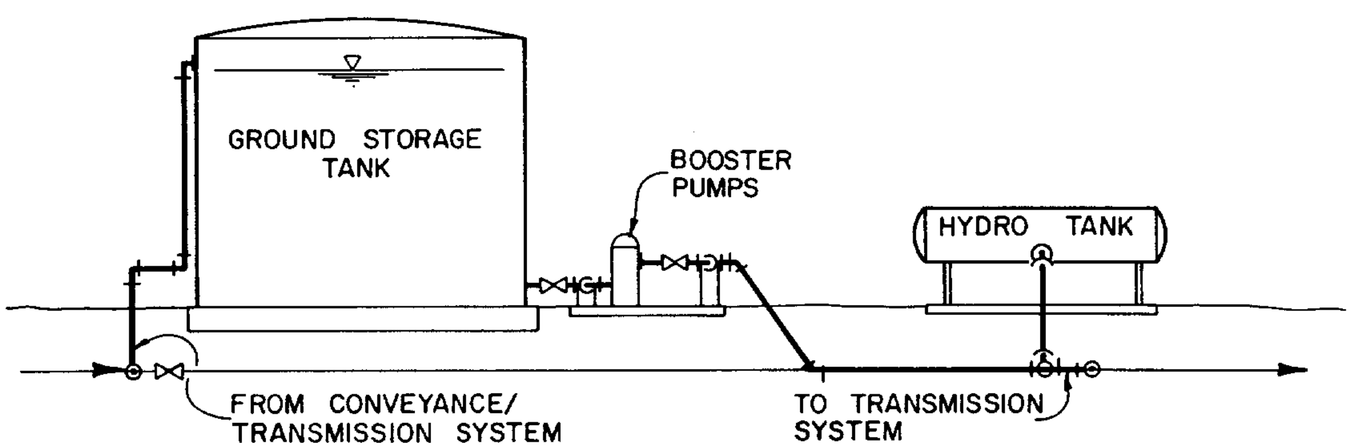
Ground Storage and Booster Pump Stations

Booster pump stations were located strategically within the WHCSWSC transmission system to supply the flow and boost pressures the required amount to serve the alternate service area demands. A typical booster pump station site layout is presented on Exhibit 9. Ground storage at each site will supplement each political subdivisions ground storage facilities and serve as a back-up supply source in the event of a temporary disruption in the surface water supply from the treatment facility.

EXHIBIT NO. 9



PLAN



ELEVATION

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

TYPICAL BOOSTER PUMP STATION SITE LAYOUT

Computer Model

The hydraulic network analysis for the various conveyance and transmission systems was accomplished through the use of computer modeling using a program called KYPIPE "Steady State Pipe Network Analysis" by the University of Kentucky. The program is based on the Hazen-Williams formula and provides pressure information, hydraulic grade line, head losses, pump heads, flow rates, velocities and system inflow and demand summaries for a variety of system configurations and components.

The various treated water conveyance and transmission systems were modeled as a series of junction nodes and pipe elements. User demands were taken out of the system at appropriate node locations. The system was supplied at a fixed grade node with a pump described by the useful horsepower needed to supply the demands of the system. A typical system contained approximately 100 pipes, 75 junction nodes and 2 fixed grade nodes. Treated water conveyance and transmission lines were located on base maps and were routed within existing street right-of-ways. Elevations of junction and fixed grade nodes were taken from USGS topographic quad maps, adjusted for depth of bury of lines, and input into the computer model. Demands were divided among junction nodes within each demand area to approximate service area water usage.

Network design criteria used in the various system models were as follows:

a. Design flow is maximum daily demand.

b. System pressures will not drop below 45 psi.

c. Velocities will not exceed 7 fps under maximum daily flow.

d. "C" Values when new will be 110 for line sizes up to 30" and 120 for line sizes 30" and larger.

Treated water conveyance and transmission systems were analyzed for various flow rate and pressure conditions which represent the water demands for a particular alternate or system routing. Output data was analyzed and compared to the established system operating criteria, improvements were made to the model as needed and the model was rerun. This procedure was repeated until all components of the system conformed to the established criteria.

In addition to the hydraulic analysis performed the computer model simulation allowed for checking of each system for disconnected lines, redundant lines, agreement of supply versus demand, and general physical layout. Line lengths and sizes determined using the computer model were taken directly from the output for use in preparing construction cost estimates.

3.0 CONVEYANCE SYSTEMS

3.0 CONVEYANCE SYSTEMS

Northeast Conveyance System

General

The Northeast Conveyance System is defined as the WHCSWSC shared portion of the proposed Northeast Treatment Plant with pumping capacity and conveyance lines sized to deliver treated water at minimum pressure to a ground storage and booster pump station located at the WHCSWSC boundary line. Figure 1 presents the alternative routes investigated for the Northeast Conveyance System.

Beltway 8 Route

The Beltway 8 Route for the Northeast Conveyance System begins at the proposed Northeast Treatment Plant Site adjacent to Lake Houston and Beltway 8. From that point the proposed conveyance line runs westward along the alignment of the Beltway approximately 19 miles to the northeast boundary of the WHCSWSC study area. The elevation at Lake Houston is approximately 50.0 feet MSL while the northeastern boundary of the study area is around 113.0 feet MSL. Because of the considerable difference in elevation and length of this conveyance line, it is assumed that a pump station will be located at the WHCSWSC study area northeast boundary to repressurize and distribute the water within the WHCSWSC service area. This allows the Northeast Conveyance line and Northeast Treatment Plant pumps to be sized to supply only the required amounts of treated water at a minimum pressure of around 20 psi. This will save WHCSWSC considerable money in both pipeline and pumping costs from the proposed Northeast Water Treatment Plant. However, as previously mentioned, it is understood that the City of Houston will probably operate this line similar to the City's transmission system.

NHCWSC Route

WHCSWSC's alternate route referred to as the NHCWSC Route for the Northeast Conveyance System would also begin at the proposed Northeast Treatment Plant site. This routing runs westward along Beltway 8 to Vickery Drive where it turns north to Greens Road. The route then proceeds west again along Greens Road to Aline Westfield Road where it again turns north until it intersects Rankin Road. The line continues west along Rankin and Spears Road until it intersects Richey Road where it turns southwest to intersect the WHCSWSC study area boundary. The total length of conveyance line for this routing is approximately 23 miles. Elevations at the beginning and end of this route are similar to those of the Beltway 8 route, with an approximately 63.0 feet of difference in elevation from Lake Houston to the WHCSWSC boundary line. As previously mentioned a pump station and ground storage facility are proposed at the northeast boundary of the WHCSWSC study area to repressurize and distribute water from the conveyance line. Routing for this alternate is consistent with the route proposed by the North Harris County Water Supply Corporation (NHCWSC) for a conveyance line to serve the NHCWSC service area.

FM 1960 Route

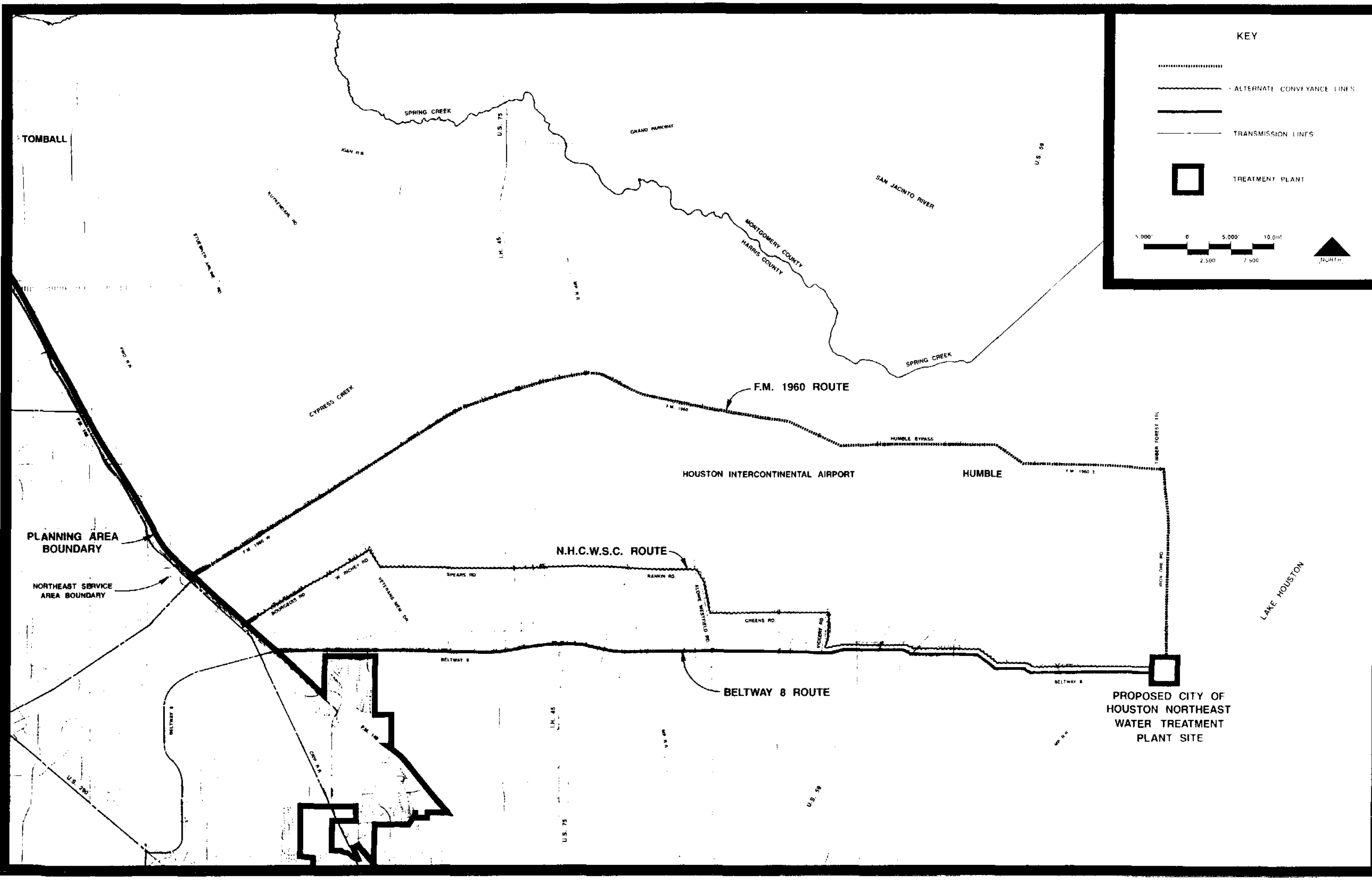
The FM 1960 Route for the Northeast Conveyance System also originates at the proposed Northeast Treatment Plant near Lake Houston. From that point it runs north along Iron Ore Road and Timber Forest Trail until it intersects FM 1960, where it turns west to follow the alignment of FM 1960 until it reaches the northeast boundary of the WHCSWSC study area. The approximate length of this route is 28 miles. A 68.0 feet elevation difference exists with Lake Houston elevation at approximately 50.0 feet MSL and the WHCSWSC boundary elevation being 118.0 feet MSL. Again, as previously assumed, a pump station will be located at the WHCSWSC study area boundary to repressurize the water prior to entering the WHCSWSC study area.

Comparison of Alternate Conveyance Systems

The alternate routings for the Northeast Conveyance System were evaluated on the basis of Technical, Environmental, Community/Social, Phasing and Financial criteria. Treated water conveyance line sizes varied from 66" to 90" to convey the required amounts of treated water which varied from 43.85 MGD to 110.30 MGD maximum daily demand (Year 2030), depending on the alternate service area investigated. For Alternate Service Area 7, the Northeast Supply was not used.

As part of the Northeast Conveyance System technical evaluation, the hydraulics of each system were investigated. To compare the three alternate treated water conveyance routes from a hydraulic standpoint, identical horsepowers were used to pump water from the proposed Northeast Treatment Plant site to the WHCSWSC northeast boundary through conveyance lines sized according to the previously presented system design criteria. Four different amounts of water were pumped through the treated water conveyance system relating to alternate service area 1 through 4 demands. Output from the computer model consistently showed that the Beltway 8 Route was hydraulically superior over the NHCWSC Route. The FM 1960 Route was consistently the worst route from a hydraulic standpoint. Delivery pressures at the WHCSWSC boundary for the Beltway 8 Route were approximately 6 psi higher than the NHCWSC Route and approximately 16 psi higher than the FM 1960 Route for the four alternate service area demands investigated. Both hydrostatic and frictional head losses increase as line lengths, elevation differences, and number of bends in the line increase. Although the sizes of the treated water conveyance lines were similar between the three alternate routes, the lengths of the routes differed somewhat. The Beltway 8 Route is the shortest route, approximately 4 miles shorter than the NHCWSC Route and 9 miles shorter than the FM 1960 Route. The Beltway 8 Route will provide substantial savings in materials compared to the other routes. Ease of construction, interferences with existing utilities and structures, and community disruption was also considered as part of the Environmental and

Community/Social evaluation. Congested areas with limited right-of-way and high numbers of existing utilities will cause difficulties in constructing the conveyance system.



NORTHEAST CONVEYANCE SYSTEM ALTERNATE ROUTES

W.H.C.S.W.S.C.
FIGURE NO. 1

Southwest Conveyance System

The Southwest Conveyance System consists of raw water pumping and conveyance facilities needed to deliver raw water from the supply source to either the treatment plant facilities in Alternate Nos. 4B and 5 or to a termination storage facility in Alternate Nos. 1, 2, 3 and 4A. The system also consist of termination storage facilities as required, treatment plant facilities, treated water storage and pumping facilities and treated water conveyance lines to transport the treated water to the WHCSWSC service area.

Numerous geographical areas exist south and southwest of the WHCSWSC study area which could serve as possible locations for a proposed Southwest Treatment Plant. After a preliminary evaluation, it was determined that this entire area could be narrowed down to five general areas. The five general areas considered for further study are the Oyster Creek/Dairy Ashford Area, Brazos River/Highway 6 Area, Oyster Creek/Highway 6 Area, F.M. 1093/Grand Parkway/Jones Creek Area and the Allens Creek/F.M. 1093 Area. After further evaluation of the five general areas, it was determined that six alternate conveyance systems should be considered which are listed below:

Site 1. Oyster Creek/Dairy Ashford Conveyance System

Site 2. Brazos River/Highway 6 Conveyance System

Site 3. Oyster Creek/Highway 6 Conveyance System

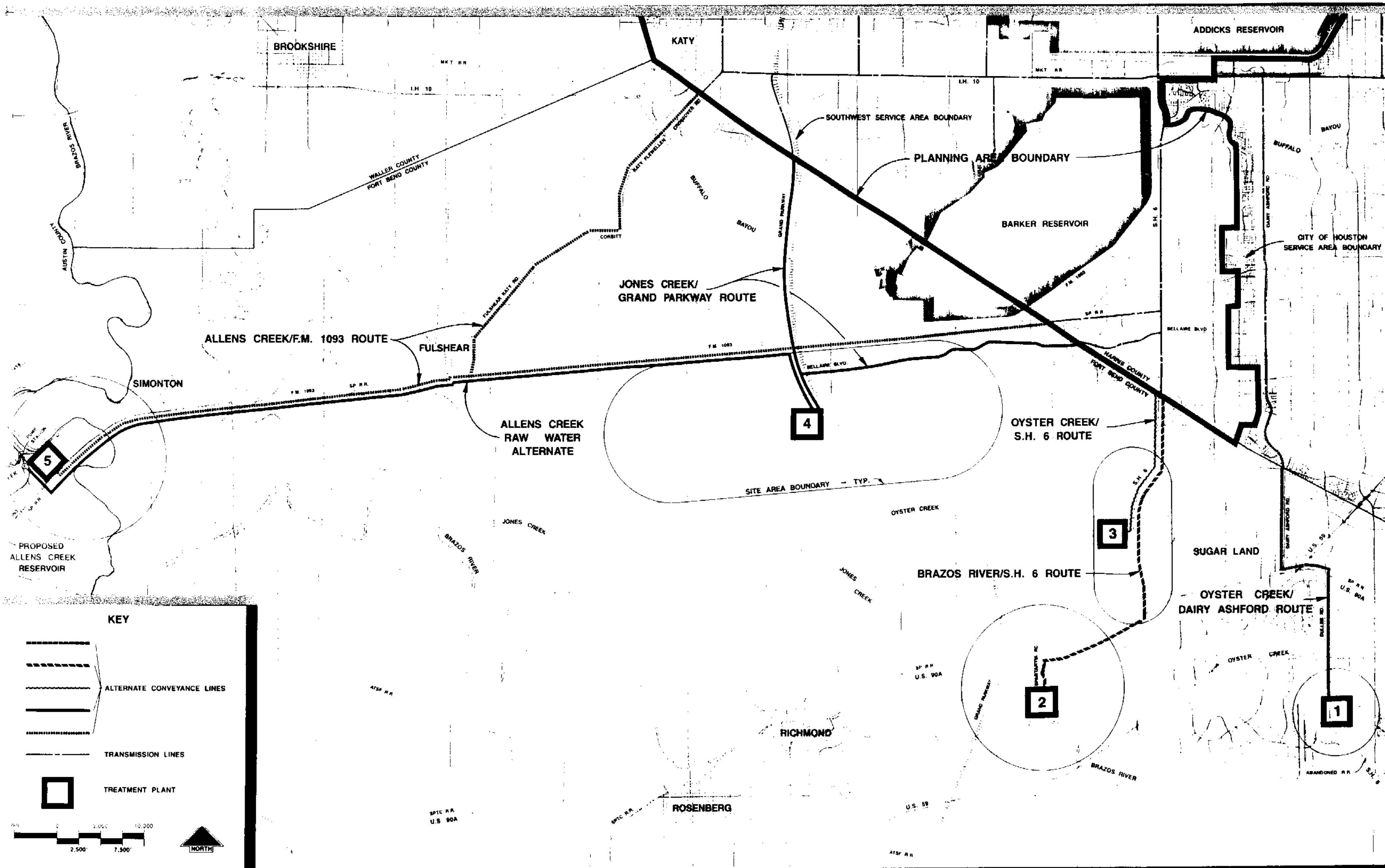
Site 4A. Jones Creek/Grand Parkway Conveyance System

Site 4B. Allens Creek/Grand Parkway Conveyance System

Site 5. Allens Creek/F.M. 1093 Conveyance System

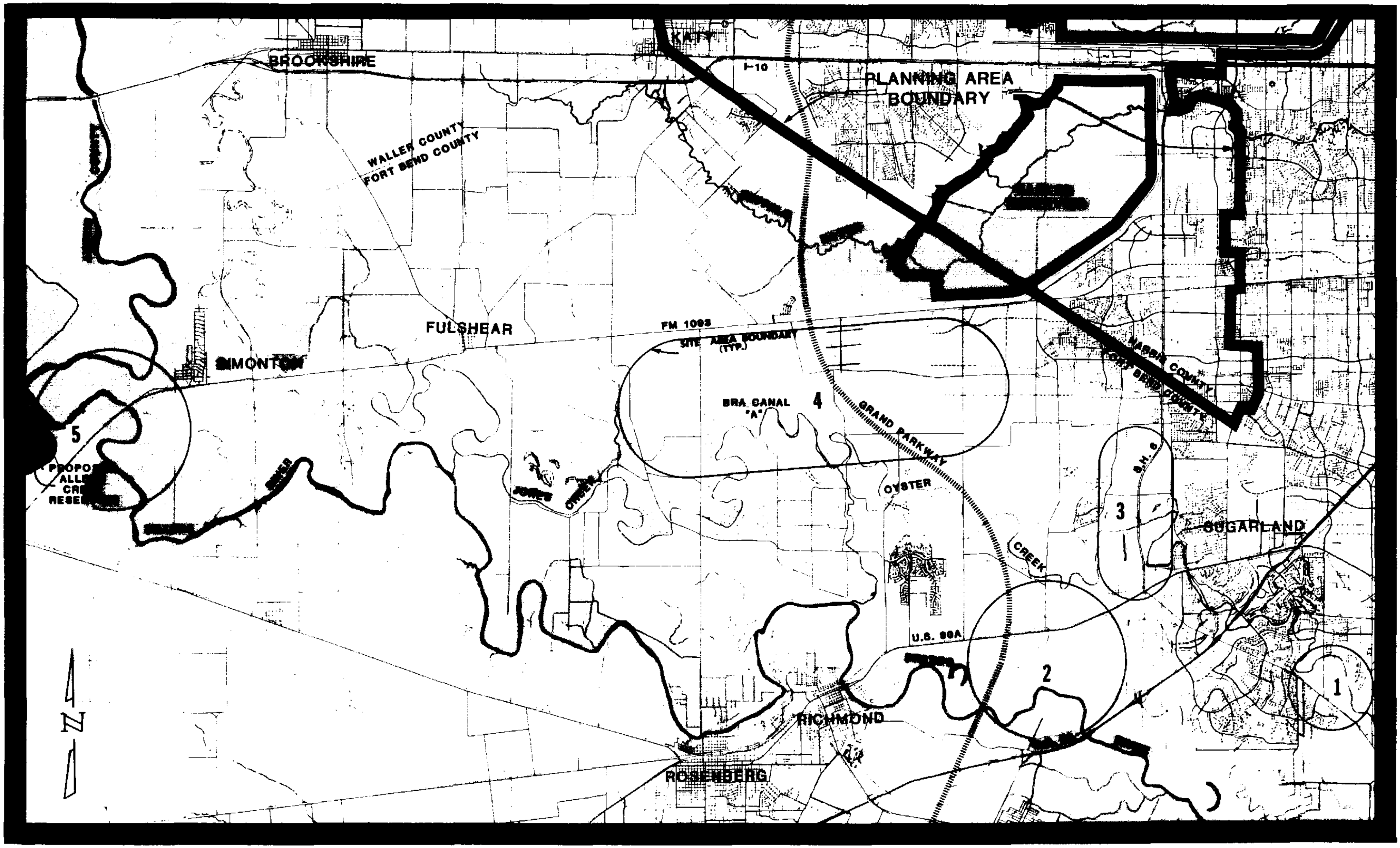
Alternate Sites 4A and 4B have similar treatment plant site locations as well as similar treated water conveyance systems. However, they differ in that 4A contains a termination storage facility and obtains raw water from the BRA Canal System while 4B has no termination storage, but does contain a raw water conveyance line from Allens Creek Reservoir.

Figure 2 shows the alternate sites and conveyance line routings investigated for the alternate Southwest Conveyance Systems. Also, refer to Exhibit 10 for 100-year flood plain locations and Exhibit 11 for general surface fault patterns as well as salt dome locations presently existing throughout the Southwest Conveyance System study area.



SOUTHWEST CONVEYANCE SYSTEM ALTERNATE ROUTES

W.H.C.S.W.S.C.
FIGURE NO. 2

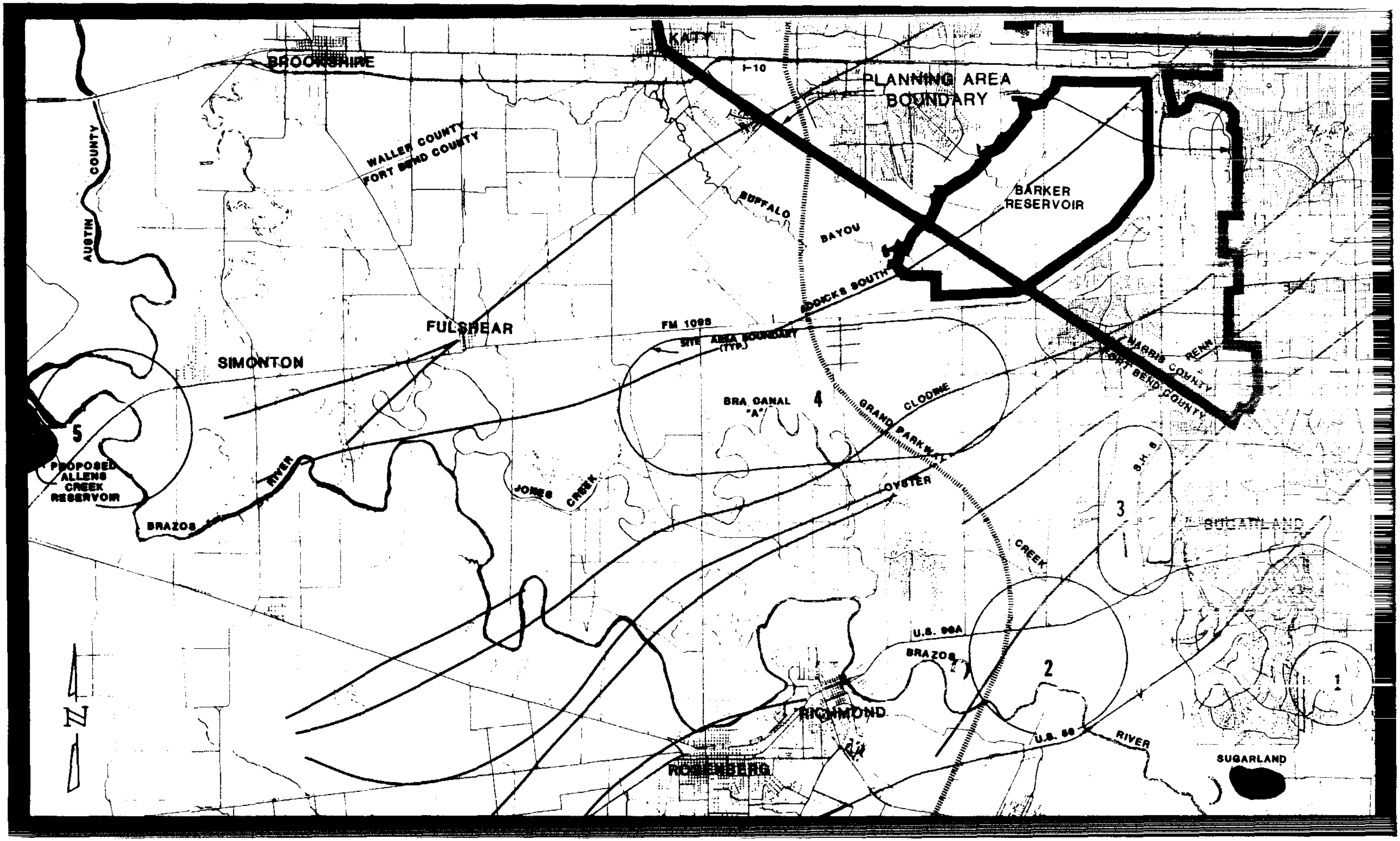


4 TREATMENT PLANT AREA

100 YEAR FLOOD PLAIN

SOUTHWEST CONVEYANCE SYSTEM STUDY AREA
(100 YEAR FLOOD PLAINS)

EXHIBIT NO. 10



4 TREATMENT PLANT AREA

FAULT LINE

SALT DOME

SOUTHWEST CONVEYANCE SYSTEM STUDY AREA

(GENERAL SURFACE FAULT PATTERN)

EXHIBIT NO. 11

SITE 1: **Oyster Creek/Dairy Ashford**

The first area investigated as a possible site for a proposed Southwest Treatment Plant is in the vicinity of Dulles Road and State Highway 6, south of Stafford. A plant at this location would treat raw water taken from Oyster Creek, which is part of the BRA canal system.

Site 1 has a sole source of raw water which is Brazos River water pumped and transferred through Oyster Creek within the BRA Canal System. The feasibility and reliability of using raw water from Oyster Creek at this site depends on several factors. Site 1 is located downstream of a number of industries and municipalities who presently dump effluent into Oyster Creek. The quantity and quality of this effluent will directly impact raw water taken from Oyster Creek at any downstream location. Site 1 is also downstream from the American Water Canal Diversion (a manmade canal) from which Galveston and Brazoria Counties receive their raw water supply. The portion of Oyster Creek downstream of this diversion only receives water which overflows BRA Dam No. 3. Modifications to the present operation of the BRA Canal System would be required to allow water to flow into this lower portion of Oyster Creek. The reliability of the canal system is linked to the reliability of the Brazos River pump station which delivers water from the Brazos River into the canal system. Site 1 is, however, downstream of several retention structures which the BRA maintains for water storage in the event of pump station failure.

Site 1 has approximately 10 percent of its land area within the 100-year flood plain of Oyster Creek as determined from Federal Emergency Management Agency (FEMA) maps for the area. Mitigation of the site to eliminate the hazard of flooding is unlikely. On site drainage of the site would be collected by an internal storm sewer system with an outfall located offsite.

The general terrain for Site 1 is fairly level prairie land with elevations ranging from 65.0 MSL to 70.0 MSL. Two small, shallow lakes are located in the eastern part of the site and several lower, marshy areas exist adjacent to these lakes. Soils in the area of Site 1 are generally clayey and loamy with slow permeability and somewhat poorly drained. A general overview of faulting in the area indicates a large salt dome located directly southwest of Site 1. Numerous ground faults are normally associated with these salt domes which could reduce the amount of land suitable for major treatment plant facilities.

General access to the proposed Southwest Treatment Plant site by automobile, truck and rail is important. Both personnel and material suppliers must have adequate means of reaching the plant site. In general all of the alternate sites have fairly good access from at least one major highway. Site 1 has one major highway, State Highway 6, which runs through it and several arterial roads such as Cartwright and Dulles which connect to major highways.

The Missouri Pacific Railroad Company (MPRR) had a track running parallel to State Highway 6, however, this track has been abandoned. Therefore, direct rail access to Site 1 does not presently exist.

Quadrangle maps published by the U.S. Geological Survey were used as an aid to preliminarily spot existing pipelines and overhead transmission lines running through each of the alternate sites. Site 1 is crossed on the west by overhead H.L. & P transmission lines which run north-south parallel to Oil Field Road. The southeast part of Site 1 is crossed by one pipeline running in a northeast direction.

Preliminary information supplied by H.L. & P. shows both 345 kv and 138 kv transmission lines in the vicinity of Site 1, which could possibly supply the proposed treatment plant.

Raw water taken from Oyster Creek would need to be stored in a termination storage facility. The termination storage facility would supply a proposed Southwest Treatment Plant located nearby. The available land for a large termination storage facility at Site 1 is limited.

The Oyster Creek/Dairy Ashford Route for the treated water conveyance line begins at the proposed Southwest Treatment Plant Site 1. From that location the proposed conveyance line runs north along Dulles Road to U.S. Highway 90A, where it turns west passing under U.S. Highway 59 to Dairy Ashford. The line then runs north along Dairy Ashford until it intersects the WHCSWSC study area southwestern boundary. The total length of the conveyance system for this route is approximately 6.5 miles. The elevation at the proposed Southwest Treatment Plant site is approximately 67.0 feet MSL, while the elevation at the point of tie-in to the transmission system is approximately 78.0 feet MSL, around 11.0 feet higher. There are no booster pump stations proposed along this route of the Southwest Conveyance System.

SITE: 2: **Brazos River/Highway 6**

The second possible site for a proposed Southwest Treatment Plant is approximately 3 miles west of First Colony between U.S. Highway 59 and U.S. Highway 90A. A plant located here would treat raw water taken directly from the Brazos River and/or the Brazos River Canal System.

Possibilities exist for Site 2 to have a dual source of raw water with the primary source being the Brazos River and the secondary source being Brazos River water transferred through Oyster Creek. Site 2 is located on Oyster Creek upstream from the majority of the industries and municipalities effluent discharge points which should increase the water quality over Site 1. Site 2 is also located upstream of the American Water Canal Diversion of Oyster Creek. Site 2 is located on the Brazos River downstream of the cities of Richmond and Rosenberg. Quantity and quality of effluent dumped into the Brazos River from these cities may affect the raw water downstream at Site 2. Reliability of raw water taken directly from the Brazos River is not dependent on transfer pumping as is raw water taken from Oyster Creek.

Approximately three fourths of the land area of Site 2 is located within the 100-year flood plain of the Brazos River. Mitigation of the site to avoid flooding would most likely be required which would in turn affect the economics of this site.

Site 2 has similar terrain to Site 1 being generally level prairie land with elevations ranging from 75.0 MSL to 80.0 MSL. Soil characteristics are also similar to Site 1. Known faulting in the area of Site 2 is restricted to one fault line passing through the northeast portion of the area.

Site 2 contains two major highways, U.S. Highway 90A as well as U.S. Highway 59 which runs adjacent to the site on the southeast. Smaller roadways such as Sartartia Road and Pecan Road run within the site but most likely would need to be improved somewhat to assure better access.

The Southern Pacific Railroad Company (SPRR) has a track which runs east-west along Highway 90A. This track runs through the north half of Site 2 and could provide rail service to a plant located in the area with some modifications. The track presently exists on the north side of Highway 90A. If a treatment plant site were located south of the highway, it would be necessary to cross Highway 90A with the railroad extension.

Site 2 does not appear to have major pipelines running through the area, however, several overhead power lines do cross to the west and south.

Preliminary information provided by H.L.&P. shows 138 kv transmission lines in the vicinity of Site 2 which could possibly supply a proposed Southwest Treatment Plant.

Raw water would be pumped from the Brazos River into a termination storage facility located adjacent to the river at Site 2. A proposed Southwest Treatment Plant would be supplied from this termination storage.

The Brazos River/Highway 6 Route for the treated water conveyance line begins at the proposed Southwest Treatment Plant Site 2. From that location the proposed conveyance line runs east to Flannigan Road before heading north on Flannigan Road to State Highway 6. The proposed conveyance line continues north on State Highway 6 until it intersects the WHCSWSC study area boundary. The total length of conveyance system for this route is approximately 8.0 miles. The elevation at the proposed Southwest Treatment Plant site is 75.0 feet MSL while the elevation at the point of connection to the transmission system is approximately 18.0 feet higher at 93.0 feet MSL. There are no proposed booster pump stations proposed along this route of the Southwest Conveyance System.

SITE 3: **Oyster Creek/Highway 6**

The third possible location for a proposed Southwest Treatment Plant is near the intersection of State Highway 6 and Oyster Creek in the vicinity of Hull Airport. A plant located at this site would treat raw water taken from Oyster Creek, which is part of the Brazos River Canal System.

The sole source of raw water for Site 3 is Brazos River water pumped into and transferred through Oyster Creek within the BRA Canal System. Site 3 is located upstream from the majority of industrial and municipal effluent discharge points and upstream from the American Water Canal Diversion. The reliability of Oyster Creek as a raw water source is dependent on the Brazos River pump station. Site 3 is upstream of the BRA retention facilities which store water for use in event of pump failure.

Site 3 has less than 10 percent of its land area within the 100-year flood plain making the need for extensive site mitigation unlikely. Site drainage would be accomplished by an internal storm sewer system with an outfall located offsite.

Site 3 is fairly flat prairie land with the southeast at elevation 75.0 MSL and the northwest at elevation 90.0 MSL. Several small lakes exist in the middle and southern parts of the area. Soil characteristics of Site 3 are similar to the previously mentioned sites. Known faulting in the area is limited to one fault line which passes directly through the middle of the area.

Site 3 has two major highways, U.S. Highway 90A and State Highway 6 which run through it. Arterial roadways such as Voss Road, West Airport Blvd. and Old Richmond Road also cross the site. The location of Hull Airport may block access from Highway 6 if a plant is located behind the airport but otherwise the site is accessible.

The same SPRR track that could serve Site 2 also runs along the southern border of Site 3 along Highway 90A. Rail service to Site 3 could be accomplished by extending a track north through the area from this existing SPRR track.

Site 3 contains two pipelines and several power lines which cross in a northwest direction north of Oyster Creek.

Preliminary information from H.L.&P. shows 138 kv transmission lines in the vicinity of Site 3 which could possibly provide electrical service to a proposed treatment plant located in the area.

Raw water would be taken from Oyster Creek and stored in a termination storage facility at Site 3. This termination storage would supply a proposed Southwest Treatment Plant located in the vicinity.

The Oyster Creek/Highway 6 Route for the treated water conveyance line begins at the proposed Southwest Treatment Plant Site 3. From that location the proposed conveyance line runs north on State Highway 6 until it reaches the WHCSWSC study area southwestern boundary. The total length of conveyance system for this routing is approximately 3.0 miles. The elevation at the proposed Southwest Treatment Plant site is approximately 80.0 feet MSL. At the point of connection to the transmission system the elevation is approximately 13.0 feet higher at 93.0 feet MSL. No booster pump stations are proposed along this route of the Southwest Conveyance System.

SITE 4A: **Jones Creek/Grand Parkway**

The fourth possible site for a proposed Southwest Treatment Plant is approximately 2 miles southeast of Gaston near the intersection of Peek Road and the proposed Grand Parkway. A plant located here would treat Brazos River water taken from Jones Creek, which is part of the Brazos River Canal System.

Site 4 has one source of raw water which is Brazos River water obtained from Jones Creek. Jones Creek forms the upper part of the Brazos canal system and has been modified to flow into Oyster Creek. Few municipal and industrial effluent discharges exist upstream of this portion of the canal system from which Site 4 would be supplied. The reliability of this source is dependent, however, on the reliability of the Brazos River pump station which delivers water from the Brazos River into the canal system.

Site 4 has less than 20 percent of its land area within the 100-year flood plain making the need for extensive site mitigation unlikely. Drainage of the site would be through an internal storm sewer system with an outfall at offsite.

In general Site 4 is also fairly flat prairie land with the eastern portions at elevation 95.0 MSL and the western portions at 115.0 MSL. The central part of the area adjacent to Jones Creek contains several small shallow lakes. Similar soils characteristics exist at Site 4 with soil being generally clayey and loamy with slow permeability. An overview of faulting within the area shows the Addicks South fault line passing through the northwest edge of the area and the Clodine fault line passing through the southwest portion of the area.

Site 4 is accessible from the North by F.M. 1093 which runs parallel to the northern boundary of the site. F.M. 723, F.M. 359, and the proposed Grand Parkway also run through the site. Extensions of Bellaire Blvd., Beechnut and Bissonet are also proposed within the area. Other roadways are Peek Road, Harlem Road, Canal Road and Precint Line Road.

The Southern Pacific Railroad Company (SPRR) has a track running east-west along F.M. 1093. Site 4 could easily be served from this track since it is located on the south side of F.M. 1093.

Preliminary information from H.L.&P. shows both 345 kv and 138 kv transmission lines in the vicinity of Site 4 which could possibly serve a proposed Southwest Treatment Plant located in the area.

Raw water taken from Jones Creek would be stored in a termination storage facility at Site 4. This termination storage would supply a proposed Southwest Treatment Plant located in the vicinity.

The Jones Creek/Grand Parkway Route for the treated water conveyance line begins at the proposed Southwest Treatment Plant Site 4. The conveyance system branches from that point with one line running east along Bellaire Blvd. to connect to the transmission line running along Dairy Ashford. The other branch of the conveyance system runs north from the plant site along the proposed Grand Parkway to intersect the WHCSWSC study area southwestern boundary. The total length of conveyance system for this routing is approximately 12.0 miles. The elevation of the proposed southwest Treatment Plant site is approximately 105.0 feet MSL. At the point of connection to the transmission system at Dairy Ashford the elevation is approximately 74.0 feet MSL, while at the point of connection to the transmission system at Interstate 10, the elevation is approximately 130.0 feet MSL. No booster pump stations are proposed along either of the two branches of this Southwest Conveyance System route.

SITE 4B: **Allens Creek/Grand Parkway**

Site 4B has the same geographical boundaries as Site 4A. The difference between the two sites is the raw water supply source. The raw water supply source for Site 4B would be obtained from the proposed Allen's Creek Reservoir instead of Jones Creek as mentioned in Site 4A. Raw water conveyance lines would be constructed from Allen's Creek Reservoir to Site 4 along F.M. 1093. Allen's Creek would serve as the termination storage facility for the proposed Southwest Treatment Plant located at Site 4. By using Allen's Creek Reservoir as the termination storage facility, the water quality can be increased without additional capital cost. The construction of Allens Creek Reservoir as proposed by the BRA offer would have to be changed from the year 2000 to the year 1995 to be compatible with the development of a Phase I Southwest System.

The termination storage facilities proposed in Sites 1, 2, 3 and 4B were sized assuming a maximum chloride concentration of 240 mg/l, however, by restricting the operations of Allen's Creek Reservoir the maximum chloride concentration could be reduced to around 100 mg/l and the total dissolved solids to 440 mg/l without reducing the reservoirs yield or increasing the capital cost. By reducing the chloride to 100 mg/l the possibility of producing treated water that exceeds the maximum allowable chloride concentration is minimized. This site also offers the flexibility of using two raw water sources, Allens Creek Reservoir and the BRA Canal System. Site 4B also offers the greatest flexibility of plant expansion to allow treatment of raw water outside of the raw water offered in the BRA proposal. This site would increase the possibility of regionalizing treatment facilities capable of serving WHCSWSC's service area as well as portions of Fort Bend County without sacrificing water quality. The Treatment plant site criteria and Grand Parkway Route for the treated water conveyance line would be the same as previously outlined for Site 4A.

SITE 5: **Allens Creek/F.M. 1093**

The final site investigated as a possible location for a proposed Southwest Treatment Plant is approximately 3 miles west of Simonton near the intersection of the Brazos River and Allens Creek. A plant located at this site would treat raw water taken from a proposed reservoir on Allens Creek. The construction time frame of the Allens Creek Reservoir as proposed by the BRA offer would have to be changed as previously mentioned in Site 4B.

Site 5 has two sources of raw water. The primary source would be the proposed Allen's Creek reservoir. In case of the contamination of Allen's Creek Reservoir, the nearby Brazos River could be used as an alternate source of raw water. This differs from the advantages offered in Site 4B in that the second source, the Brazos River, would not provide additional water rights from the BRA Canal System which is considered instrumental in the participation of certain Fort Bend County areas in regional water treatment.

Site 5 has approximately 60 percent of its land area within the 100-year flood plain. Site mitigation may be likely along with the need for a Corp of Engineers permit. On site drainage would be by an internal storm sewer system with an outfall located offsite.

Site 5 has the most drastic variation in topography of any of the previously mentioned sites. The areas adjacent to the Brazos River and to the southwest are at approximately 135.0 MSL. Across the Brazos River to the north and east the elevations are somewhat lower at approximately 105.0 MSL. General soils characteristics at Site 5 are similar to the previously mentioned sites. Faulting within the area is not documented.

Site 5 is accessible from F.M 1093 which runs through the site. F.M. 1458 and Melmar Road also provide access to the site. The Brazos River, which winds its way through the site limits access somewhat to the southwestern portions of the area.

Site 5 could be served from the same SPRR track which runs along F.M. 1093 north of Site 4. At this location the tracks exist on the north side of F.M. 1093 and could be extended to a plant site located in the northern half of the area without crossing over F.M. 1093.

Site 5 has two pipelines which cross over the Brazos River on the southeast side of the area. Preliminary investigations do not indicate any major concentrations of existing utilities.

Preliminary information from H.L.&P. shows 138 kv transmission lines located to the south of Site 5 near Wallis which could possibly serve a plant located in the area.

The proposed reservoir would serve as termination storage and raw water supply for a proposed Southwest Treatment Plant located adjacent to the reservoir. The increase in water quality for this alternate is similar to Site 4B.

The Allens Creek/FM 1093 Route for the treated water conveyance line begins at the proposed Southwest Treatment Plant Site 5. From that location the proposed conveyance line runs east along FM 1093 to just east of Fulshear where it splits into two branches. One branch continues eastward along FM 1093 and Alief-Clodine Road until it reaches the WHCSWSC transmission line which runs along Dairy Ashford. The other branch heads northeast from FM 1093 east of Fulshear along Fulshear-Katy Road and Katy-Flewellen Road to intersect the WHCSWSC study area southwestern boundary. The total length of conveyance system for this route is approximately 31.5 miles. The elevation at the proposed Southwest Treatment Plant site is approximately 135.0 feet MSL. At the point of connection to the transmission system at Dairy Ashford the approximate elevation is 74.0 feet MSL while at the point of connection to the transmission system at Interstate 10 the elevation is approximately 130.0 feet MSL. As with the other alternate routes, there are no proposed booster pumps along this routing of the Southwest Conveyance System.

Comparison of Alternate Conveyance Systems

All six of the alternate Southwest Conveyance Systems are feasible, however, each conveyance system has advantages as well as disadvantages that need to be compared before recommending an alternate. As will be explained later in the ranking section of this Appendix, the majority of the advantages and disadvantages can be grouped under five general categories: technical, environmental, community/social, phasing and financial. This section will describe the comparisons between the first four categories listed above. The fifth category, financial, will be discussed in the cost analysis section of this Appendix.

The alternate Southwest Conveyance Systems, as in the Northeast, are dependent upon which WHCSWSC service area alternate is chosen. The Southwest Conveyance System could have an ultimate capacity that ranges from 121 MGD to 231 MGD maximum daily demand (Year 2030), depending on the alternate service area chosen. This ultimate capacity could increase to approximately 300 MGD, if entities in Fort Bend County opted to participate. However, this Appendix does not address demands in Fort Bend County. The amount of land needed for treatment plant facilities, termination storage facilities and sludge disposal facilities is dependent on the plant's ultimate capacity which in turn is dependent on the service area alternate. The amount of land assumed for the mentioned facilities for each alternate is listed below.

ALTERNATE SERVICE AREA	ULTIMATE S.W.PLANT CAPACITY (MGD) (2030)	ULTIMATE LAND REQUIREMENTS (ACRES) PLANT	SLUDGE	STORAGE
NO. 1	187	100	80	658
NO. 2	177	100	80	623
NO. 3	140	80	60	525
NO. 4	121	70	60	424
NO. 7	231	120	100	808

The decision of choosing an alternate service area as well as alternate conveyance systems including plant sites should be flexible and able to satisfy the changing requirements that may occur 10-15 years after this study has been completed. With this thought in mind, we recommend that the land requirements for the Southwest Conveyance System treatment plant, sludge disposal and termination storage facilities be evaluated using the ultimate capacity that results from the largest alternate service area, Service Area Alternate No. 7. This would give the Southwest Conveyance System the ability to expand without being land locked.

Considering this assumption, the ultimate capacity for the proposed Southwest Treatment Plant is assumed to be 231 MGD excluding Fort Bend County's participation. This ultimate capacity translates into a land requirement of approximately 1028 acres for treatment plant, sludge disposal and termination storage facilities for Site 1, 2, 3 and 4A. For Site 4B and 5, the land requirement is 220 acres which results in the elimination of termination storage. All of the general areas evaluated have the required available land except Area No. 1. The purchase price of land varies with the land located further west of the WHCSWSC study area being more economical than the property in the vicinity of Highway 59 and Highway 6.

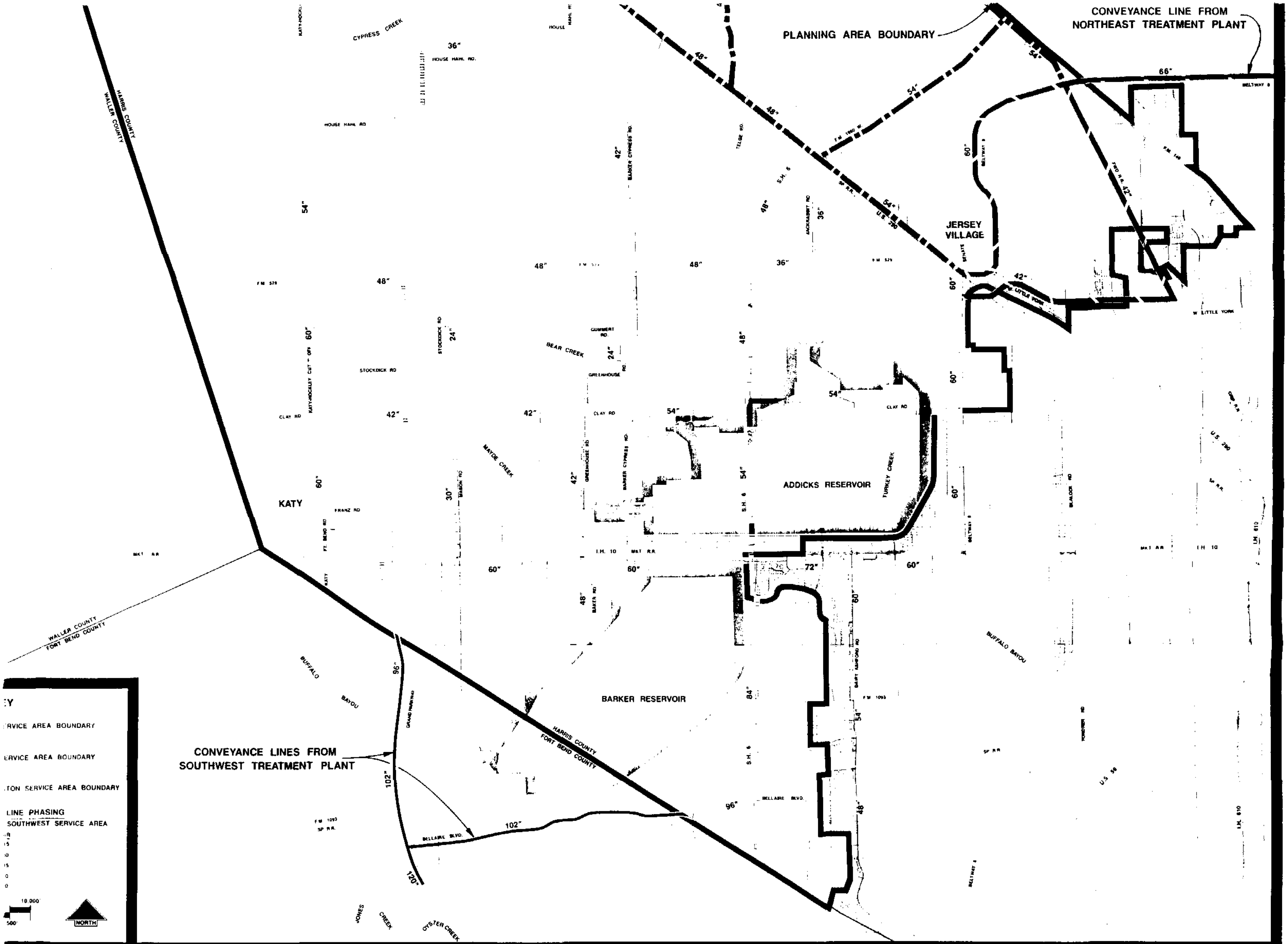
Line sizes for the alternate routings of the Southwest Conveyance System varied from 72" to 120" to convey from 120.96 MGD to 231.27 MGD maximum daily demands (Year 2030) depending on the service area supplied.

Similar amounts of treated water were pumped through each of the alternate treated water conveyance systems. Review of the computer output data revealed that the Allens Creek/FM 1093 Route required the least pump horsepower to pump the required amount of water at the desired pressures while the Oyster Creek/Dairy Ashford Route required the greatest pump horsepower. The main reason for this is that the plant site at Allens Creek is at a higher elevation than the plant site at Oyster Creek/Dairy Ashford. Ground elevations increase from the southeast to the northwest through the WHCSWSC study area. This allows the treated water conveyance lines routed further northwest to have better hydraulic characteristics than those further southeast. The length of line and the number of bends in its route, also contributed somewhat in that shorter straight runs of line produce less head losses and require less pumping horsepower.

The sizes of treated water conveyance lines used for the alternate routings were fairly consistent, however, the lengths of the different routes varied substantially. The Oyster Creek/Highway 6 Route is the shortest route, approximately 3.5 miles shorter than the Oyster Creek/Dairy Ashford Route. The longest route by far is the Allens Creek/FM 1093 Route, approximately 28.5 miles longer than the Oyster Creek/Highway 6 Route. A factor that increased the lengths of those routes farthest west was the need to run separate branches eastward to convey water to the southeast portion of the WHCSWSC study area and the City of Houston quadrant which have the earliest HGCSD conversion requirements. The Oyster Creek/Highway 6 Route, being the shortest route, will provide the most savings in materials to construct. Another consideration in evaluating the different routes is the ease of construction. Congested areas with many interferences with existing utilities and structures will make construction of the conveyance line difficult and costly.

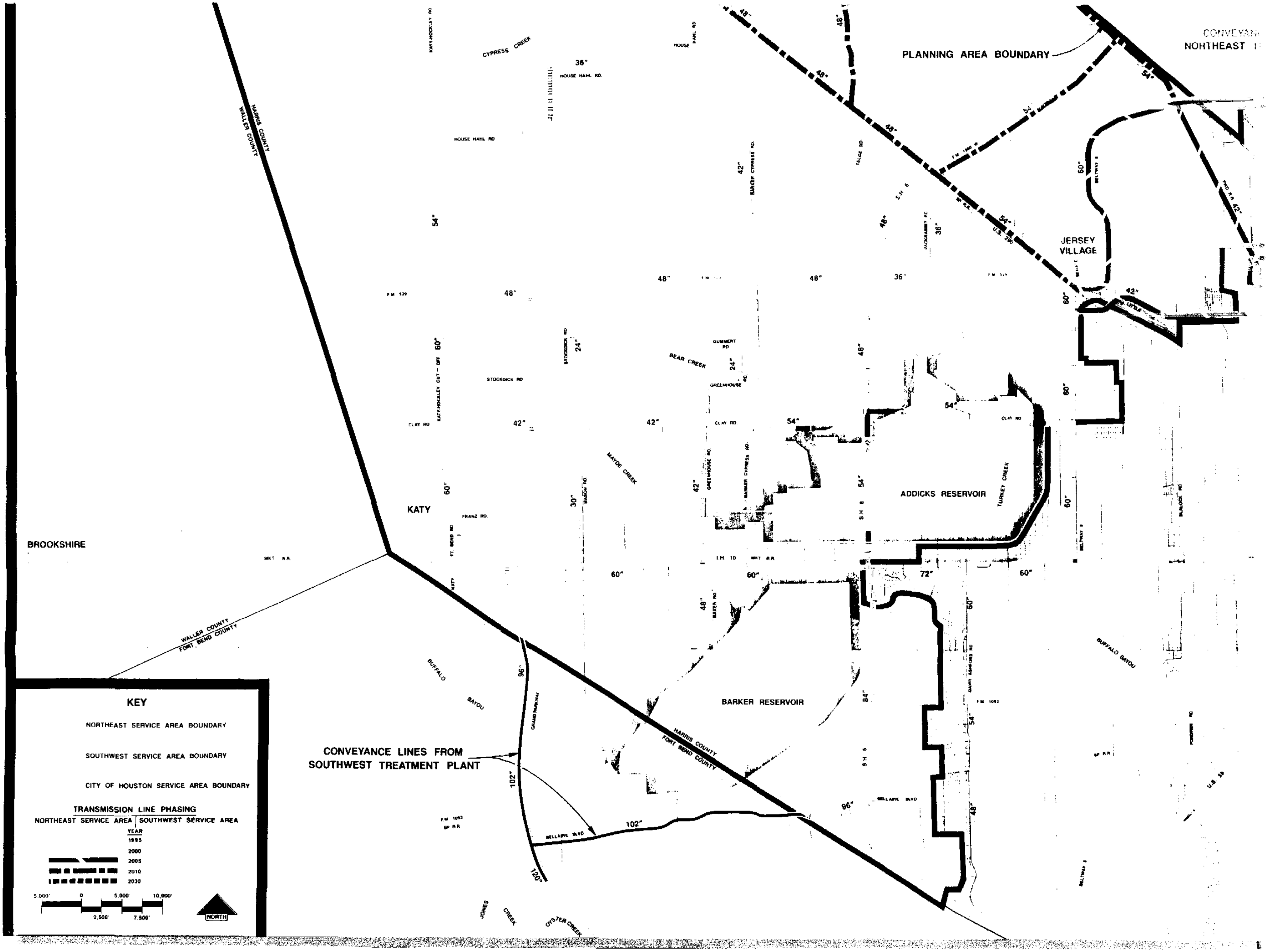
The water quality of the raw water supply is a very important factor to consider in selecting a treatment plant site. As mentioned early, Sites 4B and 5 treat raw water obtained directly from the proposed Allen's Creek Reservoir. This allows Sites 4B and 5 to assure a better quality of raw water supply than the other sites evaluated. This should translate into possible lower treatment costs, improved treated water quality and a reduction in the possibility of major future expenditures in plant upgrading due to the changing EPA water quality requirements that are in existence or will be in existence in the future.

4.0 TRANSMISSION SYSTEMS

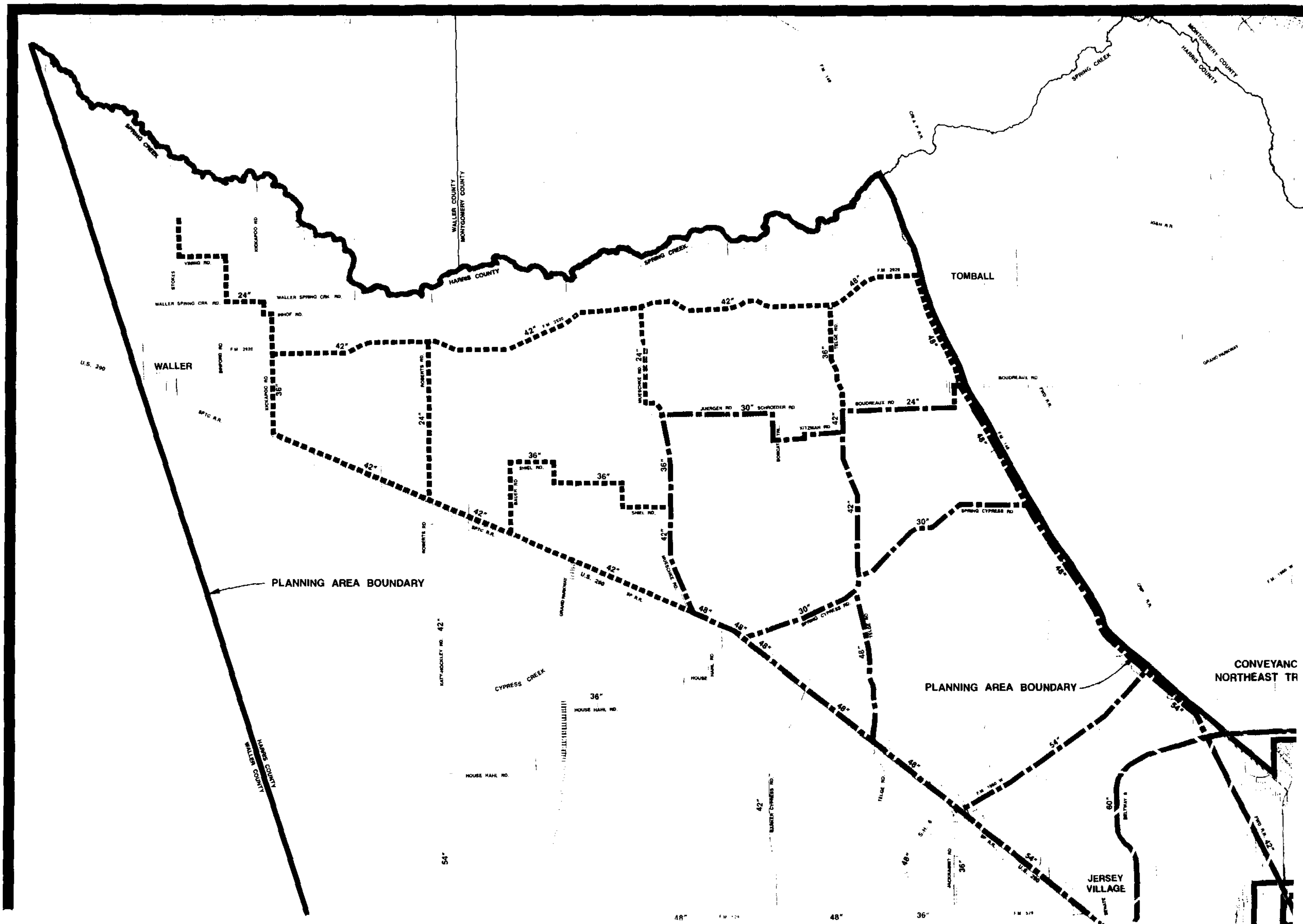


ALTERNATE 1 SERVICE AREA TRANSMISSION SYSTEM

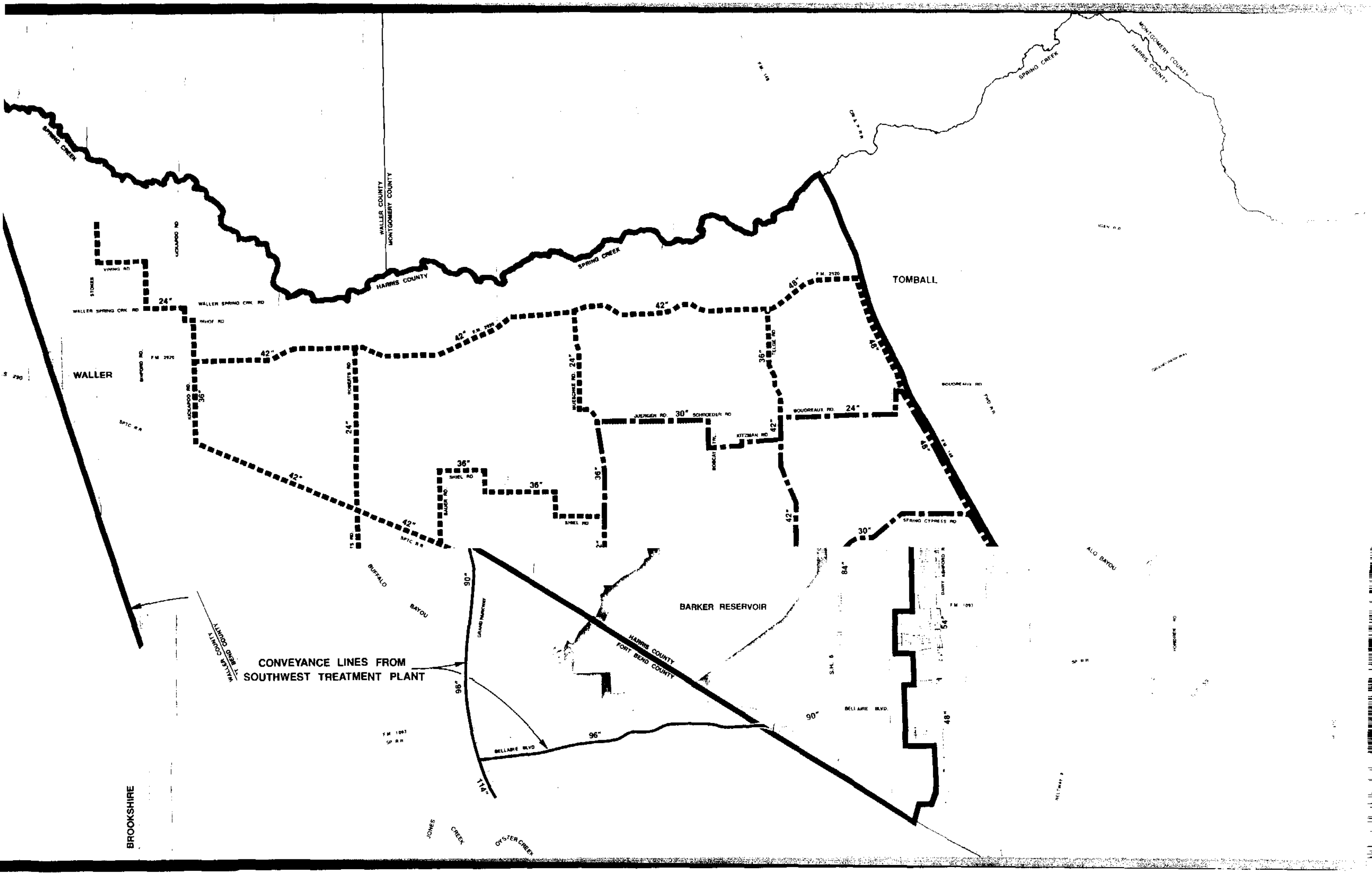
W.H.C.S.W.S.C.
FIGURE NO. 3



ALTERNATE 1 SERVICE AREA TRANSMISSION SYSTEM

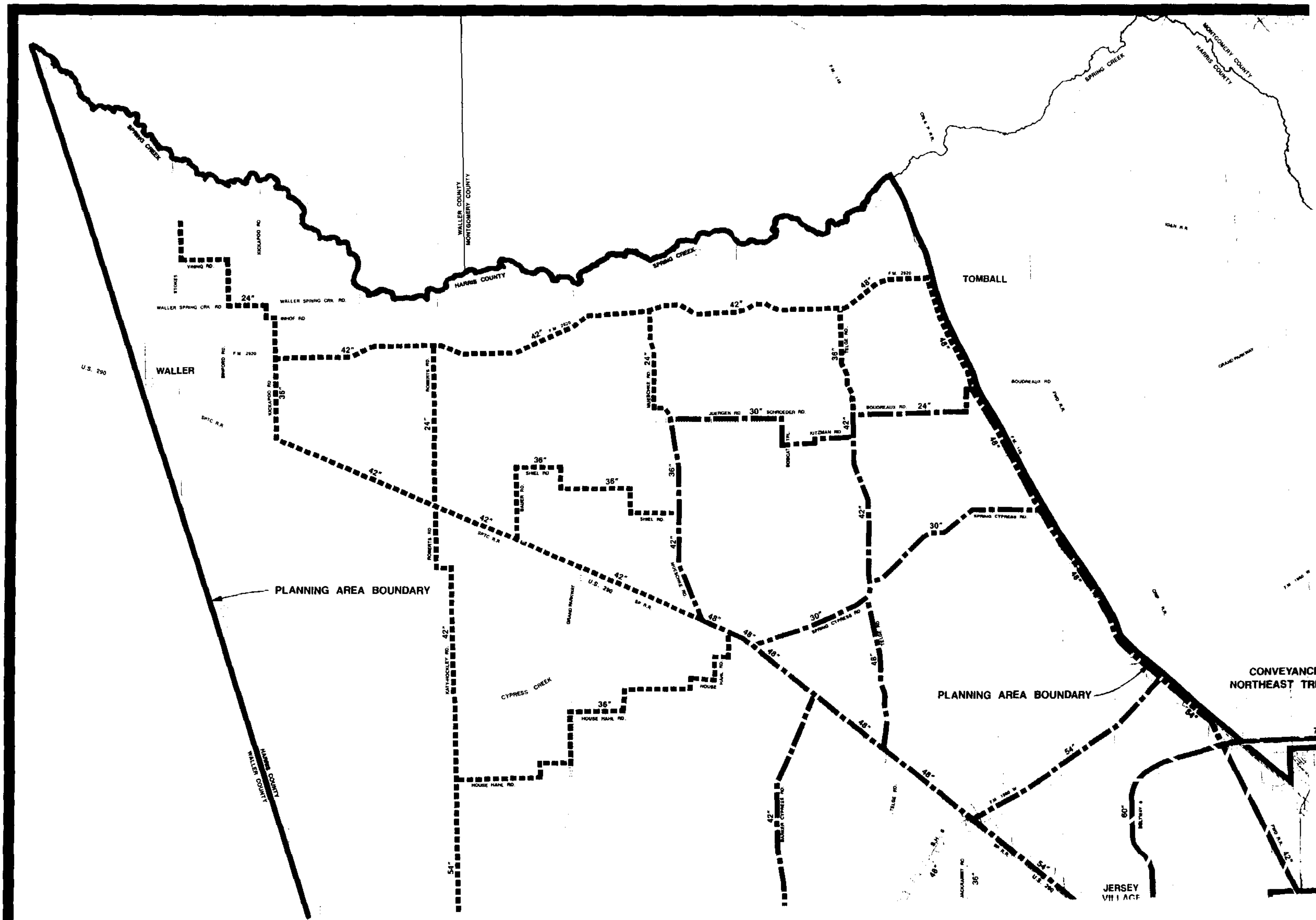


TOMBALL
WALLER
PLANNING AREA BOUNDARY
PLANNING AREA BOUNDARY
CONVEYANC
NORTHEAST TR
JERSEY VILLAGE
SPRING CREEK
HARRIS COUNTY
WALLER COUNTY
MONTGOMERY COUNTY
CYPRESS CREEK
U.S. 290
HOUSE HAHL RD.



:ERNATE 2 SERVICE AREA TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
FIGURE NO. 4

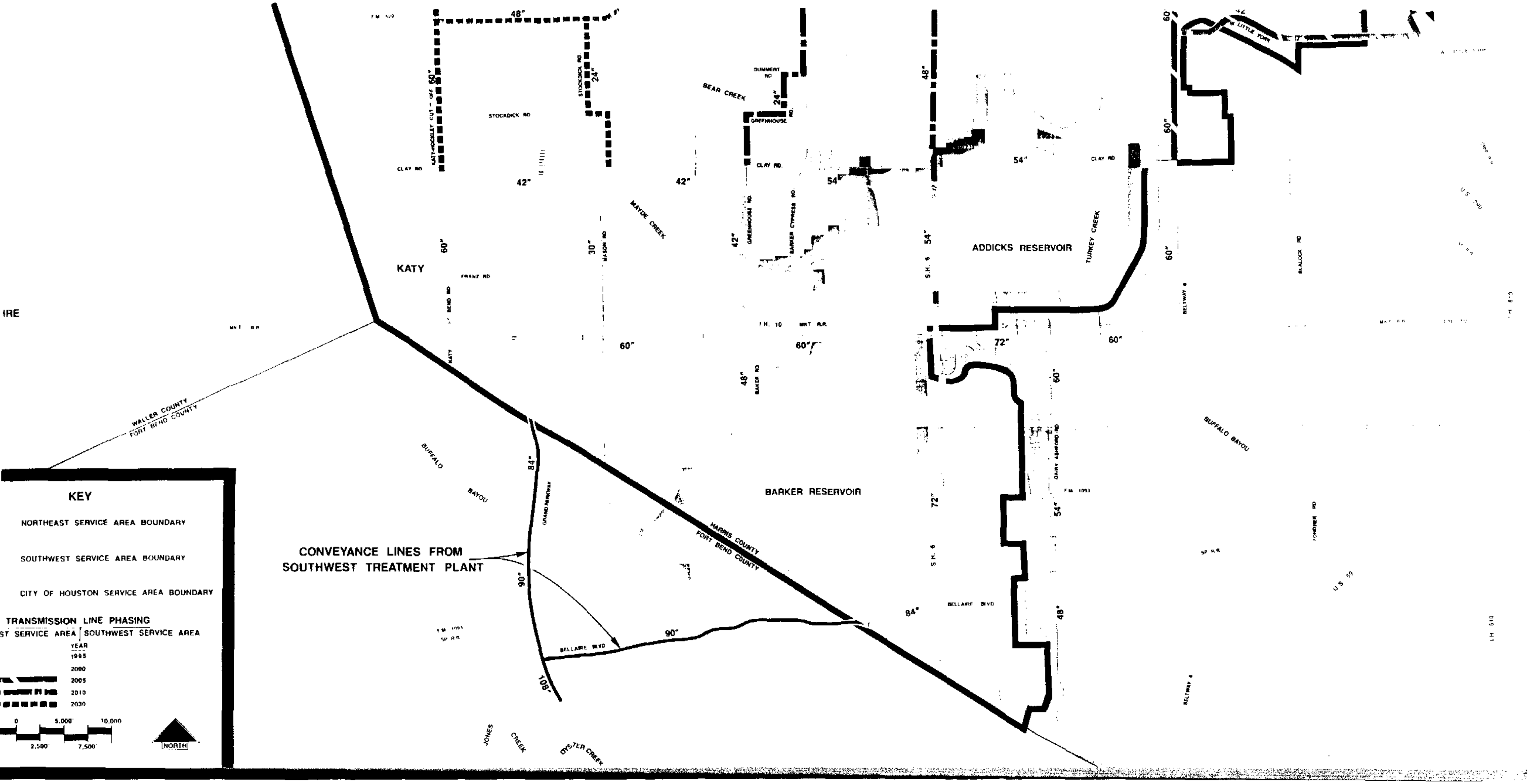


PLANNING AREA BOUNDARY
PLANNING AREA BOUNDARY
WALLER
TOMBALL
JERSEY VILLAGE
CONVEYANC
NORTHEAST TR
SPRING CREEK
HARRIS COUNTY
WALLER COUNTY
MONTGOMERY COUNTY
CYPRESS CREEK
U.S. 290
KATY-HOCKLEY RD.
ROBERTS RD
HOUSE HAHL RD.
SHIEL RD
BAUER RD.
MUESCHKE RD
JUERGEN RD
SCHROEDER RD.
KUTZMAN RD
BOBCAT TRL.
TELGE RD
BOUDREAUX RD
SPRING CYPRESS RD.
BARKER CYPRESS RD
JACKRABBIT RD
GRAND PARKWAY
KICKAPOO RD
WALLER SPRING CRK. RD.
BINFORD RD.
STOKES
VIKING RD.
F.M. 2920
BELTWAY 8
SPTC R.R.

Alternate 3 Service Area Transmission System

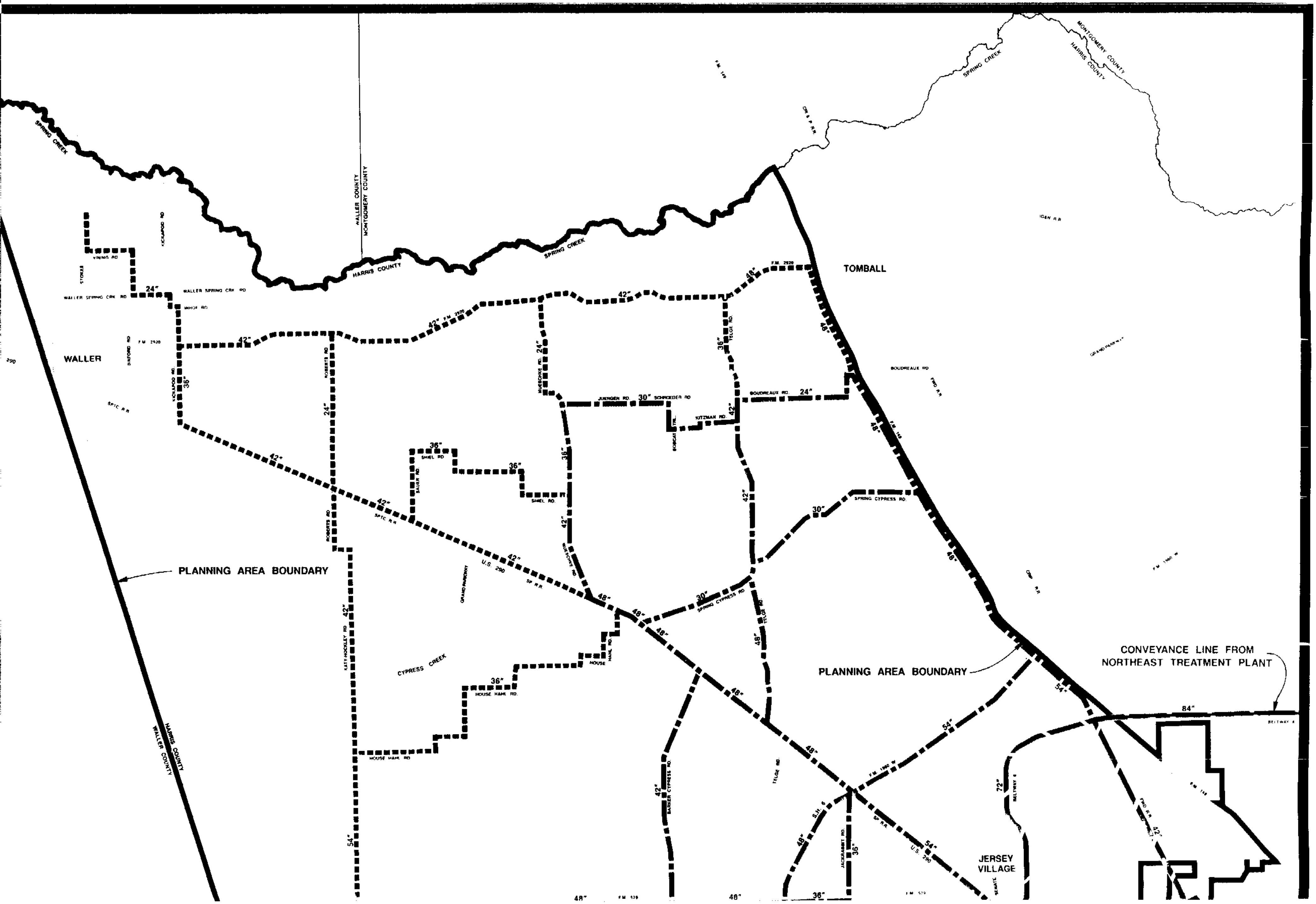
Figure 5 shows the Alternate 3 Service Area Transmission System. The boundary line for the Alternate 3 service area is Clay Road. Under this Alternate the portion of the WHCSWSC study area south of Clay Road would be served by the Southwest Supply System while the area north of Clay Road would be served by the Northeast Supply System. The Southwest Supply System would serve the City of Houston quadrant.

Phasing of this Alternate would begin in 1995 in the Southwest. The first phase of construction would be completed to serve the portion of the City of Houston located within HGCSD regulatory area 3. In 2000, the Southwest System would be extended to serve areas located within HGCSD regulatory area 4. The first phase of the Northeast System would begin in 2005 with lines being constructed to serve the areas located within HGCSD regulatory area 6. As in previous alternates the Northeast and Southwest Systems would be tied together in 2005. In 2010, no construction would occur in the Southwest while the Northeast System would be expanded to serve areas located within HGCSD regulatory area 7. In 2030, the remaining lines of the WHCSWSC transmission system would be constructed with the majority of the additions being in the Northeast.



ALTERNATE 3 SERVICE AREA TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
FIGURE NO. 5

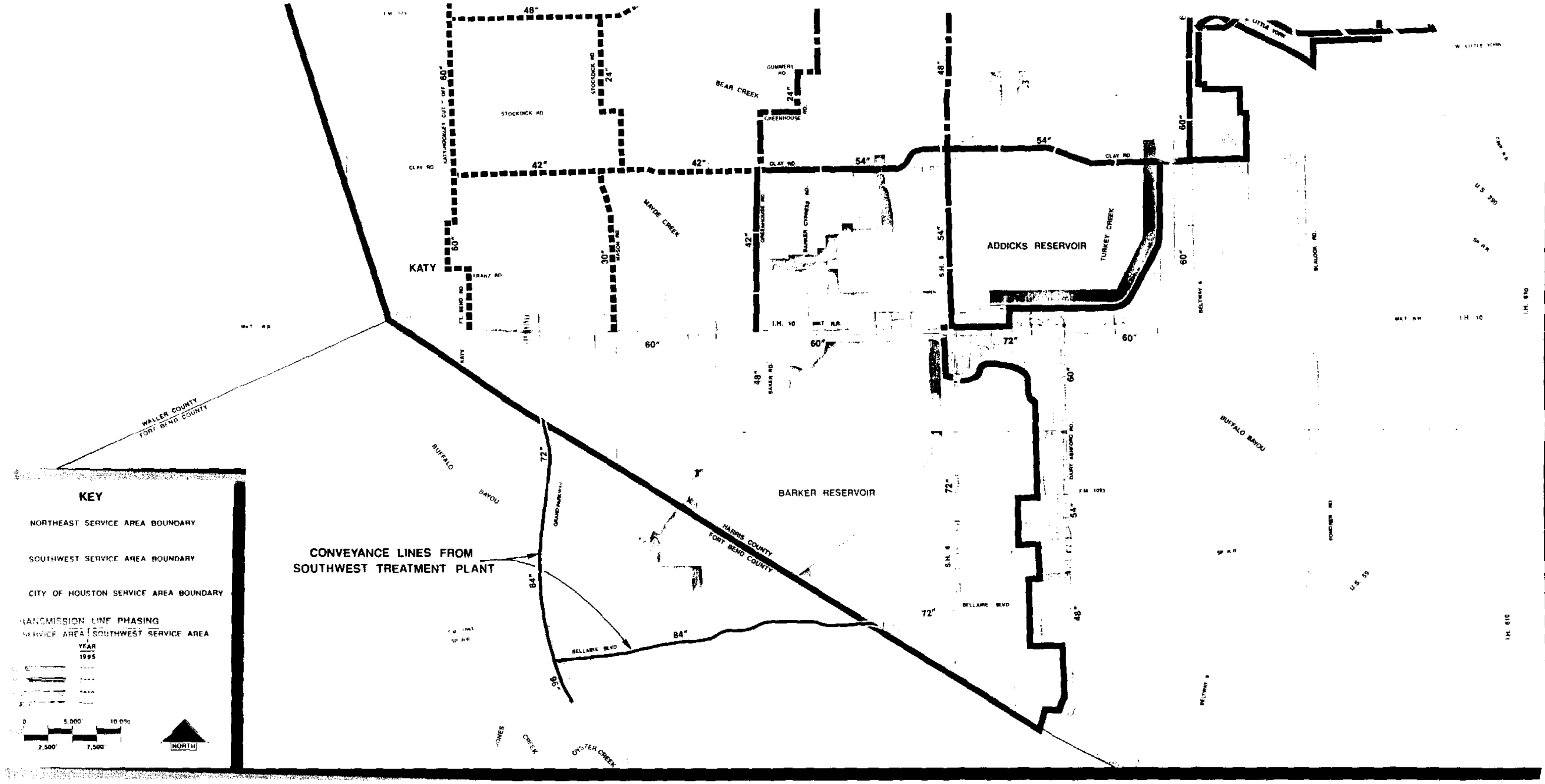


TOMBALL
WALLER
JERSEY VILLAGE
PLANNING AREA BOUNDARY
PLANNING AREA BOUNDARY
CONVEYANCE LINE FROM NORTHEAST TREATMENT PLANT
SPRING CREEK
CYPRESS CREEK
HARRIS COUNTY
WALLER COUNTY
MONTGOMERY COUNTY
U.S. 290

Alternate 4 Service Area Transmission System

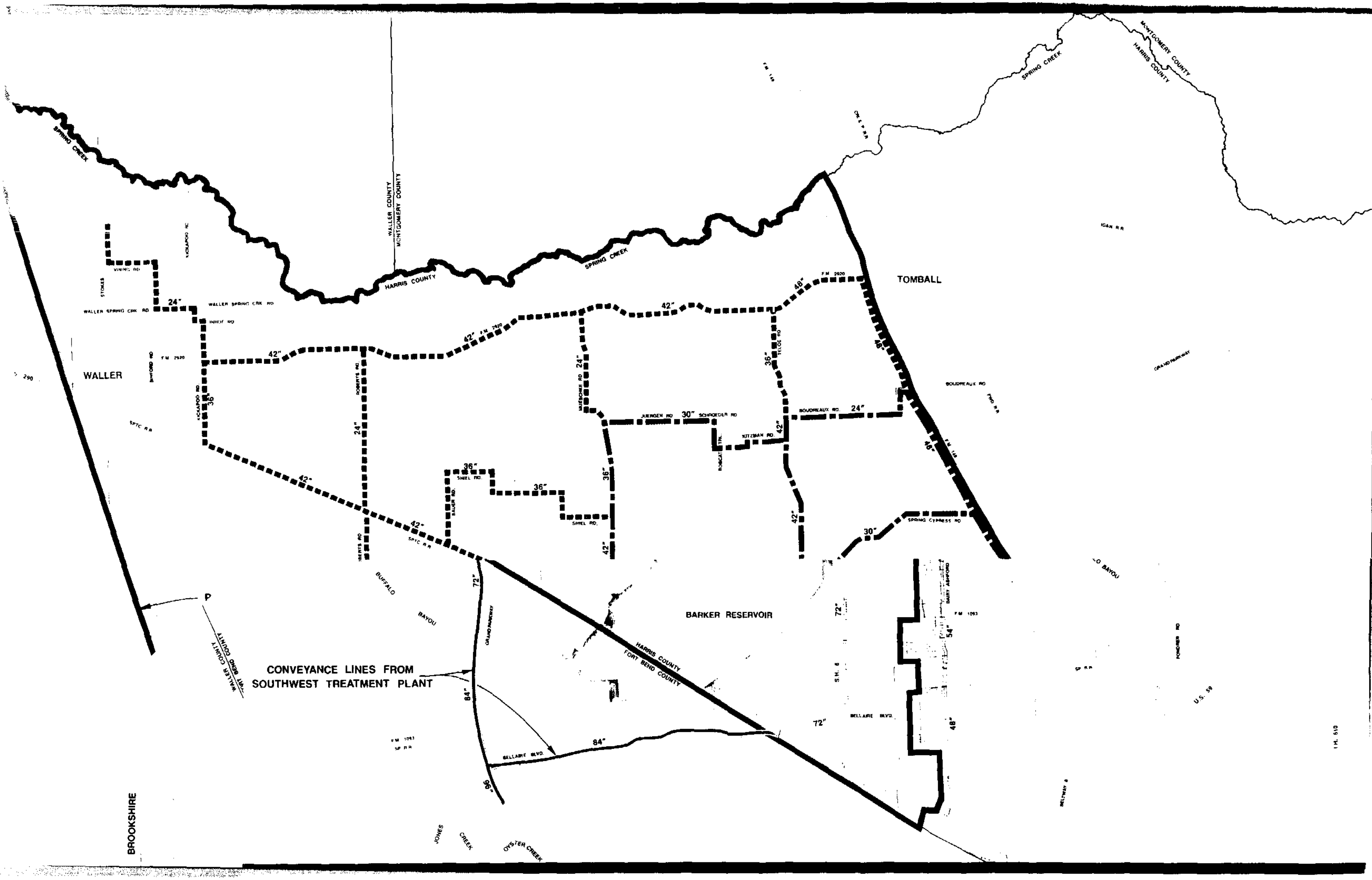
Figure 6 shows the Alternate 4 Service Area Transmission System. The boundary line for the Alternate 4 service area is Interstate 10. Under this Alternate the portion of the WHCSWSC study area south of Interstate 10 would be served by the Southwest Supply System. The area north of Interstate 10 would be served by the Northeast System. The Southwest Supply System would serve the City of Houston quadrant with both systems ultimately being tied together to form a single transmission system.

Phasing of this Alternate would begin in 1995 in the Southwest to serve of the City of Houston quadrant located within HGCSD regulatory area 3. Unlike the previous alternates, Phase I of the Northeast System would have to be constructed in 2000 to serve those areas located within HGCSD regulatory area 4. For this alternate, the Northeast and Southwest Systems would be tied together in 2000. The Northeast System would be expanded in 2005 to serve areas located within HGCSD regulatory area 6. In 2010, the Northeast System would again be expanded to serve the demands located within HGCSD regulatory area 7. In 2030, the transmission system would be completed with the majority of the lines added being in the Northeast System.



ALTERNATE 4 SERVICE AREA TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
FIGURE NO. 6



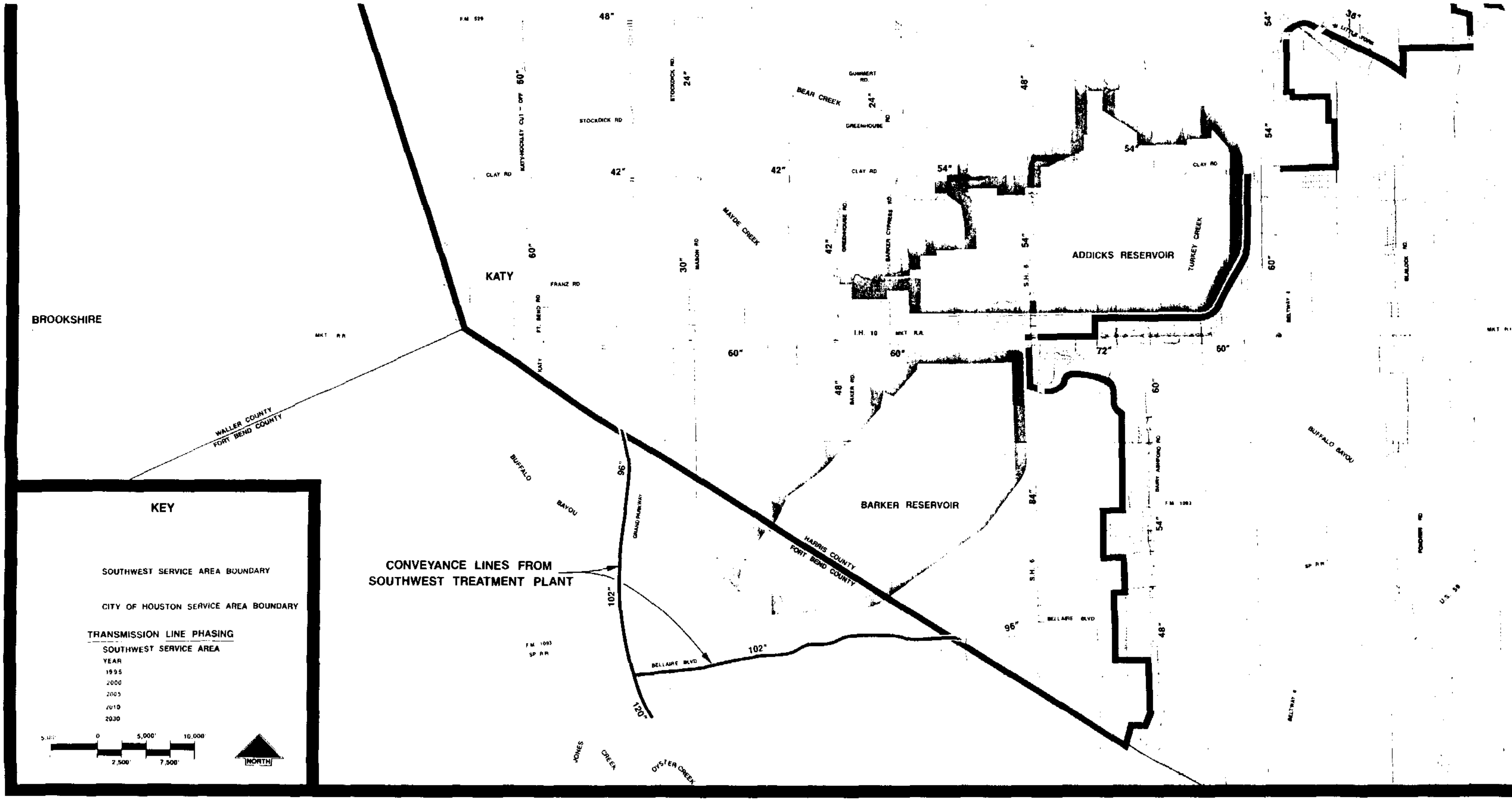
ERNATE 4 SERVICE AREA TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
FIGURE NO. 6

Alternate 7 Service Area Transmission System

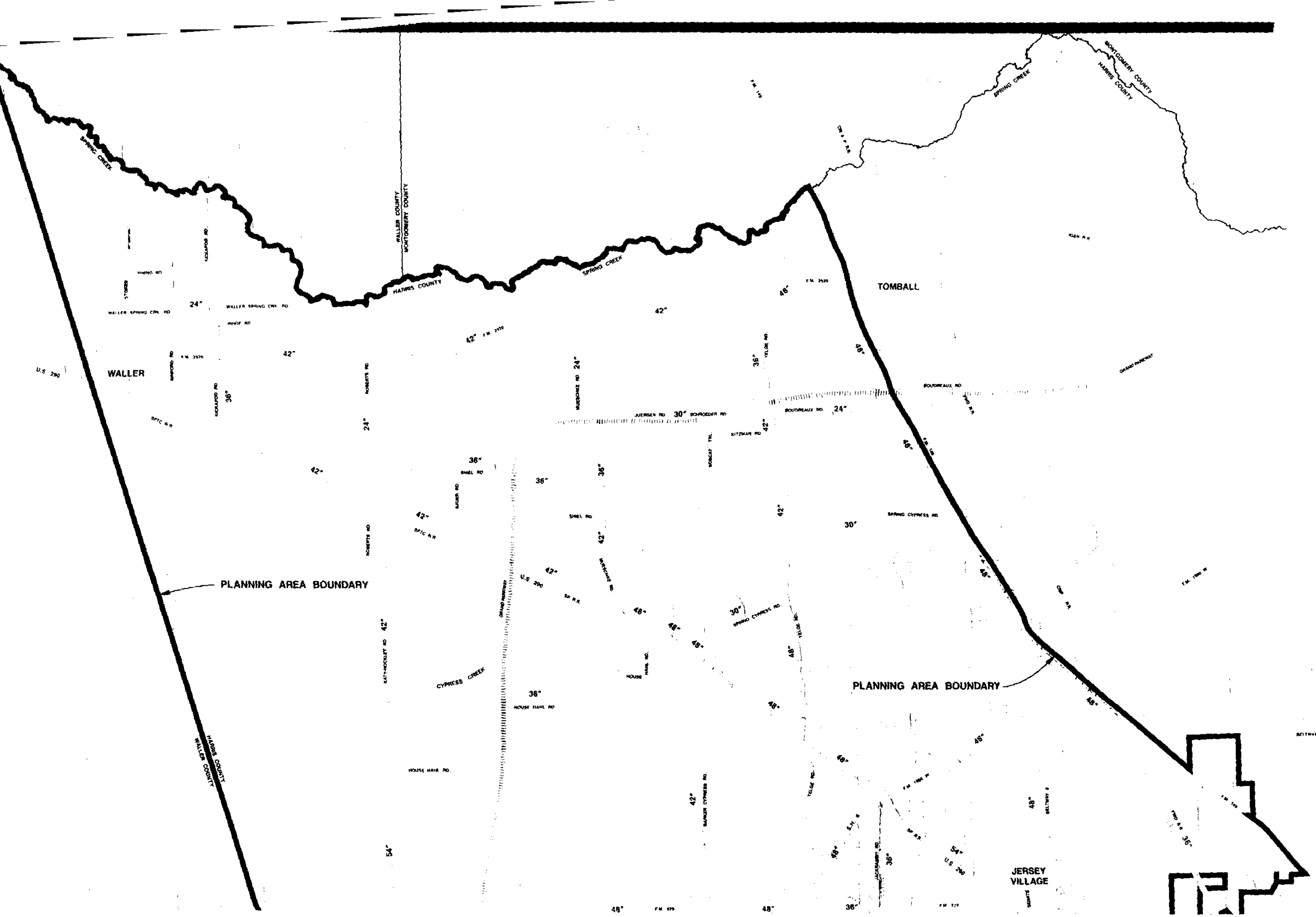
Figure 6A shows the Alternate 7 Service Area Transmission System. Under this alternate the entire WHCSWSC service area would be served by the Southwest Supply System.

Phasing of this alternate would begin in 1995 with the construction of Southwest System conveyance and transmission lines to serve the City of Houston quadrant located within HGCSD regulatory area 3. In 2000, the Southwest Transmission System would be extended to serve those areas located within HGCSD regulatory area 4. In 2005, the Southwest Transmission System would again be extended to serve the demands in HGCSD regulatory area 6. In 2010, additional transmission lines would be constructed to serve those areas within HGCSD regulatory area 7. The final additions to the transmission system would be constructed in 2030 to serve the demands within HGCSD regulatory area 8.



ALTERNATE 7 SERVICE AREA TRANSMISSION SYSTEM

W.H.C.
FIGURE



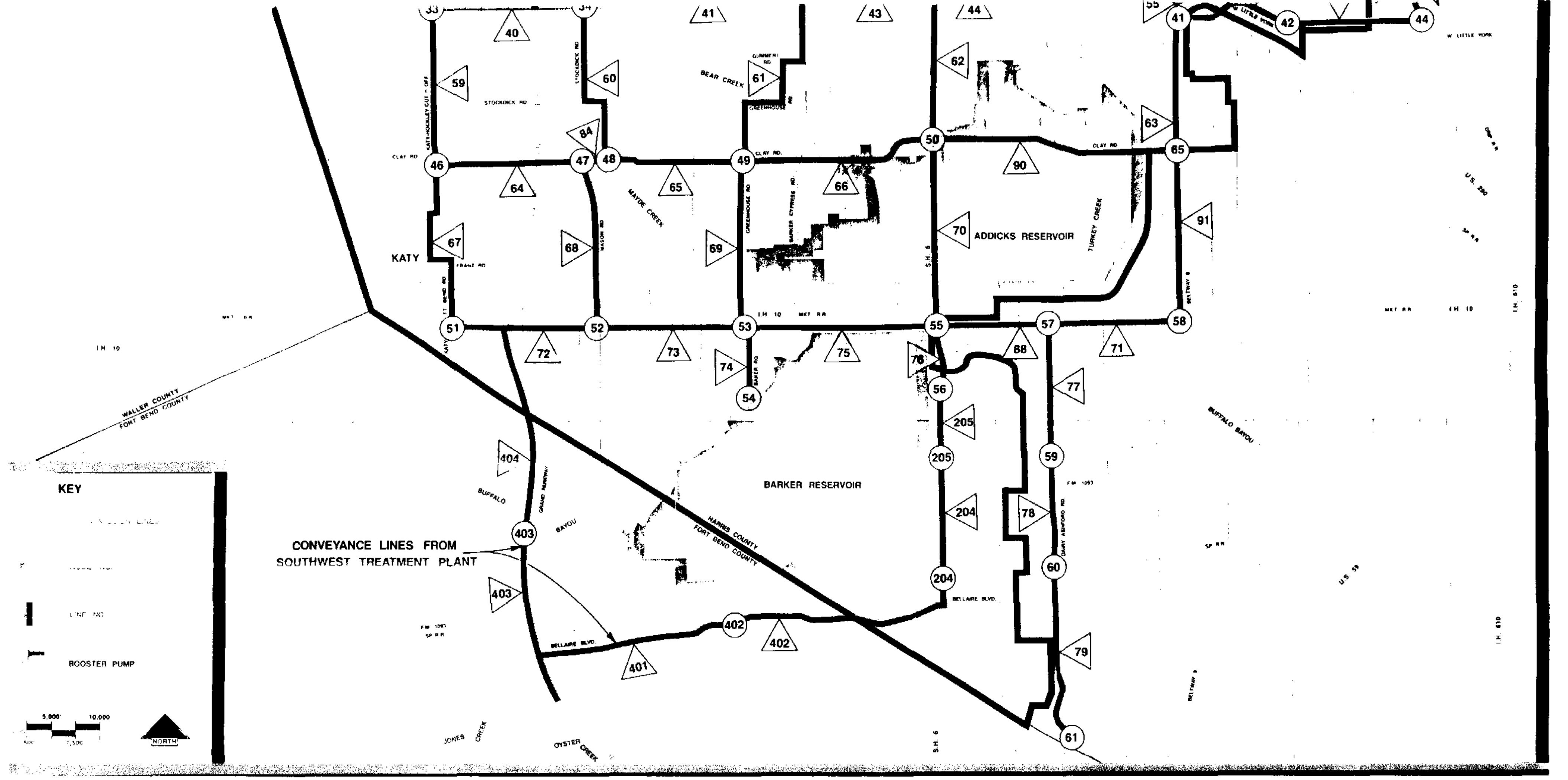
WALLER
TOMBALL
JERSEY VILLAGE
PLANNING AREA BOUNDARY
PLANNING AREA BOUNDARY
SPRING CREEK
CYPRESS CREEK
HARRIS COUNTY
WALLER COUNTY
MONTGOMERY COUNTY
ROBERTS RD.
KATY-HOCKLEY RD
HOUSE HAHL RD.
BAUER RD.
SHEL RD
MUESCHKE RD.
JUERGEN RD
SCHROEDER RD
KITZMAN RD
BOBCAT TRL.
TELGE RD.
BOUDREAUX RD.
SPRING CYPRESS RD.
BARKER CYPRESS RD.
JACKRABBIT RD.
GRAND PARKWAY
KICKAPOO RD
WALLER SPRING CRK. RD
STOKES
U.S. 290
54"
48"
42"
36"
30"
24"

Comparison of Transmission System Alternates

Figure 7 shows the schematic model used to analyze the Alternate Service Area Transmission Systems. In alternates 1 through 4, flows were varied through the conveyance lines from the proposed Northeast and Southwest Treatment Plants to correspond to the alternate service areas being investigated. For Alternate 7 the entire WHCSWSC service area was supplied from the Southwest System. Each alternate service area model was supplied from the five different Southwest Plant site locations. Lines were sized according to the criteria mentioned previously in Section 2 - "Design Considerations and Assumptions" with velocities not exceeding 7.0 fps and pressures throughout the system kept above 45 psi through the use of strategically located booster pump stations. The service area generally slopes in a northwest to southeast direction with those areas in the extreme northwest being approximately 180 feet higher than areas in the extreme southeast. Because of this elevation difference, areas of lowest pressure (approximately 45 psi) occurred in the northwest around Waller for all of the alternatives investigated. The areas of highest pressure were located in the south and southeast near the proposed locations for the Southwest Treatment Plant. Pressures in the range of 90-95 psi occurred in the conveyance line portions of the system and dropped to the 75 psi to 85 psi range upon entering the transmission system pipe network. Pressures required from the Northeast System ranged from 70-75 psi to deliver the required flows for each service area alternate. The five Alternate Service Area Transmission Systems vary only slightly when compared in their ultimate state when both the Northeast and Southwest Systems are tied together. The varying amounts of treated water supplied from the conveyance systems for the alternate service areas affects line sizes of only those lines of the transmission system closest to the entry point of the conveyance system into the transmission system.

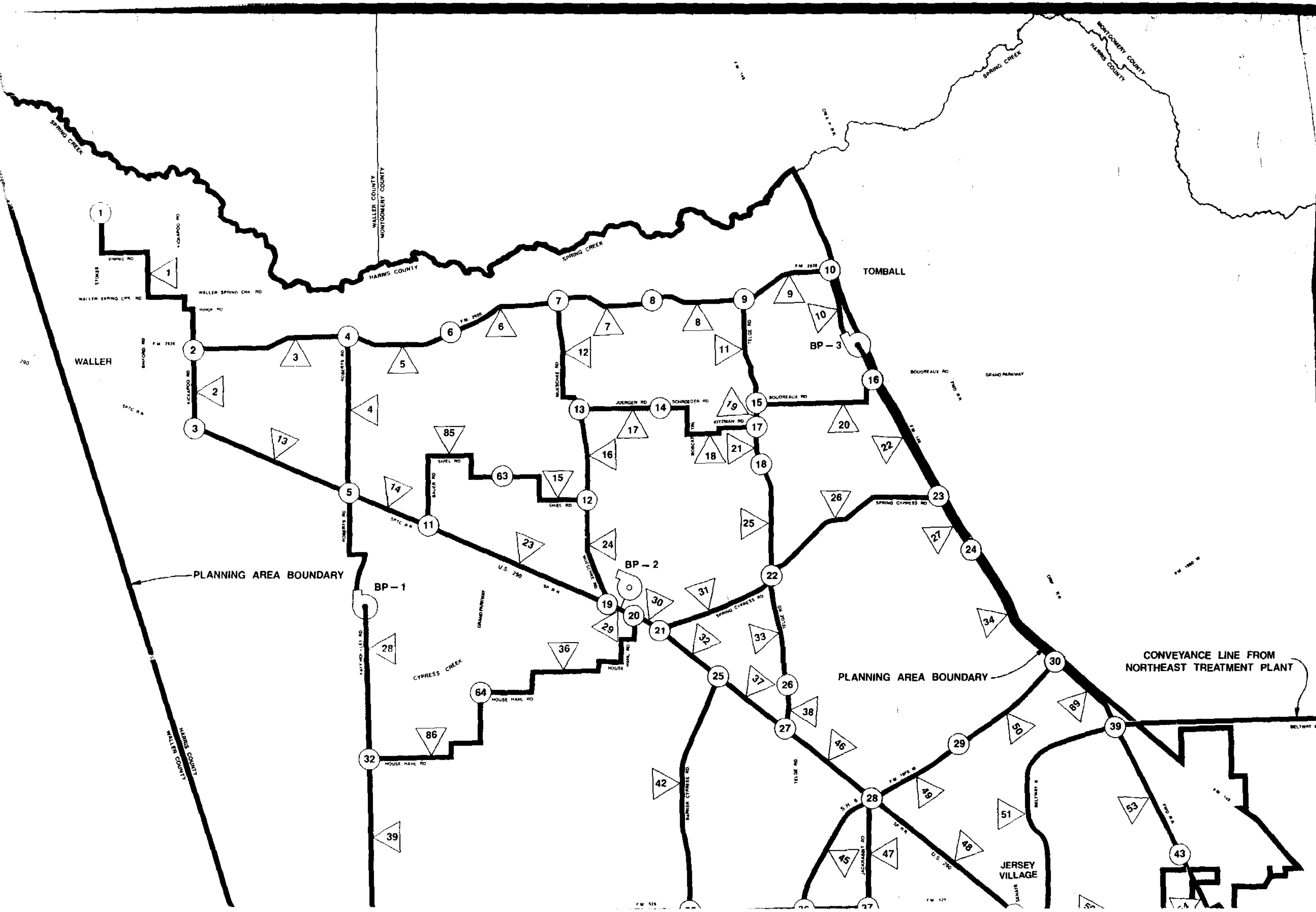
When investigating the Alternate Service Area Transmission System in regard to phasing, however, several observations can be made. The dates investigated for transmission system phasing are 1995, 2000, 2005, 2010 and 2030.

The earliest conversion dates set forth by the HGCSD are located in the southwest. This area can be easily served by the Southwest System as shown in Alternates 1, 2, 3 and 7. In Alternate 4, however, a substantial amount of line would have to be constructed in year 2000 to serve the areas located in HGCSD regulatory area 4 from a Northeast System. This makes Alternative 4 less attractive because of the substantial initial costs involved to serve such a small demand.



TRANSMISSION SYSTEM NODE MAP

W.H.C.S.W.S.C.
FIGURE NO. 7



SPRING CREEK
HARRIS COUNTY
WALLER COUNTY
MONTGOMERY COUNTY
TOMBALL
WALLER
BP – 1
BP – 2
BP – 3
PLANNING AREA BOUNDARY
CYPRESS CREEK
U.S. 290
FM 2920
FM 1960 W
CONVEYANCE LINE FROM NORTHEAST TREATMENT PLANT
JERSEY VILLAGE
BOUDREAUX RD
SPRING CYPRESS RD
HOUSE HAHL RD
TELGE RD
JUERGEN RD
SCHROEDER RD
KITZMAN RD
SHIEL RD
BAUER RD
ROBERTS RD
KICKAPOO RD
WALLER SPRING CRK RD
JACKRABBIT RD
BARKER CYPRESS RD
S.H. 6
BELTWAY 8

5.0 COST ANALYSIS

5.0 COST ANALYSIS

CONSIDERATIONS AND ASSUMPTIONS

Raw Water Costs

The raw water supply source for the Northeast System will be taken from Lake Houston. Previous reports and studies indicate an estimated raw water cost from Lake Houston to be presently in the range of $0.22 to $0.25 per thousand gallons. Correspondence recently received from the City of Houston states that for preliminary cost analysis a figure of $0.25 per thousand gallons ($0.25/1000 gal.) would be an appropriate raw water cost from Lake Houston. This cost of $0.25/1000 gallons is based on the City's cost of developing the raw water sources that presently supply the Lake Houston System. However, the City projects that this cost will increase when additional sources are developed. The HWMP considers the Lake Houston System as part of the City's "Eastern Water Alternatives". These alternatives are referred to in the HWMP as the Toledo Bend Alternative (Alternative No. 4) and the Toledo Bend plus Wallisville Alternative (Alternative No. 9). For this study the HWMP's Toledo Bend Alternative will be used for projecting future raw water costs in the Lake Houston System. After reviewing the HWMP, it was determined that the Toledo Bend Conveyance System is projected to be on line by 2010. According to the HWMP this project will increase the raw water cost in the Lake Houston System to $0.38/1000 gallons in 2010, and raw water cost will remain at this figure until 2029. In 2030 the cost of raw water will decrease to $0.32/1000 gallons. This decrease in cost is due to an increase in demand allowing the City to amortize the cost of the Toledo Bend Water over a larger customer base. For cost purposes this study will use the following raw water cost for the Northeast System:

Year	Raw Water Cost
1990-2009	$0.25/1000 Gallons
2010-2029	$0.38/1000 Gallons
2030-After	$0.32/1000 Gallons

The raw water supply source for the Southwest System will be taken from the Brazos River and/or one of its canals. Correspondence received from the Brazos River Authority (BRA) outlines an incremental schedule of water supply developments tailored to meet the demands of the WHCSWSC service area. Table 5 presents the supply designation schedule for the Southwest System. The price quoted by the BRA for future use water is $40.00 per acre-foot ($0.12 per thousand gallons) and the price for current use water is $120.00 per acre-foot ($0.37 per thousand gallons). All of the cost tables presented in this study considered the cost for future use water as a capital cost for raw water.

TABLE 5

SUPPLY DESIGNATION SCHEDULE
WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION
(Based on Average Daily Supply)

Projection Year	Supply Increments	Future Use Water AF/YR (MGD)		Minimum Current Use Water AF/YR (MGD)	
1988	First Increment (1)	75,000	(67.0 MGD)	0	0
1995	First Increment (1)	30,000	(26.8 MGD)	45,000	(40.2 MGD)
2000	Second Increment (2)	40,000	(35.7 MGD)	80,000	(71.5 MGD)
2010	Third Increment (3)	30,000	(26.8 MGD)	120,000	(107.2 MGD)
2015	Third Increment (3)	20,000	(17.9 MGD)	130,000	(116.1 MGD)
2020	Third Increment (3)	20,000	(17.9 MGD)	130,000	(116.1 MGD)
2025	Third Increment (3)	20,000	(17.9 MGD)	130,000	(116.1 MGD)
2030	Third Increment (3)	0	0	150,000	(134.0 MGD)

(1) To be furnished from existing sources.

(2) Now expected to be furnished from the Allen's Creek Project.

(3) Now expected to be furnished from the South Bend Project.

Raw Water Pumping/Conveyance Costs

Cost estimates were prepared to determine the capital and operational costs associated with the transfer of raw water from each alternate raw water supply source to the alternate treatment plant sites.

Capital cost estimates include the construction costs for raw water pump stations at each source plus the construction costs for the necessary raw water conveyance pipelines and appurtenances. All capital cost estimates were based on current construction costs for similar facilities constructed in the Houston area.

Operation costs for raw water conveyance were based on using an estimated power cost of $0.05/kilowatt-hour and an efficiency factor of 85 percent. Maintenance costs were estimated based on historical data.

Delivery costs associated with raw water taken from the Brazos Canal System were provided to the WHCSWSC from the BRA. This cost was based on utilizing the existing BRA pumps at the Brazos River and minimum improvements to the Canal System. The projected delivery cost provided by the BRA was $0.06/1000 gallons.

Termination Storage Costs

Termination storage requirements for each site were based on a water quality criteria aimed at limiting chlorides to 240 mg/l. From previously presented historic water quality data for the Brazos River (Station No. 08114000), it can be seen that chlorides are below this level approximately 95% of the time. This would mean that 5% of the time raw water would need to be pumped from storage rather than directly from the Brazos River. Termination storage facilities were sized based on this assumption of pumping maximum daily demands from storage for 5% of the year. The volume of termination storage required is as follows, assuming a usable depth of 16 feet:

Service Area	Ultimate Southwest Maximum Daily Demand (MGD)	Required Storage (Acres)
Alternate 1	187	658
Alternate 2	177	623
Alternate 3	140	525
Alternate 4	121	424
Alternate 7	231	808

Capital costs associated with termination storage include the construction cost to build such a facility plus the cost of the land required. Construction costs were based on similar construction in the Houston area and land costs were obtained from County Tax Records as well as the present cost of major tracts in the vicinity of the general areas evaluated for a proposed Southwest Plant site.

Treatment Costs

All treatment plant capital cost estimates were based on current construction costs for similar facilities in the Houston area and include land costs, engineering and contingencies.

Facilities related to the Northeast System are the WHCSWSC share of the Northeast Treatment Plant and the large booster pump station connected to the Northeast Conveyance line at the WHCSWSC boundary. Costs for the WHCSWSC share of the Northeast Treatment Plant are based on recent bids for the City of Houston Southeast and East Water Purification Plants. In allocating costs, differentiation must be made between the cost of treatment capacity and the cost of treated water pumping capacity. The transmission of treated water within the WHCSWSC service area will be accomplished from separate pump stations and local pumping facilities as opposed to facilities at the treatment plants.

The Northeast Treatment Plant capital cost used in this study was approximately \$0.80 per gallon which increased to \$1.08/gallon when adding land cost and site development cost. The Southwest Treatment Plant capital cost was based on \$0.80 per gallon for actual treatment facilities. This figure was increased depending on the plant site alternate to include land cost and site development.

Operating and treatment costs associated with the Northeast and Southwest Treatment Plants include costs for power to run the equipment, treatment chemicals, maintenance costs and supplies.

The costs of operations and treatment at the proposed Northeast Treatment Plant are estimated to be in the range of $0.40 to $0.50 per thousand gallons based on information provided by the City of Houston. For planning purposes for the WHCSWSC study, a figure of $0.40 per thousand gallons will be used for operations and treatment costs at the proposed Northeast Treatment Plant.

Operations and treatment costs at the proposed Southwest Treatment Plant are estimated to be $0.42 per thousand gallons. This figure is based on detailed cost data compiled over the past year by the Galveston County Water Authority (GCWA) who presently treats raw water taken from the Brazos River System using the BRA Canal System for conveyance purposes.

<u>Treated Water Pumping/Conveyance Costs</u>

Conveyance System cost estimates were prepared for each of the three Northeast Conveyance System alternate routes and each of the five Southwest Conveyance System alternate routes. Estimates were based on current construction costs for similar facilities constructed in the

Houston area. The majority of the conveyance lines were routed within existing street right-of-ways. Where this was not possible, allowances were included for right-of-way acquisitions. Included in the estimates were costs for crossing waterways and major thoroughfares, valves and appurtenances, corrosion protection, engineering and contingencies.

Operating costs associated with the conveyance systems includes energy costs to run the pumps required to maintain flow and system pressures and the associated maintenance of these facilities. Exact costs for the maintenance of such facilities is not readily available, however, costs for repairs to pumps, line leaks, valve failures and similar repairs were accounted for by using an estimated $0.04 per thousand gallon cost. A figure of $0.05 per kilowatt-hour was used to estimate annual pumping costs assuming an 85 percent efficiency factor.

The above costs do not include administrative costs such as record keeping, reporting, billing and system administration.

Transmission System Costs

Transmission System cost estimates were prepared for each of the alternate service areas investigated. Costs were determined for the ultimate (Year 2030) transmission system, as well as phases of construction corresponding to years 1995, 2000, 2005, 2010 and 2030. All estimates were based on current construction costs for similar facilities constructed in the Houston area and include costs for crossing major thoroughfares and waterways, valves and appurtenances, corrosion protection, engineering and contingencies. An effort was made to route the transmission lines within existing street right-of-ways. Where it was not possible, allowances were included for right-of-way acquisition.

Facilities common to both the Northeast and Southwest Transmission Systems are the three ground storage and booster pump stations required within the transmission system to maintain flow and pressure. Capital costs for these facilities were based on current construction costs for similar facilities constructed in the Houston area. Operation costs for the pumps were based on $0.05 per kilowatt-hour using an 85% efficiency factor.

CAPITAL COST ESTIMATES

General

The capital cost estimates shown in this section are for comparison purposes only. The capital cost used in this study include 10 percent construction cost increase for engineering as well as a 10 percent increase for contingencies. The capital cost shown here are for ultimate conditions from the year 1995 (Phase I) through 2030 (Phase V).

Northeast Conveyance System Alternates

The ultimate capital cost estimates for each of the three alternate Northeast Conveyance Systems are presented on Table 6 shown below. All costs are in 1988 dollars and include engineering and contingency.

TABLE 6

NORTHEAST CONVEYANCE SYSTEM CAPITAL COST
(ULTIMATE SYSTEM - YEAR 2030)
(In Thousands)

NORTHEAST CONVEYANCE ALTERNATE	SERVICE AREA ALTERNATE				
	NO. 1	NO. 2	NO.3	NO. 4	NO. 7
Beltway 8 Route	$96,578	$114,775	$173,533	$205,787	0
NHCWSC Route	102,382	122,293	185,066	219,107	0
F.M. 1960 Route	106,957	128,539	195,701	232,048	0

Southwest Conveyance System Alternates

The ultimate capital cost estimates for each of the six alternate Southwest Conveyance Systems are presented on Table 7 shown below. All costs are in 1988 dollars and include engineering and contingency. The cost shown below are ultimate costs and are not normalized to account for the varying amounts of treated water produced in each Service Area Alternate.

TABLE 7

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
(ULTIMATE SYSTEM - YEAR 2030)
(In Thousands)

SOUTHWEST CONVEYANCE ALTERNATE	SERVICE AREA ALTERNATE NO. 1	NO. 2	NO. 3	NO. 4	NO. 7
SITE 1 Oyster Creek/ Dairy Ashford	$285,408	$271,044	$224,893	$195,746	$344,109
SITE 2 Brazos River/ Highway 6	282,111	266,734	222,974	195,626	333,221
SITE 3 Oyster Creek/ Highway 6	266,023	252,003	208,091	181,742	320,022
SITE 4A Jones Creek/ Grand Parkway	281,883	266,167	221,287	189,808	331,727
SITE 4B Allens Creek/ Grand Parkway	304,076	289,554	248,497	220,566	346,247
SITE 5 Allens Creek/ F.M. 1960	313,082	296,029	248,913	220,153	355,253

Transmission System Service Area Alternates

The ultimate transmission system capital cost estimates for the years 1995 through 2030 are shown on Table 8. All costs are in 1988 dollars and include engineering and contingencies costs. As shown in the following table, the transmission system costs for each Service Area Alternate is higher when using the Southwest Conveyance System alternates Site 2 and 3. However, the cost differential is offset by the smaller Southwest Conveyance System capital cost of Site 2 and 3. Refer to Table 7 for details on these Southwest Conveyance System costs.

TABLE 8

TRANSMISSION SYSTEM CAPITAL COST
(ULTIMATE SYSTEM - YEAR 2030)
(In Thousands)

SERVICE AREA ALTERNATE	SOUTHWEST CONVEYANCE SYSTEM ALTERNATE					
	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
ALTERNATE 1 SERVICE AREA						
Northeast	$151,865	$151,865	$151,865	$151,865	$151,865	$151,865
Southwest	$215,312	$228,797	$215,287	$215,287	$215,287	$215,698
TOTAL	**$367,177**	**$380,622**	**$380,662**	**$367,152**	**$367,152**	**$367,563**
ALTERNATE 2 SERVICE AREA						
Northeast	$183,437	$183,437	$183,437	$183,437	$183,437	$183,437
Southwest	$170,247	$194,126	$194,126	$182,112	$182,112	$183,786
TOTAL	**$353,684**	**$377,563**	**$377,563**	**$365,549**	**$365,549**	**$367,223**
ALTERNATE 3 SERVICE AREA						
Northeast	$246,498	$246,498	$246,498	$242,504	$242,504	$242,504
Southwest	$116,357	$131,026	$131,026	$121,425	$121,425	$116,386
TOTAL	**$362,855**	**$377,524**	**$377,524**	**$363,929**	**$363,929**	**$358,890**
ALTERNATE 4 SERVICE AREA						
Northeast	$288,262	$288,262	$288,262	$284,267	$284,267	$284,267
Southwest	$ 69,509	$ 85,583	$ 85,583	$ 76,539	$ 76,539	$ 72,248
TOTAL	**$357,771**	**$373,845**	**$373,845**	**$360,806**	**$360,806**	**$356,515**
ALTERNATE 7 SERVICE AREA						
Northeast	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Southwest	$360,164	$373,649	$373,649	$360,139	$360,139	$360,551
TOTAL	**$360,164**	**$373,649**	**$373,649**	**$360,139**	**$360,139**	**$360,551**

COST COMPARISONS

General

The evaluation of cost between numerous combinations of alternatives is a complicated issue. The information previously presented identifies five service area alternatives, six southwest conveyance system alternatives and three northeast conveyance system alternatives which produces approximately 100 different combinations. This section of the report will only compare in detail five service area alternates in combination with the recommended Northeast Conveyance System Alternate (Beltway 8 Route) and the top two ranked Southwest Conveyance System Alternates as identified and recommended in the following sections of this appendix. The top two ranked Southwest Conveyance System Alternates are Alternate No. 4B (Allens Creek/Grand Parkway) and Alternate No. 5 (Allens Creek/F.M. 1093).

This study has utilized two cost methods when comparing cost between alternatives, total annualized cost analysis and present worth analysis.

Annualized Cost Analysis

The annualized cost for each alternate was determined by adding capital cost amortized at 8% over 30 years with the associated annual operation and maintenance cost. The annual cost was further refined into annual cost per thousand gallons of water delivered by dividing the annual cost by the maximum daily water delivered for each phase of conversion. This final refinement will place the alternates on a comparable basis independent of the amount of water delivered by the phased developments. Tables 9, 10 and 11 present the cumulative annualized cost of each phase for the Southwest Conveyance System Alternates, the Northeast Conveyance System Alternates and the Service Area Alternates. The annualized cost table for the Service Area Alternates includes the recommended alternatives for the Northeast and Southwest Conveyance Systems as previously mentioned.

Table 9 shows that the Beltway 8 Route is the least expensive Northeast Conveyance System route with regards to annualized cost in all alternatives and all phases. Table 10 shows that the Southwest Conveyance System Alternate Site 5 produces a significantly lower annualized cost in the year 2030 than the remaining alternate sites studied. As can be seen in Table 11, Service Area Alternate 7 produces the lowest overall annualized cost in the year 2030 with the remaining Service Area Alternates producing an annualized cost within 5 percent of Service Area Alternate 7. The Service Area Alternate annualized costs for Phases III, IV and V as shown on Table 11 do not reflect the real cost differences between serving an area with Southwest versus Northeast water. When combining the annualized Southwest Conveyance, Northeast Conveyance and Transmission System costs for various Service Area Alternates, the cost differences appear quite small. This cost difference reduction is due to the large difference in annualized cost between serving an area from the

Southwest versus the Northeast. An example of the subsidizing affect by the Southwest System can be explained by evaluating the Southwest System separately from the Northeast System in each phase within each Service Area Alternate. When evaluating annualized cost in Phase III (Year 2005) it was determined that the area under mandate to convert in Phase III would cost approximately $1.62/1000 gallons if served from the Southwest and approximately $5.10/1000 gallons when served from the Northeast. Further justification of the advantages in the early phases of using southwest water over northeast water can be found when evaluating Phase II (Year 2000). It was determined that the area between I-10 and Clay Road could be served from the Southwest at a cost of $1.59/1000 gallons, however, to serve this area from the Northeast it would cost approximately $7.14/1000 gallons. As a result of the above comparisons, it can be concluded that it is significantly cheaper to serve the areas mandated in the years 1995, 2000 and 2005 from the Southwest System rather than the Northeast System.

TABLE 9

ANNUALIZED COST PER 1,000 GALLONS
(CUMULATIVE)
NORTHEAST CONVEYANCE SYSTEM

NORTHEAST CONVEYANCE ALTERNATE	*NORTHEAST CONVEYANCE SYSTEM ($/1000 GALLONS)				
	PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V
BELTWAY 8 ROUTE					
Service Area Alt. 1	0	0	2.06	1.43	1.37
Service Area Alt. 2	0	0	2.20	1.44	1.35
Service Area Alt. 3	0	0	2.63	1.40	1.32
Service Area Alt. 4	0	4.81	2.30	1.42	1.31
Service Area Alt. 7	0	0	0	0	0
NHCWSC ROUTE					
Service Area Alt. 1	0	0	2.19	1.47	1.39
Service Area Alt. 2	0	0	2.37	1.48	1.38
Service Area Alt. 3	0	0	2.89	1.44	1.35
Service Area Alt. 4	0	5.52	2.54	1.47	1.34
Service Area Alt. 7	0	0	0	0	0
F.M. 1960 ROUTE					
Service Area Alt. 1	0	0	2.29	1.50	1.42
Service Area Alt. 2	0	0	2.52	1.51	1.41
Service Area Alt. 3	0	0	3.13	1.48	1.38
Service Area Alt. 4	0	6.21	2.77	1.52	1.37
Service Area Alt. 7	0	0	0	0	0

*All costs are compounded from previous phases and annualized at 8% for 30 years.

All costs above are for the Northeast Conveyance System only.

TABLE 10

ANNUALIZED COST PER 1,000 GALLONS
(CUMULATIVE)
SOUTHWEST CONVEYANCE SYSTEM

SOUTHWEST CONVEYANCE ALTERNATE	*SOUTHWEST CONVEYANCE SYSTEM ($/1000 Gallon) PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V
SITE 1					
Service Area Alt.1	1.58	1.46	1.48	1.44	1.41
Service Area Alt.2	1.56	1.46	1.47	1.44	1.42
Service Area Alt.3	1.53	1.44	1.45	1.47	1.45
Service Area Alt.4	1.50	1.42	1.44	1.46	1.46
Service Area Alt.7	1.58	1.46	1.46	1.40	1.38
SITE 2					
Service Area Alt.1	1.49	1.38	1.40	1.36	1.33
Service Area Alt.2	1.47	1.37	1.39	1.36	1.33
Service Area Alt.3	1.53	1.41	1.42	1.44	1.41
Service Area Alt.4	1.42	1.35	1.37	1.39	1.39
Service Area Alt.7	1.49	1.38	1.38	1.32	1.30
SITE 3					
Service Area Alt.1	1.48	1.40	1.42	1.39	1.37
Service Area Alt.2	1.47	1.39	1.41	1.39	1.37
Service Area Alt.3	1.45	1.38	1.40	1.42	1.40
Service Area Alt.4	1.43	1.37	1.39	1.41	1.41
Service Area Alt.7	1.48	1.40	1.40	1.36	1.34
SITE 4A					
Service Area Alt.1	1.46	1.38	1.40	1.38	1.39
Service Area Alt.2	1.44	1.38	1.39	1.38	1.40
Service Area Alt.3	1.43	1.37	1.38	1.40	1.44
Service Area Alt.4	1.40	1.35	1.37	1.39	1.45
Service Area Alt.7	1.46	1.38	1.39	1.35	1.36
SITE 4B					
Service Area Alt.1	1.46	1.35	1.37	1.38	1.37
Service Area Alt.2	1.45	1.34	1.36	1.39	1.38
Service Area Alt.3	1.42	1.33	1.35	1.37	1.39
Service Area Alt.4	1.40	1.33	1.34	1.36	1.41
Service Area Alt.7	1.46	1.35	1.35	1.33	1.33

*All costs are compounded from previous phases and annualized at 8% for 30 years.

All costs above are for the Southwest Conveyance System only.

TABLE 10 (CONT'D)

ANNUALIZED COST PER 1,000 GALLONS
(CUMULATIVE)
SOUTHWEST CONVEYANCE SYSTEM

SOUTHWEST CONVEYANCE ALTERNATE	*SOUTHWEST CONVEYANCE SYSTEM ($/1000 Gallon) PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V
SITE 5					
Service Area Alt.1	1.43	1.31	1.33	1.28	1.32
Service Area Alt.2	1.41	1.30	1.32	1.29	1.33
Service Area Alt.3	1.38	1.28	1.30	1.32	1.38
Service Area Alt.4	1.37	1.28	1.30	1.32	1.41
Service Area Alt.7	1.43	1.31	1.30	1.24	1.27

*All costs are compounded from previous phases
and annualized at 8% for 30 years.

All costs above are for the Southwest Conveyance System only.

TABLE 11

ANNUALIZED COST PER 1,000 GALLONS
(CUMULATIVE)
SERVICE AREA ALTERNATIVES

SERVICE AREA ALTERNATE	SERVICE AREA ALTERNATE ($/1000 GALLONS) PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V
SERVICE AREA ALT. 1					
S.W. Conveyance Site 4B	1.69	1.59	1.71	1.76	1.77
S.W. Conveyance Site 5	1.64	1.54	1.66	1.67	1.73
SERVICE AREA ALT. 2					
S.W. Conveyance Site 4B	1.69	1.59	1.71	1.76	1.77
S.W. Conveyance Site 5	1.64	1.54	1.66	1.68	1.73
SERVICE AREA ALT. 3					
S.W. Conveyance Site 4B	1.69	1.59	1.74	1.74	1.76
S.W. Conveyance Site 5	1.64	1.54	1.69	1.71	1.75
SERVICE AREA ALT. 4					
S.W. Conveyance Site 4B	1.69	1.75	1.75	1.75	1.76
S.W. Conveyance Site 5	1.64	1.71	1.71	1.72	1.75
SERVICE AREA ALT. 7					
S.W. Conveyance Site 4B	1.69	1.59	1.63	1.70	1.73
S.W. Conveyance Site 5	1.64	1.54	1.58	1.60	1.68

ASSUMPTIONS:

(1) All costs assume Northeast Conveyance - Beltway 8 Route.

(2) $/1000 Gallons above include cost of conveyance and transmission systems per Service Area Alternate.

(3) All costs are compounded from previous phases and annualized at 8% for 30 years.

(4) Phase I costs for all service area alternates include Southwest System only based on 65 MGD maximum daily capacity.

Present Worth Analysis

The annualized cost analysis presented previously is important in analyzing the cost per unit of water delivered for each phase of a particular alternate. However, this annualized analysis does not consider the timing or (phasing) of projects within a particular alternate. The present worth analysis can be defined as the amount of money required to put in the bank at the beginning of a study period that will meet all capital and operational costs throughout the study period. For example two alternates with similar total cost might have projects that come on line at different times. The alternate with a large project required early would be less preferable than the alternate whose first major project is not required for several years. Furthermore, the present worth analysis must be normalized to compare alternates that produce varying amounts of water.

The present worth analysis presented in this section was calculated assuming the following assumptions:

- Project capital cost have a 30 year life and are amortized at 8%.
- Time period beginning 1988 and ending in 2030 (Study Period).
- All present worth cost in 1988 dollars.
- Operation and maintenance cost (O & M) are considered annually throughout study period.

- O & M Costs are inflated at 10% per year.
- The normalized present worth analysis was used for the Conveyance System Alternates by dividing the present worth by the million gallons per day (MGD) of maximum daily water delivered.
- The actual present worth amounts were used when comparing Service Area Alternates (Through Year 2030) because the ultimate water delivered (231 MGD) was consistent for all Service Area Alternates.
- Capital cost for each component was calculated as previously mentioned.

Table 12 presents the normalized present worth of the Northeast Conveyance System Alternates within each Service Area Alternate.

TABLE 12

NORMALIZED PRESENT WORTH PER MGD
NORTHEAST CONVEYANCE SYSTEM
($/MGD)

NORTHEAST CONVEYANCE ALTERNATE	ALT. 1	ALT. 2	ALT. 3	ALT. 4	ALT. 7
BELTWAY 8 ROUTE	8.73	8.22	7.77	7.53	0
NHCWSC ROUTE	8.87	8.37	7.91	7.70	0
F.M. 1960 ROUTE	8.99	8.50	8.04	7.86	0

(The above normalized present worth costs include only the Northeast Conveyance System.)

Within each Service Area Alternate the Beltway 8 Route always produces the least Northeast Conveyance System cost with regard to normalized present worth. The normalized present worth for each Northeast Conveyance System must be compared within each Service Area Alternate. Comparison of conveyance routes between Service Area Alternatives would not be a valid comparison due to the Northeast Conveyance System being only one component out of the total cost to serve the WHCSWSC demands.

Table 13 presents the normalized present worth of the Southwest Conveyance System Alternates for each Service Area Alternate.

TABLE 13

NORMALIZED PRESENT WORTH PER MGD
SOUTHWEST CONVEYANCE SYSTEM
($/MGD)

SOUTHWEST CONVEYANCE ALTERNATE	ALT. 1	ALT. 2	ALT. 3	ALT. 4	ALT. 7
SITE 1	12.42	12.78	14.18	15.51	11.72
SITE 2	11.59	11.91	13.22	14.46	10.93
SITE 3	12.11	12.46	13.83	15.14	11.45
SITE 4A	12.22	12.58	13.98	15.30	11.54
SITE 4B	11.73	12.08	13.26	14.55	11.04
SITE 5	11.14	11.47	12.77	14.03	10.46

(The above normalized present worth costs include only the Southwest Conveyance System.)

Within each Service Area Alternate the Southwest Conveyance Site 5 always produces the least Southwest Conveyance System cost with regard to normalized present worth. The normalized present worth for each Southwest Conveyance System must be compared within each Service Area Alternate. Comparing conveyance routes between Service Area Alternates would not be a valid comparison due to the Southwest Conveyance System being only one component out of the total cost to serve the WHCSWSC demands.

Table 14 presents the present worth of the Service Area Alternates including the recommended Northeast Conveyance System Alternate (Beltway 8 Route) and the top two recommended Southwest Conveyance System Alternates (4B and 5) as previously described. The present worth analysis of the Service Area Alternates did not need normalizing since all of the Alternates would ultimately deliver the same amount of treated water (231 MGD). If the present worth costs were normalized using 231 MGD, then the normalized present worth would range between $12.20/MGD in Service Area Alternate No. 7 to $12.90/MGD in Service Area Alternate 4.

TABLE 14

PRESENT WORTH
SERVICE AREA ALTERNATES
(Total Dollars)

SERVICE AREA ALTERNATES	SITE 4B	SITE 5
SERVICE AREA ALTERNATE 1	$2,980,823,000	$2,869,244,000
SERVICE AREA ALTERNATE 2	2,984,829,000	2,875,663,000
SERVICE AREA ALTERNATE 3	2,962,650,000	2,888,405,000
SERVICE AREA ALTERNATE 4	2,965,835,000	2,898,512,000
SERVICE AREA ALTERNATE 7	2,952,546,000	2,818,814,000

(The above total present worth costs include the Northeast Conveyance System, Southwest Conveyance System and Transmission System.)

When investigating Table 14, it is apparent that when combining the cost of all three components (the Northeast Conveyance System, the Southwest Conveyance System and the associated Transmission System) that Service Area Alternate No. 7 produces the least total present worth cost from either Southwest Conveyance Site 4B or Site 5.

6.0 RANKING OF ALTERNATES

6.0 RANKING OF ALTERNATES

Methodology

Previous Appendices along with the previous sections of this Appendix have identified three Northeast Conveyance System Alternates, six Southwest Conveyance System Alternates and seven Service Area Alternates. At the request of the WHCSWSC Board, Service Area Alternates No. 5 and No. 6 were deleted from further consideration before beginning Appendix IV. Alternates 5 and 6 were deleted because of the lack of interest on the part of the city of Houston in developing the HWMP's "Western Alternative" which includes the WHCSWSC's North Supply System.

Since the majority of alternatives have both advantages and disadvantages when compared to one another, a systematic method of identifying the most feasible alternate must be developed. The method chosen to rank alternates in this Appendix will address the following general categories:

- Technical
- Environmental
- Community/Social
- Phasing
- Financial

Each set of Alternate Systems were evaluated and ranked in varying levels of detail within each of the general categories mentioned above.

Northeast Conveyance System Alternates

After initial comparisons it was found that the Northeast Conveyance System Alternates could be evaluated and ranked independent of the Southwest Conveyance System Alternates. The sizing of facilities within the Northeast Conveyance System Alternates is dependent upon the amount ofwater demand produced in each Service Area Alternate. As a result, the selection of a Service Area Alternate could affect the ranking of the Northeast Conveyance Systems.

After initial review, the Northeast Conveyance System alternates which are the Beltway 8 route; the NHCWSC route; and the F.M. 1960 route, were all determined feasible and consistent with the HWMP. However, after detailed evaluation within the five general categories it has been determined that the Beltway 8 route is superior in all categories for the following reasons:

Technical

- o Superior hydraulic characteristics producing a maximum of 16 psi more residual pressure at the WHCSWSC boundary than the other two routes.

- Reduced line lengths; 9 miles and 4 miles shorter than the F.M. 1960 and NHCWSC routes, respectively.

- Reduced possibility of needed land acquisitions outside existing street rights-of-way.

- Reduced possibility of problems during construction due to large rights-of-way, decreasing the construction time.

Environmental and Community/Social

- Routed through less existing and possible future residential developments than the NHCWSC and F.M. 1960 routes.

- Minimizes disruptions to traffic flow and utility relocations.

- Preferred route by the City of Houston.

Phasing and Financial

- Beltway 8 Route results in a shorter route and smaller cost to convey treated water to the WHCSWSC service area within the first conversion date of 2005 as determined by the HGCSD.

- Utilizes a portion of the NHCWSC proposed routing scheme producing a reduction in cost due to pro rata share with NHCWSC.

- o Reduction in present worth cost of approximately $6,000,000.

- o Reduction in operating cost.

As a result of the advantages previously listed, a numerical ranking was not performed when evaluating the Northeast Conveyance System Alternates. This appendix concludes that the Beltway 8 route is the preferred route over the two routes previously discussed. The Beltway 8 route will be used as the recommended Northeast Conveyance System Alternate when evaluating and ranking the Service Area Alternates later in this section.

<u>Southwest Conveyance System Alternates</u>

The Southwest Conveyance System is defined as the facilities required to pump, convey and store raw water from the supply source to the treatment plant. Also, included is treatment facilities and treated water storage and conveyance facilities needed to deliver treated water to the WHCSWSC Service Area. After initial review, the six alternate Southwest Conveyance Systems considered for study are as listed below:

Site 1: Oyster Creek/Dairy Ashford

Site 2: Brazos River/Highway 6

Site 3: Oyster Creek/Highway 6

Site 4A: Jones Creek/Grand Parkway

Site 4B: Allens Creek/Grand Parkway

Site 5: Allens Creek/F.M. 1093

(Refer to Figure 2 Southwest Conveyance System Alternates for a graphical representation of these systems.)

As mentioned previously, the Southwest Conveyance System evaluation and ranking is independent of the Northeast Conveyance System selection, but could be affected by the Service Area Alternate selection. However, it was determined that the Southwest Conveyance System should be evaluated and selected before a detailed evaluation is made of the individual Service Area Alternates. The reasoning behind this decision is that the recommended Service Area Alternates may be altered before future phases are completed; however, after the Southwest Conveyance System treatment plant site is constructed, it is fixed throughout the life of the project. As a result the selection of a treatment plant site within the Southwest Conveyance System is more important than the selection of a final Service Area Alternate. To effectively evaluate treatment plant alternates, the entire conveyance system associated with the treatment plant alternate, must also be evaluated.

After initial review and because of the importance attached to the selection of a Southwest Conveyance System, a very detailed ranking criteria and methodology has been developed within the confines of the previously mentioned five general ranking categories. Each of the general ranking categories were evaluated based on the sub-categories outlined in the Individual Ranking Form located in Attachment 1 of this Appendix.

A ranking committee was established that included experts in the field of water resource development including a member of the City of Houston's Public Works Department assigned by the Director of Public Works. All of the committee members attended a briefing on the facts and findings with regards to the varying Southwest Conveyance System Alternates. Each committee member assigned a weighted percentage to each of the five general ranking categories, as well as, each sub-category. The weighted percentages were averaged among the committee members and then applied to the individual numerical ratings given to each category. This resulted in a final individual ranking schedule that contained final numerical point totals for each Southwest Conveyance System, as well as, ranking orders for each conveyance system that ranged from one to six with one being the most preferred site. The final conveyance system rankings for individual raters; the final average ranking between raters and the final overall ranking of each system can be viewed in the chart below:

FINAL RANKING OF ALTERNATES
SOUTHWEST CONVEYANCE SYSTEM

RANKING COMMITTEE MEMBER	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
	SOUTHWEST CONVEYANCE ALTERNATES					
RATER NO. 1	6	4	5	3	1	2
RATER NO. 2	6	4	5	2	1	3
RATER NO. 3	6	5	4	3	1	2
RATER NO. 4	6	4	5	2	1	3
RATER NO. 5	6	4	5	2	2	1
RATER NO. 6	6	4	5	3	2	1
RATER NO. 7	6	5	4	3	2	1
FINAL AVERAGE RATING	6	4.3	4.7	2.6	1.4	1.9
FINAL RANKING	(6)	(4)	(5)	(3)	(1)	(2)

From the final ranking chart it can be concluded that Site 4B, the Allens Creek/Grand Parkway Alternate is the ranking committee's preferred Southwest Conveyance System alternate. Site 5, the Allens Creek/F.M. 1093 system was very close with Site 4A, the Jones Creek/Grand Parkway, a distant third. It can be concluded that Site 1 (Oyster Creek/Dairy Ashford); Site 2 (Brazos River/Highway 6); and Site 3 (Oyster Creek/Highway 6) are the least preferred. However, before final conclusions can be drawn, the ranking system should be evaluated for the sensitivity of individual major categories. Due to the subjectivity of this ranking methodology, the final ranking chart was re-evaluated five different times deleting one of the general categories in each re-evaluation. As can be seen in the final sensitivity chart below, Site

4B remains the preferred alternate throughout all five evaluations. Site 5 remains second and Site 4A third with Site 1, 2 and 3 varying between third and sixth.

SENSITIVITY CHART - FINAL RANKING
SOUTHWEST CONVEYANCE SYSTEM

		SUMMARY - AVERAGE RANKING				
ELIMINATED RANKING CATEGORY	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1.0 TECHNICAL	(6)	(5)	(4)	(3)	(1)	(2)
2.0 ENVIRONMENTAL	(6)	(5)	(4)	(3)	(1)	(2)
3.0 COMMUNITY/ SOCIAL	(6)	(4)	(5)	(3)	(1)	(2)
4.0 PHASING	(6)	(4)	(5)	(3)	(1)	(2)
5.0 FINANCIAL	(6)	(4)	(5)	(3)	(1)	(2)

It can be concluded from the above chart that the sensitivity of each of the five general ranking categories has no effect on the conclusion recommending Site 4B as the preferred Southwest Conveyance alternate. However, due to the relative close ranking (it could be concluded that an exact plant site located along F.M. 1093 within Areas 4 and 5 between the proposed Grand Parkway and the proposed Allens Creek Reservoir would be accepted as a preferred site. Another conclusion that can be obtained from this ranking exercise is that it is more preferable to select a conveyance system site that utilizes raw water directly from Allens Creek

Reservoir as proposed in Alternates 4B and 5. Therefore, only Southwest Conveyance System Alternates 4B and 5 will be included in the following evaluation of the Service Area Alternates.

Service Area Alternates

The Service Area Alternates considered for evaluation and ranking are described as follows:

- o Alternate No. 1 - Boundary at Highway 290
- o Alternate No. 2 - Boundary at F.M. 529
- o Alternate No. 3 - Boundary at Clay Road
- o Alternate No. 4 - Boundary at I.H.10
- o Alternate No. 7 - Entire Service Area Served by Southwest Supply System

The boundaries mentioned in the descriptions refer to the service area boundary between the Northeast and Southwest Supply Systems.

The following Service Area Alternatives will be ranked and evaluated considering the Beltway 8 Route as the preferred Northeast Conveyance System Alternate. Both the Allens Creek/Grand Parkway Route (Site 4B) as well as the Allens Creek/F.M. 1093 Route (Site 5) will be considered as the preferred Southwest Conveyance System Alternates. The ranking evaluation for the Service Area Alternates will be based on the five general categories mentioned in the previous ranking evaluations.

The evaluation, ranking and eventual selection of a particular Service Area Alternate is somewhat different than the Conveyance System Rankings. The proposed facilities within each Service Area Alternate are sized for ultimate conditions (Year 2030). The selection of a Service Area Alternate has little affect on the ultimate transmission line sizes. This study is based on the initial assumption that all transmission lines constructed will be designed for ultimate conditions regardless of the phasing. The advantages and disadvantages corresponding to two of the general ranking categories, Environmental and Community/Social are similar for all Service Area Alternates. The Technical category has two major issues that may differ between Service Area Alternates:

- o Availability of an ample raw water source to supply each alternate;
- o Possibility of maximizing the use of existing water supply facilities.

The only general categories to be evaluated involve phasing and financial. The phasing issue becomes a function of when and how much transmission system is built. The financial issue becomes a function of the cost associated with each phase and how that phased cost affects the cost per unit of water delivered. Also, associated with the financial issue is the present worth value of the ultimate conveyance and transmission systems based on the timing of the phases as dictated by the Service Area Alternates.

After careful evaluation, it can be concluded that the Service Area Alternates that initially maximize the Southwest Supply System would produce a more economical transmission system during the early phases of transmission system development. This is due to the fact that the earliest HGCSD Conversion Dates within WHCSWSC's boundaries are located in the southwest area which is geographically closer to the Southwest Supply System, therefore, reducing the amount and cost of the transmission system.

When evaluating each Service Area Alternate in detail, it is apparent that Service Area Alternate No. 7 which maximizes the use of southwest water is less costly from both an annualized cost per unit of water delivered and ultimate present worth. The cumulative annualized cost per thousand gallons in the year 2030 for Alternate No. 7 is $1.68/1000 gallons which is approximately $0.07/1000 gallons less expensive than the nearest Service Area Alternate. However, the large differences in annualized costs are produced when analyzing the Northeast System against the Southwest System in Phases I through III within each Service Area Alternate. As mentioned previously the cost to serve the area between I-10 and Clay Road in Phase II from the southwest is $1.59/1000 gallons while the cost would increase to $7.19/1000 gallons if serving the same area from the northeast. In Phase III the cost would be $5.10/1000 gallons when serving from the northeast and $1.62/1000 gallons when serving from the southwest. As a result, it is more economical on an annual basis to serve areas from the Southwest Supply.

The ultimate present worth for Service Area Alternate 7 is $2,952,546,000 when assuming Southwest Conveyance Site 4B and $2,818,814,000 when considering Site 5. Service Area Alternate 7 would require $13,000,000 less in 1988 dollars than Service Area Alternate 4 to serve the WHCSWSC service area when assuming Site 4B and $80,000,000 less when assuming Site 5. However, it should be pointed out that the ultimate present worth and compounded annualized cost for all of the assumed Service Area Alternates are very close. As a result, the financial differences in Service Area Alternates when considering the final study year (2030) is not as important as the phasing issue. However, when evaluating the normalized present worth per unit of water delivered for each component in each service area alternate, it can be readily shown that Service Area Alternate 7 utilizing the Southwest Conveyance Alternate Site 5 produces a significant reduction in the normalized present worth for the conveyance system components. The normalized present worth for the transmission systems in each Service Area Alternate are approximately equal at around $2.50/MGD of water delivered. To prove this point, the normalized present worth for each component within the two extreme service area alternates is shown below.

Service Area Alternate	NORMALIZED PRESENT WORTH/MGD Southwest Conveyance (Site 5)	Northeast Conveyance (Beltway 8)	Total Transmission
Alternate 7 (Maximizing Southwest Water)	10.46	0	2.50
Alternate 4 (Maximizing Northeast Water)	14.03	7.53	2.50

It is apparent that the Service Area Alternate that follows the HGCSD Conversion Plan would be preferable. The HGCSD's earliest conversion dates of 1995 and 2000 are located in the southwest and the remaining conversion dates of 2005, 2010 and the assumed 2030 are located in the north and far northwest of the WHCSWSC study area. As a result, the Service Area Alternate that has its first phases in the southwest will be less expensive from a phasing standpoint. Service Area Alternate 7 which proposes to serve the study area from south to north produces the least cost from both an annualized and present worth analysis.

As a result of the above analogy, we recommend Alternate No. 7 as the preferred Service Area Alternate. However, this recommendation could be changed in future updates to this study without appreciable affecting the final ultimate cost of the entire transmission system.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

General

Several conclusions can be reached after reviewing this Appendix. The most important conclusion is that the entire WHCSWSC Service Area, including the City of Houston Southwest, as previously defined, can be served by a Southwest Supply System (Brazos River Basin) at a cost equal to or less than the cost that would be experienced if using a Northeast Supply System (treated water from City of Houston Northeast Treatment Plant). Also, obtained from this Appendix are the following general conclusions:

- The Brazos River Authority has the available water from the Brazos River Basin (Southwest Supply) without utilizing water rights from the BRA Canal System to supply the entire WHCSWSC service area including City of Houston Southwest.

- The City of Houston can make enough water available to serve the entire WHCSWSC service area if the "Eastern Alternative" of HWMP is developed.

- It is not economical to serve the entire WHCSWSC service area with the Northeast Supply due to the earliest conversion mandate being located in the Southwest as set by HGCSD Plan.

- o Treatment of Brazos River water is viable with the operations and treatment cost being within 10 percent of the cost presently experienced by the City when treating Lake Houston water.

- o The entire project cost differential is more sensitive to the phasing cost than the ultimate cost.

<u>Northeast Conveyance System Alternate</u>

The major conclusion reached when evaluating the Northeast Conveyance System Alternate is that the Beltway 8 Route is superior over the NHCWSC and F.M. 1960 Routes for the following reasons:

- o Superior hydraulic characteristics producing a maximum of 16 psi more residual pressure at the WHCWSC boundary than the other two routes.

- o Reduced line lengths; 9 miles and 4 miles shorter than the F.M. 1960 and NHCSWSC routes, respectively.

- o Reduced possibility of needed land acquisitions outside existing street rights-of-way.

- o Reduced possibility of problems during construction due to large rights-of-way, decreasing the construction time required.

- Routed through fewer residential developments than the NHCWSC and F.M. 1960 routes.

- Minimizes disruptions to traffic flow and utility relocations.

- Preferred route by the City of Houston.

- Beltway 8 Route results in a shorter route and less cost to convey treated surface water to the area within the first conversion date of 2005 as determined by the HGCSD.

<u>Southwest Conveyance System Alternates</u>

Several conclusions can be reached after evaluating the information presented in this Appendix with regards to the Southwest Conveyance System Alternates. The most noticeable conclusion is that the financial comparisons of the Southwest Conveyance System Alternates are not as significant as the decisions regarding water quality and existing land usages. All of the alternate Southwest Conveyance System costs are within 10% of each other and as a result of this the decision becomes technical and not financial.

After evaluating the various site alternatives and performing a detailed ranking analysis it became readily apparent that the Allens Creek/Grand Parkway (Site 4B) and the Allens Creek/F.M. 1093 (Site 5) were the most preferred routes by the Ranking Committee. The remaining sites ranked considerably lower and as a result, Sites 1, 2, 3 and 4A are the least preferred. Also, concluded from this Appendix is the following:

- Water quality is substantially higher in Alternate Site 4B and 5 due to the direct use of Allen's Creek Reservoir.

- Water quality for Sites 1, 2, 3 and 4A are marginal when utilizing the termination storage design assumption limiting chlorides to a minimum of 240 mg/l.

- Sites 4B and 5 could lower chloride contamination to 100 mg/l without added cost while at the other alternate sites the termination storage cost would more than double to achieve these results.

- The Southwest Conveyance System should be based on the maximum daily demand experienced in Service Area Alternate No. 7 (231 MGD), maximizing the southwest water supply while maintaining the flexibility needed to accommodate service area changes.

- Site 4B has the potential of providing a more versatile water supply than Site 5 due to the possibility of utilizing the BRA Canal System as an alternate source. Along with this versatility brings the possibility of additional water rights from the BRA enhancing the possibility of regionalization with Fort Bend County.

- Sites 1 and 3 are least preferred because of the lack of undeveloped land, increased land cost, increased chances of reduction in water quality and close proximity to residential developments.

- Site 2 is not preferred because of reduction in water quality and flood plain restrictions.

- Site 4B and 5 better fits City of Houston's goal of maximizing water quality while minimizing costs.

- Site 5 produces the least annual cost in the year 2030.

- Site 5 produces the smallest normalized present worth cost when utilizing either of the Service Area Alternates.

Service Area Alternates

The conclusions reached regarding Service Area Alternates are not as concrete as the conclusions reached when evaluating the Conveyance System Alternates. Flexibility is the most important item to be considered when formulating conclusions with regards to the Service Area Alternates. The final decision and recommendations today may change in the future due to unforeseen circumstances. This Appendix has considered flexibility in Service Area boundaries as the prime issue when making the following conclusions:

- o The ultimate transmission system will basically be identical for all Service Area Alternates.

- o The ultimate transmission line size will be constructed regardless of phasing, however, phasing will determine when and how much line is to be built.

- o Service Area Alternates that produce Phase I (1995) and Phase II (2000) treatment facilities and raw water supplies geographically closer to the Southwest area are more economical with respect to the phasing cost.

- o The recommended Service Area Alternate will include the Beltway 8 Route for its Northeast Conveyance System and either Allens Creek/Grand Parkway (Site 4B) or the Allens Creek/F.M. 1093 (Site 5) as the preferred Southwest Conveyance System.

- o Service Area Alternate No. 7 is more economical throughout the study period based on an annualized and present worth analysis.

- o A Service Area Alternate that utilizes all northeast water was not considered because of obvious major economic disadvantages in Phase I and Phase II which would produce the most expensive present worth cost. As a result, it was eliminated from consideration in this Appendix.

- Service Area Alternate No. 7 produces relative constant annual cost throughout life of the study which is directly due to Alternate No. 7's phasing compatibility with the HGCSD plan.

- Service Area Alternate No. 4 will produce the least desirable annual cost curve throughout the study period. The cost of conversion in Phases I, II, and III are significantly higher when using Service Area Alternate No. 4 which could result in the need for volatile water rates when amortizing the increased up front cost of development.

RECOMMENDATIONS

Appendix IV concludes with the following recommendations:

- The Northeast Conveyance System should follow the Beltway 8 Route eliminating the NHCWSC and F.M. 1960 Routes from further study.

- Eliminate the Southwest Conveyance System Alternates 1, 2, 3 and 4A from further study.

- The Southwest Conveyance System Alternates No. 4B (Allens Creek/Grand Parkway) and No. 5 (Allens Creek/F.M. 1093) should be considered for further study.

- Phase V should study in detail the possibility of locating a plant along F.M. 1093, in the area of the Grand Parkway/F.M. 1093 intersection, west to the proposed Allens Creek Reservoir site.

- The Southwest Conveyance System plant site should be located to allow future development of an alternate and/or additional raw water source utilizing the available water rights in the BRA Canal System. This would enhance the possibility of surface water regionalization with entities in Fort Bend County.

- The Southwest Conveyance System should obtain its raw water supply directly from Allens Creek Reservoir which will result in a higher quality water supply.

- Phase V should further study the Allens Creek Reservoir operational procedures required to limit chloride concentrations to 150 mg/l and total dissolved solids to 500 mg/l.

- The Southwest Conveyance System plant site should contain sufficient acreage to develop an ultimate plant capacity of approximately 300 MGD allowing the flexibility to meet demands due to possible Service Area modifications. This capacity is based on Service Area Alternate No. 7's ultimate capacity of 231 MGD, maximizing the water supply offer by the BRA, and the possibility of treating the available water rights of approximately 60 MGD from the BRA Canal System for possible wholesale to entities in Fort Bend County.

- Phase V should further study the ultimate transmission system utilizing the demands developed from either Service Area Alternate No. 7 or No. 4. This would maintain the flexibility required to meet future Service Area modifications at a increased cost of less than 5 percent of the total ultimate transmission system cost.

- WHCSWSC should request the BRA to upgrade its recent proposal based on the conclusions and recommendations outlined in this Appendix. The BRA proposal should include the construction of Allens Creek Reservoir by 1995.

- WHCSWSC should authorize the Engineer to begin Phase V - The Detail Evaluation of Selected Alternatives, as soon as possible.

ATTACHMENTS

ATTACHMENT 1

INDIVIDUAL RANKING FORM

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION
SOUTHWEST CONVEYANCE SYSTEM
INDIVIDUAL RANKING FORM

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

A. WEIGHTING FACTOR EVALUATION

0.0 GENERAL

CRITERIA DESCRIPTION (GENERAL)	WEIGHTING PERCENTAGE							AVERAGE WEIGHTING FACTOR
	RATER NO. 1	RATER NO. 2	RATER NO. 3	RATER NO. 4	RATER NO. 5	RATER NO. 6	RATER NO. 7	
1.0 TECHNICAL								
2.0 ENVIRONMENTAL								
3.0 COMMUNITY/SOCIAL								
4.0 PHASING								
5.0 FINANCIAL								
TOTAL: (%)	100	100	100	100	100	100	100	100

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

A. WEIGHTING FACTOR EVALUATION

1.0 TECHNICAL

CRITERIA DESCRIPTION (TECHNICAL)	WEIGHTING PERCENTAGE RATER NO. 1	RATER NO. 2	RATER NO. 3	RATER NO. 4	RATER NO. 5	RATER NO. 6	RATER NO. 7	AVERAGE WEIGHTING FACTOR
A. AVAILABLE LAND								
B. AVAILABLE/QUALITY RAW WATER								
C. TREATMENT PLANT ACCESS								
D. UTILITY ACCESS								
E. DRAINAGE								
F. GEOTECHNICAL								
G. TERMINATION STORAGE								
H. SLUDGE DISPOSAL								
I. OPERATIONS/ MAINTENANCE								
TOTAL: (%)	100	100	100	100	100	100	100	100

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

A. WEIGHTING FACTOR EVALUATION

2.0 ENVIRONMENTAL

CRITERIA DESCRIPTION (ENVIRONMENTAL)	WEIGHTING PERCENTAGE							AVERAGE WEIGHTING FACTOR
	RATER NO. 1	RATER NO. 2	RATER NO. 3	RATER NO. 4	RATER NO. 5	RATER NO. 6	RATER NO. 7	
A. FLOOD PLAIN								
B. WETLANDS								
C. AIR QUALITY								
D. PLANT WASTE BY-PRODUCT DISPOSAL								
E. NOISE								
F. OPERATIONAL PROCEDURES (PLANT)								
TOTAL (%)	100	100	100	100	100	100	100	100

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

A. WEIGHTING FACTOR EVALUATION

3.0 COMMUNITY/SOCIAL

CRITERIA DESCRIPTION (COMMUNITY/SOCIAL)	WEIGHTING PERCENTAGE RATER NO. 1	RATER NO. 2	RATER NO. 3	RATER NO. 4	RATER NO. 5	RATER NO. 6	RATER NO. 7	AVERAGE WEIGHTING FACTOR
A. POLITICAL SUBDIVISION JURISDICTION								
B. COUNTY CONTROL								
C. FLOOD CONTROL/ DRAINAGE DISTRICT								
D. CORP OF ENGINEERS CONTROL								
E. TEXAS WATER COMMISSION REQM'TS								
F. BRAZOS RIVER AUTH.								
G. GALVESTON COUNTY WATER AUTHORITY								
TOTAL (%)	100	100	100	100	100	100	100	100

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

A. WEIGHTING FACTOR EVALUATION

4.0 PHASING

	WEIGHTING PERCENTAGE							AVERAGE WEIGHTING FACTOR
CRITERIA DESCRIPTION (PHASING)	RATER NO. 1	RATER NO. 2	RATER NO. 3	RATER NO. 4	RATER NO. 5	RATER NO. 6	RATER NO. 7	
A. AVAILABILITY TO MEET DEMANDS								
B. EXPANSION CAPABILITIES								
C. AVAILABILITY TO MEET HGCSD PLAN								
D. COMPATABILITY WITH RAW WATER AVAILABILITY								
E. FLEXIBILITY TO MEET FUTURE DEMANDS OUTSIDE SERVICE AREA								
TOTAL (%)	100	100	100	100	100	100	100	100

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

A. WEIGHTING FACTOR EVALUATION

5.0 FINANCIAL

CRITERIA DESCRIPTION (FINANCIAL)	WEIGHTING PERCENTAGE							AVERAGE WEIGHTING FACTOR
	RATER NO. 1	RATER NO. 2	RATER NO. 3	RATER NO. 4	RATER NO. 5	RATER NO. 6	RATER NO. 7	
A. PHASE I - PRESENT WORTH (1988)$								
B. PHASE I - ANNUAL COST								
C. PHASE II - PRESENT WORTH (1988)$								
D. PHASE II ANNUAL COST								
E. PHASE III - PRESENT WORTH (1988)$								
F. PHASE III - ANNUAL COST								
G. PHASE IV - PRESENT WORTH (1988)$								
H. PHASE IV - ANNUAL COST								
TOTAL: (%)	100	100	100	100	100	100	100	100

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

B. INDIVIDUAL RANKING OF SOUTHWEST CONVEYANCE SYSTEM

1.Ø TECHNICAL

COMMITTEE MEMBER: RATER NO. 1							
CRITERIA DESCRIPTION (TECHNICAL)	INDIVIDUAL SITE RATING: S.W. CONVEYANCE SYSTEM						
	1	2	3	4A	4B	5	
A. AVAILABLE LAND							
B. AVAILABLE/QUALITY RAW WATER							
C. TREATMENT PLANT ACCESS							
D. UTILITY ACCESS							
E. DRAINAGE							
F. GEOTECHNICAL							
G. TERMINATION STORAGE							
H. SLUDGE DISPOSAL							
I. OPERATIONS/ MAINTENANCE							

*MAXIMUM 1ØØ POINTS WITH 1ØØ POINTS BEING MOST FAVORABLE.

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

B. INDIVIDUAL RANKING OF SOUTHWEST CONVEYANCE SYSTEM

2.0 ENVIRONMENTAL

COMMITTEE MEMBER: RATER NO. 1							
CRITERIA DESCRIPTION (ENVIRONMENTAL)	INDIVIDUAL SITE RATING: S.W. CONVEYANCE SYSTEM						
	1	2	3	4A	4B	5	
A. FLOOD PLAIN							
B. WETLANDS							
C. AIR QUALITY							
D. PLANT WASTE BY-PRODUCT DISPOSAL							
E. NOISE							
F. OPERATIONAL PROCEDURES (PLANT)							

*MAXIMUM 100 POINTS WITH 100 POINTS BEING MOST FAVORABLE.

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

B. INDIVIDUAL RANKING OF SOUTHWEST CONVEYANCE SYSTEM

3.Ø COMMUNITY/SOCIAL

COMMITTEE MEMBER: RATER NO. 1							
CRITERIA DESCRIPTION (COMMUNITY/SOCIAL)	INDIVIDUAL SITE RATING: S.W. CONVEYANCE SYSTEM						
	1	2	3	4A	4B	5	
A. POLITICAL SUBDIVISION JURISDICTION							
B. COUNTY CONTROL							
C. FLOOD CONTROL/ DRAINAGE DISTRICT							
D. CORP OF ENGINEERS CONTROL							
E. TEXAS WATER COMMISSION REQM'TS							
F. BRAZOS RIVER AUTH.							
G. GALVESTON COUNTY WATER AUTHORITY							

*MAXIMUM 1ØØ POINTS WITH 1ØØ POINTS BEING MOST FAVORABLE.

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

B. INDIVIDUAL RANKING OF SOUTHWEST CONVEYANCE SYSTEM

4.Ø PHASING

COMMITTEE MEMBER: RATER NO. 1

CRITERIA DESCRIPTION (PHASING)	INDIVIDUAL SITE RATING: S.W. CONVEYANCE SYSTEM						
	1	2	3	4A	4B	5	
A. AVAILABILITY TO MEET DEMANDS							
B. EXPANSION CAPABILITIES							
C. AVAILABILITY TO MEET HGCSD PLAN							
D. COMPATABILITY WITH RAW WATER AVAILABILITY							
E. FLEXIBILITY TO MEET FUTURE DEMANDS OUTSIDE SERVICE AREA							

*MAXIMUM 1ØØ POINTS WITH 1ØØ POINTS BEING MOST FAVORABLE.

I. INDIVIDUAL RANKING BY COMMITTEE MEMBER

B. INDIVIDUAL RANKING OF SOUTHWEST CONVEYANCE SYSTEM

5.Ø FINANCIAL

COMMITTEE MEMBER: RATER NO. 1							
CRITERIA DESCRIPTION (FINANCIAL)	INDIVIDUAL SITE RATING: S.W. CONVEYANCE SYSTEM						
	1	2	3	4A	4B	5	
A. PHASE I - PRESENT WORTH (1988)$							
B. PHASE I - ANNUAL COST							
C. PHASE II - PRESENT WORTH (1988)$							
D. PHASE II ANNUAL COST							
E. PHASE III - PRESENT WORTH (1988)$							
F. PHASE III - ANNUAL COST							
G. PHASE IV - PRESENT WORTH (1988)$							
H. PHASE IV - ANNUAL COST							

*MAXIMUM 1ØØ POINTS WITH 1ØØ POINTS BEING MOST FAVORABLE.

ATTACHMENT 2

DETAILED CAPITAL COST TABLES

TABLE A-1

NORTHEAST CONVEYANCE SYSTEM CAPITAL COST
BELTWAY 8 ROUTE

	ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1.	Raw Water Conveyance	4,800,000	5,300,000	5,800,000	6,300,000	0
2.	Treatment Plant (WHCSWSC Portion)	39,070,000	47,090,000	78,240,000	94,440,000	0
3.	Treated Water Conveyance Lines, Incl.Crossings, Cathodic Protection, Valves and Appurtenances	31,371,433	36,875,583	52,450,993	60,958,863	0
4.	Booster Pump Station/ Ground Storage	5,240,000	6,380,000	8,120,000	9,790,000	0
	SUB-TOTAL	80,481,433	95,645,583	144,610,993	171,488,863	0
5.	Contingency (10%)	8,048,143	9,564,558	14,461,099	17,148,886	0
6.	Engineering (10%)	8,048,143	9,564,558	14,461,099	17,148,886	0
	TOTAL CAPITAL COSTS	96,577,720	114,774,700	173,533,192	205,786,635	0

TABLE A-2

NORTHEAST CONVEYANCE SYSTEM CAPITAL COST
NHCWSC ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	4,800,000	5,300,000	5,800,000	6,300,000	0
2. Treatment Plant (WHCSWSC Portion)	39,070,000	47,090,000	78,240,000	94,440,000	0
3. Treated Water Conveyance Lines, Incl.Crossings, Cathodic Protection, Valves and Appurtenances	36,208,014	43,140,632	62,062,013	72,059,554	0
4. Booster Pump Station/ Ground Storage	5,240,000	6,380,000	8,120,000	9,790,000	0
SUB-TOTAL	85,318,014	101,910,632	154,222,013	182,589,554	0
5. Contingency (10%)	8,531,801	10,191,063	15,422,201	18,258,955	0
6. Engineering (10%)	8,531,801	10,191,063	15,422,201	18,258,955	0
TOTAL CAPITAL COSTS	102,381,617	122,292,758	185,066,416	219,107,465	0

TABLE A-3

NORTHEAST CONVEYANCE SYSTEM CAPITAL COST
F.M. 1960 ROUTE

	ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1.	Raw Water Conveyance	4,800,000	5,300,000	5,800,000	6,300,000	0
2.	Treatment Plant (WHCSWSC Portion)	39,070,000	47,090,000	78,240,000	94,440,000	0
3.	Treated Water Conveyance Lines, Incl.Crossings, Cathodic Protection, Valves and Appurtenances	40,020,431	48,345,769	70,924,519	82,843,257	0
4.	Booster Pump Station/ Ground Storage	5,240,000	6,380,000	8,120,000	9,790,000	0
	SUB-TOTAL	89,130,431	107,115,769	163,084,519	193,373,257	0
5.	Contingency (10%)	8,913,043	10,711,577	16,308,452	19,337,326	0
6.	Engineering (10%)	8,913,043	10,711,577	16,308,452	19,337,326	0
	TOTAL CAPITAL COSTS	106,956,517	128,538,923	195,701,423	232,047,908	0

TABLE A-4

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
SITE 1 - OYSTER CREEK/DAIRY ASHFORD ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	3,370,000	3,191,400	2,511,600	2,173,000	4,140,800
2. Termination Storage/ Pump Station	37,290,000	35,490,000	30,050,000	24,770,000	48,675,000
3. Treatment Plant	160,622,000	152,400,600	121,830,400	106,419,000	196,488,700
4. Treated Water Pump/ Storage/Conveyance Lines Incl. Crossings Cathodic Protection, Valves & Appurtenances	36,557,880	34,788,240	33,018,600	29,759,260	37,452,630
SUB-TOTAL	237,839,880	225,870,240	187,410,600	163,121,260	286,757,130
5. Contingency (10%)	23,783,988	22,587,024	18,741,060	16,312,126	28,675,713
6. Engineering (10%)	23,783,988	22,587,024	18,741,060	16,312,126	28,675,713
TOTAL CAPITAL COSTS	285,407,856	271,044,288	224,892,720	195,745,512	344,108,556

TABLE A-5

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
SITE 2 - BRAZOS RIVER/HIGHWAY 6 ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	4,112,000	3,894,000	3,065,000	2,651,000	5,052,500
2. Termination Storage/ Pump Station	23,472,000	22,407,000	19,025,000	15,866,000	30,300,000
3. Treatment Plant	161,414,000	152,342,000	122,546,000	107,525,000	194,746,000
4. Treated Water Pump/ Storage/Conveyance Lines Incl. Crossings, Cathodic Protection, Valves & Appurtenances	46,094,800	43,635,400	41,176,000	36,979,730	47,586,050
SUB-TOTAL	235,092,800	222,278,400	185,812,000	163,021,730	277,684,550
5. Contingency (10%)	23,509,280	22,227,840	18,581,200	16,302,173	27,768,455
6. Engineering (10%)	23,509,280	22,227,840	18,581,200	16,302,173	27,768,455
TOTAL CAPITAL COSTS	282,111,360	266,734,080	222,974,400	195,626,076	333,221,460

TABLE A-6

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
SITE 3 - OYSTER CREEK/HIGHWAY 6 ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	3,120,000	2,955,000	2,325,000	2,011,000	3,833,600
2. Termination Storage/ Pump Station	30,710,000	29,260,000	24,800,000	20,530,000	39,925,000
3. Treatment Plant	159,807,000	150,872,000	120,502,000	105,216,000	194,280,900
4. Treated Water Pump/ Storage/Conveyance Lines Incl. Crossings, Cathodic Protection, Valves & Appurtenances	28,048,760	26,915,480	25,782,200	23,694,520	28,645,260
SUB-TOTAL	221,685,760	210,002,480	173,409,200	151,451,520	266,684,760
5. Contingency (10%)	22,168,576	21,000,248	17,340,920	15,145,152	26,668,476
6. Engineering (10%)	22,168,576	21,000,248	17,340,920	15,145,152	26,668,476
TOTAL CAPITAL COSTS	266,022,912	252,002,976	208,091,040	181,741,824	320,021,712

TABLE A-7

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
SITE 4A - JONES CREEK/GRAND PARKWAY ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	3,120,000	2,955,000	2,325,000	2,011,000	3,833,600
2. Termination Storage/ Pump Station	22,156,000	21,161,000	17,975,000	15,018,000	28,550,000
3. Treatment Plant	156,065,000	148,060,000	118,015,000	102,924,000	185,369,000
4. Treated Water Pump/ Storage/Conveyance Lines Incl. Crossings, Cathodic Protection, Valves & Appurtenances	53,561,400	49,629,600	46,090,500	38,220,400	58,686,300
SUB-TOTAL	234,902,400	221,805,600	184,405,500	158,173,400	276,438,900
5. Contingency (10%)	23,490,240	22,180,560	18,440,550	15,817,340	27,643,890
6. Engineering (10%)	23,490,240	22,180,560	18,440,550	15,817,340	27,643,890
TOTAL CAPITAL COSTS	281,882,880	266,166,720	221,286,600	189,808,080	331,726,680

TABLE A-8

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
SITE 4B - ALLENS CREEK/GRAND PARKWAY ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	43,770,000	43,605,000	42,975,000	42,661,000	44,483,600
2. Termination Storage/ Pump Station	0	0	0	0	0
3. Treatment Plant	156,065,000	148,060,000	118,015,000	102,924,000	185,369,000
4. Treated Water Pump/ Storage/Conveyance Lines Incl. Crossings, Cathodic Protection, Valves & Appurtenances	53,561,400	49,629,600	46,090,500	38,220,400	58,686,300
SUB-TOTAL	253,396,400	241,294,600	207,080,500	183,805,400	288,538,900
5. Contingency (10%)	25,339,640	24,129,460	20,708,050	18,380,540	28,853,890
6. Engineering (10%)	25,339,640	24,129,460	20,708,050	18,380,540	28,853,890
TOTAL CAPITAL COSTS	304,075,680	289,553,520	248,496,600	220,566,480	346,246,680

TABLE A-9

SOUTHWEST CONVEYANCE SYSTEM CAPITAL COST
SITE 5 - ALLENS CREEK/F.M. 1093 ROUTE

ITEM	ALTERNATE 1	ALTERNATE 2	ALTERNATE 3	ALTERNATE 4	ALTERNATE 7
1. Raw Water Conveyance	3,784,000	3,583,000	2,820,000	2,440,000	4,640,000
2. Termination Storage/ Pump Station	0	0	0	0	0
3. Treatment Plant	155,412,000	147,443,000	117,531,000	102,506,000	181,528,060
4. Treated Water Pump/ Storage/Conveyance Lines Incl. Crossings, Cathodic Protection, Valves & Appurtenances	101,705,560	95,664,880	87,076,900	78,514,620	109,876,000
SUB-TOTAL	260,901,560	246,690,880	207,427,900	183,460,620	296,044,060
5. Contingency (10%)	26,090,156	24,669,088	20,742,790	18,346,062	29,604,406
6. Engineering (10%)	26,090,156	24,669,088	20,742,790	18,346,062	29,604,406
TOTAL CAPITAL COSTS	313,081,872	296,029,056	248,913,480	220,152,744	355,252,872

TABLE A-10

TRANSMISSION SYSTEM CAPITAL COST
ALTERNATE 1 SERVICE AREA

NORTHEAST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	123,204,568	123,204,568	123,204,568	123,204,568	123,204,568	123,204,568
2. Booster Pump Station/Ground Storage	3,350,000	3,350,000	3,350,000	3,350,000	3,350,000	3,350,000
3. Contingency (10%)	12,655,457	12,655,457	12,655,457	12,655,457	12,655,457	12,655,457
4. Engineering (10%)	12,655,457	12,655,457	12,655,457	12,655,457	12,655,457	12,655,457
NORTHEAST TOTAL	151,865,482	151,865,482	151,865,482	151,865,482	151,865,482	151,865,482
SOUTHWEST SYSTEM						
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	177,766,647	189,003,818	189,003,818	177,745,595	177,745,595	178,088,636
2. Booster Pump Station/Ground Storage	1,660,000	1,660,000	1,660,000	1,660,000	1,660,000	1,660,000
3. Contingency (10%)	17,942,665	19,066,382	19,066,382	17,940,560	17,940,560	17,974,864
4. Engineering (10%)	17,942,665	19,066,382	19,066,382	17,940,560	17,940,560	17,974,864
SOUTHWEST TOTAL	215,311,976	228,796,582	228,796,582	215,286,714	215,286,714	215,698,363
GRAND TOTAL	367,177,458	380,622,064	380,662,064	367,152,196	367,152,196	367,563,845

TABLE A-11

TRANSMISSION SYSTEM CAPITAL COST
ALTERNATE 2 SERVICE AREA

NORTHEAST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	147,854,575	147,854,575	147,854,575	147,854,575	147,854,575	147,854,575
2. Booster Pump Station/Ground Storage	5,010,000	5,010,000	5,010,000	5,010,000	5,010,000	5,010,000
3. Contingency (10%)	15,286,458	15,286,458	15,286,458	15,286,458	15,286,458	15,286,458
4. Engineering (10%)	15,286,458	15,286,458	15,286,458	15,286,458	15,286,458	15,286,458
NORTHEAST TOTAL	183,437,490	183,437,490	183,437,490	183,437,490	183,437,490	183,437,490
SOUTHWEST SYSTEM						
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	141,872,244	161,771,894	161,771,894	151,759,952	151,759,952	153,155,129
2. Booster Pump Station/Ground Storage	0	0	0	0	0	0
3. Contingency (10%)	14,187,224	16,177,189	16,177,189	15,175,995	15,175,995	15,315,513
4. Engineering (10%)	14,187,224	16,177,189	16,177,189	15,175,995	15,175,995	15,315,513
SOUTHWEST TOTAL	170,246,693	194,126,273	194,126,273	182,111,942	182,111,942	183,786,155
GRAND TOTAL	353,684,183	377,563,763	377,563,763	365,549,432	365,549,432	367,223,645

TABLE A-12

TRANSMISSION SYSTEM CAPITAL COST
ALTERNATE 3 SERVICE AREA

NORTHEAST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	200,405,284	200,405,284	200,405,284	197,076,429	197,076,429	197,076,429
2. Booster Pump Station/Ground Storage	5,010,000	5,010,000	5,010,000	5,010,000	5,010,000	5,010,000
3. Contingency (10%)	20,541,528	20,541,528	20,541,528	20,208,643	20,208,643	20,208,643
4. Engineering (10%)	20,541,528	20,541,528	20,541,528	20,208,643	20,208,643	20,208,643
NORTHEAST TOTAL	246,498,341	246,498,341	246,498,341	242,503,715	242,503,715	242,503,715

SOUTHWEST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	96,964,391	109,188,248	109,188,248	101,187,298	101,187,298	96,988,119
2. Booster Pump Station/Ground Storage	0	0	0	0	0	0
3. Contingency (10%)	9,696,439	10,918,825	10,918,825	10,118,730	10,118,730	9,698,812
4. Engineering (10%)	9,696,439	10,918,825	10,918,825	10,118,730	10,118,730	9,698,812
SOUTHWEST TOTAL	116,357,269	131,025,898	131,025,898	121,424,758	121,424,758	116,385,743
GRAND TOTAL	362,855,610	377,524,239	377,524,239	363,928,473	363,928,473	358,889,458

TABLE A-13

TRANSMISSION SYSTEM CAPITAL COST
ALTERNATE 4 SERVICE AREA

NORTHEAST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	235,208,403	235,208,403	235,208,403	231,879,548	231,879,548	231,879,548
2. Booster Pump Station/Ground Storage	5,010,000	5,010,000	5,018 000	5,010,000	5,010,000	5,010,000
3. Contingency (10%)	24,021,840	24,021,840	24,021,840	23,688,955	23,688,955	23,688,955
4. Engineering (10%)	24,021,840	24,021,840	24,021,840	23,688,955	23,688,955	23,688,955
NORTHEAST TOTAL	288,262,084	288,262,084	288,262,084	284,267,458	284,267,458	284,267,458
SOUTHWEST SYSTEM						
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	57,924,183	71,319,191	71,319,191	63,782,594	63,782,594	60,206,900
2. Booster Pump Station/Ground Storage	0	0	0	0	0	0
3. Contingency (10%)	5,792,418	7,131,919	7,131,919	6,378,259	6,378,259	6,020,690
4. Engineering (10%)	5,792,418	7,131,919	7,131,919	6,378,259	6,378,259	6,020,690
SOUTHWEST TOTAL	69,509,020	85,583,029	85,583,029	76,539,113	76,539,113	72,248,280
GRAND TOTAL	357,771,104	373,845,113	373,845,113	360,806,571	360,806,571	356,515,738

TABLE A-14

TRANSMISSION SYSTEM CAPITAL COST
ALTERNATE 7 SERVICE AREA

NORTHEAST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	0	0	0	0	0	0
2. Booster Pump Station/Ground Storage	0	0	0	0	0	0
3. Contingency (10%)	0	0	0	0	0	0
4. Engineering (10%)	0	0	0	0	0	0
NORTHEAST TOTAL	0	0	0	0	0	0

SOUTHWEST SYSTEM	SITE 1	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5
1. Treated Water Transmission Lines Incl. Crossings, Cathodic Protection, Valves, and Appurtenances	295,126,915	306,364,086	306,364,086	295,105,863	295,105,863	295,448,904
2. Booster Pump Station/Ground Storage	5,010,000	5,010,000	5,010,000	5,010,000	5,010,000	5,010,000
3. Contingency (10%)	30,013,692	31,137,409	31,137,409	30,011,586	30,011,586	30,045,890
4. Engineering (10%)	30,013,692	31,137,409	31,137,409	30,011,586	30,011,586	30,045,890
SOUTHWEST TOTAL	360,164,298	373,648,903	373,648,903	360,139,036	360,139,036	360,550,685
GRAND TOTAL	360,164,298	373,648,903	373,648,903	360,139,036	360,139,036	360,550,685

ATTACHMENT 3

BRAZOS RIVER AUTHORITY PROPOSAL

BRAZOS RIVER AUTHORITY

4400 COBBS DRIVE • P. O. BOX 7555 • TELEPHONE AREA CODE 817 776-1441
WACO, TEXAS 76714-7555

January 11, 1988

Mr. Louis H. Jones, Jr., P.E.
Dannenbaum Engineering Corporation
P. O. Box 22292
Houston, Texas 77027

Re: West Harris County Surface Water Supply Corporation (WHCSWSC)

Dear Mr. Jones:

This letter and its attachments are submitted in response to your letter dated November 6, 1987.

The Brazos River Authority operates a basin-wide water supply system consisting of 11 major reservoirs, from which water is committed to supply needs both in the immediate vicinities of the individual reservoirs and in areas downstream all the way to the Gulf of Mexico. Essentially all of the long-term dependable yield of this basin-wide system has for years been contractually committed. On the basis of option contracts with water users ("the Option Group") in a number of growing regions in the mid Brazos Basin, the Authority is currently engaged in preconstruction planning of a major new water supply reservoir in the upper basin.

Within the past year, an opportunity to recapture substantial amounts of presently committed water supplies and to acquire the Allen's Creek Reservoir site for future development has raised the possibility of more economically meeting the future water supply needs of the Option Group if we can find another sizeable customer to share the costs and customer benefits with them. Accordingly, in June 1987, we offered the City of Houston an opportunity to contract for a substantial amount of currently available water and an option for a substantial additional amount to come from, and be contingent upon, the development of a reservoir at the Allen's Creek site. Our offer to Houston was firm until December 31, 1987. Since we have had no reply of any kind in response to this offer, we now consider ourselves free to offer to others the water supplies and options included in the offer to Houston.

The offer to WHCSWSC contained herein contemplates use of the water previously offered to Houston and has been developed in coordination with an offer that is being made concurrently to the Option

Group, based upon joint use by WHCSWSC and the Option Group of water from existing and proposed future sources of supply. Both offers are tailored to the schedule of development that will most economically meet the combination of the needs of WHCSWSC corresponding to Alternative No. 3 in your November 6, 1987 letter and the projected needs of the Option Group. On the basis of this approach, the offer to WHCSWSC is for an incrementally developed water supply of 150,000 acre-feet per year on the following terms:

1. The initial increment of supply will consist of 75,000 acre-feet of water per year from existing sources, which can be made available for immediate diversion by WHCSWSC from the Brazos River, subject only to obtaining a State permit for inter-basin diversion of the water and the necessary State and Federal permits for the actual diversion facilities.

   a. In accordance with the attached "Supply Designation Schedule", which was developed based on the projections you provided for Alternative No. 3, this entire 75,000 acre-feet per year can initially be committed as "Future Use Water". WHCSWSC may at any time designate any amount up to the entire 75,000 acre-feet per year it wishes to have made available for diversion and use. The amount so designated shall be considered "Current Use Water". Beginning with the years shown in the Supply Designation Schedule and thereafter, the amounts designated as Current Use Water may be more but may not be less than the corresponding amounts shown as "Minimum Current Use Water" in the Schedule. The entire 75,000 acre-feet per year of the initial increment of supply shall be designated as Current Use Water beginning January 1, 2000, if not so designated prior to that date.

   b. Water not designated as Current Use Water shall continue to be considered Future Use Water. The amount of water that has been designated as Current Use Water cannot be reduced.

   c. The price for Future Use Water shall be $40.00 per acre-foot (in 1988 dollars) and the price for Current Use Water shall be $120.00 per acre-foot (in 1988 dollars). Both prices shall be subject to escalation in accordance with the Consumer Price Index (CPI).

2. The second increment of supply will come from a source yet to be developed. The schedule for the planning, design, and construction of this new source, now proposed to be a new reservoir developed by BRA at the Allen's Creek site, will correspond to the combined demands of both the WHCSWSC and the Option Group. Using the projected demands for Alternative No. 3 in the Dannenbaum letter dated November 6, 1987, and the projected demands for the Option Group as prepared by the Authority staff, water from the second increment supply source will be needed in the year 2000.

   a. Projections of water needs will be updated annually, and BRA will be obligated to schedule and use its best efforts to complete the second increment supply source by the time the water from it is needed, contingent upon being able to obtain permits and provide for financing and construction.

   b. WHCSWSC will be allocated an additional water supply of 45,000 acre-feet per year to be available upon completion of the second increment supply source. The amount can be less if WHCSWSC so desires and others can be found to contract for the balance, or more if additional supplies become available as a result of the desire of others to release all or a part of their allocation, or as a result of additional development.

   c. The 45,000 acre-feet per year committed to WHCSWSC from the second increment supply source will be designated as Current Use Water and Future Use Water in accordance with the attached Supply Designation Schedule. As discussed in Item 1.a., the WHCSWSC may designate any additional amounts of its Future Use Water as Current Use Water, but the minimum amounts of Current Use Water will be designated according to the attached Schedule. The entire 45,000 acre-feet per year shall be designated Current Use Water beginning January 1, 2010, if not so designated prior to that date.

   d. The amount of water that has been designated as Current Use Water cannot be reduced. Water not designated as Current Use Water shall continue to be considered Future Use Water.

   e. The price for all Current Use Water and Future Use Water shall, after completion of the second increment of supply, be determined based on the cost of developing the source for the second increment of supply. Based on the best estimates and projections of demands now available, the prices for Current Use Water and Future Use Water in 1988 dollars would continue to be the prices quoted in Item 1.c., above.

f. Upon execution of a contract based upon this offer, the Authority proposes to acquire an option to purchase the Allen's Creek site in order to have the site available for development to meet the requirements as set forth in the attached Schedule for the second increment of supply.

3. The third increment of supply is presently planned to come from the proposed South Bend Reservoir Project. According to the current WHCSWSC Alternative No. 3 projections and the Authority's projections for the Option Group, the third increment of water supply will be needed by the year 2010.

   a. Projections of water needs will continue to be updated annually, and BRA will be obligated to schedule and use its best efforts to complete the third increment supply source by the time water from it is needed, contingent upon being able to obtain permits and provide for financing and construction.

   b. Upon completion of the supply source for the third increment of water supply, the WHCSWSC would have an additional allocation of 30,000 acre-feet per year of water supply to be available upon completion of the third increment supply source. The amount can be less if WHCSWSC so desires and others can be found to contract for the balance, or more if additional supplies become available as a result of the desire of others to release all or a part of their allocation, or as a result of additional development.

   c. The 30,000 acre-feet per year allocated to WHCSWSC from the third increment supply source will be designated as Current Use Water and Future Use Water in accordance with the attached Supply Designation Schedule. As discussed in Item 1.a., the WHCSWSC may designate any additional amounts of its Future Use Water as Current Use Water, but the minimum amounts of Current Use Water will be designated according to the attached Schedule. The entire 30,000 acre-feet per year shall be designated Current Use Water beginning January 1, 2030, if not so designated prior to that date.

d. The amount of water that has been designated as Current Use Water cannot be reduced. Water not designated as Current Use Water shall continue to be considered Future Use Water.

e. The price for all Current Use Water and Future Use Water shall, after completion of the third increment of supply, be determined based on the cost of developing the source for the third increment of supply. Based on the best estimates and projections of demands now available, the prices for Current Use Water and Future Use Water in 1988 dollars would continue to be the prices quoted in Item 1.c., above.

The relationship of this offer to the activities we have in progress to meet the needs of the Option Group and the fact that our offer to Houston is still open, though no longer exclusive, makes it urgent that we have your response as soon as possible.

A number of attachments have been included to respond to most of your list of information requests. Under Attachment No. 1, we have summarized and provided tables and graphs to show the incremental water supply development for meeting the WHCSWSC and Option Group demands through the year 2030. Estimates on the cost of delivery are provided under Attachment No. 2. A discussion of the termination storage impoundments that might be needed is provided under Attachment No. 3. Under Attachment No. 4, the water quality for both the Lower Brazos River and the Allen's Creek Project are discussed. Attachment No. 5 includes information and a report on the treatability of Brazos River water. We would also encourage you to discuss the matter of treatability with Mr. Joe Willhelm of the Galveston County Water Authority. Finally, some additional information on the Canal System A, its pumping station, and the Oyster Creek - Jones Creek conveyance, is provided under Attachment No. 6.

The cost information that we have provided is limited to information that we have directly available. We have provided some general guidelines on impoundment sizes and the cost of similar type projects, but we have not provided the cost estimates or any detail on the types of projects that would be specifically needed by the WHCSWSC. We hope the information that is provided will help you to make these decisions and to determine appropriate cost.

Please review the offer outlined and the information in the attachments. If you have any questions about this information, please contact Mr. Tom Ray on the water supply schedule and the engineering information, Mr. Gary Neighbors on the price for water supply, or me.

Very truly yours,

Carson H. Hoge

CARSON H. HOGE, P.E.
General Manager

CHH:cg
Attachments

BRAZOS RIVER AUTHORITY

4400 COBBS DRIVE • P. O. BOX 7555 • TELEPHONE AREA CODE 817 776-1441
WACO, TEXAS 76714-7555

October 29, 1987

Mr. Louis H. Jones, Jr., P.E.
Dannenbaum Engineering Corporation
3100 West Alabama
Houston, Texas 77098

Dear Louis:

The following is furnished in response to your request for our basis for estimating the cost of Allen's Creek Reservoir in the water supply package we have offered the City of Houston.

The original project known as the Allen's Creek Reservoir was designed by EBASCO Services Incorporated for Houston Lighting & Power Company (HL&P), the owner of the project site, to serve as a cooling pond for a planned thermonuclear generating plant. On the basis of a reevaluation of power needs in its service area, HL&P has now offered to sell the Allen's Creek Reservoir site to the Brazos River Authority as part of a package deal involving also the return of 87,400 acre-feet of water per year which Brazos River Authority is currently contracted to supply to HL&P from existing reservoir storage.

Data and information on the Allen's Creek Project, as originally planned by EBASCO for HL&P, is summarized on Attachment 1. EBASCO has performed a very preliminary re-analysis of the project modified for use as municipal water supply and updated the estimated project cost to 1986 dollars. Brazos River Authority has further updated the estimated project cost to 1987 dollars for a project with a yield of 75,000 acre-feet of water per year.

The analysis is for a reservoir having an 8,000-acre surface area at a maximum normal operating level of 118 feet above m.s.l., a total storage volume of 120,000 acre-feet and a useable storage volume between elevations 105 and 118 feet above m.s.l. of 95,000 acre-feet. The effects of honoring downstream water rights and of evaporation, which ranges at the site from an average of 0.1 foot per month in December to 0.5 foot per month in July, were taken into account. The analysis was run for the 1940-1984 period of record for the Brazos River Richmond Gauge of the USGS. The EBASCO cost estimates are summarized as follows:

Construction Costs

The original alignment of Allen's Creek dam for the 8,000 acres cooling pond was utilized. The dam, reservoir, spillway and drainage canal were kept unchanged. The southern access road as well as the dam access road were also included in the cost estimate.

The Brazos River pumping station will house twelve 37,000 gpm, 1,250 HP pumping units and will be located in the same section of Brazos River as planned in the original nuclear project.

Allen's Creek pumping station (Allen's Creek Reservoir to the treatment plant) will have the same type of units as those selected for the Brazos River pumping station. Two units will be required to pump 150 cfs to the treatment plant located within an assumed radius of ten miles from the reservoir.

A ten-mile pipeline linking the pumping station to the treatment plant was included in the cost estimate.

The total capital cost was estimated to be 69,920,000 1981 dollars. Another 10,333,000 dollars was estimated for escalating prices to 1986. Adding interest during construction at 10 percent interest rate brings the total estimated cost to $97.4 million with the following major cost components:

- dam	14 million
- spillway	12 million
- water conveyance from Brazos River	14 million
- water conveyance to the treatment plant	20 million

<u>Annual Costs</u>

Fixed charges on capital investment, other fixed charges and O&M were estimated to be 15.6 percent of the total investment. The annual pumping energy costs estimated to be $1,085,600 were calculated based upon the on-peak and off-peak tariffs of Houston Lighting & Power Company. With the above assumptions the raw water cost amounts to 46 cents/1000 gal.

The update of the EBASCO cost estimates to 1987 dollars performed by BRA is summarized on Attachment 2. Estimated O&M costs, other than power costs, have been modified to accord with BRA costs for operation of similar existing projects. Land costs for the Allen's Creek Project have not been included in the cost estimate because BRA proposes to require the site with revenues from the sale of the water supplies from existing storage proposed to be recaptured from HL&P as part of the package deal.

The cost estimates shown on Attachment 2 were used by BRA in formulating the offer made to the City of Houston. You will note that, even without inclusion of land costs, the estimated unit cost of water from Allen's Creek is greater than the anticipated price for water after development of Allen's Creek set out in our offer to the City of Houston. The reason for this is that the BRA offer to Houston contemplates averaging the costs of water from existing sources with the cost of water from the more expensive Allen's Creek to bring the overall cost to less than the cost of water from Allen's Creek alone. If Allen's Creek can be developed and operated within the estimated costs (in 1987 dollars) shown on Attachment 2, the price for water anticipated in the BRA offer to Houston will not be exceeded.

Please let me know if you have questions concerning the information herein furnished.

Very truly yours,

CARSON H. HOGE, P.E.
General Manager

CHH:gls
Encl.

ATTACHMENT 4

CORRESPONDENCE

CITY OF HOUSTON
Post Office Box 1562 · Houston, Texas 77251-1562
Kathryn J. Whitmire, Mayor

December 21, 1987

Mr. Louis H. Jones, P.E.
Project Manager
Dannenbaum Engineering Corporation
3100 West Alabama
P.O. Box 22292
Houston, Texas 77027

Subject: Projected Treated Surface Water Costs
Northeast Water Purification Plant

Dear Mr. Jones:

In response to your December 2, 1987 letter concerning the City's plans with regard to the Northeast Water Purification Plant, the following information is provided:

1. Redesign of the first increment of the Northeast Plant was recently authorized by the Houston City Council. This plant, which will have a nominal peak production capacity in the range of 35 to 50 mgd, could be completed and in operation by early 1991 if binding commitments are received from capital cost participants. To date, no such commitments have been provided. This initial plant construction project is to be designed to be consistent with an overall site development plan for providing peak daily production in the range of 600 mgd. No firm schedule for future plant expansions currently exists -- the construction of new facilities will undoubtedly "track" demand patterns in the area. You might be interested to know that the City's current master planning projections envision the capacity of the Northeast Plant to be 400 to 500 mgd by the year 2030.

2. Final design of the Northeast Plant facilities will establish exact discharge pressures and pump operating characteristics. It is anticipated that design concepts for this plant will closely mirror those used in the Southeast Plant, resulting in nominal discharge pressures in the range of 90 psi at the plant discharge header.

3. Our preliminary estimate of plant construction costs is $65

million. Of this cost, approximately $9.1 million is directly attributable to pumping and storage facilities, and another $18.3 million is assigned to general site improvements. On this basis, it is expected that approximately 20 percent of the total plant cost will be assigned to production/storage, with the remainder allocated to production/raw water supply.

4. Actual costs of treatment at the new plant are difficult to project at this time, given the uncertainty about initial dates of operation of the plant. It appears that a "current dollar" estimate of operating costs in the range of $0.40 to $0.50 per thousand gallons is appropriate for planning purposes.

5. Likewise, raw water costs may be impacted in the long term by major capital projects and changes in levels of demand, but it appears appropriate to use a current nominal raw water of approximately $0.25 per thousand gallons in preliminary cost analysis.

It should be clearly understood that the foregoing information is provided for your use in formulating and screening alternatives, and does not constitute a "commitment" by the City to construct any improvements according to a defined time schedule or at such times as required by your demand. Such a commitment would be best addressed through execution of a binding contract for surface water supply or capital cost participation.

Please feel free to contact me if you require further information.

Truly yours,

12.21.87

Michael S. Marcotte, P.E.
Assistant to the Director
Department of Pulic Works

MSM:pr
cc: Danny Davis

ATTACHMENT 5

GALVESTON COUNTY WATER AUTHORITY
OPERATING REPORTS

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT -- JANUARY 1987

Contract Water	$ 19,553.61		Operating Supplies	$ 95.19
Salaries	44,969.78		Contract Service	2,595.00
Power	21,749.60		Lab Supplies	1,218.18
Admin. Central	31,217.35		Misc. Purchases	168.04
Chemicals:			Tools	0.00
Lime		$ 3,626.73	Mgmt. Expense	0.00
Phosphate		6,986.54	Office Supplies	61.29
Chlorine		2,142.83	Janitorial	754.71
Cat. Polymer		4,955.39	Uniforms	514.17
Carbon Dioxide		1,336.72	Safety Equipment	136.75
Fluoride		1,902.73	Training	51.94
Ferric Sulfate		454.67	Transportation	269.61
Sodium Chlorite		4,201.51	Cont. Svc.-Optg.	595.00
Ammonia		717.88	Sludge Disposal	4,858.50
Misc. Chemicals		66.00	Maintenance & Equip.	23,624.39
Sub-Total Chemicals		$26,391.00		

30 days	$212,304.90	TOTAL AMOUNT SPENT	$178,825.11
31 days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	319,546 KGAL
		AVERAGE COST PER THOUSAND GALLONS	$ 0.5596
Available	$ 40,556.62	AVG. CHEMICAL COST PER THOUSAND	$ 0.0826

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT - FEBRUARY 1987

Contract Water	$19,553.61		Operating Supplies	$ 0.00
Salaries	44,800.84		Contract Service	2,595.00
Power	16,204.38		Lab Supplies	326.11
Admin. Central	25,617.62		Misc. Purchases	129.19
Chemicals:			Tools	0.00
Lime		$ 3,797.66	Mgmt. Expense	0.00
Phosphate		4,562.58	Office Supplies	61.16
Chlorine		1,839.99	Janitorial Supplies	494.68
Cat. Polymer		4,085.18	Uniforms	504.20
Carbon Dioxide		1,160.80	Safety Supplies	56.00
Fluoride		1,645.46	Training	101.00
Ferric		743.66	Transportation	678.60
Sodium Chlorite		3,462.31	Cont. Svc. Optg.	0.00
Ammonia		601.29	Sludge Disposal	0.00
Misc. Chemicals		0.00	Maintenance & Equip.	36,223.01
Sub-Total Chemicals		$21,898.93		

30 days	$212,304.90	TOTAL AMOUNT SPENT	$169,244.33
31 days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	273,431 KGAL
		AVERAGE COST PER THOUSAND GALLONS	$ 0.6190
Available	$ 43,060.57	AVG. CHEMICAL COST PER THOUSAND	$ 0.0800

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT - MARCH 1987

Contract Water	$ 19,553.61		Operating Supplies	$ 24.01
Salaries	44,411.16		Contract Service	2,595.00
Power	21,039.99		Lab Supplies	2,325.14
Administration Central	46,958.71		Misc. Purchases	94.12
Chemicals:			Tools	0.00
Lime		$ 4,280.30	Mgmt. Expense	213.00
Phosphate		6,849.70	Office Supplies	223.04
Chlorine		2,328.25	Janitorial Supplies	299.84
Cat. Polymer		5,700.00	Uniforms	507.40
Carbon Dioxide		1,113.96	Safety Equipment	56.00
Fluoride		1,868.76	Training	851.21
Ferric Sulfate		333.45	Transportation	336.65
Sodium Chlorite		4,385.92	Contract Svc.-Optg.	0.00
Ammonia		684.83	Sludge Disposal	0.00
Misc. Chemicals		0.00	Maintenance & Equip.	39,089.09
Sub-Total Chemicals		$ 27,545.17		

30 Days	$212,304.90	TOTAL AMOUNT SPENT	$206,123.14
31 Days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	318,710 KGAL
		AVERAGE COST PER THOUSAND GALLONS	$ .6467
Available	$ 13,258.59	AVERAGE CHEMICAL COST PER THOUSAND	$ .0864

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT - APRIL 1987

Contract Water	$19,553.61		Operating Supplies	$ 0.00
Salaries	46,939.01		Contract Service	2,595.00
Power	25,035.24		Lab Supplies	4,341.56
Admin. Central	29,307.09		Misc. Purchases	844.88
Chemicals:			Tools	0.00
Lime		$ 6,016.47	Mgmt. Expense	0.00
Phosphate		6,928.02	Office Supplies	334.13
Chlorine		2,384.03	Janitorial	415.45
Cat. Polymer		3,829.68	Uniforms	723.25
Carbon Dioxide		576.20	Safety Equipment	409.66
Fluoride		1,871.90	Training	344.47
Ferric		497.42	Transportation	425.85
Sodium Chlorite		5,511.28	Cont. Svc. Optg.	4,568.06
Ammonia		743.58	Sludge Disposal	0.00
Misc. Chemicals		0.00	Maint. & Equip.	42,090.41
Sub-Total Chemicals		$28,358.58		

30 days	$212,304.90	TOTAL AMOUNT SPENT	$206,286.25
31 days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	348,602 KGAL
		AVERAGE COST PER THOUSAND GALLONS	$ .5918
Available	$ 6,018.65	AVG. CHEMICAL COST PER THOUSAND GALLONS	$ .0814

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT - MAY 1987

CONTRACT WATER	$ 19,553.61	
SALARIES	44,817.21	
POWER	21,699.39	
ADMIN. CENTRAL	28,006.87	
CHEMICALS:		
LIME		$ 5,184.23
PHOSPHATE		7,098.08
CHLORINE		2,578.16
CAT. POLYMER		3,512.84
CARBON DIOXIDE		139.64
FLUORIDE		1,912.79
FERRIC DULFATE		330.98
SODIUM CHLORITE		12,457.45
AMMONIA		697.37
MISC. CHEMICALS		3,013.24
SUB-TOTAL CHEMICALS		$ 36,924.78

OPERATING SUPPLIES	$ 0.00
CONTRACT SERVICE	2,595.00
LAB SUPPLIES	1,436.06
MISC. PURCHASES	215.33
TOOLS	0.00
MGMT. EXPENSE	0.00
OFFICE SUPPLIES	225.95
JANITORIAL	433.40
UNIFORMS	616.00
SAFETY	114.85
TRAINING	124.17
CONTRACT SER.-OPTG.	1,850.23
SLUDGE DISPOSAL	0.00
MAINTENANCE & EQUIP.	24,776.37
TRANSPORTATION	533.35

30 Days	$212,304.90
31 Days	$219,381.73
Available	$ 35,459.16

TOTAL AMOUNT SPENT	$183,922.57
TOTAL AMOUNT OF WATER TREATED	342,409 KGAL
AVERAGE COST PER THOUSAND GALLONS	$ .5371
AVG. CHEMICAL COST PER THOUSAND	$ .1078

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT - JUNE 1987

Contract Water	$ 20,291.20		Operating Supplies	$ 0.00
Salaries	49,501.74		Contract Service	2,595.00
Power	22,369.99		Lab Supplies	932.24
Admin. Central	29,378.10		Misc. Purchases	853.01
Chemicals:			Tools	0.00
Lime		$ 4,128.67	Mgmt. Expense	0.00
Phosphate		7,190.48	Office Supplies	209/78
Chlorine		4,775.59	Janitorial	599.10
Cat.Polymer		4,406.36	Uniforms	470.40
Carbon Dioxide		190.72	Safety Supplies	89.24
Fluoride		1,831.02	Training	44.93
Ferric Sulfate		389.88	Transportation	160.07
Sodium Chlorite		14,039.03	Contract Svc. Optg.	364.00
Ammonia		667.39	Sludge Disposal	0.00
Misc. Chemicals		0.00	Maintenance & Equip.	36,921.87
Sub-Total Chemicals		$37,618.14		

30 Days	$212,304.90	TOTAL AMOUNT SPENT	$202,399.91
31 Days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	326,939 KGAL
		AVERAGE COST PER THOUSAND GALLONS	$ .6191
Available	$ 9,904.99	AVERAGE CHEMICAL COST PER THOUSAND	$ .1151

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATION COST REPORT - JULY 1987

Contract Water	$ 22,617.03		Operating Supplies	$ 0.00
Salaries	69,940.28		Contract Service	2,595.00
Power	23,180.10		Lab Supplies	1,450.92
Admin. Central	33,812.41		Misc. Purchases	357.46
Chemicals:			Tools	0.00
Lime		$ 5,189.68	Mgmt. Expense	0.00
Phosphate		7,533.46	Office Supplies	161.52
Chlorine		2,962.41	Janitorial Supplies	1,084.09
Cat. Polymer		6,074.00	Uniforms	637.79
Carbon Dioxide		293.56	Safety Supplies	323.63
Fluoride		1,943.61	Training	53.00
Ferric		209.29	Transportation	1,085.11
Sodium Chlorite		15,131.27	Cont. Svc. Optg.	1,822.00
Ammonia		748.17	Sludge Disposal	1,134/00
Misc. Chemicals		573.50	Maintenance & Equip.	21,164.48
Sub-Total Chemicals		$40,658.95		

30 days	$212,304.90	TOTAL AMOUNT SPENT	$ 222,078.11
31 days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	362,088 GKAL
		AVERAGE COST PER THOUSAND GALLONS	.6133
Available	$ -2,696.38	AVG. CHEMICAL COST PER THOUSAND GALLONS	.1123

Note: Three payroll periods during the month of July

GALVESTON COUNTY WATER AUTHORITY SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT - AUGUST 1987

Contract Water	$ 22,617.03		Operating Supplies	$ 0.00
Salaries	44,958.43		Contract Service	2,076.00
Power	25,357.08		Lab Supplies	1,990.65
Admin. Central	32,405.76		Misc. Purchases	138.30
Chemicals:			Tools	0.00
Lime		$ 6,185.17	Mgmt. Expense	0.00
Phosphate		7,926.38	Office Supplies	133.00
Chlorine		3,000.43	Janitorial Supplies	360.55
Cat. Polymer		6,266.21	Uniforms	499.55
Carbon Dioxide		550.36	Safety Supplies	71.00
Fluoride		1,657.42	Training	738.00
Ferric		223.92	Transportation	187.59
Sodium Chlorite		15,886.64	Cont. Svc. Optg.	436.00
Ammonia		766.22	Sludge Disposal	0.00
Misc. Chemicals		0.00	Maintenance & Equip.	20,824.73
Sub-Total Chemicals		$ 42,462.75		

30 Days	$212,304.90	TOTAL AMOUNT SPENT	$ 195,256.42
31 Days	$219,381.73	TOTAL AMOUNT OF WATER TREATED	381,320 KGAL
		AVERAGE COST PER THOUSAND GALLONS	$ .5121
Available	$ 24,125.31	AVG. CHEMICAL COST PER THOUSAND GALLONS	$ .1114

GALVESTON COUNTY WATER AUTHORITY
SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT
SEPTEMBER 1987

CONTRACT WATER	$ 26,628.84	
SALARIES	47,977.30	
POWER	21,727.14	
ADMIN. CENTRAL	29,770.31	
CHEMICALS:		
SODIUM CHLORITE		$ 15,626.32
ZINC PHOSPHATE		7,731.46
CATIONIC POLYMER		5,518.39
LIME		5,768.23
FERRIC SULFATE		222.10
FLUORIDE		1,703.14
CARBON DIOXIDE		637.40
CHLORINE		3,328.04
AMMONIA		757.96
MISC. CHEMICALS		0.00
SUB-TOTAL CHEMICALS		$ 41,293.04
OPERATING SUPPLIES	0.00	
CONTRACT SERVICE	2,076.00	
LAB SUPPLIES	2,720.26	
MISC. PURCHASES	322.76	
TOOLS	0.00	
MGMT. EXPENSE	0.00	
OFFICE SUPPLIES	912.16	
JANITORIAL	534.58	
UNIFORMS	500.40	
SAFETY SUPPLIES	1,368.50	
TRAINING	736.29	
TRANSPORTATION	835.69	
CONTRACT SVC. OPTG.	61.15	
SLUDGE DISPOSAL	250.00	
MAINT. & EQUIPMENT	30,008.19	

TOTAL AMOUNT SPENT	$ 207,662.61
TOTAL AMOUNT OF WATER TREATED	371,940 KGAL
AVERAGE COST PER THOUSAND GALLONS	$ .5582
AVERAGE CHEMICAL COST PER THOUSAND GALLONS	$ .1110

30 DAYS $ 206,337.00
31 DAYS $ 213,556.00 AVAILABLE $ -1,325.61

GALVESTON COUNTY WATER AUTHORITY
SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT
OCTOBER 1987

CONTRACT WATER	$	26,628.84
SALARIES		45,201.91
POWER		22,118.37
ADMIN. CENTRAL		30,417.46
SUB-TOTAL	$	124,267.58
CHEMICALS:		
SODIUM CHLORITE	$	6,616.11
ZINC PHOSPHATE		5,874.44
CATIONIC POLYMER		2,463.64
LIME		5,522.01
FERRIC SULFATE		196.12
FLUORIDE		1,910.22
CARBON DIOXIDE		982.88
CHLORINE		3,378.20
AMMONIA		684.22
MISC. CHEMICALS		0.00
SUB-TOTAL CHEMICALS	$	27,627.84
OPERATING SUPPLIES	$	0.00
CONTRACT SERVICE		2,234.78
LAB SUPPLIES		1,684.03
MISC. PURCHASES		144.47
TOOLS		0.00
MGMT. EXPENSE		446.00
OFFICE SUPPLIES		323.39
JANITORIAL		752.00
UNIFORMS		625.50
SAFETY SUPPLIES		264.95
TRAINING		145.00
TRANSPORTATION		221.75
CONTRACT SVC. OPTG.		398.00
SLUDGE DISPOSAL		236.44
MAINT. & EQUIPMENT		29,144.73
SUB-TOTAL	$	36,621.04
TOTAL AMOUNT SPENT	$	188,516.46
TOTAL AMOUNT OF WATER TREATED		330,841 KGAL
AVERAGE COST PER THOUSAND GALLONS	$	.5698
AVG. CHEMICAL COST PER THOUSAND GALLONS	$	.0835
31 DAYS $ 213,556.00 AVAILABLE	$	25,039.54

GALVESTON COUNTY WATER AUTHORITY
SURFACE WATER TREATMENT PLANT
MONTHLY OPERATIONAL COST REPORT
NOVEMBER 1987

CONTRACT WATER	$	26,628.84
SALARIES		44,119.71
POWER		20,871.52
ADMIN. CENTRAL		25,755.63
SUB-TOTAL	$	117,375.70
CHEMICALS:		
SODIUM CHLORITE	$	7,276.12
ZINC PHOSPHATE		5,271.86
CATIONIC POLYMER		1,964.47
LIME		6,562.72
FERRIC SULFATE		196.12
FLUORIDE		1,910.22
CARBON DIOXIDE		1,369.36
CHLORINE		2,567.66
AMMONIA		684.22
MISC. CHEMICALS		496.25
SUB-TOTAL CHEMICALS	$	28,399.00
OPERATING SUPPLIES	$	0.00
CONTRACT SERVICE		2,076.00
LAB SUPPLIES		1,284.35
MISC. PURCHASES		304.82
TOOLS		0.00
MGMT. EXPENSE		1,033.15
OFFICE SUPPLIES		182.50
JANITORIAL		270.62
UNIFORMS		600.60
SAFETY SUPPLIES		0.00
TRAINING		0.00
TRANSPORTATION		649.70
CONTRACT SVC. OPTG.		0.00
SLUDGE DISPOSAL		0.00
MAINT. & EQUIPMENT		6,958.37
SUB-TOTAL	$	13,260.11
TOTAL AMOUNT SPENT	$	158,934.81
TOTAL AMOUNT OF WATER TREATED		317,123 KGAL
AVERAGE COST PER THOUSAND GALLONS	$	.5012
AVG.CHEMICAL COST PER THOUSAND GALLONS	$	.0892

31 DAYS $ 206,337.00 AVAILABLE $ 47,402.19

ATTACHMENT 6

ACKNOWLEDGEMENTS

ACKNOWLEDGMENTS:

Prior reports and studies dealing with water demands and supplies in the City of Houston and surrounding areas were utilized as needed in preparing this study. Materials reviewed during the course of this project are as follows:

1. Houston Water Master Plan, Appendices A through M, August 1985 to March 1987 and latest revisions, by Metcalf and Eddy, Inc.

2. District Plan, Adopted November 1985, by Harris-Galveston Coastal Subsidence District.

3. Subsidence '87, February 1987 by Harris-Galveston Coastal Subsidence District.

4. Proposal to City of Houston on sale of Brazos River water, January 1988, by the Brazos River Authority.

5. Utility District Listing, Creation and Bond Issue Reports, Texas Water Commission Records, January 1987.

6. Yearly Groundwater Pumpage Records, Harris-Galveston Coastal Subsidence District.

7. Planning Report/Draft Environmental Statement, San Jacinto Project, Texas, September 1987, by United States Department of the Interior Bureau of Reclamation.

8. Surface Water Conversion Plan, North Harris County Water Supply Corporation, June 1987, by Pate Engineers/Jones & Carter.

9. West Harris County Surface Water Supply Corporation Implementation Plan, Appendix II (Including Revision One) - Water Demand and Supply, October 1987, by Dannenbaum Engineering Corporation.

10. Southeast Water Distribution Improvements, Preliminary Engineering Report, Volumes 1 through 4, July 1986, by Bovay Engineers, Inc.

11. Waste Load Evaluation for Upper Oyster Creek in the Brazos River Basin, Segment 1245, June 1985 by Texas Department of Water Resources.

12. Intensive Survey of Oyster Creek, Segment 1110, March 1984 by Texas Department of Water Resources.

13. Intensive Surface Water Monitoring Survey for Segment 1110, Oyster Creek - Above Tidal, September 1977 by Texas Department of Water Resources.

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION
IMPLEMENTATION PLAN

APPENDIX V

DETAILED EVALUATION OF SELECTED ALTERNATIVES

NOVEMBER 1988

DANNENBAUM ENGINEERING CORPORATION
CONSULTING ENGINEERS
3100 WEST ALABAMA
HOUSTON, TEXAS 77098
(713) 622-8011

EXECUTIVE SUMMARY

Projected Water Demands vs. Supply

Year	Projected Surface Water Demands With Conser.	Without Conser.	Supply Alternative 3 GCWA/BRA
1995	36.8 MGD	38.0 MGD	36.8/0 MGD
2000	59.4 MGD	61.5 MGD	59.4/0 MGD
2005	64.5 MGD	66.9 MGD	59.4/5.1 MGD
2010	92.9 MGD	97.0 MGD	59.4/33.5 MGD
2012	98.0 MGD	103.6 MGD	59.4/38.6 MGD
2020	124.5 MGD	132.8 MGD	59.4/65.1 MGD

Raw Water Supply

- o Final recommended plan has been developed utilizing raw water from the Brazos River Basin as the original source to serve the entire WHCSWSC planning area.
- o The plan has built in the flexibility to allow the utilization of treated water from the Northeast System in the later phases (Year 2005, 2010 and 2030) as an alternate source.
- o The recommended facilities should be developed utilizing a primary and secondary source from the Brazos Basin as outlined in Supply Alternate No. 3. The primary source being 59.4 MGD of raw water from the GCWA for Phase I (1995) and Phase II (2000). The secondary source being the 65.1 MGD of raw water from the BRA System for Phase III (2005), Phase IV (2010) and Phase V (2030).
- o The raw water cost for 59.4 MGD of (primary) raw water from the GCWA canal system is projected at $0.11/1000 gallons.
- o The raw water cost for 65.1 MGD of secondary raw water from the BRA system is projected at $0.20/1000 gallons for Supply Alternate No. 3.

Final Selected Alternative

The final recommended plan consists of developing the facilities as follows:

- o A major southwest treatment plant and termination storage facility on Site 7, a 350 acre tract, just west of the future Bellaire-Grand Parkway intersection. (Refer to Exhibit 6 for details.)

- o The plant facilities have been developed to include the option of utilizing Site 4, 5 or 6, if Site 7 is not available without appreciably affecting the viability of the plan.

- o Treatment facility and transmission facilities have been developed in phases with the following capacities:

Phase	Year	Cumulative Capacity
I	1995	37.5 MGD
II	2000	62.5 MGD
III	2005	75.0 MGD
IV	2010	100.0 MGD
V	2030	150.0 MGD

- o A total of eight sites along FM 1093 were developed from the following initial screening criteria:

  - * Minimum 350 usable acres
  - * Within 2 miles of F.M. 1093 between future Allens Creek Reservoir and Grand Parkway
  - * Known faults/geotechnical abnormalities
  - * Not a current business (other than farming)
  - * Not a utility district/development with improvements
  - * Pipelines onsite
  - * Future roadways onsite
  - * Maximum three land owners

- o An eight member ranking committee was formed consisting of three City of Houston staff members from the Department of Public Works.

- o The numerical results were summated for each site and the results tabulated as shown below:

FINAL RANKING OF PLANT SITE ALTERNATIVES

Ranking Committee Member	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
RATER NO. 1	71.7	71.9	63.6	82.4	79.4	79.3	95.0	69.5
RATER NO. 2	81.0	85.0	77.8	88.2	90.3	89.7	94.3	81.9
RATER NO. 3	88.6	90.0	86.0	93.1	91.3	91.6	96.6	87.1
RATER NO. 4	73.4	74.5	58.1	74.1	71.3	66.6	68.5	62.1
RATER NO. 5	64.8	64.8	55.1	79.9	78.9	79.1	77.1	76.6
RATER NO. 6	70.7	71.4	67.4	86.5	81.1	83.5	92.0	72.3
RATER NO. 7	65.5	66.6	54.7	80.5	77.1	77.7	87.1	75.6
RATER NO. 8	56.8	57.9	52.0	84.1	80.3	81.5	82.9	69.9
AVERAGE	71.6	72.8	64.3	83.6	81.2	81.1	86.7	74.4
*FINAL RANKING	7	6	8	2	3	4	1	5

- The ranking committee selected Site 7 as the preferred site with Sites 4, 5 and 6 as alternates.

- Raw Water Supply Alternate No. 1, 2 and 3 were evaluated with Alternate No. 3 being selected as the most economical. Refer to summary below:

Supply Alternate	Expenditures through 2000
Supply Alternate No. 1	$51,428,000
Supply Alternate No. 2	$34,499,120
Supply Alternate No. 3	$18,668,600

Projected Annual Expenditures

- Total annual expenditures for WHCSWSC to develop the selected alternate have been calculated on a yearly basis from a schedule of phased construction prepared to meet the service area demands and maximize revenues. The total annual expenditures are subdivided to include: capital costs for conveyance and transmission systems, raw water supply cost, raw water transportation cost and anticipated operation and maintenance costs. A cash flow analysis was prepared by the financial consultants based on the expected annual costs to develop and operate the plan. See "Schedule of Capital Expenditures and Related Bond Sales" and "Cash Flow Analysis of Annual Expenditures and Revenues" contained in Attachment No. 4, Sections A and B, respectively. The following table summarizes the results.

Summary of Projected Expenditures

Annual

Phase	Period	Maximum Net Debt Service Cost ($1,000,000)	*O & M Cost ($1,000,000)	Cost /1000 Gallons to Customers
I	1990-1995	6.4	1.2	-
II	1996-2000	10.7	5.2	1.26
III	2001-2005	12.3	8.6	1.26
IV	2006-2010	19.2	10.5	1.26
V	2011-2030	37.8	16.4**	***1.45

* Raw water cost included in O & M.
** $23.4 MM from 2031-2055.
*** Varies between $1.55 and $0.85 with a peak of $1.55/1000 gallons in 2013 through 2019.

Financing Method

The WHCSWSC will cover all costs, including (i) debt service and (ii) operating and maintenance costs, with revenues from payments made by wholesale water purchasers under water supply contracts executed between such purchasers and WHCSWSC. WHCSWSC customers will include the City of Houston (expected to be the sole customer for Phase I service and the principal customer for Phase II service - 1989 through 2000), other municipalities, and a large number of municipal utility and other kinds of special purpose districts. WHCSWSC will finance the construction of planned facilities with the proceeds of the sale of tax exempt revenue bonds. WHCSWSC will have no taxing authority. Initial financings are expected to include bonds sold by WHCSWSC to the Texas Water Development Board or other State agency.

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1.0 INTRODUCTION

1.0 INTRODUCTION

Purpose and Scope

This study was undertaken by the West Harris County Surface Water Supply Corporation (WHCSWSC) for the purpose of producing an implementation program that will provide a reliable long term surface water supply to the residents of west Harris County.

The project scope of work for this phase entails the detailed evaluation of alternatives selected under Phase IV. The following alternates and conclusions were approved as a result of Appendix IV:

- Phase V should evaluate in detail specific Southwest Plant sites along FM 1093 in the area of the Grand Parkway/FM 1093 intersection, west to the proposed Allens Creek Reservoir site.

- The Southwest Plant site should be located to allow future development of an alternate and/or additional raw water source.

- Phase V should evaluate the possibility of utilizing all or a portion of the available surface water from the Galveston County Water Authority canals (formerly the Brazos River Authority Canal).

- o The Southwest Conveyance and Transmission System should be sized for average daily demands with the ability to provide the maximum daily needs when required.

- o Service Area Alternate No. 7, serving the entire WHCSWSC planning area from the southwest is more economical than the service area alternates serving from the northeast. As a result, the northeast conveyance system will not be studied in Appendix V.

- o The Southwest Conveyance and Transmission System should be sized to allow the entire WHCSWSC's service area to be served from the southwest (Service Area Alternate No. 7), maximizing the surface water available from the Brazos Basin. The WHCSWSC system should, also, have the flexibility to allow future service from the Northeast Conveyance System (Service Area Alternate No. 4), if deemed appropriate in the future.

Major philosophical changes affecting the conveyance and transmission systems included the application of water conservation, design revision for average daily demands and the postponement of the construction of the Allens Creek Reservoir. Water conservation has reduced the ultimate projected water demand to 124.5 MGD (Average Daily Flow). This reduction from the figures reported in Appendix IV decreases land and termination storage requirements. Transmission lines were checked with the applied water conservation, but provided no significant downsizing of transmission lines. As reported in

Appendix IV, transmission lines had been sized for maximum daily flow with applied velocity limits.

2.0 PROJECTED WATER DEMANDS AND SUPPLY

2.0 PROJECTED WATER DEMANDS AND SUPPLY

Projected Water Demands

The following table represents projected surface water demands for the entire WHCSWSC service area revised for the affects of water conservation.

TABLE 1

Average Daily Projected Demand

Year	With Conservation	Without Conservation
1995	36.8 MGD	38.0 MGD
2000	59.4 MGD	61.5 MGD
2005	64.5 MGD	66.9 MGD
2010	92.9 MGD	97.0 MGD
2012	98.0 MGD	103.6 MGD
2030	124.5 MGD	132.8 MGD

The flows reported have been developed on a census tract basis with reduced demands provided by the City of Houston. The approximate 7% reduction for water conservation can be realized by instituting some of the following programs suggested in Appendix No. 1:

- o Leak Detection and Repair
- o Universal Metering
- o Lower Pressures
- o Wastewater Reuse for Industrial Purposes
- o Installation of Zeriscope

These potential reductions do not have significant effects on the transmission line sizes, however, they do reduce the ultimate demand on the Southwest Conveyance System. Exhibit No. 1 shows the study area demands, the City of Houston demands and the plant phases of construction.

SURFACE WATER REQUIREMENTS
(AVERAGE DAILY DEMAND)

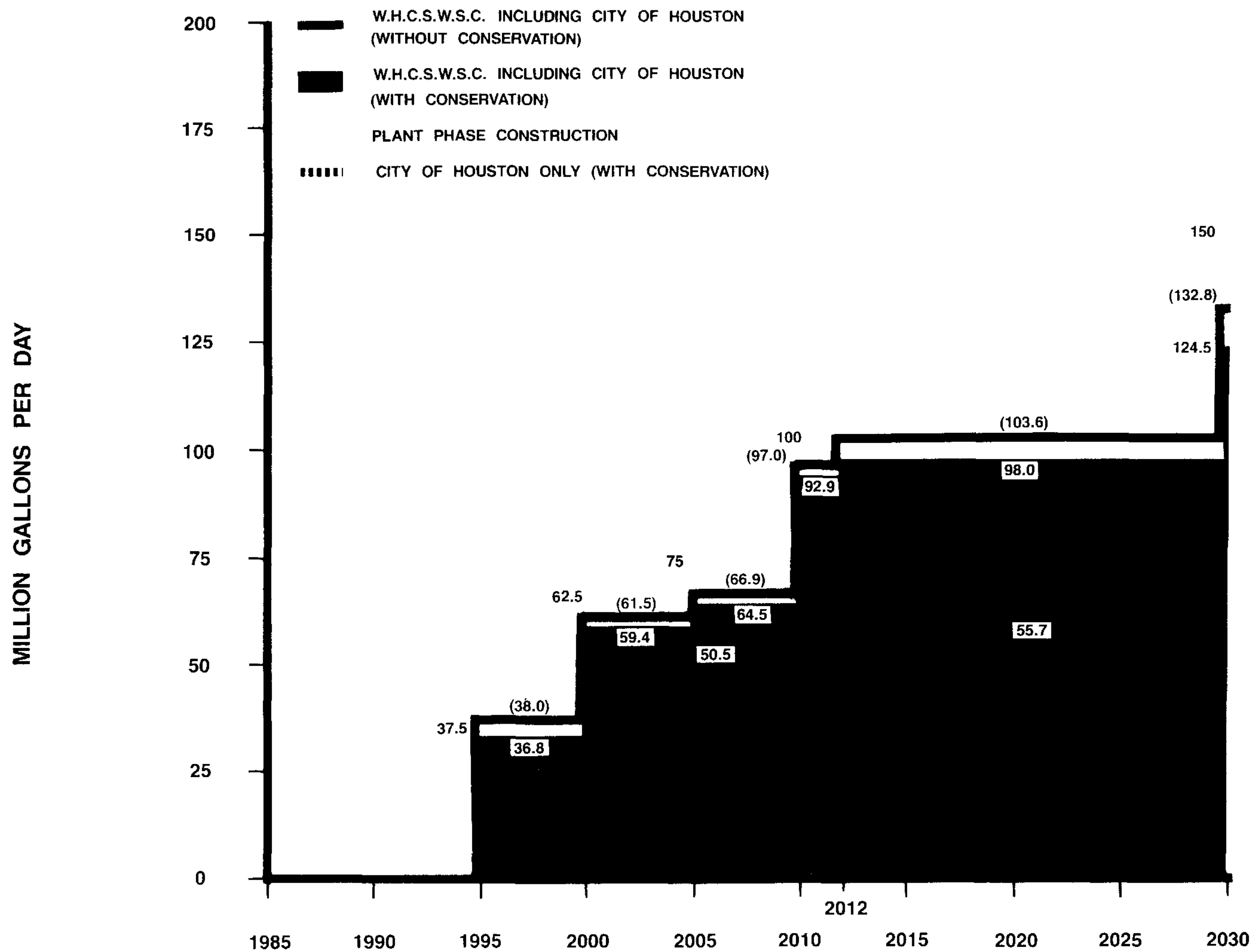


EXHIBIT NO. 1

Surface Water Supply

The raw water source for the Southwest Conveyance System is the Brazos River System including the proposed Allens Creek Reservoir and the Galveston County Water Authority Canal System (previously owned by BRA). The three alternatives for southwest surface water supply are as shown below on Table 2. A graphic representation of the three alternatives is shown on Exhibit 2, 3 and 4.

TABLE 2

Year	Projected Surface Water Demands With Conser.	Without Conser.	Supply Alternative 1 BRA Water	Supply Alternative 2 GCWA/BRA	Supply Alternative 3 GCWA/BRA
1995	36.8 MGD	38.0 MGD	36.8 MGD	36.8/0 MGD	36.8/0 MGD
2000	59.4 MGD	61.5 MGD	59.4 MGD	36.8/22.6 MGD	59.4/0 MGD
2005	64.5 MGD	66.9 MGD	64.5 MGD	36.8/27.7 MGD	59.4/5.1 MGD
2010	92.9 MGD	97.0 MGD	92.9 MGD	36.8/56.1 MGD	59.4/33.5 MGD
2012	98.0 MGD	103.6 MGD	98.0 MGD	36.8/61.2 MGD	59.4/38.6 MGD
2020	124.5 MGD	132.8 MGD	124.5 MGD	36.8/87.7 MGD	59.4/65.1 MGD

SURFACE WATER SUPPLY
BRAZOS RIVER AUTHORITY
(AVERAGE DAILY DEMAND WITH CONSERVATION)
ALTERNATE 1

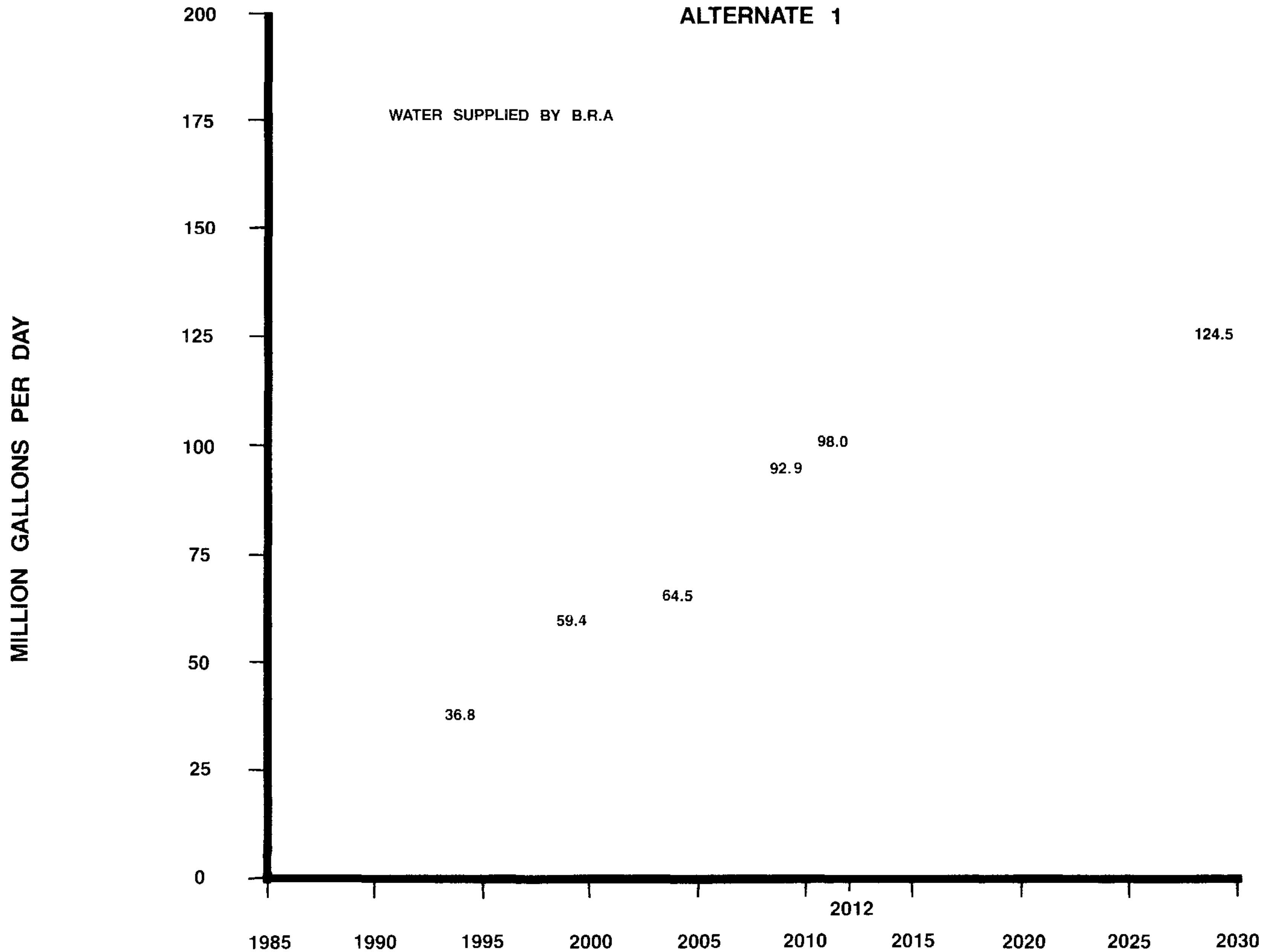


EXHIBIT NO. 2

SURFACE WATER SUPPLY

GALVESTON COUNTY WATER AUTHORITY (36.8 MGD)

BRAZOS RIVER AUTHORITY (87.7 MGD)

(AVERAGE DAILY DEMAND WITH CONSERVATION)

ALTERNATE 2

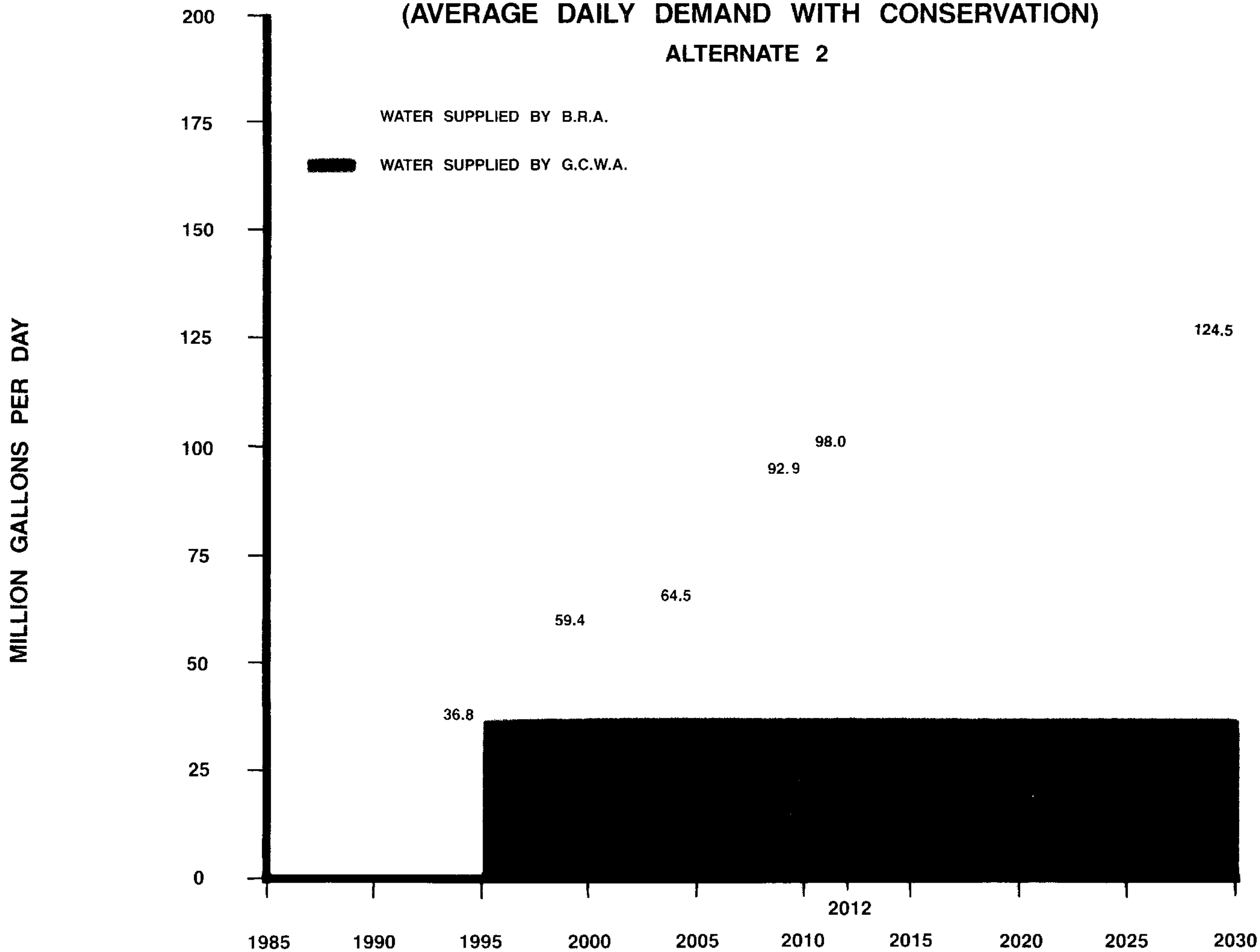


EXHIBIT NO. 3

SURFACE WATER SUPPLY

GALVESTON COUNTY WATER AUTHORITY (59.4 MGD)
BRAZOS RIVER AUTHORITY (65.1 MGD)
(AVERAGE DAILY DEMAND WITH CONSERVATION)

ALTERNATE 3

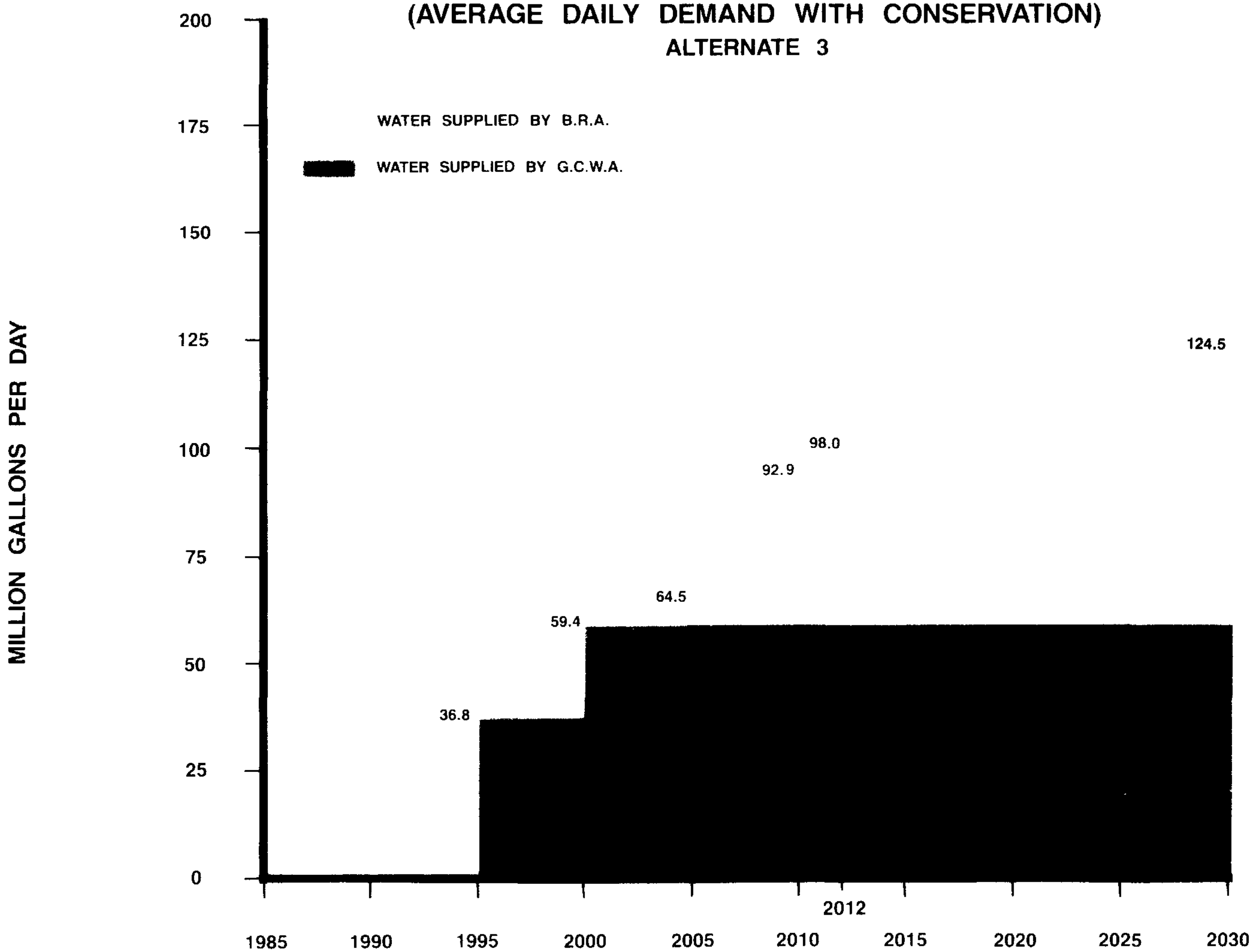


EXHIBIT NO. 4

Surface Water Unit Cost

The cost of surface water reported below is based on 100% firm yield. The projected surface water demands reflected above are based on 80% of the total average daily water demands in accordance with the Harris Galveston Coastal Subsidence District's plan. The remaining 20% will be met through the conjunctive use of the existing groundwater wells. The raw water costs (not including future use costs) are as follows:

TABLE 3

		1995-2000 $/1000 Gal.	2000-2005 $/1000 Gal.	2005-2010 $/1000 Gal.	2010-2030 $/1000 Gal.
Alternative 1 -	BRA	$0.3068	$0.3068	$0.3068	$0.3068
	* GCWA	$0.06	$0.06	$-0-	$-0-
Alternative 2 -	GCWA	$0.11	$0.11	$0.11	$0.11
	BRA	$ -0-	$0.25	$0.25	$0.25
Alternative 3 -	GCWA	$0.11	$0.11	$0.11	$0.11
	BRA	$ -0-	$ -0-	$0.20	$0.20

*GCWA Canal Transportation Cost from Brazos River to Plant Site

Raw Water Characteristics

In April of 1988, the WHCSWSC Board of Directors authorized a testing program of the GCWA canals and the Brazos River to extend over a six month period. To date, two sets of samples have been taken for analysis for the interim primary and secondary drinking water standards. Radiological parameters were also analyzed for the first set of samples. The results available on samples taken to date are presented in Table 4.

TABLE 4

RAW WATER ANALYSIS

CONTAMINANT	OYSTER CREEK AT HWY 6 Set 1	Set 2	Set 3	Set 4	BRAZOS RIVER AT HWY 59 Set 1	Set 2	Set 3	Set 4	BRA CANAL AT DULLES Set 1	Set 2	Set 3	Set 4	BRAZOS RIVER AT FM 1093 Set 1	Set 2	Set 3	Set 4	MAXIMUM ALLOWABLE
Arsenic mg/l	0.005	<0.02			0.005	<0.010			0.005	<0.01			0.007	<0.01			0.05 mg/l
Barium mg/l	0.18	0.21			0.21	0.18			0.17	0.23			0.16	0.26			1.0
Cadmium mg/l	<0.01	<0.01			<0.01	<0.01			<0.01	<0.01			<0.01	<0.01			0.010
Chromium mg/l	<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			0.05
Lead mg/l	<0.05	<0.05			<0.05	<0.05			<0.05	<0.05			<0.05	<0.05			0.05
Mercury mg/l	<0.002	<0.002			<0.002	<0.002			<0.002	<0.002			<0.002	<0.002			0.002
Nitrate Nitrogen mg/l	0.54	0.57			<0.05	0.27			0.45	0.23			<0.05	0.20			10.0
Selenium mg/l	<0.001	<0.01			<0.001	<0.010			<0.001	<0.01			<0.001	<0.01			0.01
Silver mg/l	<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			0.05
Fluoride mg/l	0.32	0.33			0.32	0.35			0.31	0.35			0.35	0.34			-
Endrin mg/l	<0.0002	<0.0002			<0.0002	<0.0002			<0.0002	<0.0002			<0.0002	<0.0002			0.0002
Lindane mg/l	<0.0001	<0.0001			<0.0001	<0.0001			<0.0001	<0.0001			<0.0001	<0.0001			0.004
Methoxychlor mg/l	<0.0003	<0.0003			<0.0003	<0.0003			<0.0003	<0.0003			<0.0003	<0.0003			0.10
Toxaphene mg/l	<0.003	<0.003			<0.003	<0.003			<0.003	<0.003			<0.003	<0.003			0.005
2, 4-D mg/l	<0.005	<0.005			<0.005	<0.005			<0.005	<0.005			<0.005	<0.005			0.10
2,4,5-TP Silvex mg/l	<0.001	<0.001			<0.001	<0.001			<0.001	<0.001			<0.001	<0.001			0.01

RAW WATER ANALYSIS

CONTAMINANT	OYSTER CREEK AT HWY 6 Set 1	Set 2	Set 3	Set 4	BRAZOS RIVER AT HWY 59 Set 1	Set 2	Set 3	Set 4	BRA CANAL AT DULLES Set 1	Set 2	Set 3	Set 4	BRAZOS RIVER AT FM 1093 Set 1	Set 2	Set 3	Set 4	MAXIMUM ALLOWABLE
Total Trihalo-methanes mg/l	<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			0.10
Coliform Bacteria (Col/100 ml)	TNTC	TNTC			TNTC	TNTC			TNTC	TNTC			TNTC	TNTC			-
Fecal Coliform (Col/100 ml)	-				-				-				-				-
Turbidity	178	68			18.1	64			13.5	25			71.8	90			-
Chloride mg/l	277	97.5			346	100			253	102			230	107			250
Color	>70	<5			<5	<5			<5	<5			>70	<5			15
Copper mg/l	<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			<0.02	<0.02			1
Corrositivity	NC	NC			NC	NC			NC	NC			NC	NC			Non-Corrosive
Foaming Agents	0.15	0.06			0.12	0.08			<0.06	<0.05			0.08	<0.05			<0.5
Iron mg/l	0.58	0.31			0.15	0.32			0.23	0.33			0.28	0.33			0.3
Manganese mg/l	0.07	0.04			0.03	0.05			0.03	0.06			0.05	0.06			0.05
Odor	ND	ND			ND	ND			ND	ND			ND	ND			3
pH	7.3	7.2			8.1	6.8			7.9	6.6			8.2	7.3			6.5-8.5
Sulfate mg/l	74.1	66			96.4	70			76.5	67			78.3	60			250
Total Dissolved Solids mg/l	504	478			558	478			536	465			524	502			500

RAW WATER ANALYSIS

CONTAMINANT	OYSTER CREEK AT HWY 6 Set 1	Set 2	Set 3	Set 4	BRAZOS RIVER AT HWY 59 Set 1	Set 2	Set 3	Set 4	BRA CANAL AT DULLES Set 1	Set 2	Set 3	Set 4	BRAZOS RIVER AT FM 1093 Set 1	Set 2	Set 3	Set 4	MAXIMUM ALLOWABLE
Zinc mg/l	<0.01	0.01			<0.01	0.02			0.02	0.02			0.05	0.02			5
Hydrogen Sulfide mg/l	1.33	5.36			<0.5	5.12			1.07	5.44			1.33	8.80			0.05
Gross Alpha PCi/Liter	15+/-8	-	-	-	8+/-7	-	-	-	16+/-8	-	-	-	<2	-	-	-	-
Gross Beta PCi/Liter	18+/-7	-	-	-	8+/-7	-	-	-	17+/-7	-	-	-	10+/-7	-	-	-	-
Radium 226 PCi/Liter	<1	-	-	-	<1	-	-	-	<1	-	-	-	<1	-	-	-	-
Radium 228 PCi/Liter	<1	-	-	-	<1	-	-	-	<1	-	-	-	<1	-	-	-	-

SAMPLE SET 1 TAKEN MAY 25, 1988

SAMPLE SET 2 TAKEN JULY 28, 1988

SAMPLE SET 3 TAKEN

SAMPLE SET 4 TAKEN

For the purposes of Appendix IV, raw water quality of Oyster Creek was assumed to be similar to the results found at the Texas Water Commission active monitoring station on Oyster Creek at U.S. Highway 90 in Sugar Land and reported in the draft wasteload evaluation for upper Oyster Creek published June 20, 1985. Comparing the Texas Water Commission data at Highway 6 and Oyster Creek and samples taken May 25, 1988, the dissolved solids, sulfates and chlorides are all elevated above the Texas Water Commission reported figures for December (1978). Due to the timing of the samples being taken, the variation is not unexpected.

Also in Appendix IV, the raw water quality of the Brazos River was characterized by the historical data at the USGS Richmond, Texas gauge. Comparing recent analysis and the previously presented historical data, turbidity, chlorides and sulfates were higher than the mean but were within the historical maximum and minimum and not unreasonable for the time of year the sample was taken.

The recent data presented on Table 4 is a confirmation of historical analysis acquired from the Texas Water Commission, Galveston County Water Authority and USGS. As expected, whether the raw water is taken from the Galveston County Water Authority Canal System, Brazos River, the original source is the Brazos Basin and the raw water is high in color, turbidity and seasonal high chlorides extending beyond 300 mg/l.

3.0 SOUTHWEST CONVEYANCE SYSTEM EVALUATION

Introduction

The components of the Southwest Conveyance System consists of a raw water pump station, raw water conveyance line, termination storage facilities, southwest water treatment plant, ground storage and treated pump station and treated water conveyance line to intersection of Bellaire and Grand Parkway. As concluded in Appendix IV a detailed evaluation should be performed along FM 1093 from the intersection of Bellaire-Grand Parkway west to the proposed Allens Creek Reservoir. This section evaluates individual treatment plant sites along with their associated lines and pumping facilities.

Treatment Process

As concluded in Appendix IV, the primary raw water supply will be water from the Brazos Basin. After a detailed review a solids contact process was employed in this evaluation. Galveston County Water Authority and other industrial users currently treat Brazos River water, successfully employing this process. Galveston County Water Authority, producing approximately 18 MGD to drinking water standards, utilizes the solids contact process and provides a 5 year treatability history. Polymer is currently utilized as a primary coagulant with chlorine dioxide controlling taste and odor problems

3.0 SOUTHWEST CONVEYANCE SYSTEM EVALUATION

and reducing trihalomethane potentials. Mixed media filters are currently envisioned with available space for carbon contactors if required in the future due to changed criteria.

The solids contact process requires less land area than a similar sized conventional treatment process utilizing rapid mixing flocculation and sedimentation. Since the use of the conventional treatment process is feasible and may be desirable following a complete treatability analysis, sufficient land area has been allowed for the use of either process in performing the detailed site evaluation in the appendices. The use of the solids contact process also allows the treatment facility to be constructed in increments as small as 12.5 MGD, where the conventional process dictates nothing less than 25 MGD increments without increasing the capital cost due to the duplication of facilities.

Raw Water Conveyance

For the first phase of facility construction, the Brazos River or Galveston County Water Authority Canal System is considered to be the primary source of raw water. When completed, Allens Creek Reservoir will become an alternate source of raw water. The raw water conveyance systems are envisioned to encompass the pump station located on the river, canal or reservoir and the transfer to the plant onsite termination storage via an enclosed pipeline. A canal system was considered but eliminated for maintenance and potential liability considerations. The dual raw water source, when ultimately completed, provides the utmost flexibility for plant operation. The raw water source can be Allens Creek Reservoir (or mixed) when Brazos River chlorides are high or when algae/organics create an odor and taste problem. The raw water source can be the GCWA canals just as easily when drought lowers the reservoir level even though this scenario is unlikely.

Termination Storage

First phase termination storage is required to limit chloride concentrations in the raw water to less than 250 mg/l, the current secondary drinking water standard for chlorides. The volume of termination storage was determined based on having to supply raw water, should pumping out of the Brazos River System be suspended, for approximately 5% of the year due to high chloride concentrations. Termination storage will be required for the first two phases of the plant based on an average day demand of up to 64.5 MGD. Upon completion of Allens Creek Reservoir, there is sufficient volume in the reservoir to dissipate and average any excessive chloride concentrations, should they occur. It is anticipated that the Allens Creek Reservoir will be operated to insure a chloride concentration of below 150 mg/l.

The termination storage has been anticipated to be onsite, approximately 185 acres. Refer to Table 5 with the following depth according to flow ratio when providing 18 days of raw water storage.

TABLE 5

Flow	Working Depth	Acre Feet
36.8 MGD	11 Foot	2035 Ac. Ft.
59.4 MGD	18 Foot	3330 Ac. Ft.
64.5 MGD	19 Foot	3515 Ac. Ft.

Offsite storage has been considered, using existing natural lakes along Oyster Creek or Sugar Land Lakes. The results of this investigation indicate that an additional tract along Oyster Creek would have to be acquired for offsite storage. The purchase of a single site is more desirable. There are several drawbacks to utilizing the existing storage in the Sugar Land Lakes System. The volume in these lakes estimated at 3475 acre-feet (excluding channel storage), is currently utilized by Galveston County Water Authority as a buffer between their Brazos River lift station and their re-lift station at Dulles Avenue. The 3475 acre feet is estimated at normal levels and includes Horseshoe Lake (724 Ac-Ft.), Alkire Lake (796 Ac-Ft.), Eldridge Lake (1458 Ac-Ft.), Cleveland Lake (211 Ac-Ft.) and Brooks Lake (286 Ac-Ft.). After discussions with the GCWA General Manager, it was concluded that the GCWA would not allow WHCSWSC to acquire exclusive rights to this storage, due to their downstream demand. Furthermore, Galveston County Water Authority can not guarantee low chloride levels, in fact, their historical data shows chlorides in excess of 250 mg/l at the Dulles Avenue re-lift station. Without exclusive rights to this storage, WHCSWSC would not have full control of its raw water supply. The drastic drawdown that would be required during drought conditions would create public dissention and may possibly reduce the property values located along the lake shorelines.

Once Allens Creek Reservoir is completed and on line as a raw water source, the existing onsite termination storage can be decreased, turning over excess volume for dewatered sludge disposal.

Treatment Facilities

The detailed site location and evaluation for the Southwest Treatment Plant is presented later in this report. Sites were selected along the FM 1093 corridor between the future Allens Creek Reservoir and Grand Parkway. This area was designated as Site Area 4 and 5 in Appendix IV. The treatment plant is sized for 150 MGD ultimate (year 2030) average daily flow, with available land for an additional 50 MGD should Fort Bend County choose to participate in the future. Peak flows are met with a ground storage volume ultimately sized at 48 MG and a distribution (treated water) pump station capable of flows to 225 MGD at 95 PSI. To meet growth and demand projections the development of a Southwest Treatment Plant has been phased as shown on Table 6.

TABLE 6

Phase	Cum. Flow.	Year
I	37.5 MGD	1995
II	62.5 MGD	2000
III	75 MGD	2005
IV	100 MGD	2010
V	150 MGD	2030

The treatment process has been described earlier in this report as a solids contact process with polymer as a primary coagulant. Onsite facilities comprising the treatment scheme include termination storage, low lift pump station, rapid mix, reactor clarifier, mixed media filtration, space for possible carbon contactors, clearwell storage, ground storage, distribution (treated water) pump station and supporting facilities such as filter backwash tanks and a office and laboratory building. Sludge handling facilities would consist of sludge pump station, thickeners, centrifuges, conveyors, etc., with the centrifuges and controls to be contained within a building. A generic site layout, showing phased construction is included as Exhibit 5 on page of this Appendix.

Offsite facilities excluding facilities for wet and dry utility services consist of a raw water pump station and conveyance line from Oyster/Jones Creek or the Brazos River, a raw water pump station and conveyance line from Allens Creek Reservoir to be added in the later phases of the plant and a treated water conveyance line from the distribution (treated water) pump station to the point of connection with the transmission system at the Grand Parkway and Bellaire intersection.

Ultimate land requirements for the Southwest Surface Water Treatment Plant have been calculated at a minimum of 350 acres, based upon a worst case scenario. The worst case scenario is considered to be the following:

- Allens Creek Reservoir constructed in 2013.
- Termination Storage requires for up to 64.5 MGD average daily flow.
- Plant First Phase constructed by 1995.
- Site will require storm water detention.

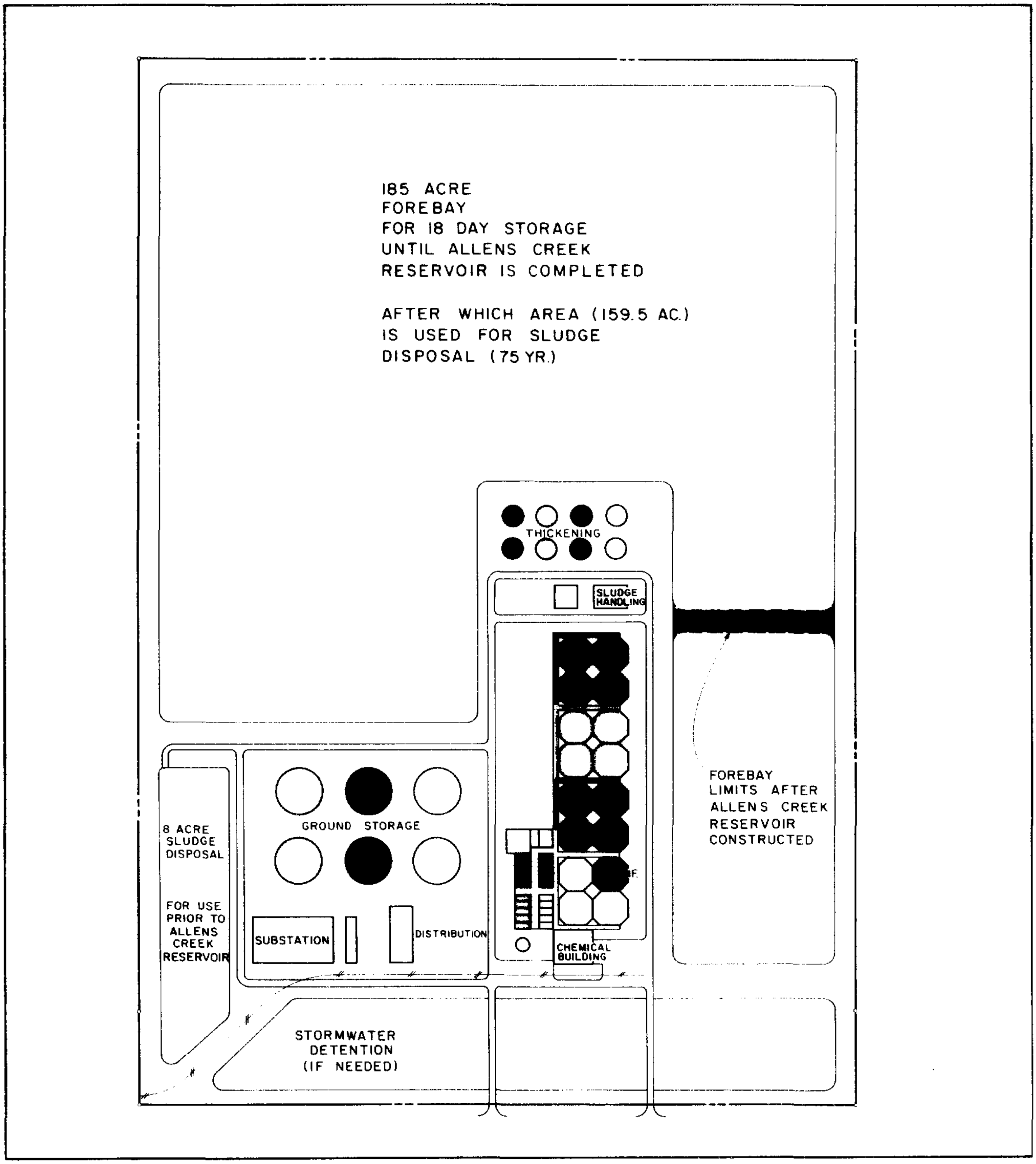
The above assumptions create the need to include 185 acres of temporary termination storage and 20 acres of detention ponds. This is pictorially represented in the Generic Site Layout, Exhibit 5.

Treated Water Storage/Pumping

Ultimately the treated water storage and pumping facilities includes six 8 million gallon ground storage tanks to provide the difference between plant production and a 6 hour period of maximum daily demand. The distribution (treated water) pump station and pumping capacity was also sized to meet maximum daily demand.

Treated Water Conveyance

For the purposes of this Appendix, the treated water conveyance system is defined as the treated water conveyance line from the plant site to the connection point with the transmission system at the Bellaire and Grand Parkway intersection. The 108-inch pipeline is sized to maintain between 3-5 feet per second velocity at average daily demand with velocities not exceeding



☐ PHASE I (37.5 MGD)

■ PHASE II (25 MGD)

■ PHASE III (12.5 MGD)

■ PHASE IV (25 MGD)

☐ PHASE V (50 MGD)

■ PHASE VI (SPACE FOR 50 MGD AVAILABLE FOR FORT BEND COUNTY)

GENERIC SITE LAYOUT

W.H.C.S.W.S.C.

EXHIBIT NO. 5

7 FPS at peak demands. In previous appendices the separation point of the conveyance system to the transmission system was defined as the service area boundaries. Now that the conveyance system has been isolated to the FM 1093 corridor, the point of connection at Bellaire and Grand Parkway will be utilized as the separation point.

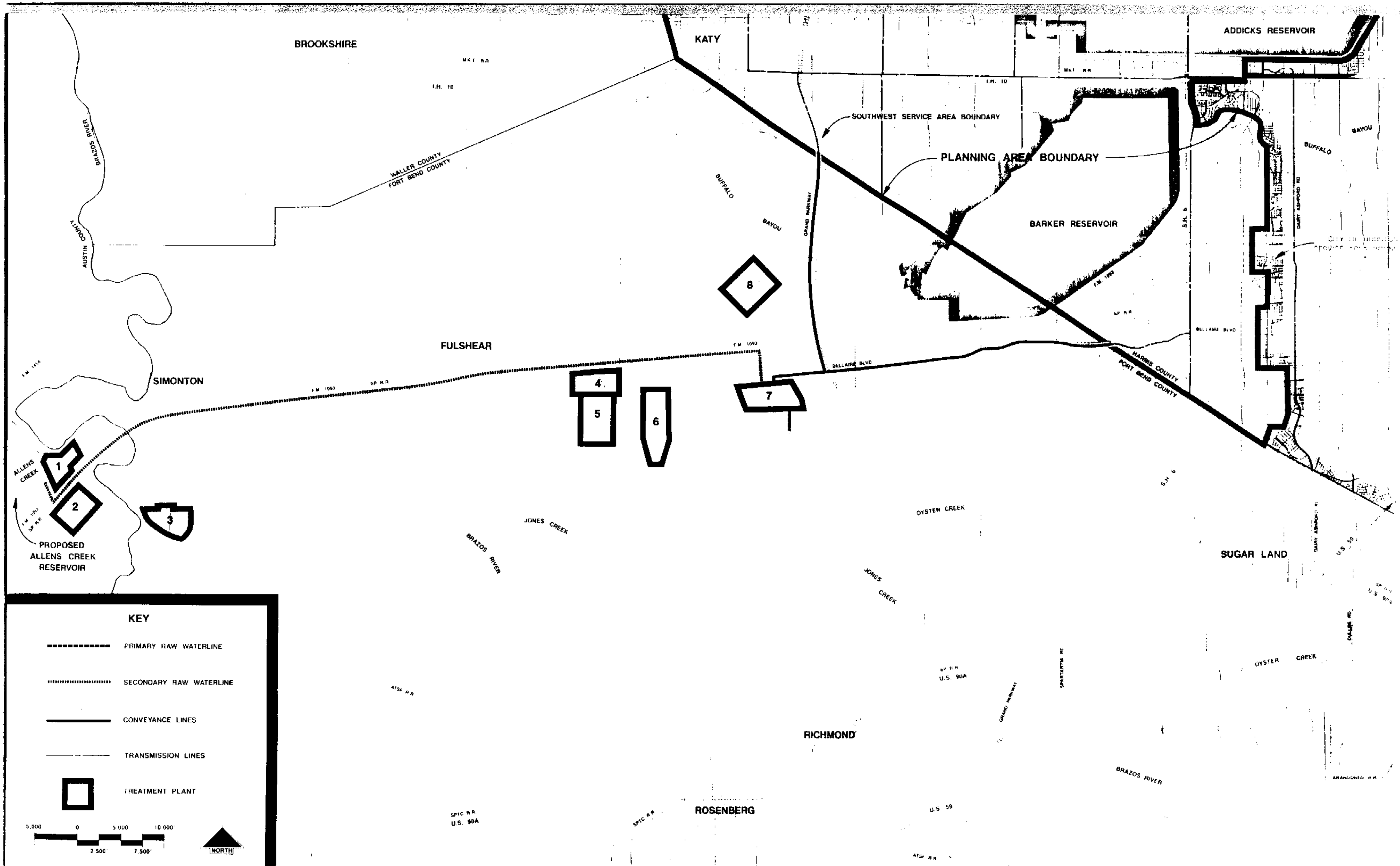
Alternate Site Evaluations

Initial Screening Parameters

A total of 15 potential sites were located by Zingery Maps for consideration. The 15 potential sites were reduced to eight when applying the following initial screening criteria:

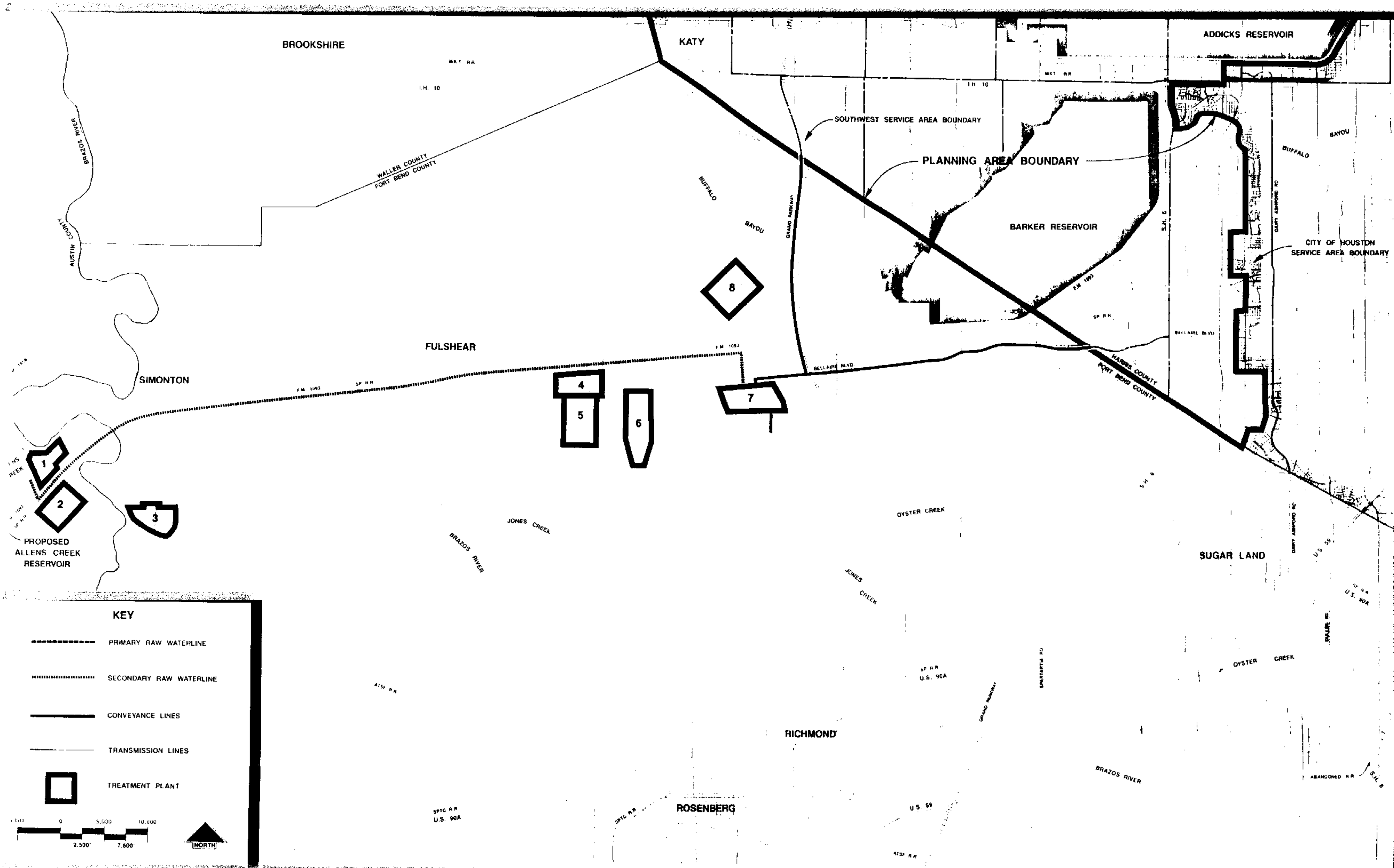
* Minimum 350 usable acres (additional land allowed for site encumbrances)
* Within 2 miles of F.M. 1093 between future Allens Creek and Grand Parkway, north of Jones Creek, Oyster Creek and Brazos
* Known faults/geotechnical abnormalities
* Not a current business (other than farming)
* Not a utility district/development with improvements
* Pipelines onsite
* Future roadways onsite
* Maximum three land owners

The remaining eight sites were thoroughly researched with various authorities and an on the ground reconnaisance performed. The eight sites to be evaluated are presented in Exhibit 6. The final eight sites were



SOUTHWEST CONVEYANCE SYSTEM ALTERNATE SITES

W.H.C.S.W.S.C.
EXHIBIT NO 6



SOUTHWEST CONVEYANCE SYSTEM ALTERNATE SITES

W.H.C.S.W.S.C.
EXHIBIT NO 6

presented along with all technical and financial data to an eight member ranking committee for final ranking. The methodology of this ranking and the results are presented later in this report.

Technical Evaluation

Site No. 1 is located on the west side of FM 1093 and on the south side of the Brazos River. Site No. 1 offers the advantages of low land cost, close proximity to the Brazos River and the future Allens Creek Reservoir, completely outside of the 100-year floodplain and no stormwater detention necessary. The disadvantages include additional costs for a treated water conveyance bridge/support across the Brazos River, need for a railroad overpass to acquire rail service, the acquisition of offsite electrical service from Wallis; need for a long treated water conveyance line; limited load transfer electrical circuits and the location of the plant site would be over 10 miles from the transmission system.

Site No. 2 is located on the east side of FM 1093 and the south side of the Brazos River. This site has all the advantages of Site No. 1 with less disadvantages. The railroad is adjacent to this site and would not require construction of an overpass. Site 2 requires the treated water conveyance line to cross the Brazos River which will require a substantial structure.

Site No. 3 is located 2 miles south of FM 1093 on Guyler Road. Although this site is reasonably close to both the Brazos River and the future Allens Creek Reservoir, it is also far removed from the railroad

(2 miles) and power (5 miles) both of which require the acquisition of right-of-way. This and other available sites are in the 100-year floodplain, however, this fact does not significantly change the site economics. Site 3 is more than 10 miles from the transmission system.

Site No. 4 - Site No. 4 is one of three sites located in the area of FM 359 south of FM 1093. This site, while having excellent access from FM 1093 and the railroad, requires a 1.75 mile power transmission line. Flewellen Creek divides the site and will require dedication of the ultimate section, approximately 190 feet. Site No. 4 is more than 12 miles from Allens Creek Reservoir which will require extensive right-of-way be acquired in the future and is adjacent to Hines Nursery creating a need to control fugitive emissions.

Site No. 5 - This site has good access from FM 359 while not being as expensive as property directly on FM 1093. Railroad access would cross FM 359 and require a crossing signal and guards. Flewellen Creek does cross the site, however, the amount of land lost to drainage easement is not significant. Being more than 12 miles from Allens Creek Reservoir, a large amount of right-of-way will have to be acquired for the secondary raw water supply. This site is adjacent to Hines Nursery.

Site No. 6 - Site No. 6 is located on the east side of FM 359 south of FM 1093. This site has extensive frontage to FM 359 which may be reflected in the land costs. For this site, right-of-way must be acquired for the railroad and approximately 3500 feet for power transmission. This site has a small subdivision just to the east. Land topography is smooth and flat. Site 6 is more than 12 miles from the future Allens Creek Reservoir which will require the acquisition of extensive right-of-way at a future date. This site is adjacent to Hines Nursery and special fugitive emission controls may be necessary.

Site No. 7 - This site is the closest site to power transmission (2,500 feet) and the GCWA canal (Jones Creek). Site boundaries are limited by future roadways and a pipeline. A small portion of the southernmost portion of the site is in the 100-year floodplain but has no net effect on the use of this tract. Railroad access will require a small amount of right-of-way be acquired from FM 1093, south to the site.

Site No. 8 is within the boundaries of Municipal Utility District No. 35 (undeveloped). This site offers the advantage of existing sewage treatment within MUD No. 34, improved drainage channel and good access along recently paved Katy Gaston Road. This site, being north of FM 1093, requires a railroad overpass for service. Approximately 1 mile of power transmission would be required to this site. Access to any raw water source would be across FM 1093. Cinco Ranch abuts this property to the north.

Both sites 7 and 8 are close to the distribution system and will require approximately 18 miles of raw water conveyance from Allens Creek Reservoir in future phases.

You will note the sites gravitate around three general areas (1) FM 1093 and future Grand Parkway; (2) FM 1093 and FM 359, and (3) FM 1093 at the Brazos River. While this was not intentional, these areas represent (1) shortest distance to the transmission system (2) shortest distance for power service and (3) shortest distance to future Allens Creek Reservoir.

Capital Cost Evaluation

A base estimate of the plant facilities has been prepared for an ultimate (year 2030) plant capacity of 150 MGD (average daily) with treated water pumping and storage facilities sized for an ultimate maximum daily demand of 225 MGD. This base estimate is represented as onsite facilities in Table 7. Also, shown in Table 7 is each site specific cost. These costs represent costs such as land cost, offsite power transmission, offsite rail serve, treated water conveyance line to the Bellaire-Grand Parkway intersection and raw water pumping/conveyance facilities from the raw water source to individual plant sites.

TABLE 7

SOUTHWEST PLANT SITING - ULTIMATE COST (2030)

DESCRIPTION	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7	SITE 8
Onsite Facilities	110,350,996	110,350,996	111,111,316	110,350,996	110,509,396	110,350,996	110,984,596	110,350,996
Power Transmission	5,400,000	5,400,000	5,400,000	2,100,000	1,800,000	798,000	600,000	600,000
Railroad	4,860,000	60,000	1,310,400	60,000	702,000	402,000	708,000	5,880,000
Treated Water Conveyance	96,707,964	95,356,584	94,680,894	31,606,236	31,606,236	30,254,856	5,267,706	11,787,780
Raw Water Conveyance	3,559,080	5,726,640	13,457,604	66,736,764	61,864,838	70,964,844	80,502,108	102,517,025
Land	3,513,118	3,640,506	3,797,522	10,904,728	11,895,868	12,836,232	19,763,537	19,254,733
TOTAL	224,391,158	220,534,726	229,757,736	221,758,724	218,378,338	225,606,928	217,825,947	250,390,534
PER GALLON (150 MGD)	$1.496	$1.470	$1.532	$1.478	$1.456	$1.504	$1.452	$1.670

4.0 RANKING OF SOUTHWEST CONVEYANCE ALTERNATES

4.0 RANKING OF SOUTHWEST CONVEYANCE ALTERNATES

Methodology

Previous appendices selected service area Alternate No. 7 and Southwest Conveyance System Sites 4B and 5. This results in providing treated water to the entire service area from the Southwest Plant to be located along F.M. 1093 between Grand Parkway and the future Allens Creek Reservoir site. The purpose of this appendix is to perform an evaluation and rank the eight selected plant site locations. The ranking and selection of a final plant site is independent of the raw water supply alternate previously mentioned under the surface water supply section of this Appendix.

As data collection for use by the Ranking Committee was needed, a total of eight potential sites as previously mentioned were located on Zingery Maps for consideration based on the mentioned criteria on page 24 (Alternate Site Evaluation).

These sites were investigated on aerial photographs, USGS quadrangle and major thoroughfare maps. The geotechnical aspects of these sites were discussed with recognized area consultants. Availability and cost of services such as electric power, gas, railroad, drainage and raw water supply have been researched with the appropriate governmental/private agency. An on the ground field reconnaisance was performed to verify data collected and real estate agents were contacted to establish land costs. Detailed site specific cost estimates for first phase and ultimate plant construction were developed utilizing published cost guides combined with area historical data.

The collected information was then presented to an eight member Ranking Commitee of practicing professionals in the field of water resource development. This panel then evaluated the eight potential conveyance systems on nine subjective criteria plus first phase cost and ultimate cost. Subjective criteria were as follows:

- Convenience of Location
- Power Availability
- Location of Raw Water Supply
- Geotechnical/Faulting
- Effective Land Use
- Required Right-of-Way Acquisition
- Effect on Surrounding Property
- Destruction of Natural Habitat.

Weighting factors were assigned to each of the 11 criteria by the individual raters, then each site was ranked with respect to the criteria given. Final ranking was established as an average of the individual weighting factors times the individual percent ranking as assigned by the ranking committee. The numerical results were summated for each site and the results tabulated as shown in Table 8.

TABLE 8

FINAL RANKING OF PLANT SITE ALTERNATIVES

Ranking Committee Member	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
RATER NO. 1	71.7	71.9	63.6	82.4	79.4	79.3	95.0	69.5
RATER NO. 2	81.0	85.0	77.8	88.2	90.3	89.7	94.3	81.9
RATER NO. 3	88.6	90.0	86.0	93.1	91.3	91.6	96.6	87.1
RATER NO. 4	73.4	74.5	58.1	74.1	71.3	66.6	68.5	62.1
RATER NO. 5	64.8	64.8	55.1	79.9	78.9	79.1	77.1	76.6
RATER NO. 6	70.7	71.4	67.4	86.5	81.1	83.5	92.0	72.3
RATER NO. 7	65.5	66.6	54.7	80.5	77.1	77.7	87.1	75.6
RATER NO. 8	56.8	57.9	52.0	84.1	80.3	81.5	82.9	69.9
	—	—	—	—	—	—	—	—
AVERAGE	71.6	72.8	64.3	83.6	81.2	81.1	86.7	74.4
*FINAL RANKING	7	6	8	2	3	4	1	5

*This ranking is an average of individual weighting factors times the individual percent ranking.

It is clear from the chart that the Ranking Committee has selected Site No. 7, located just south of F.M. 1093 and just west of Grand Parkway as the primary site. However, it should be pointed out that the remaining seven sites evaluated are all technically feasible. The above ranking exercise reflects benefits and drawbacks to individual sites. It is important to note that Sites 7, 4, 5 and 6 ranked numerically very close to each other. Allowing for standard deviation, it can be stated that these sites are generally equal and can be pursued for the implementation plan on that basis.

Sensitivity Analysis

To substantiate the ranking a sensitivity analysis was performed, re-ranking each site with a specific criteria removed from consideration. Regardless of the criteria removed, Site 7 and 4 remained the first and second highest ranked sites, while Site 3 was consistently the lowest ranked. The sensitivity analysis is presented in the following Table 9:

TABLE 9

SENSITIVITY CHART
RANKING OF PLANT SITE ALTERNATIVES

	SUMMARY - AVERAGE RANKING							
CRITERIA DESCRIPTION ELIMINATED	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7	SITE 8
CONVENIENCE OF LOCATION	6	5	8	2	4	3	1	7
POWER AVAILABILITY	6	5	8	2	4	3	1	7
LOCATION OF FUTURE SERVICE AREAS	7	6	8	2	4	3	1	5
LOCATION OF RAW WATER SUPPLY	7	6	8	2	4	3	1	5
GEOTECHNICAL/ FAULTING	7	6	8	2	4	3	1	5
EFFECTIVE LAND USE	7	6	8	2	3	4	1	5
REQUIRED R.O.W. ACQUISITION	7	6	8	2	4	3	1	5
EFFECT ON SURROUND-ING PROPERTY	7	6	8	2	4	3	1	5
DESTRUCTION OF NATURAL HABITAT	7	6	8	2	4	3	1	5
FIRST PHASE COST	6	5	8	2	4	3	1	7
ULTIMATE COST	7	6	8	2	4	3	1	5

Results of Ranking Committee

Plant site ranking of the eight sites identified for consideration were reviewed and graded as previously outlined. The plant sites have been listed below in the order of the most favorable locations as determined during the ranking phase:

1. Site No. 7 - Between F.M. 723 and Grand Parkway South of F.M. 1093
2. Site No. 4 - Frontage on F.M. 1093 at F.M. 359
3. Site No. 6 - Frontage on F.M. 359 South of F.M. 1093
4. Site No. 5 - West of F.M. 359 South of F.M. 1093
5. Site No. 8 - Between Katy-Gaston and Grand Parkway South of F.M. 1093
6. Site No. 2 - F.M. 1093 at the Brazos River - East
7. Site No. 1 - F.M. 1093 at the Brazos River - West
8. Site No. 3 - 2 Miles South of F.M. 1093 on Guyler Road

The above listing of sites should not be taken as the only available or suitable sites in the area. There are other sites available with similar economics but perhaps more encumbrances. However, to be consistent with the ranking committee's decision and to perform further comparisons Site No. 7 will be used for evaluation and final selection of a raw water supply alternative. Site No. 7 will, also, be used when outlining the final implementation plan.

5.0 TRANSMISSION SYSTEM EVALUATION

5.0 TRANSMISSION SYSTEM EVALUATION

The previous evaluation and ranking of southwest plant site alternates was considered independent of the final transmission system after the Bellaire/Grand Parkway intersection. The final transmission system line sizes shown in Exhibit No. 7 have decreased significantly from the system reported in Appendix IV. The line size reductions are a result of the design criteria change as mentioned previously and as reiterated below:

TRANSMISSION SYSTEM

FINAL DESIGN CRITERIA

* Base system design to handle average daily demands per HGSCD from previously selected Site 7 using either Alternate 7 or Alternate 4 service areas.

* Average Day: Max. Velocity = 5 FPS
Max. Pressure = 96 PSI @ Plant
Min. Pressure = 45 PSI
(35 PSI Min. system pressure required under normal operating conditions by T.D.H.)

* Base system rerun with maximum daily demands per HGCSD from previously selected Site 4 using Alternate 7 service areas.

* Maximum Day: Max. Velocity = 7 FPS

  Max. Pressure = 96 PSI @ Plant

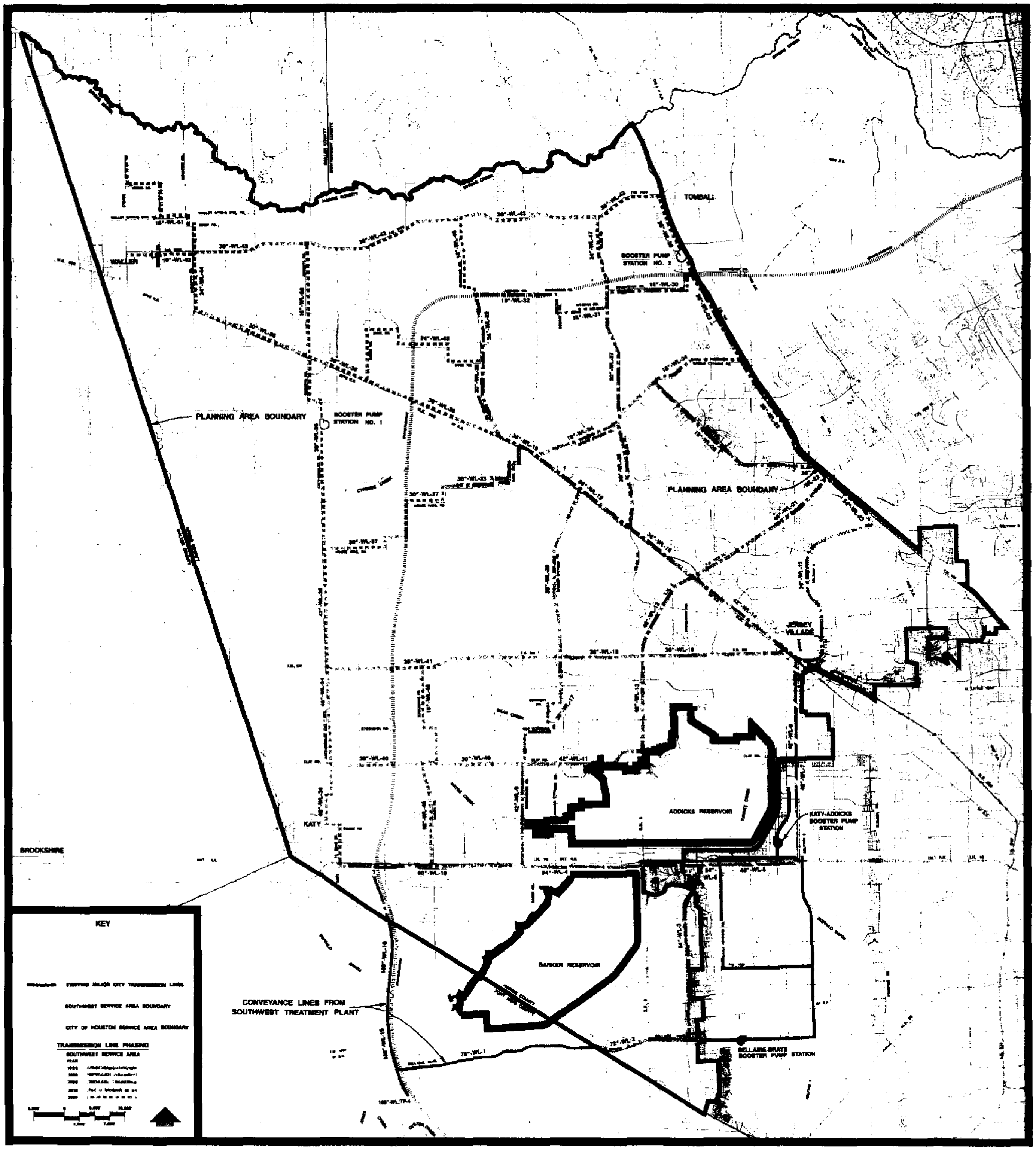
  Min. Pressure = 20 PSI

  (20 PSI Min. system pressure required under peak operating conditions by T.D.H.)

Due to the revised transmission line sizes, the transmission cost has been reduced by as much as 40-50 percent.

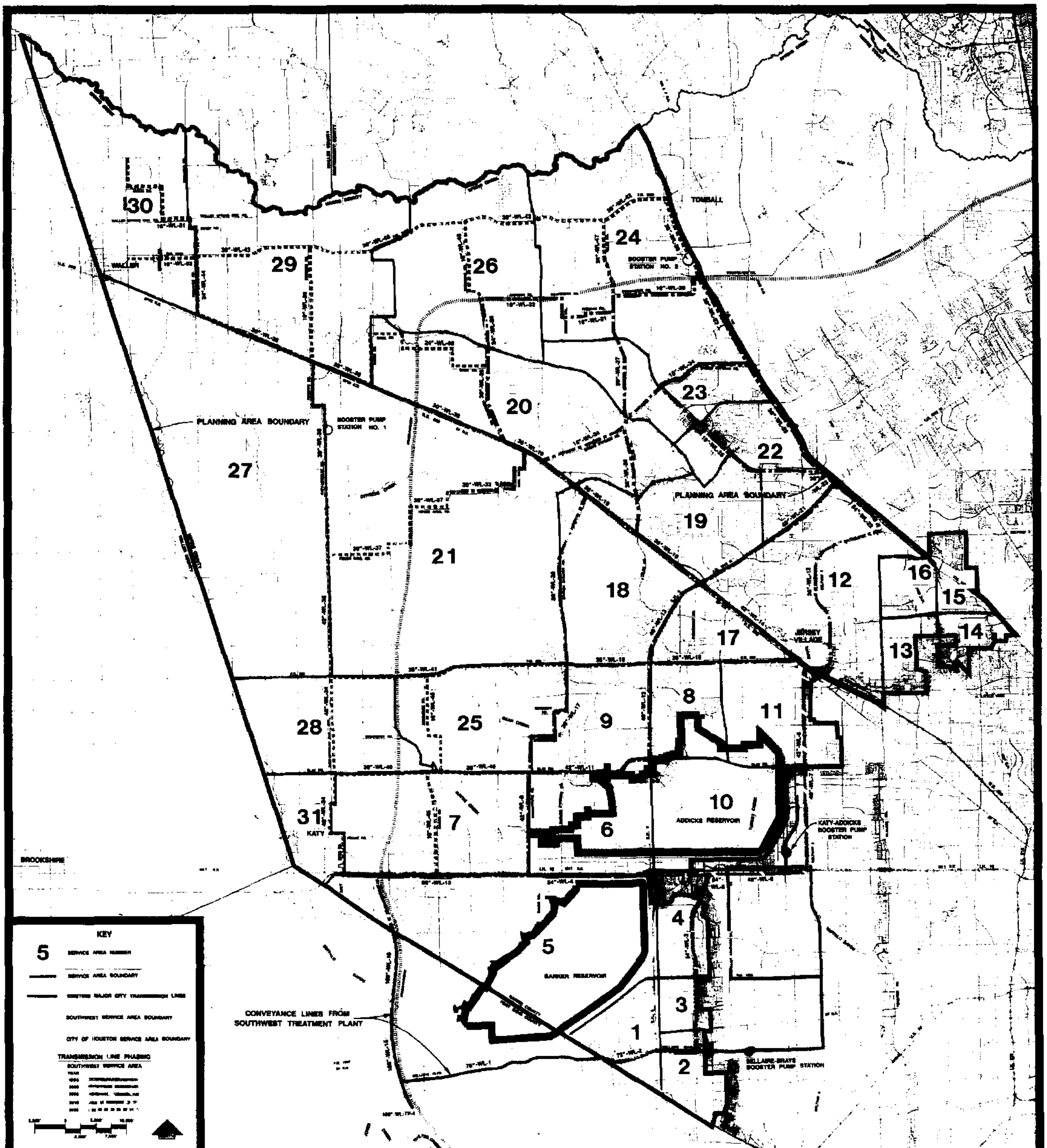
The revised transmission system has been evaluated and analyzed for phasing considerations. To reduce the first and second phase cost the transmission line in Appendix IV along Highway 6 between Bellaire and IH-10 has been relocated and now runs north-south along Eldridge Parkway. The line in Appendix IV along Dairy Ashford has been deleted with north-south water delivery being transported through the new Eldridge Parkway line.

For detail routing layouts, phasing of construction and annual cost refer to Attachment No. 1 entitled WHCSWSC Capital Improvement Program (1989-2030) and Attachment No. 2 entitled Plan Schematics. These attachments outline and detail the facilities to be developed in the implementation plan.



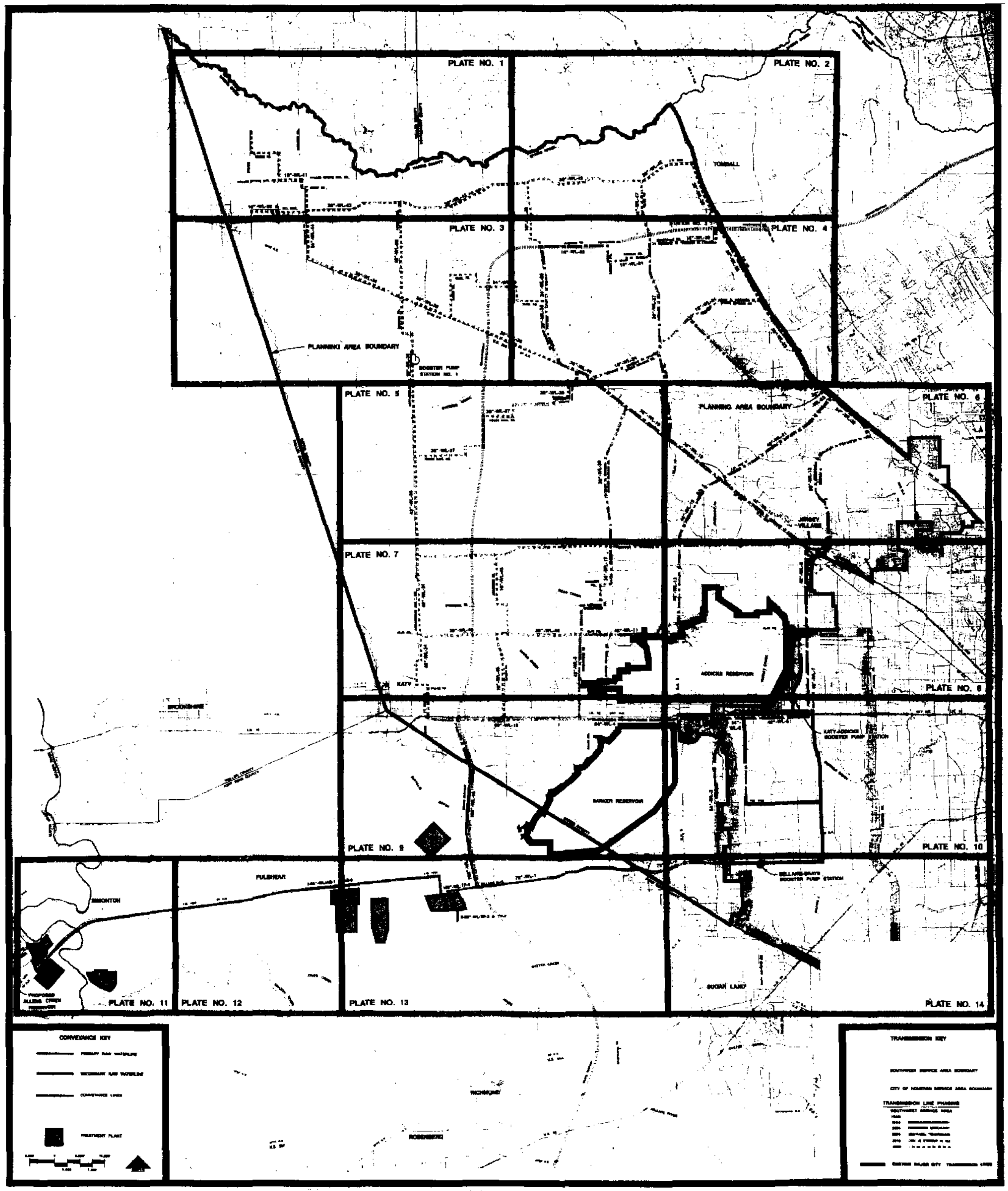
SERVICE AREA TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
EXHIBIT NO. 7



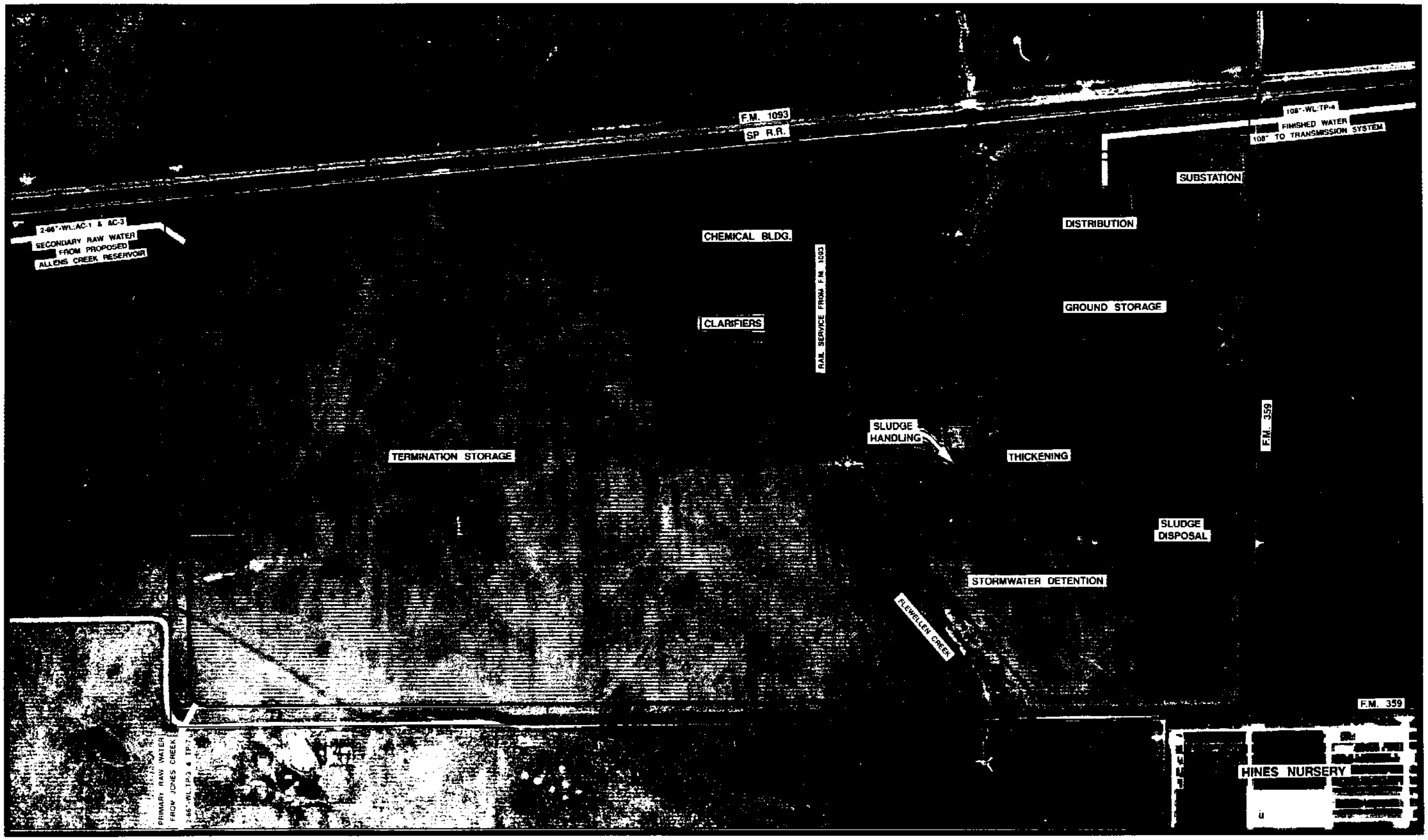
SERVICE AREA MAP

W.H.C.S.W.S.C.
EXHIBIT NO. 8



CONVEYANCE/TRANSMISSION SYSTEM INDEX MAP

W.H.C.S.W.S.C.
EXHIBIT NO. 9



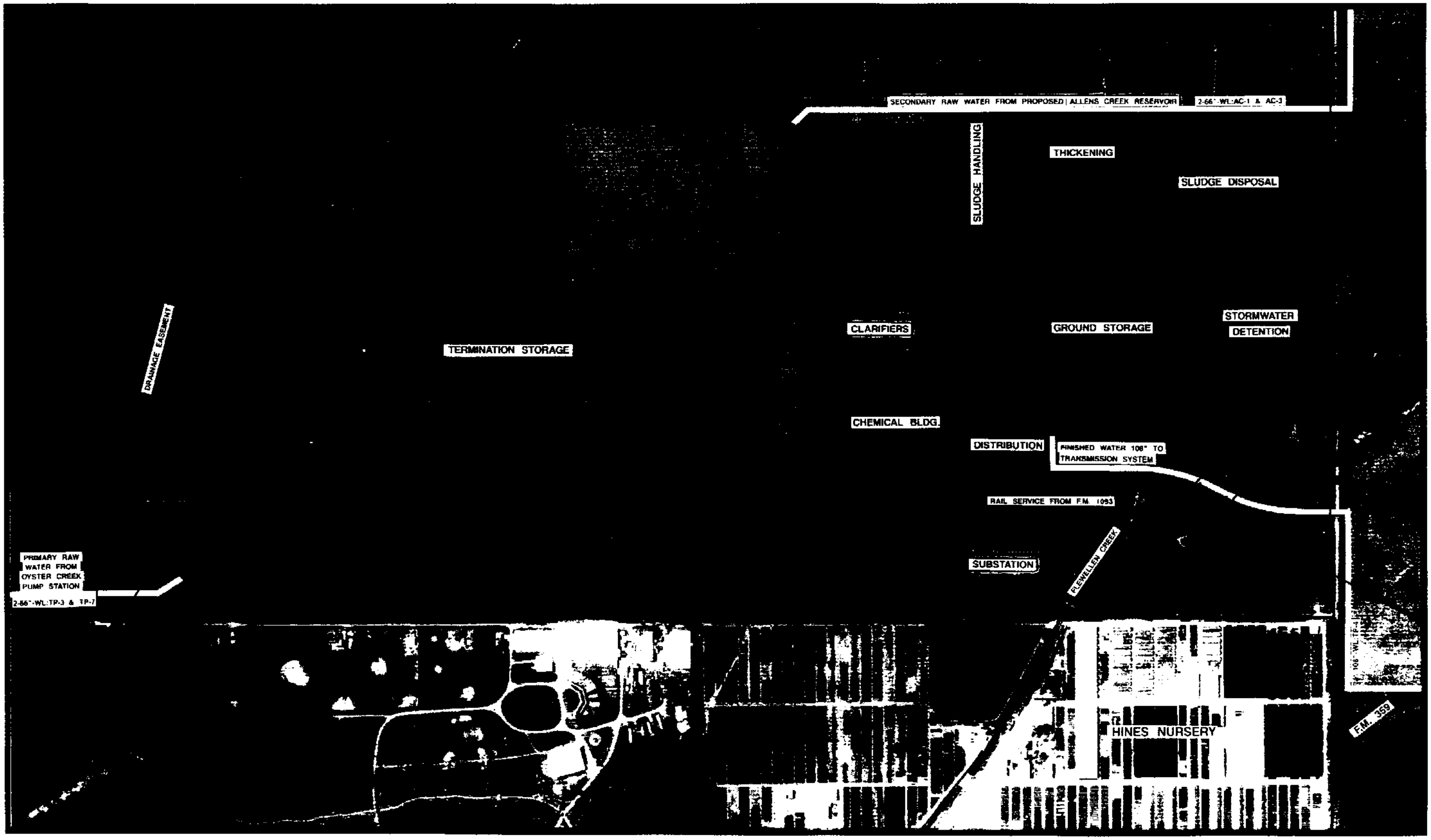
250' 0 250' 500'

NORTH

ALTERNATE SITE PLANT FACILITIES LAYOUT

(SITE NO. 4 FROM APPENDIX V)

W.H.C.S.W.S.C.
EXHIBIT NO. 10



ALTERNATE SITE PLANT FACILITIES LAYOUT

(SITE NO. 6 FROM APPENDIX V)

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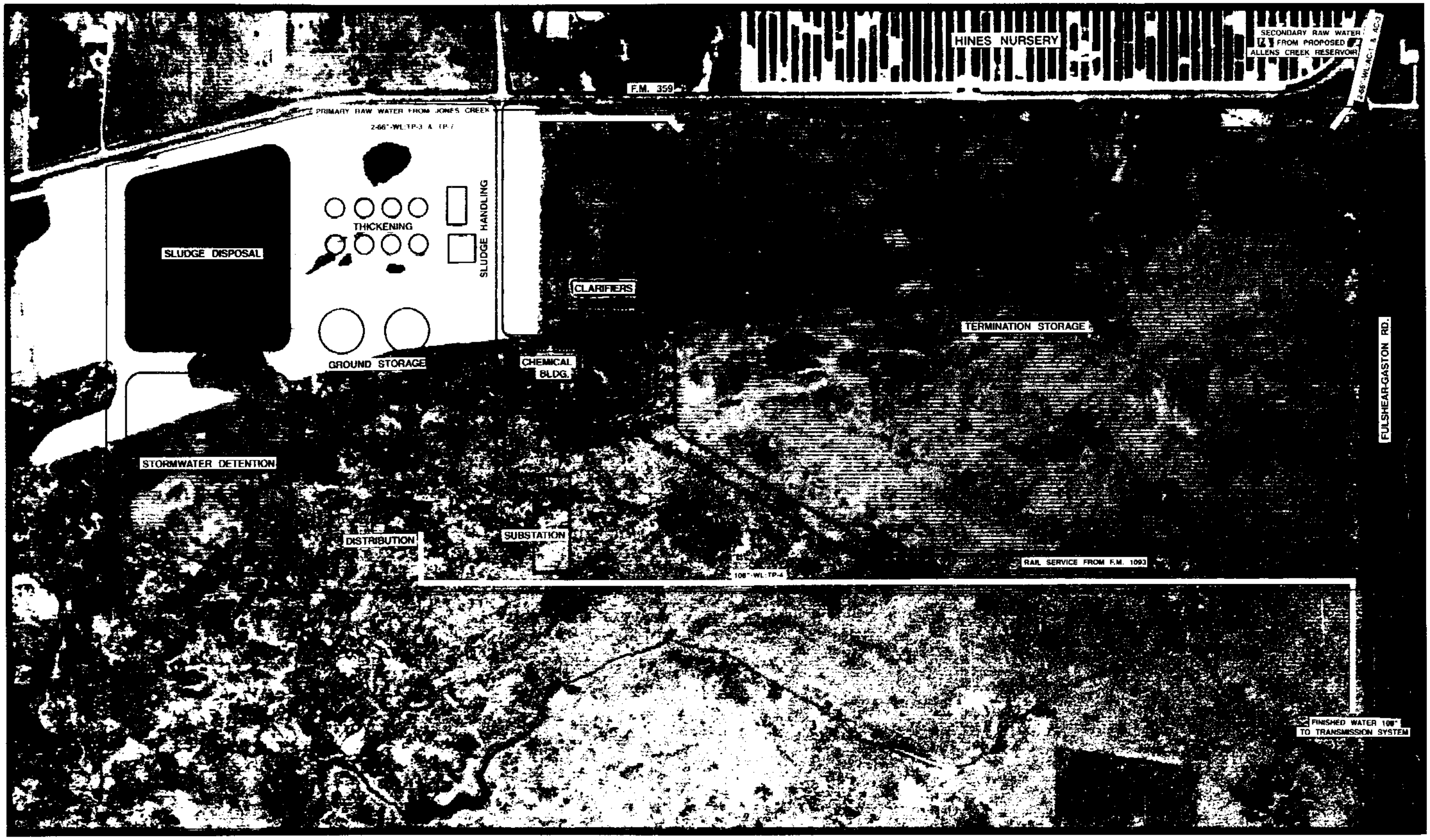
EXHIBIT NO. 11



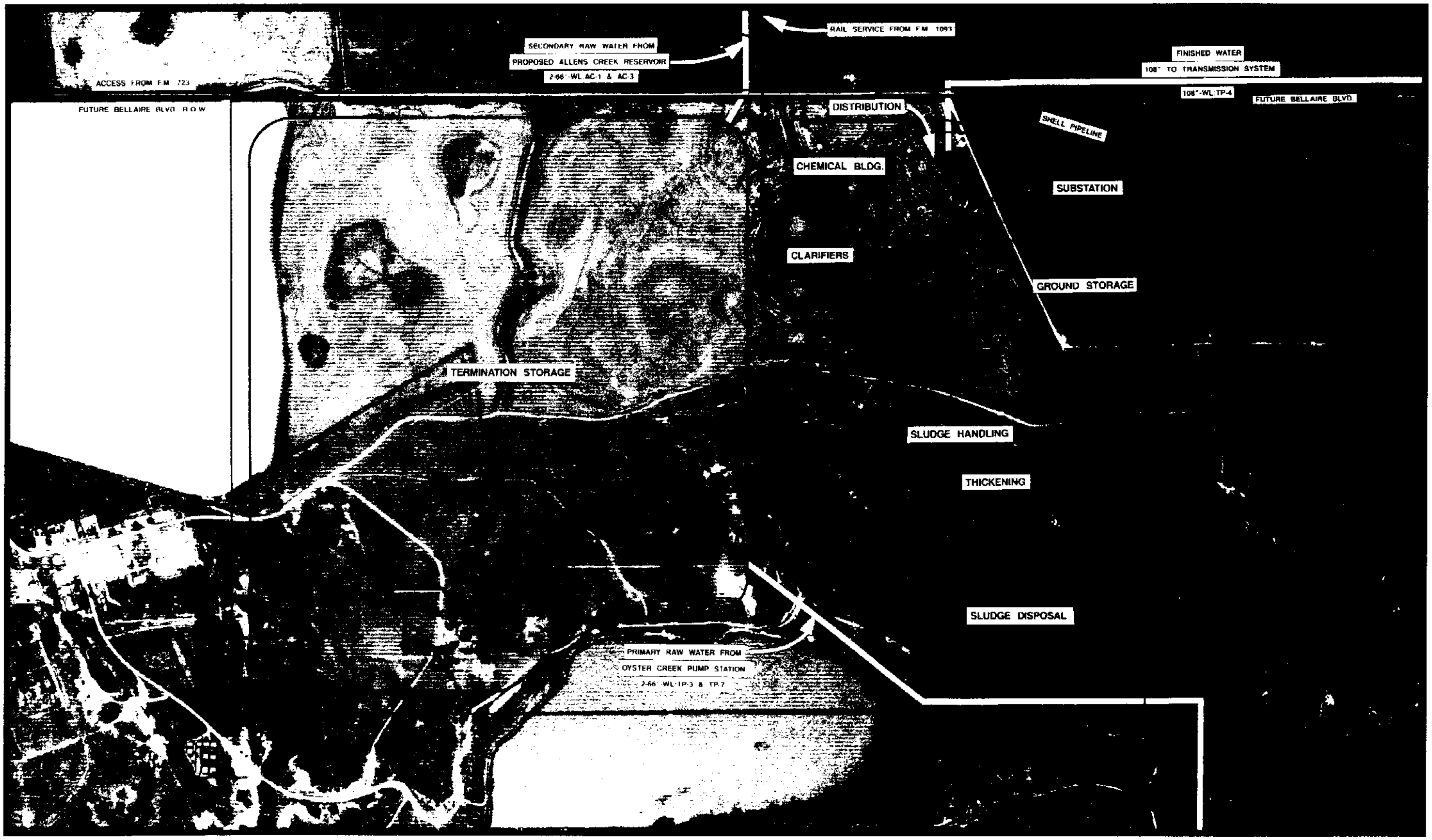
250' 0 250' 500'

NORTH

ALTERNATE SITE PLANT FACILITIES LAYOUT

(SITE NO. 8 FROM APPENDIX V)

W.H.C.S.W.S.C.
EXHIBIT NO.12



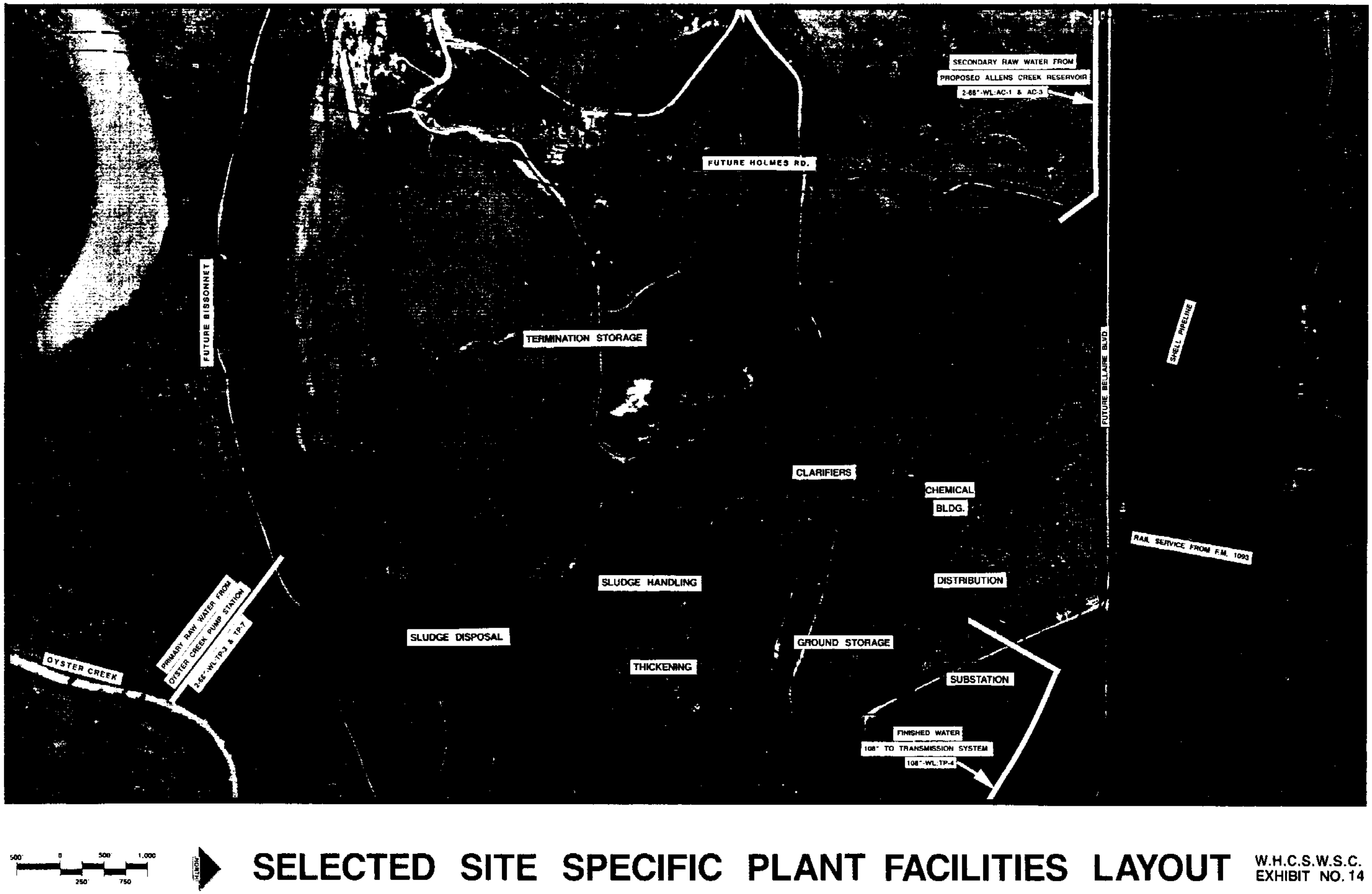
250' 0 250' 500'

NORTH

SELECTED SITE SPECIFIC PLANT FACILITIES LAYOUT

W.H.C.S.W.S.C.
EXHIBIT NO. 13

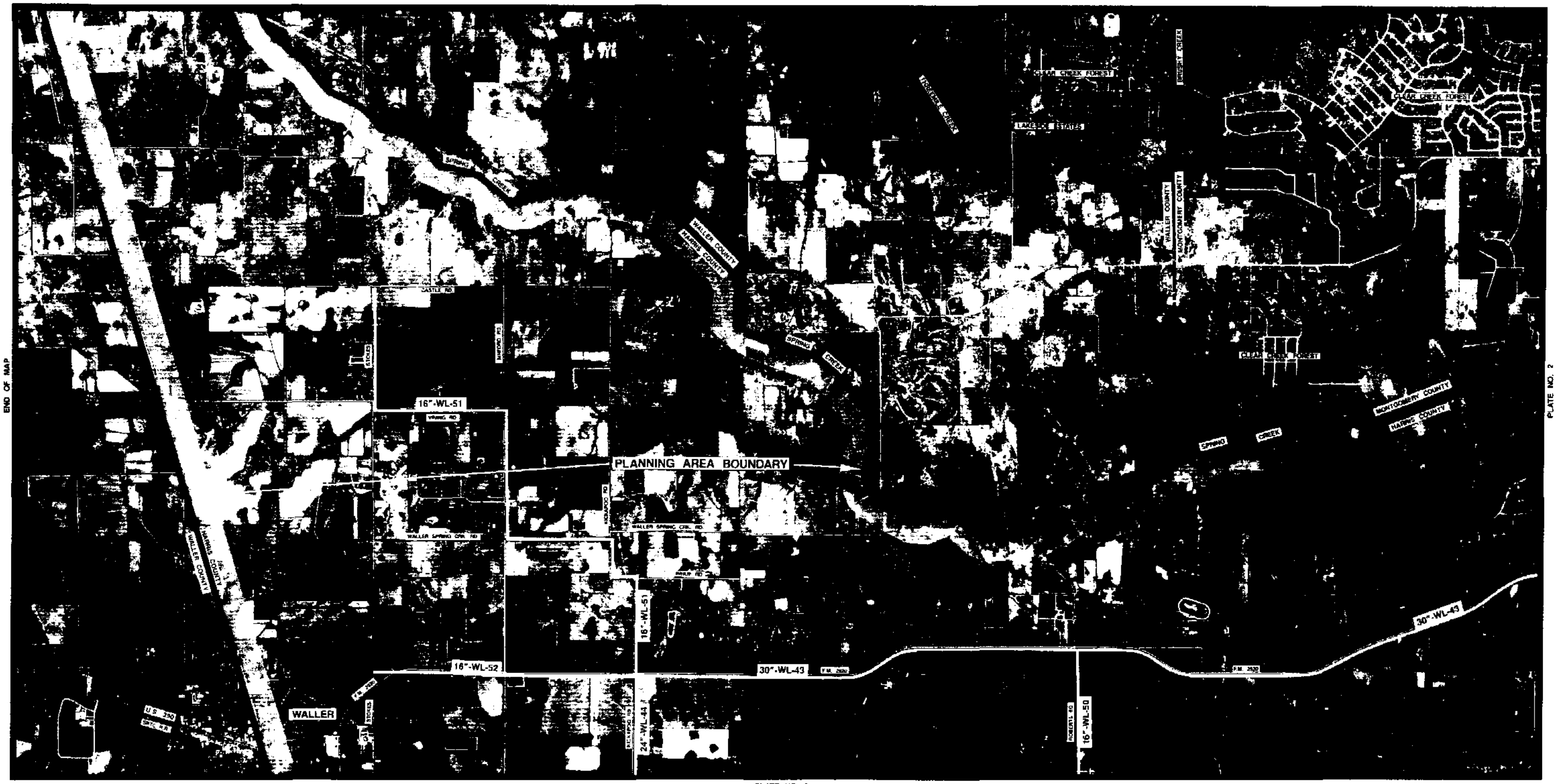
(SITE NO. 7A FROM APPENDIX V)



SELECTED SITE SPECIFIC PLANT FACILITIES LAYOUT

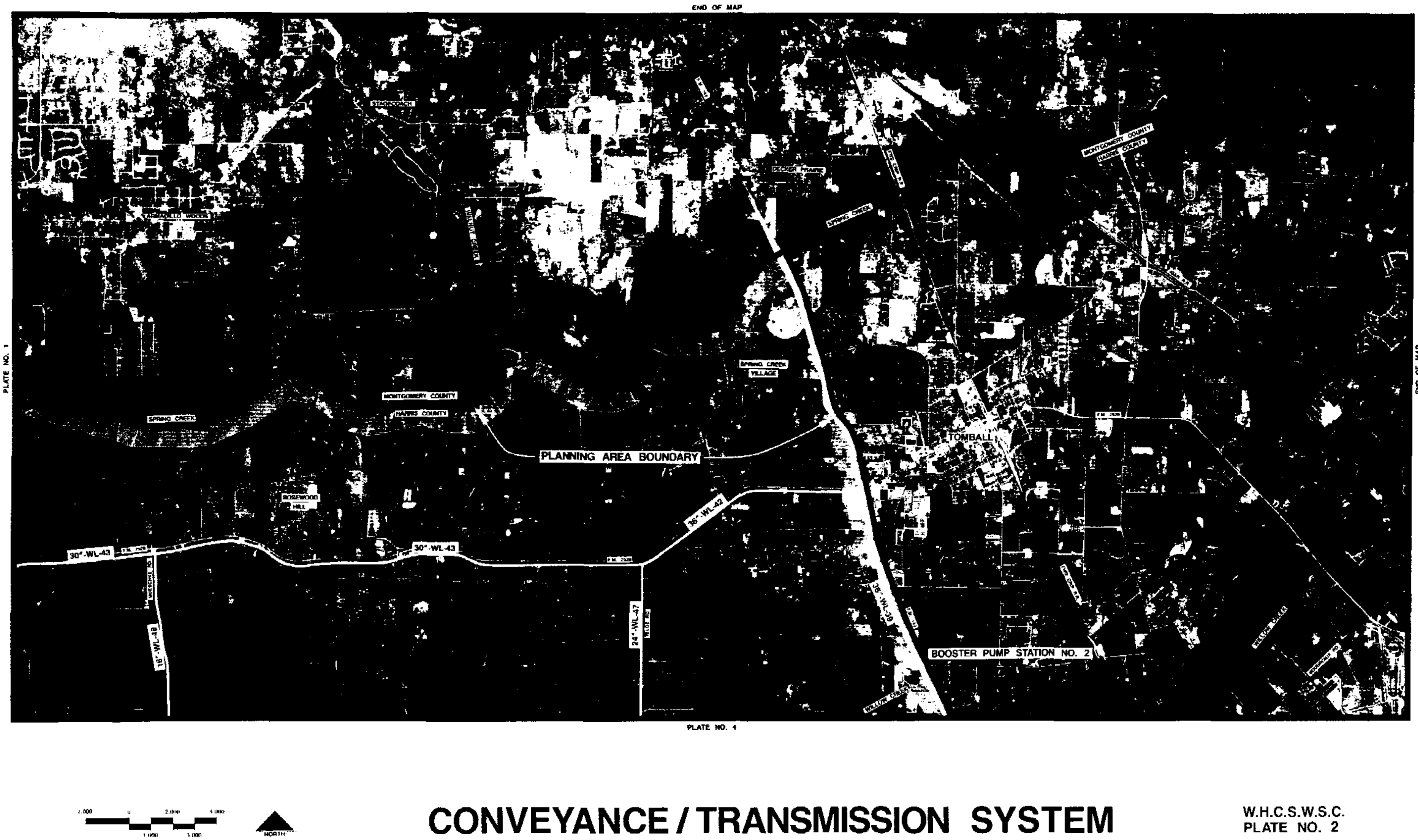
W.H.C.S.W.S.C.
EXHIBIT NO. 14

(SITE NO. 7B FROM APPENDIX V)



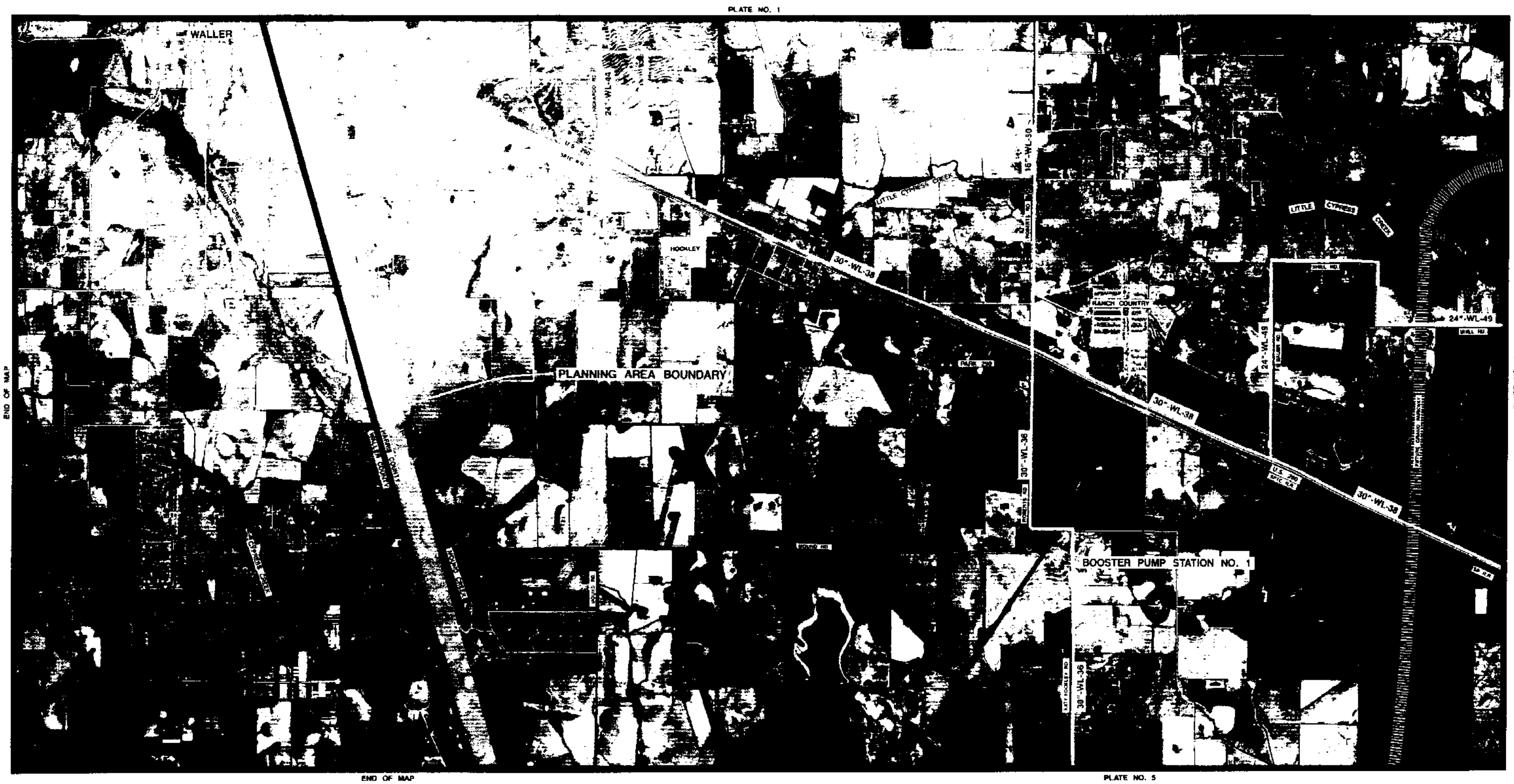
CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 1



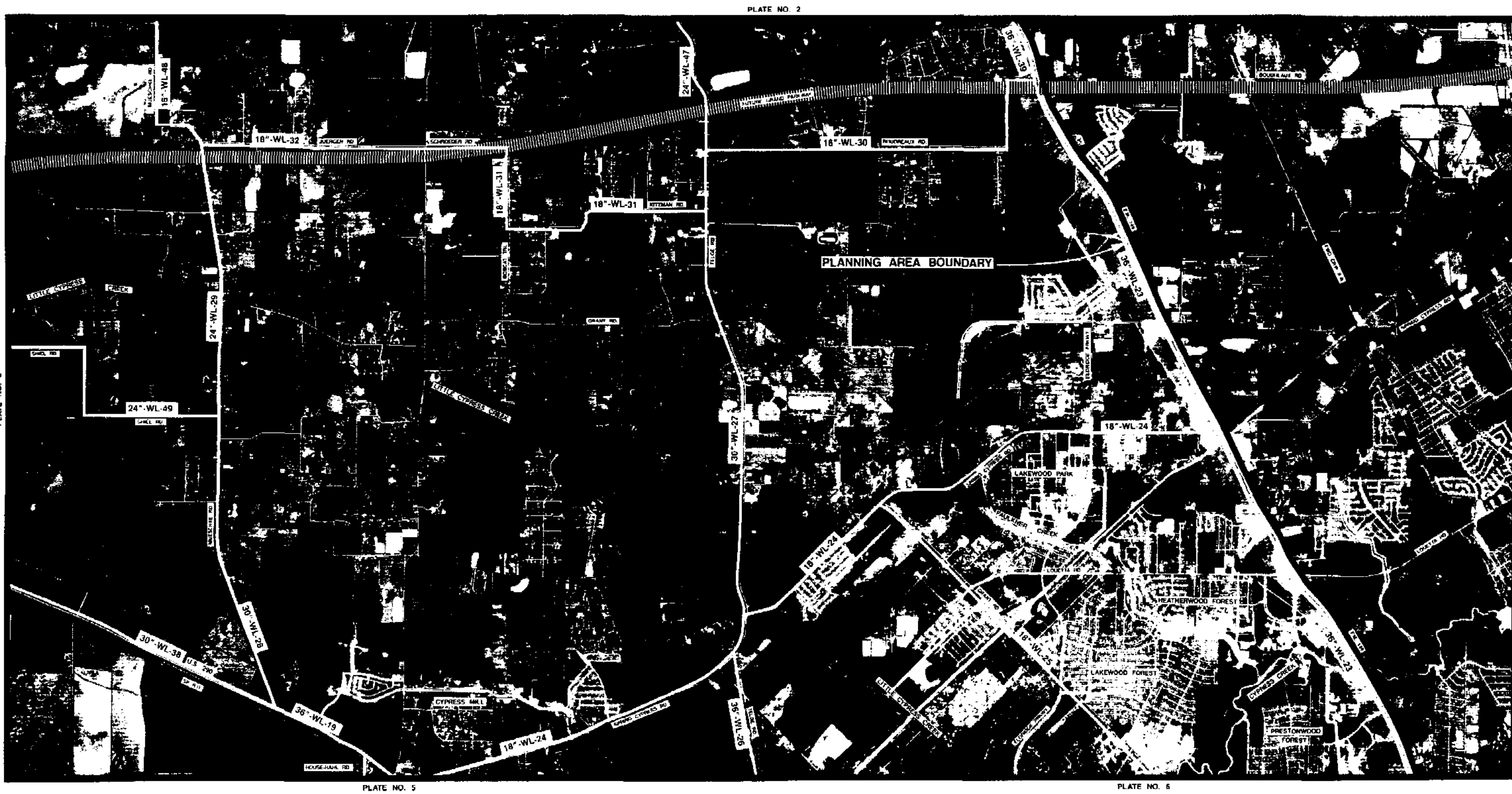
CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 2



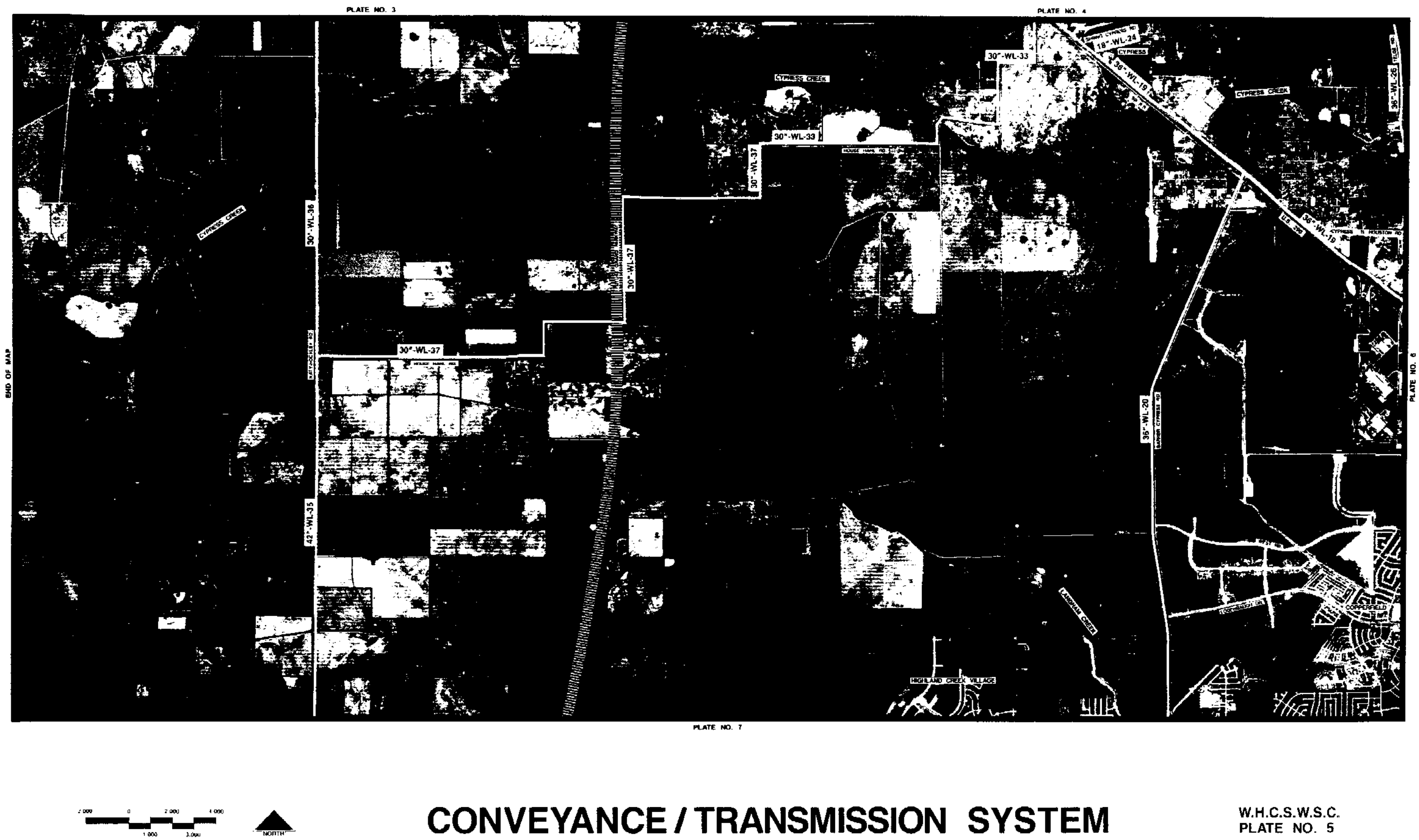
CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 3



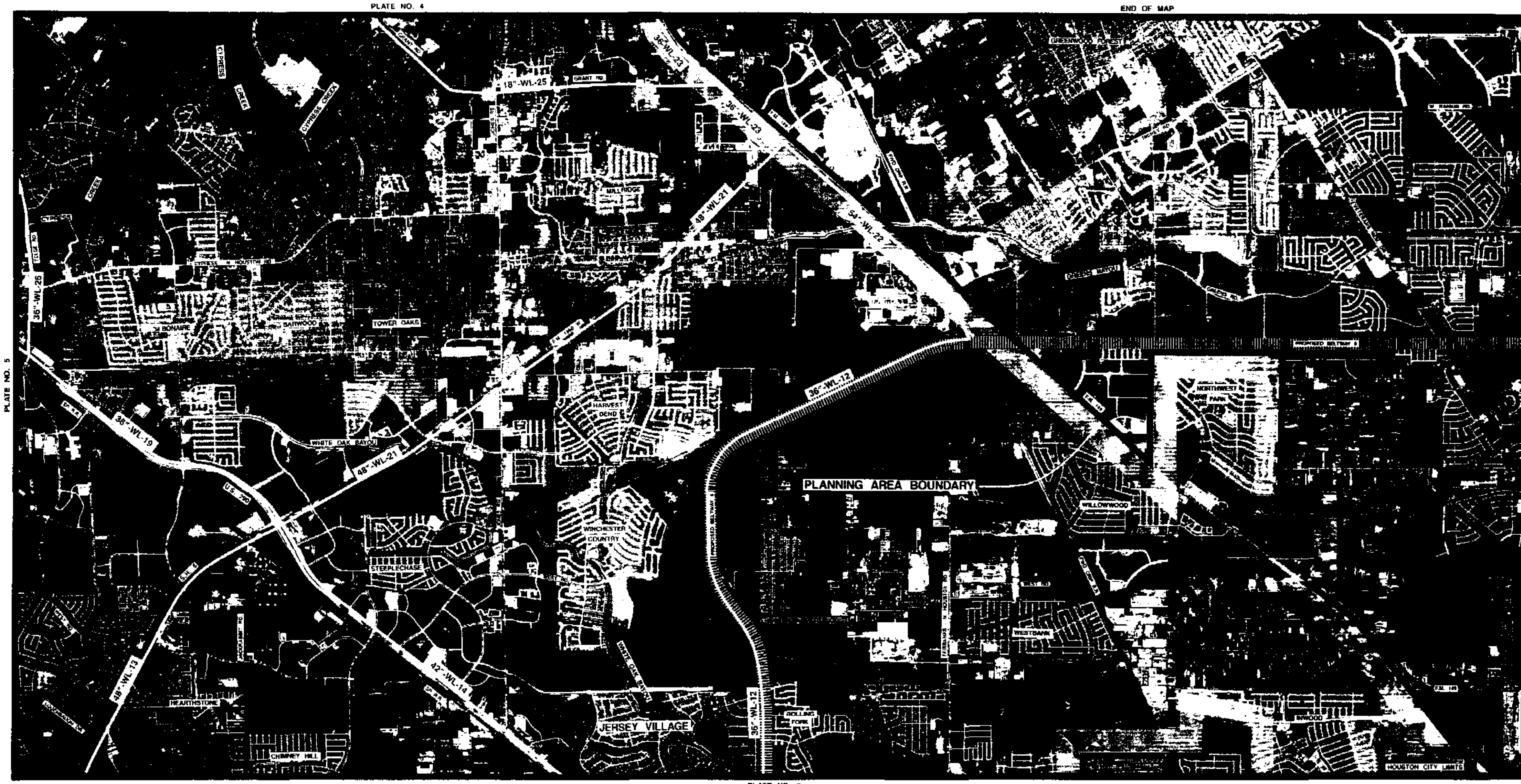
CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 4



CONVEYANCE / TRANSMISSION SYSTEM

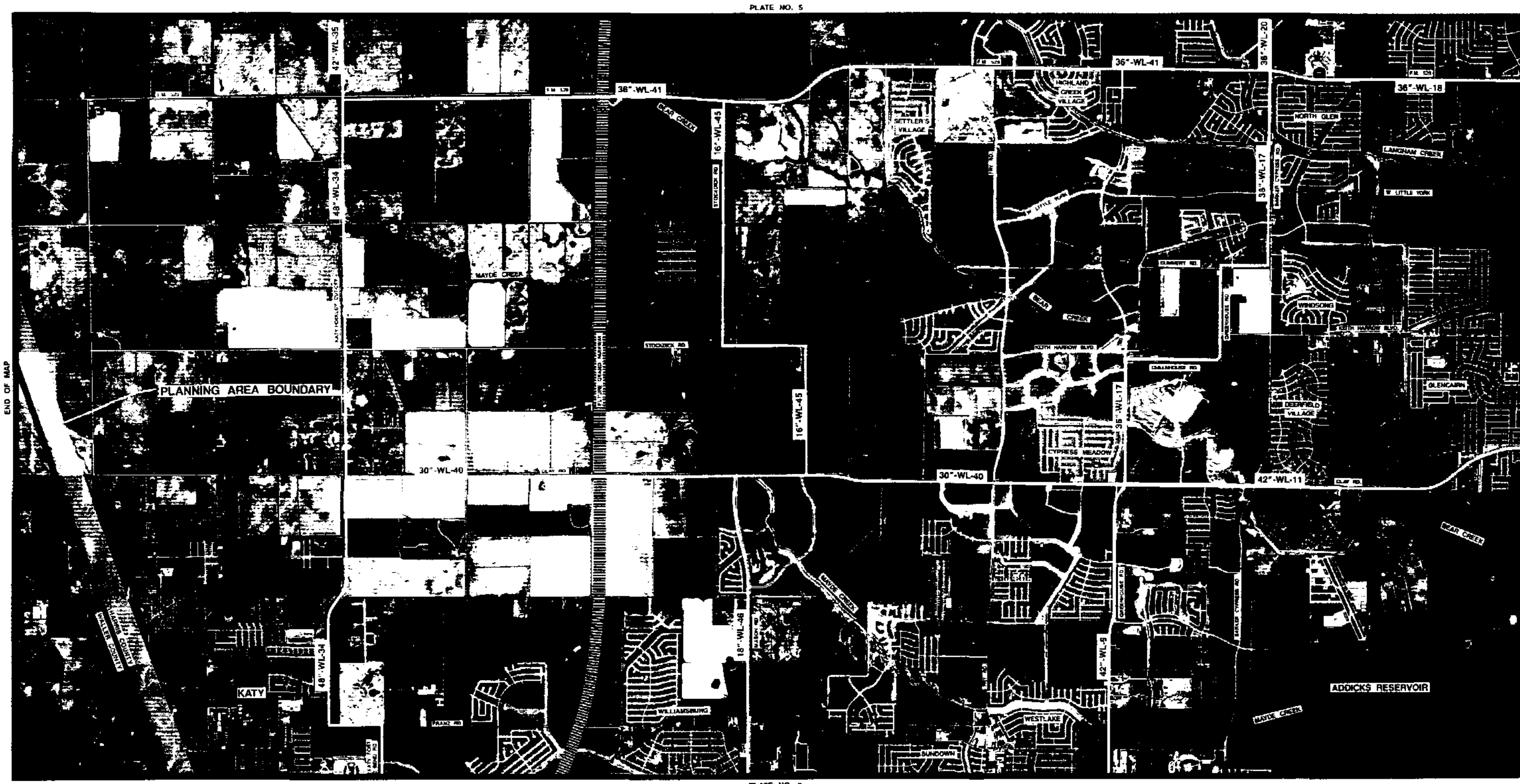
W.H.C.S.W.S.C.
PLATE NO. 5



NORTH

CONVEYANCE / TRANSMISSION SYSTEM

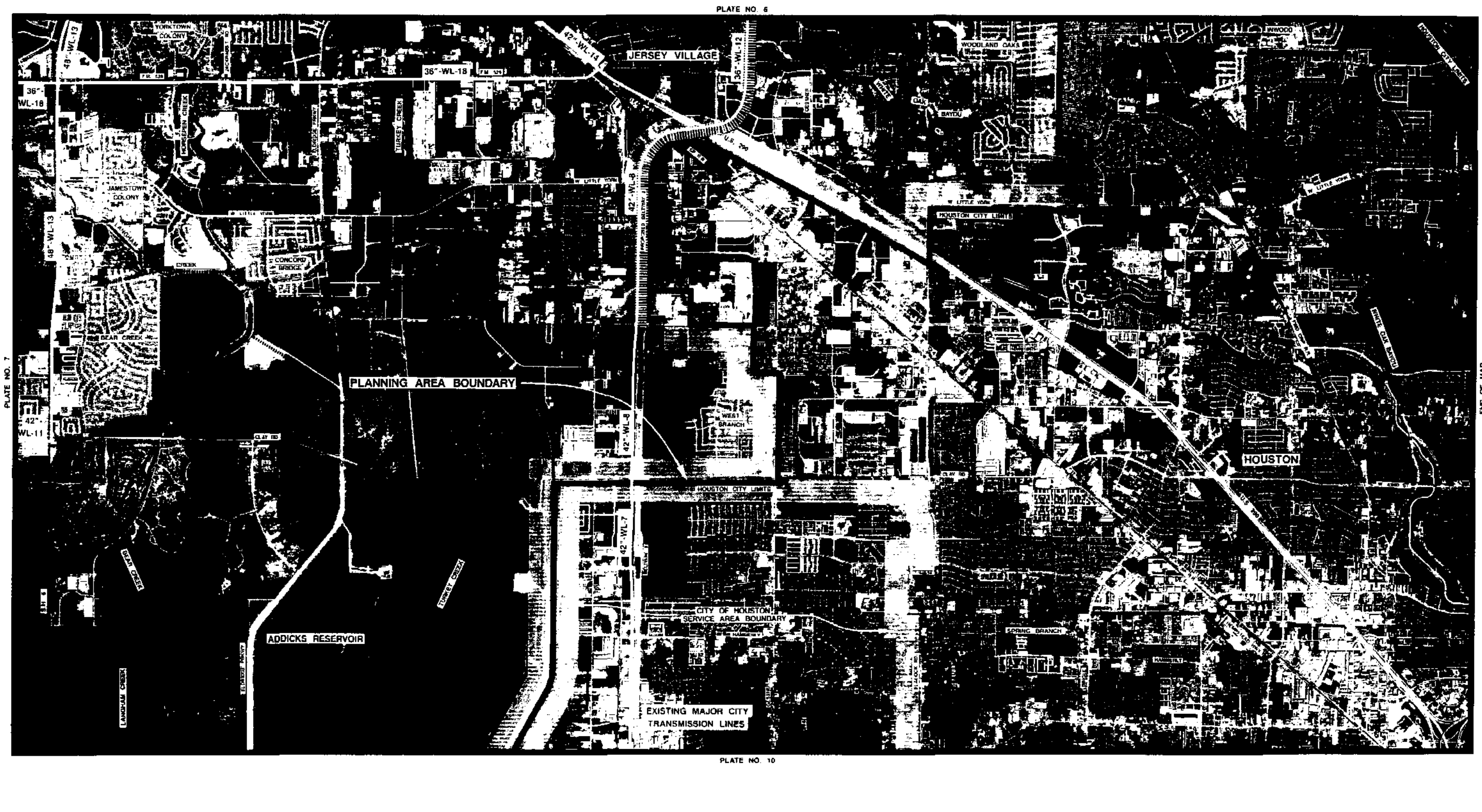
W.H.C.S.W.S.C.
PLATE NO. 6



2,000 0 2,000 4,000
1,000 3,000
NORTH

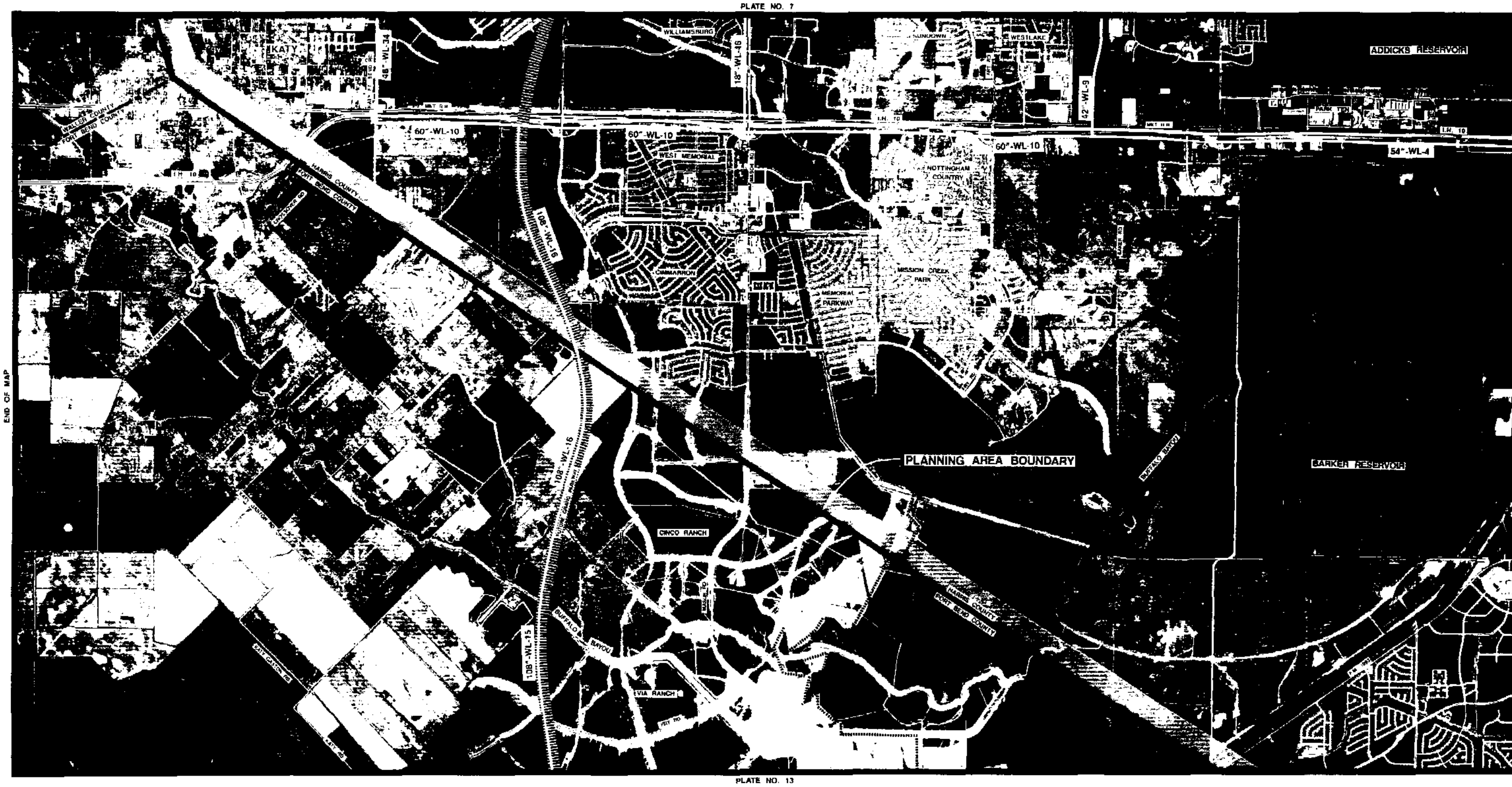
CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 7



CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 8



NORTH

CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 9

PLATE NO. 6

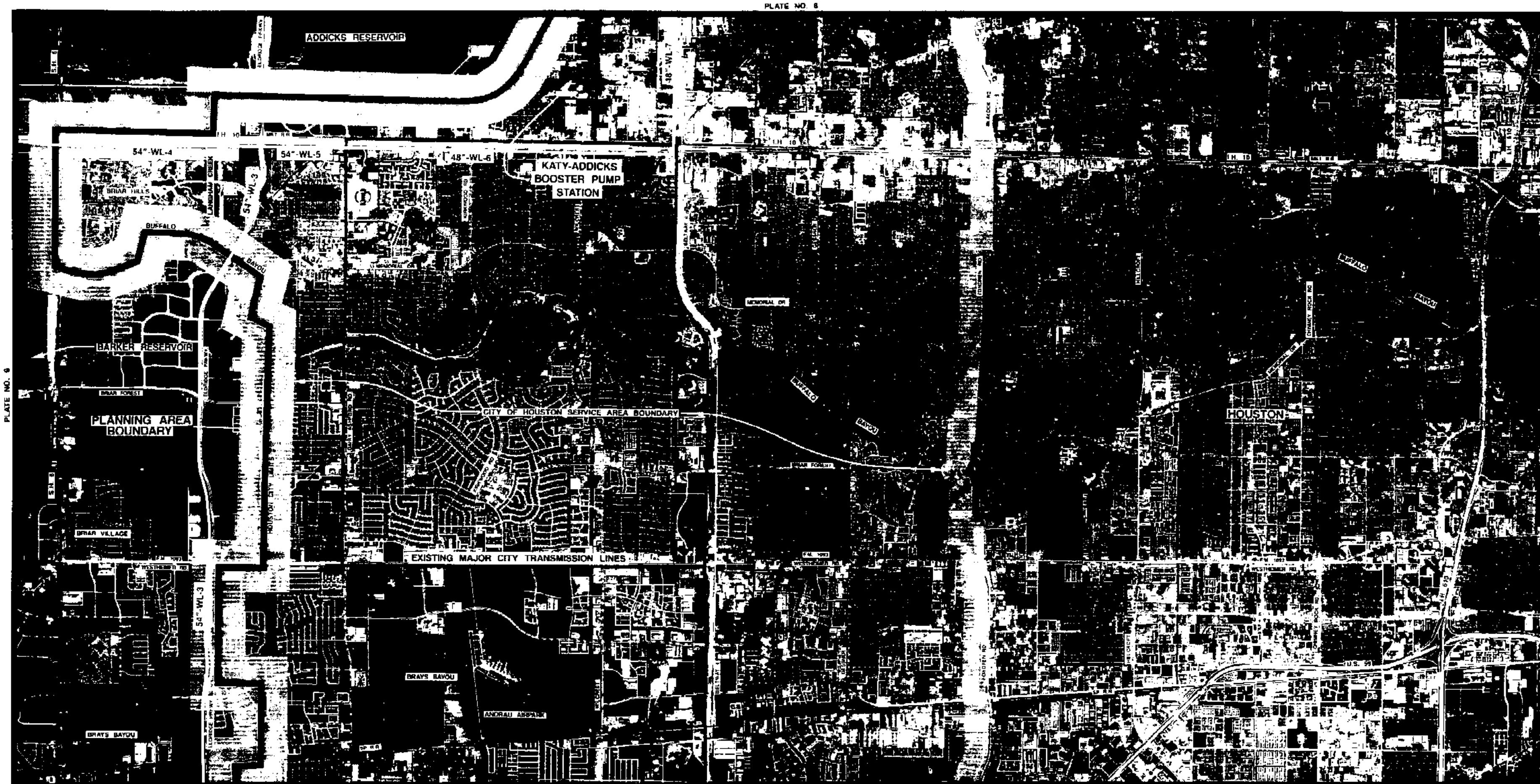


PLATE NO. 9

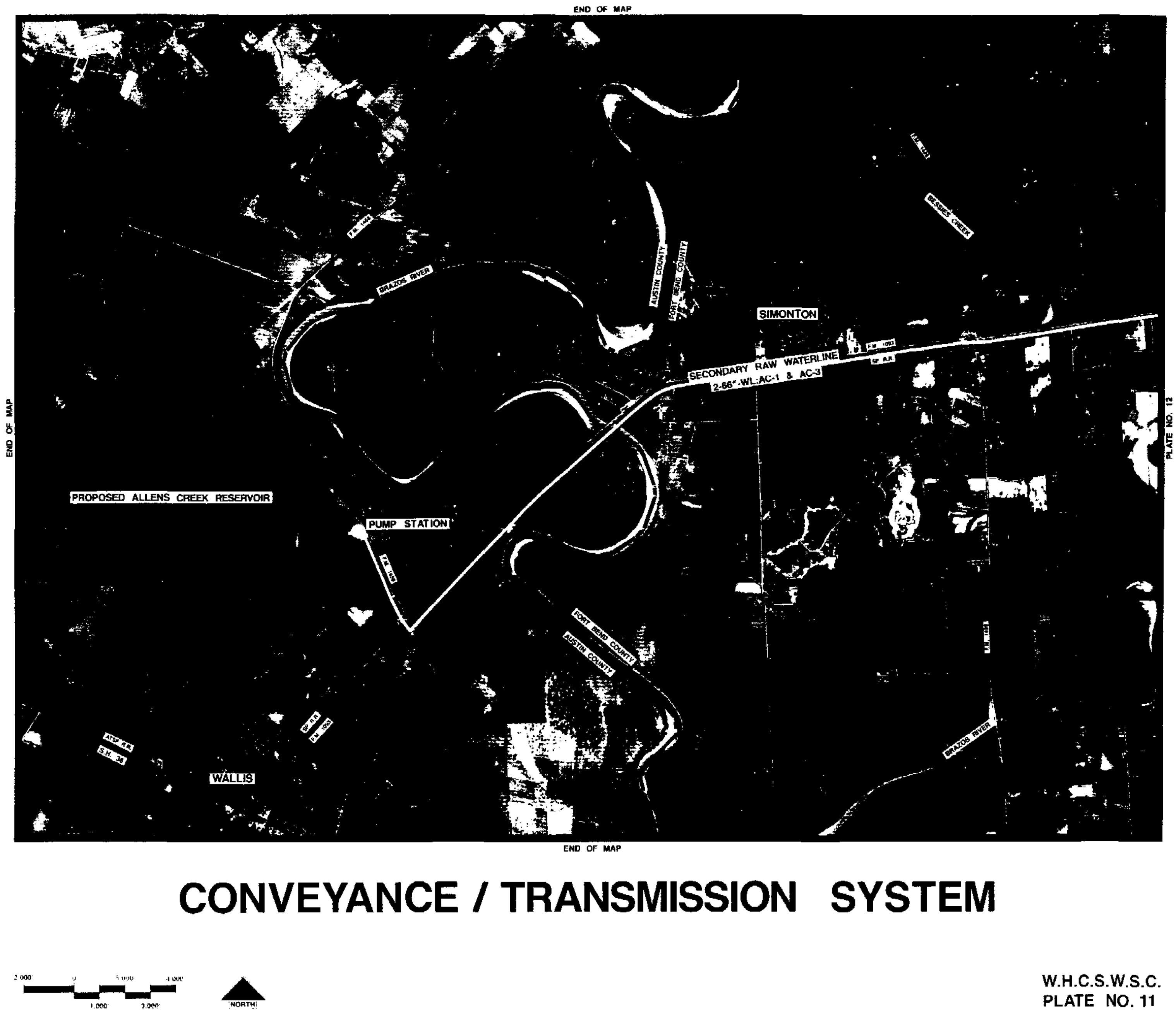
END OF MAP

PLATE NO. 14

NORTH

CONVEYANCE / TRANSMISSION SYSTEM

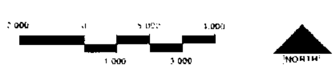
W.H.C.S.W.S.C.
PLATE NO. 10



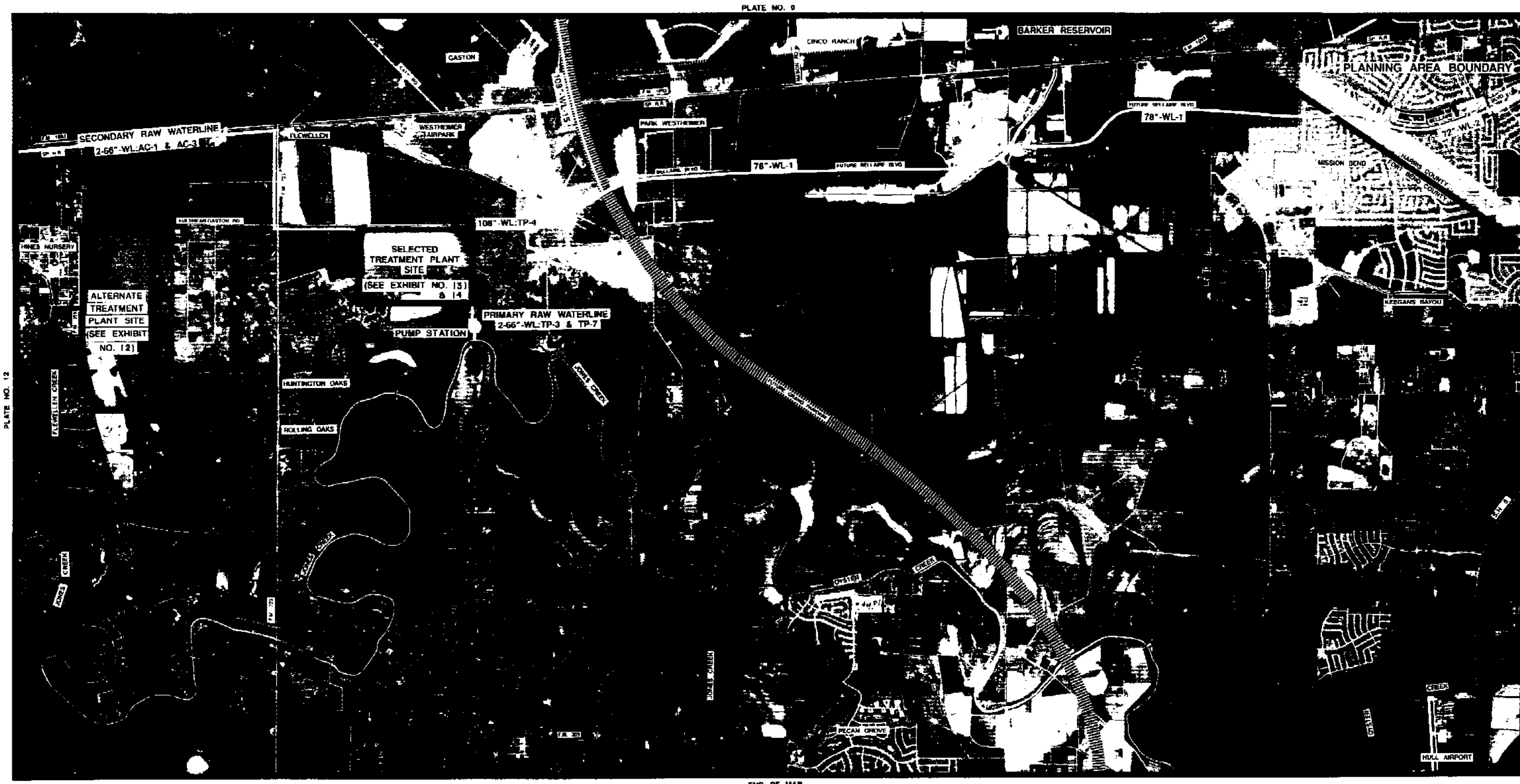
CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 11

CONVEYANCE / TRANSMISSION SYSTEM



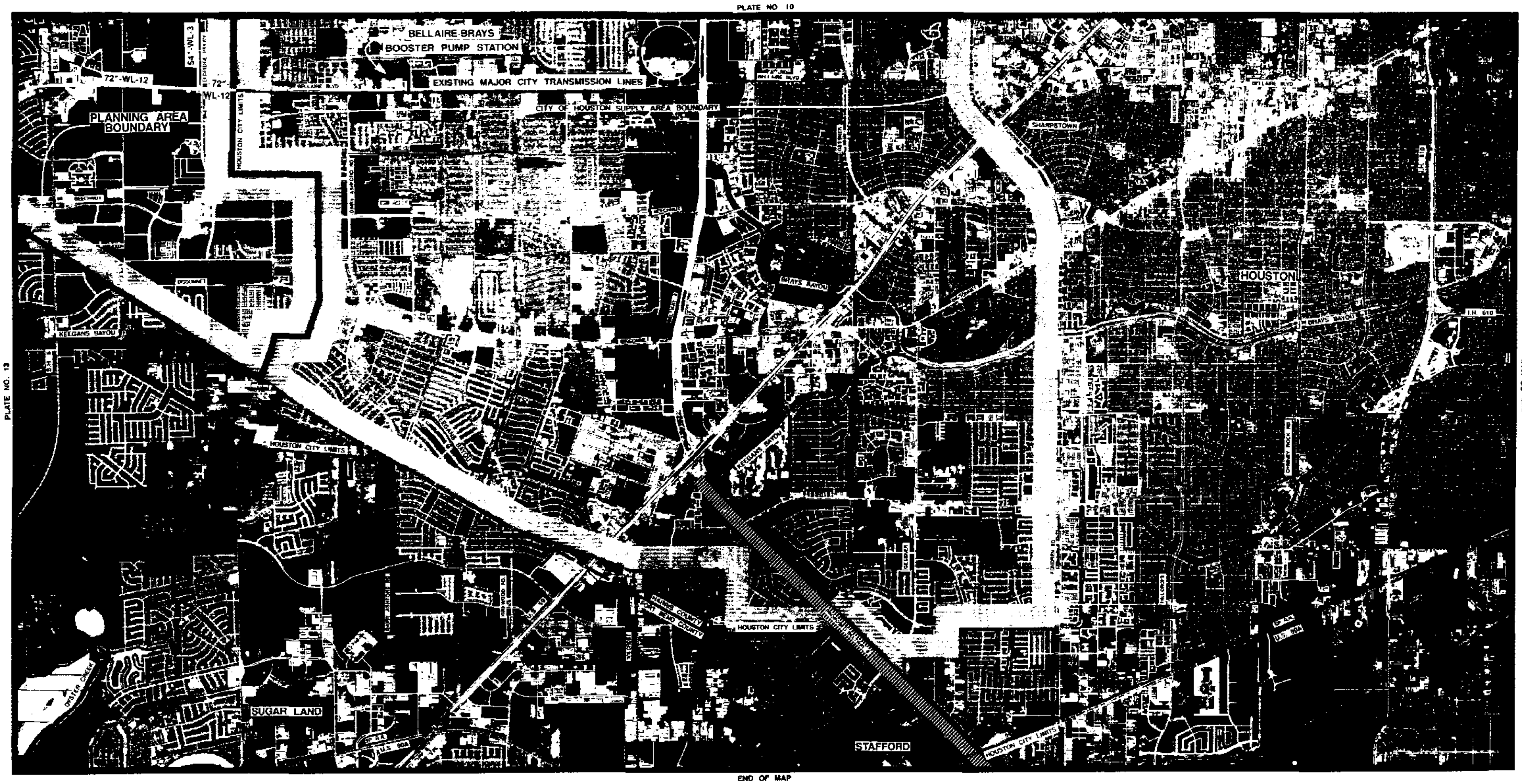
W.H.C.S.W.S.C.
PLATE NO. 12



NORTH

CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 13



CONVEYANCE / TRANSMISSION SYSTEM

W.H.C.S.W.S.C.
PLATE NO. 14

6.0 SOUTHWEST RAW WATER SUPPLY ALTERNATE EVALUATION

6.0 SOUTHWEST RAW WATER SUPPLY ALTERNATE EVALUATION

As mentioned previously the southwest supply from the Brazos River Basin has been narrowed to three water supply alternates. The three supply alternates are defined as follows:

- o Supply Alternate No. 1 consist of utilizing 124.5 MGD of raw water from the BRA and no raw water from the GCWA canal system.

- o Supply Alternate No. 2 consist of utilizing 36.8 MGD of raw water from the GCWA canal system for phase one (1995) with the remainding 87.7 MGD being obtained for future phases from the BRA system.

- o Supply Alternate No. 3 consist of utilizing 59.4 MGD of GCWA canal water to supply the area through the first two phases (1995 and 2000) with the remaining phases being served from the BRA system approximately 65.1 MGD.

The total expenditure for raw water including future cost up to and through the year 2000 for each supply alternate is shown below.

Supply Alternate	Expenditures through 2000
Supply Alternate No. 1	$51,428,000
Supply Alternate No. 2	$34,499,120
Supply Alternate No. 3	$18,668,600

As can be seen from the above comparison Supply Alternate No. 3 maximizing the use of GCWA canal water is approximately 65% less costly than Alternate No. 1 and 50% less than Alternate No. 2. Due to the significant cost savings, the recommendation is that Supply Alternate No. 3 be considered for the final implementation plan.

7.0 SUMMARY OF FINAL RECOMMENDED PLAN

7.0 SUMMARY OF FINAL RECOMMENDED PLAN

<u>**Description of Facilities**</u>

The final recommended plan consists of developing the following facilities:

- Major Southwest Treatment Plant and termination storage facility at Site 7 with option to develop Site 4, 5 and 6, if Site 7 is not available.

- Primary raw water conveyance system from the GCWA canal system to plant site by 1995.

- Secondary raw water conveyance system from proposed Allens Creek to above mentioned plant site.

- Transmission system to bring treated water from plant site to wholesale customers within planning area to allow surface water conversion to occur in accordance with HGCSD plan.

For details on facility layouts, refer to Attachment No. 2 Plan Schematics.

Development Criteria

The final recommended facilities mentioned previously were developed utilizing the following criteria:

- Utilize Raw Water Supply Alternate No. 3 consisting of purchasing GCWA raw water (59.4 MGD) for Phase I (1995) and Phase II (2000) and BRA System water (65.1 MGD) for Phases III (2005), Phase IV (2010) and Phase V (2030).

- Design all facilities for average daily demands utilizing 80% of the total water demands as outlined in the HGCSD plan.

- Design the transmission system with the flexibility to allow transmission of water from the northeast conveyance system for Phases III, IV and V.

- Develop onsite termination storage.

- The conveyance and transmission facilities will be developed in phases to allow conversion in accordance with the HGCSD plan.

- The capacity of the phased system will be developed as follows:

Year	Capacity (MGD)
1995	37.5
2000	62.5
2005	75.0
2010	100.0
2030	150.0

Development Program/Plan Schematics

Capital Improvement Program

The development program recommended is detailed in Attachment No. 1 - WHCSWSC Capital Improvement Program (CIP). The CIP divides all of the proposed facilities into three major categories referred to as treatment plant (TP), raw water supply from Allens Creek (AC) and transmission lines (WL). The recommended facilities are broken down into projects and given project numbers within each major category. For instance the CIP refers to the first phase (1995) of the treatment plant as TP-1. The CIP divides the funds allocated for each project into three allocation categories, acquisition (land), design fees and capital construction cost. The CIP does not report annual operation and maintenance costs. Funds are allocated for specific projects within 5 year increments representing the period in which that project will be developed.

Plan Schematics

The plan schematics are shown in Attachment No. 2 of this Appendix. The schematics consist of aerials with the recommended conveyance and transmission facilities outlined and categorized. Categorizing the facilities was done in accordance with the CIP plan. An example of this would be the 36-inch waterline in Beltway 8 is categorized as WL-12 on the CIP and 36-WL-12 on the plan schematics. Routing of the transmission lines was based on the use of aerials and not field verified.

Development Cost

The development cost for the recommended facilities is broken down into individual project cost and allocated into 5 year increments as shown in the CIP.

Annual Project Cost

The capital cost from the CIP was divided into annual project cost as shown in Attachment No. 3. Also, shown in this attachment is the annual cost associated with operation and maintenance including the raw water cost associated with the development of the recommended system. Attachment No. 3 is summarized as shown below:

Summary of Project Cost

	Phase I (Thru 1995)	Phase II (Thru 2000)	Phase III (Thru 2005)	Phase IV (Thru 2010)	Phase V (Thru 2030)
		($1,000,000)			
Capital Cost	94	127	158	308	474
Operation/ Maintenance	15	55	113	189	714
Available Capacity (MGD)	37.5	62.5	75.0	100.0	150.0
Projected Demands (MGD)	36.8	59.4	64.5	92.8	124.5

Financial Analysis

The financial analysis was performed by the WHCSWSC co-financial advisors Underwood Neuhaus & Co. Incorporated and Masterson & Company. See (i) Attachment No. 4, Section A for a summary "Schedule of Capital Expenditures and Related Bond Sales", (ii) Attachment No. 4, Section B for a summary "Cash Flow Analysis of Annual Expenditures and Revenues", and Attachment No. 4, Section C and D for detailed amortization schedules and analysis of cash flow requirements. All of the schedules in the referenced attachment are based on projected costs as reported in Attachment No. 3 of this report.

The financing plan contemplates that the WHCSWSC will finance the construction of planned facilities with the proceeds of the sale of twenty-one (21) tax exempt revenue bond issues between the years 1990 and 2030. Attachment No. 4, Section A summarizes the mentioned bond issues. All bonds are assumed to bear interest at 8% per annum and each bond issue is assumed to mature serially so as to have "level" annual debt service requirements for a twenty-five year term. The proceeds of each issue of bonds include amounts sufficient to establish a bond reserve fund equal to the maximum annual debt service requirement associated with such issue. Earnings from the investment of construction fund balances are assumed to be utilized for capital expenditures. Earnings from the investment of reserve fund balances are assumed to be used (i) for capital expenditures in the first two years after each such issue is sold, and (ii) for debt service purposes in all remaining years, including the year following the last principal maturity for each issue, in which the total remaining amount of principal plus interest of the reserve fund is deposited into the debt service account.

The cash flow analysis shown in Attachment No. 4, Section B assumes that the raw water cost and O & M costs are directly passed through to the wholesale water customer and will not affect long term bond financing.

This schedule indicated (i) annual net debt service requirements (hereinafter defined) on all series of bonds enumerated in the Schedule of Capital Expenditures and Related Bond Sales, (ii) raw water costs, (iii) operations and maintenance costs, (iv) total expenditures, (v) total revenues, (vi) cumulative balance, and (vii) annual cost of water per 1,000 gallons. It is noted that total revenues are based upon the most conservative case, which expresses projected demand "With Conservation". Net debt service requirements give effect to (i) the annual transfer of interest earnings and principal when applicable from the reserve fund to the debt service fund and (ii) the subtraction of capitalized interest from debt service requirements in any applicable year. The cumulative balance column enumerates the difference between expenditures and revenues.

The cash flow analysis in Attachment No. 4, Section B reflects two cases, Case A and Case B. The difference between the two cases is that Case A assumes a constant water rate between 1996 through 2000 at $1.26/1000 gallons and then a reduction to $1.08/1000 gallons in 2001 through 2005. Case B reflects a constant water rate through 2010 at $1.26/1000 gallons. As can be seen in the referenced cash flow analysis, Case B reflects a more constant water rate allowing the WHCSWSC to establish a lower rate in the years after 2013. This plan recommends that Case B be considered for further development.

Water Rate Analysis

The projected revenues required to finance the development of this plan are shown in the cash flow analysis, Attachment No. 4, Section B. As mentioned in previous appendices, the WHCSWSC has no taxing authority. The financing plan contemplates the sale of WHCSWSC revenue bonds backed by water supply contracts with wholesale water users. The water rate (cost of water/1000 gallons) shown in the cash flow analysis assumes that wholesale water supply contracts will materialize in accordance with the projected water demand schedules considering the impacts of water conservation. The water rate calculations also assume that all wholesale water users served by the WHCSWSC will contract on a take or pay basis at the same rate resulting in identical water rates throughout the service area. This assumption may be modified during contract negotiations. The following table summarizes the projected water rate to be charged to wholesale water users anywhere along the planned transmission system.

TABLE 10

SUMMARY OF COST OF WATER

(MGD)

Phase	Period	Projected Demand w/Conservation	Projected Capacity (MGD)	Average Annual Cost/1000 Gallons Case B
I	1989-1995	36.8	37.5	1.26
II	1996-2000	59.4	62.5	1.26
III	2001-2005	64.5	75.0	1.26
IV	2006-2010	72.9	100.0	1.26
V	2011-2030	124.5	150.0	*1.45

* Varies between $1.55 and $0.85 with a peak of $1.55/1000 gallons in 2013 through 2019.

Method of Financing

Funds to finance the construction of planned facilities associated with the development of this plan will be obtained through the sale of tax exempt revenue bonds that are backed by water supply contracts with wholesale water suppliers in the planning area. It is noted that a distinct difference exists between Phases I and II and the balance of the phases. Phase I has as its sole customer the City of Houston, and the City of Houston is the principal customer for Phase II service. Phases III through VI have as customers a mix of small municipalities other than the City of Houston and a large number of municipal utility district. Since the City of Houston is the sole customer for Phase I service, and since the Corporation will have no credit history until it begins to issue bonds to finance Phase I facilities, it is assumed that all costs associated with Phase I are a straight pass-through to the City of Houston, and that Phase I bonds will be sold to the Texas Water Development Board or some other State agency. Beginning in 1996, the year in which treated water will be first delivered to the City of Houston, it is possible to express a cost in terms of delivered product. Since there are, beginning with Phase III, customers other than the City of Houston, bonds issued on and after 2001 in some select instances contain interest capitalized from the proceeds thereof which augment revenues to facilitate cost averaging.

ATTACHMENTS

ATTACHMENT NO. 1

WHCSWSC CAPITAL IMPROVEMENT PROGRAM BY PROJECT (1989-2030)

PROGRAM: PROJECT SUMMARY SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
TP	TREATMENT PLANT	8,778	63,297	29,119	5,200	12,913	22,960	142,267
AC	RAW WATER SUPPLY FROM ALLENS CREEK RESERVOIR	-	-	-	-	5,890	78,775	84,665
WL	TRANSMISSION LINES	-0-	21,649	17,824	12,372	130,722	63,707	246,274
	PROJECT TOTAL	8,778	84,946	46,943	17,572	149,525	165,442	473,206

PROGRAM: TREATMENT PLANT CONSTRUCTION SUMMARY OF FUNDS (Thousands)

CIP No.	Proposed Encumbrances (Thousands)							Project Total
	Project	FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
TP-1	37.5 MGD FIRST PHASE OF PLANT (37.5 MGD ADF)	8,778	38,500					47,278
TP-2	TERMINATION STORAGE PHASE 1	-	18,294					18,294
TP-3	RAW WATERLINE FROM BRAZOS SYSTEM (1-66")	-	1,082					1,082
TP-4	FINISHED WATERLINE FROM GRAND PARKWAY/ BELLAIRE INTERSECTION	-	5,421					5,421
TP-5	25 MGD ADDITION (62.5 MGD ADF)	-	-	11,959				11,959
TP-6	TERMINATION STORAGE PHASE II	-	-	17,160				17,160

PROGRAM: TREATMENT PLANT CONSTRUCTION SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
TP-7	12.5 MGD ADDITION (75 MGD ADF)	-	-	-	5,200			5,200
TP-8	ADD 1-66" RAW WATER-LINE FROM BRAZOS SYSTEM	-	-	-	-	954		954
TP-9	25 MGD ADDITION (100 MGD ADF)	-	-	-	-	11,959		11,959
TP-10	REDUCE FOREBAY	-	-	-	-	-	900	900
TP-11	50 MGD ADDITION (150 MGD ADF)	-	-	-	-	-	22,060	22,060
	TREATMENT PLANT	8,778	63,297	29,119	5,200	12,913	22,960	142,267

PROJECT: CONSTRUCT FIRST PHASE OF PLANT (TP-1)

DESCRIPTION: CONSTRUCT 37.5 MGD AVER. DAILY FLOW PLANT ON ULTIMATE SIZE TRACT

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION	8,778						8,778
DESIGN		3,208					3,208
CONSTRUCTION		35,292					35,292
TOTAL ALLOCATION	8,778	38,500					47,278

PROJECT: TERMINATION STORAGE (TP-2)

DESCRIPTION: LAND AND CONSTRUCTION OF RAW WATER FOREBAY REQUIRED IF ALLENS CREEK RESERVOIR IS NOT CONSTRUCTED UNTIL YEAR 2013 (PHASE I - 36.8 MGD)

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION		4,494					4,494
DESIGN		1,150					1,150
CONSTRUCTION		12,650					12,650
TOTAL ALLOCATION		18,294					18,294

PROJECT: RAW WATERLINE FROM BRAZOS SYSTEM (TP-3)

DESCRIPTION: LAND AND CONSTRUCTION COST FOR ONE 66" LINE FROM THE BRAZOS SYSTEM TO THE PLANT SITE

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION		128					128
DESIGN		80					80
CONSTRUCTION		874					874
TOTAL ALLOCATION		1,082					1,082

PROJECT: FINISHED WATER LINE TO GRAND PARKWAY/BELLAIRE INTERSECTION (TP-4)

DESCRIPTION: RAW AND CONSTRUCTION FOR 108" TREATED WATER LINE FROM PLANT SITE TO TRANSMISSION LINES

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION		153					153
DESIGN		439					439
CONSTRUCTION		4,829					4,829
TOTAL ALLOCATION		5,421					5,421

PROJECT: 25.0 MGD ADDITION (TP-5)

DESCRIPTION: CONSTRUCT 25.0 MGD ADDITION BRINGING TOTAL PLANT CAPACITY UP TO 62.5 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION			-				-
DESIGN			997				997
CONSTRUCTION			10,962				10,962
TOTAL ALLOCATION			11,959				11,959

PROJECT: TERMINATION STORAGE (TP-6)

DESCRIPTION: LAND AND CONSTRUCTION OF RAW WATER FOREBAY REQUIRED IF ALLENS CREEK RESERVOIR IS NOT CONSTRUCTED UNTIL THE YEAR 2013 (PHASE II - 27.7 MGD)

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION			3,360				3,360
DESIGN			1,150				1,150
CONSTRUCTION			12,650				12,650
TOTAL ALLOCATION			17,160				17,160

PROJECT: 12.5 MGD ADDITION (TP-7)

DESCRIPTION: CONSTRUCT 12.5 MGD ADDITION BRINGING TOTAL PLANT CAPACITY UP TO 75 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION				-			-
DESIGN				433			433
CONSTRUCTION				4,767			4,767
TOTAL ALLOCATION				5,200			5,200

PROJECT: ADD RAW WATER LINE FROM BRAZOS SYSTEM TO PLANT SITE (TP-8)

DESCRIPTION: CONSTRUCT ADDITIONAL 66" RAW WATERLINE FROM BRAZOS SYSTEM TO PLANT SITE IN EXISTING R.O.W.

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					-		-
DESIGN					80		80
CONSTRUCTION					874		874
TOTAL ALLOCATION					954		954

PROJECT: 25 MGD ADDITION (TP-9)

DESCRIPTION: CONSTRUCT 25 MGD ADDITION BRINGING TOTAL PLANT CAPACITY UP TO 100 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					-		-
DESIGN					997		997
CONSTRUCTION					10,962		10,962
TOTAL ALLOCATION					11,959		11,959

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: REDUCE FOREBAY SIZE (TP-10)

DESCRIPTION: ISOLATE TERMINATION STORAGE FOR SLUDGE DISPOSAL AS STORAGE IS NO LONGER NECESSARY WITH ALLENS CREEK RESERVOIR COMPLETED

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						-	-
DESIGN						75	75
CONSTRUCTION						825	825
TOTAL ALLOCATION						900	900

PROJECT: 50 MGD ADDITION (TP-11)

DESCRIPTION: CONSTRUCT 50 MGD ADDITION BRINGING TOTAL PLANT CAPACITY UP TO 150 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						-	-
DESIGN						1,838	1,838
CONSTRUCTION						20,222	20,222
TOTAL ALLOCATION						22,060	22,060

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROGRAM: RAW WATER SUPPLY FROM ALLENS CREEK RESERVOIR SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
AC-1	RAW WATERLINE FROM ALLENS CREEK RESERVOIR (1-66")	-	-	-	-	5,890	35,880	41,770
AC-2	RAW WATER PUMP STATION	-	-	-	-	-	3,598	3,598
AC-3	RAW WATERLINE EXPANSION FROM ALLENS CREEK RESERVOIR (ADD 1-66")	-	-	-	-	-	39,297	39,297
	RAW WATER SUPPLY FROM ALLENS CREEK RESERVOIR	-	-	-	-	5,890	78,775	84,665

PROJECT: RAW WATERLINE FROM ALLENS CREEK RESERVOIR (AC-1)

DESCRIPTION: ROW AND CONSTRUCTION OF ONE 66" RAW WATERLINE FROM ALLENS CREEK RESERVOIR TO SITE

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					2,473	-	2,473
DESIGN					3,417	-	3,417
CONSTRUCTION					-	35,880	35,880
TOTAL ALLOCATION					5,890	35,880	41,770

PROJECT: RAW WATER PUMP STATION (AC-2)

DESCRIPTION: CONSTRUCT RAW WATER PUMP STATION CONTIGUOUS WITH ALLENS CREEK RESERVOIR

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						-	-
DESIGN						300	300
CONSTRUCTION						3,298	3,298
TOTAL ALLOCATION						3,598	3,598

PROJECT: RAW WATERLINE EXPANSION FROM ALLENS CREEK RESERVOIR (AC-3)

DESCRIPTION: CONSTRUCT ADDITIONAL 66" RAW WATERLINE IN EXISTING ROW FROM RESERVOIR TO PLANT SITE

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						-	-
DESIGN						3,275	3,275
CONSTRUCTION						36,022	36,022
TOTAL ALLOCATION						39,297	39,297

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROGRAM: TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Proposed Encumbrances (Thousands)							Project Total
	Project	FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
WL-1	78" IN BELLAIRE		10,014					10,014
WL-2	72" IN BELLAIRE		11,635					11,635
WL-3	54" IN ELDRIDGE			9,371				9,371
WL-4	54" IN I-10			8,453				8,453
WL-5	54" IN I-10				1,187			1,187
WL-6	48" IN I-10				3,467			3,467
WL-7	48" IN BELTWAY 8				3,363			3,363
WL-8	42" IN BELTWAY 8				4,355			4,355
WL-9	42" IN GREENHOUSE					3,230		3,230
WL-10	60" IN I-10					9,872		9,872
WL-11	42" IN CLAY ROAD					3,563		3,563
WL-12	36" IN BELTWAY 8					4,432		4,432
WL-13	48" IN HIGHWAY 6					8,181		8,181

PROGRAM: TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Proposed Encumbrances (Thousands)							Project Total
	Project	FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
WL-14	42" IN US 290	-	-	-	-	3,087		3,087
WL-15	108" IN GRAND PARKWAY	-	-	-	-	16,072		16,072
WL-16	108" IN GRAND PARKWAY	-	-	-	-	22,246		22,246
WL-17	36" IN GREENHOUSE	-	-	-	-	3,776		3,776
WL-18	36" IN FM 529	-	-	-	-	6,129		6,129
WL-19	36" IN US 290	-	-	-	-	6,047		6,047
WL-20	36" IN BARKER CYPRESS	-	-	-	-	4,148		4,148
WL-21	48" IN FM 1960	-	-	-	-	7,805		7,805
WL-22	54" IN FM 149	-	-	-	-	3,826		3,826
WL-23	36" IN FM 149	-	-	-	-	6,076		6,076
WL-24	18" IN SPRING CYPRESS	-	-	-	-	3,602		3,602
WL-25	18" IN GRANT	-	-	-	-	3,027		3,027
WL-26	36" IN TELGE	-	-	-	-	2,949		2,949

PROGRAM: TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Proposed Encumbrances (Thousands)							Project Total
	Project	FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
WL-27	30" IN TELGE	-	-	-	-	2,825		2,825
WL-28	30" IN MUESCHKE	-	-	-	-	1,558		1,558
WL-29	24" IN MUESCHKE	-	-	-	-	1,370		1,370
WL-30	16" IN BOUDREAUX	-	-	-	-	1,298		1,298
WL-31	18" IN KTZMAN	-	-	-	-	1,991		1,991
WL-32	18" IN JUERGEN	-	-	-	-	952		952
WL-33	30" IN HOUSE HAHL	-	-	-	-	3,415		3,415
WL-34	48" IN KATY HOCKLEY	-	-	-	-	-	8,557	8,557
WL-35	42" IN KATY HOCKLEY	-	-	-	-	-	3,750	3,750
WL-36	30" IN KATY HOCKLEY	-	-	-	-	-	4,194	4,194
WL-37	30" IN HOUSE HAHL	-	-	-	-	-	2,560	2,560
WL-38	30" IN US 290	-	-	-	-	-	6,642	6,642
WL-39	36" IN FM 149	-	-	-	-	-	2,215	2,215

PROGRAM: TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Proposed Encumbrances (Thousands)							Project Total
	Project	FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
WL-40	30" IN CLAY ROAD						4,027	4,027
WL-41	36" IN FM 529						6,101	6,101
WL-42	36" IN FM 2920						1,739	1,739
WL-43	30" IN FM 2920						8,234	8,234
WL-44	24" IN KICKAPOO						1,088	1,088
WL-45	16" IN STOCKDICK						1,531	1,531
WL-46	18" IN MASON ROAD						2,000	2,000
WL-47	24" IN TELGE						1,451	1,451
WL-48	16" IN MUESCHKE						1,186	1,186
WL-49	24" IN SHIELD						3,461	3,461
WL-50	16" IN ROBERTS						1,594	1,594
WL-51	15" IN WALLER SPRING CREEK						2,356	2,356

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROGRAM: TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		FY 89	FY 1990-95	FY 1995-00	FY 2000-05	FY 2005-10	FY 2010-30	
WL-52	16" IN FM 2920						1,021	1,021
	TRANSMISSION LINES	-	21,649	17,824	12,372	131,477	63,707	247,029

PROJECT: 78" IN BELLAIRE (WL-1)

DESCRIPTION: ROW AND 78" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION		418					418
DESIGN		835					835
CONSTRUCTION		8,761					8,761
TOTAL ALLOCATION		10,014					10,014

PROJECT: 72" IN BELLAIRE (WL-2)

DESCRIPTION: ROW AND 72" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION		485					485
DESIGN		970					970
CONSTRUCTION		10,180					10,180
TOTAL ALLOCATION		11,635					11,635

PROJECT: 54" IN ELDRIDGE (WL-3)

DESCRIPTION: ROW AND 54" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION TO SERVE AREAS 3 AND 4

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION			390				390
DESIGN			781				781
CONSTRUCTION			8,200				8,200
TOTAL ALLOCATION			9,371				9,371

PROJECT: 54" IN I-10 (WL-4)

DESCRIPTION: ROW AND 54" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION TO SERVE AREAS 5 & 6

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION			352				352
DESIGN			704				704
CONSTRUCTION			7,397				7,397
TOTAL ALLOCATION			8,453				8,453

PROJECT: 54" IN I-10 (WL-5)

DESCRIPTION: ROW AND 54" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION TO SERVE THE CITY OF HOUSTON

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION				50			50
DESIGN				99			99
CONSTRUCTION				1,038			1,038
TOTAL ALLOCATION				1,187			1,187

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 48" IN I-10 (WL-6)

DESCRIPTION: ROW AND 48" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION TO SERVE THE CITY OF HOUSTON

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION				144			144
DESIGN				289			289
CONSTRUCTION				3,034			3,034
TOTAL ALLOCATION				3,467			3,467

PROJECT: 48" IN BELTWAY 8 (WL-7)

DESCRIPTION: ROW AND 48" WATERLINE CONSTRUCTION FOR FINISHED WATER DISTRIBUTION TO SERVE THE CITY OF HOUSTON

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION				140			140
DESIGN				280			280
CONSTRUCTION				2,943			2,943
TOTAL ALLOCATION				3,363			3,363

PROJECT: 42" IN BELTWAY 8 (WL-8)

DESCRIPTION: ROW AND 42" WATERLINE CONSTRUCTION FOR EXTENSION OF DISTRIBUTION SYSTEM TO SERVE AREA 11

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION				181			181
DESIGN				363			363
CONSTRUCTION				3,811			3,811
TOTAL ALLOCATION				4,355			4,355

PROJECT: 42" IN GREENHOUSE (WL-9)

DESCRIPTION: ROW AND 42" WATERLINE CONSTRUCTION FOR EXTENDING DISTRIBUTION SYSTEM TO SERVE AREAS 6 AND 7

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					135		135
DESIGN					269		269
CONSTRUCTION					2,826		2,826
TOTAL ALLOCATION					3,230		3,230

PROJECT: 60" IN I-10 (WL-10)

DESCRIPTION: ROW AND CONSTRUCTION OF 60" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 7 AND 5

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					412		412
DESIGN					823		823
CONSTRUCTION					8,637		8,637
TOTAL ALLOCATION					9,872		9,872

PROJECT: 42" IN CLAY ROAD (WL-11)

DESCRIPTION: ROW AND CONSTRUCTION OF 42" WATERLINE FOR EXTENSION OF DISTRIBUTION SYSTEM TO SERVE AREAS 6,8,9 & 10

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					149		149
DESIGN					297		297
CONSTRUCTION					3,117		3,117
TOTAL ALLOCATION					3,563		3,563

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 36" IN BELTWAY 8 (WL-12)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 12,13,14,15&16

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					185		185
DESIGN					369		369
CONSTRUCTION					3,878		3,878
TOTAL ALLOCATION					4,432		4,432

PROJECT: 48" IN HIGHWAY 6 (WL-13)

DESCRIPTION: ROW AND CONSTRUCTION OF 48" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 9,17 & 18

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					341		341
DESIGN					682		682
CONSTRUCTION					7,158		7,158
TOTAL ALLOCATION					8,181		8,181

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 42" IN US 290 (WL-14)

DESCRIPTION: ROW AND CONSTRUCTION OF 42" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 12 AND 17

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					129		129
DESIGN					257		257
CONSTRUCTION					2,701		2,701
TOTAL ALLOCATION					3,087		3,087

PROJECT: 108" IN GRAND PARKWAY (WL-15)

DESCRIPTION: ROW AND CONSTRUCTION OF 108" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					670		670
DESIGN					1,339		1,339
CONSTRUCTION					14,063		14,063
TOTAL ALLOCATION					16,072		16,072

PROJECT: 108" IN GRAND PARKWAY (WL-16)

DESCRIPTION: ROW AND CONSTRUCTION OF 108" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					927		927
DESIGN					1,854		1,854
CONSTRUCTION					19,465		19,465
TOTAL ALLOCATION					22,246		22,246

PROJECT: 36" IN GREENHOUSE (WL-17)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 9 AND 25

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					158		158
DESIGN					315		315
CONSTRUCTION					3,303		3,303
TOTAL ALLOCATION					3,776		3,776

PROJECT: 36" IN FM 529 (WL-18)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 8,9,11,17&18

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					255		255
DESIGN					511		511
CONSTRUCTION					5,363		5,363
TOTAL ALLOCATION					6,129		6,129

PROJECT: 36" IN US 290 (WL-19)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 18,19,20&21

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					252		252
DESIGN					504		504
CONSTRUCTION					5,291		5,291
TOTAL ALLOCATION					6,047		6,047

PROJECT: 36" IN BARKER CYPRESS (WL-20)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 18 AND 21

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					173		173
DESIGN					346		346
CONSTRUCTION					3,629		3,629
TOTAL ALLOCATION					4,148		4,148

PROJECT: 48" IN FM 1960 (WL-21)

DESCRIPTION: ROW AND CONSTRUCTION OF 48" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 12,19 & 22

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					325		325
DESIGN					650		650
CONSTRUCTION					6,830		6,830
TOTAL ALLOCATION					7,805		7,805

PROJECT: 54" IN FM 149 (WL-22)

DESCRIPTION: ROW AND CONSTRUCTION OF 54" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 12

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					159		159
DESIGN					319		319
CONSTRUCTION					3,348		3,348
TOTAL ALLOCATION					3,826		3,826

PROJECT: 36" IN FM 149 (WL-23)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 22,23 & 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					253		253
DESIGN					506		506
CONSTRUCTION					5,317		5,317
TOTAL ALLOCATION					6,076		6,076

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 18" IN SPRING CYPRESS (WL-24)

DESCRIPTION: ROW AND CONSTRUCTION OF 18" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 20,23 & 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					150		150
DESIGN					300		300
CONSTRUCTION					3,152		3,152
TOTAL ALLOCATION					3,602		3,602

PROJECT: 18" IN GRANT (WL-25)

DESCRIPTION: ROW AND CONSTRUCTION OF 18" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 22,23 & 19

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					126		126
DESIGN					252		252
CONSTRUCTION					2,649		2,649
TOTAL ALLOCATION					3,027		3,027

PROJECT: 36" IN TELGE (WL-26)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 19 AND 20

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					123		123
DESIGN					246		246
CONSTRUCTION					2,580		2,580
TOTAL ALLOCATION					2,949		2,949

PROJECT: 30" IN TELGE (WL-27)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 24 AND 23

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					118		118
DESIGN					235		235
CONSTRUCTION					2,472		2,472
TOTAL ALLOCATION					2,825		2,825

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 30" IN MUESCHKE (WL-28)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 20

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					65		65
DESIGN					130		130
CONSTRUCTION					1,363		1,363
TOTAL ALLOCATION					1,558		1,558

PROJECT: 24" IN MUESCHKE (WL-29)

DESCRIPTION: ROW AND CONSTRUCTION OF 24" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 26

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					57		57
DESIGN					114		114
CONSTRUCTION					1,199		1,199
TOTAL ALLOCATION					1,370		1,370

PROJECT: 16" IN BOUDREAUX (WL-30)

DESCRIPTION: ROW AND CONSTRUCTION OF 16" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					54		54
DESIGN					108		108
CONSTRUCTION					1,136		1,136
TOTAL ALLOCATION					1,298		1,298

PROJECT: 18" IN KITZMAN (WL-31)

DESCRIPTION: ROW AND CONSTRUCTION OF 18" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					83		83
DESIGN					166		166
CONSTRUCTION					1,742		1,742
TOTAL ALLOCATION					1,991		1,991

PROJECT: 18" IN JUERGEN (WL-32)

DESCRIPTION: ROW AND CONSTRUCTION OF 18" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 26

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					40		40
DESIGN					79		79
CONSTRUCTION					833		833
TOTAL ALLOCATION					952		952

PROJECT: 30" IN HOUSE HAHL (WL-33)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 21

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION					143		143
DESIGN					285		285
CONSTRUCTION					2,987		2,987
TOTAL ALLOCATION					3,415		3,415

PROJECT: 48" IN KATY-HOCKLEY (WL-34)

DESCRIPTION: ROW AND CONSTRUCTION OF 48" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 28, 7 & 31

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						357	357
DESIGN						713	713
CONSTRUCTION						7,487	7,487
TOTAL ALLOCATION						8,557	8,557

PROJECT: 42" IN KATY-HOCKLEY (WL-35)

DESCRIPTION: ROW AND CONSTRUCTION OF 42" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 21 AND 27

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						156	156
DESIGN						313	313
CONSTRUCTION						3,281	3,281
TOTAL ALLOCATION						3,750	3,750

PROJECT: 30" IN HOUSE HAHL (WL-37)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 21

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						107	107
DESIGN						213	213
CONSTRUCTION						2,240	2,240
TOTAL ALLOCATION						2,560	2,560

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 30" IN US 290 (WL-38)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 20,21,27 & 29

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						277	277
DESIGN						553	553
CONSTRUCTION						5,812	5,812
TOTAL ALLOCATION						6,642	6,642

PROJECT: 36" IN FM 149 (WL-39)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE AND BOOSTER PUMP STATION FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						92	92
DESIGN						185	185
CONSTRUCTION						1,938	1,938
TOTAL ALLOCATION						2,215	2,215

PROJECT: 30" IN CLAY ROAD (WL-40)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 7, 25 AND 28

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						168	168
DESIGN						336	336
CONSTRUCTION						3,523	3,523
TOTAL ALLOCATION						4,027	4,027

PROJECT: 36" IN FM 529 (WL-41)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 21, 25 AND 28

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						254	254
DESIGN						508	508
CONSTRUCTION						5,339	5,339
TOTAL ALLOCATION						6,101	6,101

PROJECT: 36" IN FM 2920 (WL-42)

DESCRIPTION: ROW AND CONSTRUCTION OF 36" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						72	72
DESIGN						145	145
CONSTRUCTION						1,522	1,522
TOTAL ALLOCATION						1,739	1,739

PROJECT: 30" IN FM 2920 (WL-43)

DESCRIPTION: ROW AND CONSTRUCTION OF 30" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 29, 26 AND 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						343	343
DESIGN						686	686
CONSTRUCTION						7,205	7,205
TOTAL ALLOCATION						8,234	8,234

PROJECT: 24" IN KICKAPOO (WL-44)

DESCRIPTION: ROW AND CONSTRUCTION OF 24" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 29 AND 30

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						45	45
DESIGN						91	91
CONSTRUCTION						952	952
TOTAL ALLOCATION						1,088	1,088

PROJECT: 16" IN STOCKDICK (WL-45)

DESCRIPTION: ROW AND CONSTRUCTION OF 16" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 25

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						64	64
DESIGN						128	128
CONSTRUCTION						1,339	1,339
TOTAL ALLOCATION						1,531	1,531

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION 1989 - 2030 CAPITAL IMPROVEMENT PLAN

PROJECT: 18" IN MASON ROAD (WL-46)

DESCRIPTION: ROW AND CONSTRUCTION OF 18" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 7

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						83	83
DESIGN						167	167
CONSTRUCTION						1,750	1,750
TOTAL ALLOCATION						2,000	2,000

PROJECT: 24" IN TELGE (WL-47)

DESCRIPTION: ROW AND CONSTRUCTION OF 24" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 24

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						60	60
DESIGN						121	121
CONSTRUCTION						1,270	1,270
TOTAL ALLOCATION						1,451	1,451

PROJECT: 16" IN MUESCHKE ROAD (WL-48)

DESCRIPTION: ROW AND CONSTRUCTION OF 16" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 26

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						49	49
DESIGN						99	99
CONSTRUCTION						1,038	1,038
TOTAL ALLOCATION						1,186	1,186

PROJECT: 24" IN SHIEL ROAD (WL-49)

DESCRIPTION: ROW AND CONSTRUCTION OF 24" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 29 AND 20

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						144	144
DESIGN						288	288
CONSTRUCTION						3,029	3,029
TOTAL ALLOCATION						3,461	3,461

PROJECT: 16" IN ROBERTS (WL-50)

DESCRIPTION: ROW AND CONSTRUCTION OF 16" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 29

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						66	66
DESIGN						133	133
CONSTRUCTION						1,395	1,395
TOTAL ALLOCATION						1,594	1,594

PROJECT: 16" IN WALLER/SPRING CREEK (WL-51)

DESCRIPTION: ROW AND CONSTRUCTION OF 16" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREAS 30 AND 29

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						98	98
DESIGN						196	196
CONSTRUCTION						2,062	2,062
TOTAL ALLOCATION						2,356	2,356

PROJECT: 16" IN FM 2920 (WL-52)

DESCRIPTION: ROW AND CONSTRUCTION OF 16" WATERLINE FOR DISTRIBUTION SYSTEM EXTENSION TO SERVE AREA 30

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	FY 89	FY 1990-95	FY 1995-2000	FY 2000-2005	FY 2005-2010	FY 2010-2030	
ACQUISITION						43	43
DESIGN						85	85
CONSTRUCTION						893	893
TOTAL ALLOCATION						1,021	1,021

ATTACHMENT NO. 2

PLAN SCHEMATICS OF WHCSWSC

CAPITAL IMPROVEMENT PROJECTS

ATTACHMENT NO. 3

ANNUALIZED COSTS

UTILIZING SOUTHWEST SUPPLY ALTERNATE NO. 3

($ 1988)

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION
PROJECTED ANNUAL COST
(1988 DOLLARS)
SOUTHWEST SUPPLY ALTERNATE NO. 3
RAW WATER SUPPLY BY GCWA (59.4 MGD) AND BY BRA (65.1 MGD)
(PLANT AND WATERLINE COSTS)
(Revised 9/5/88)

YEAR	(7) ANNUAL COSTS					CANAL TRANSPORT COST (GCWA) (6)	OPERATION & MAINTENANCE	AVAILABLE PLANT CAPACITY (ADF)	PROJECTED DEMANDS		TOTAL PROJECTED ANNUAL COSTS	YEAR
	CAPITAL (1) COSTS	RAW WATER SUPPLY - BRA (2)		RAW WATER SUPPLY - GCWA					WITH CONSERVATION	WITHOUT CONSERVATION		
		FUTURE - BRA (3)	CURRENT - BRA (3)	FUTURE-GCWA (4)	CURRENT-GCWA (4)							
1989	$ -0-	$118,000	$ -0-	$1,084,000	$ -0-	$ -0-	$ -0-				$ 1,202,000	1989
1990	8,778,000	"	"	"	"	"	"				9,980,000	1990
1991	1,604,000	"	"	"	"	"	"				2,806,000	1991
1992	1,604,000	"	"	"	"	"	"				2,806,000	1992
1993	12,948,000	"	"	"	"	"	"				14,150,000	1993
1994	19,732,000	"	"	"	"	"	"				20,934,000	1994
1995	49,058,000	"	"	"	"	"	"				50,260,000	1995
1996	-0-	"	"	412,000	1,477,520	"	5,212,428	37.5 MGD	36.8 MGD	37.9 MGD	7,219,948	1996
1997	-0-	"	"	"	"	"	"	"	(41,224 Ac	(42,512 Ac	7,219,948	1997
1998	656,500	"	"	"	"	"	"	"	Ft/Year)	Ft/Year)	7,876,448	1998
1999	7,195,500	"	"	"	"	"	"	"			14,415,448	1999
2000	25,066,000	"	"	"	"	"	"	"			32,285,948	2000
2001	767,000	"	"	-0-	2,385,000	"	8,648,633	62.5 MGD	59.4 MGD	61.5 MGD	11,918,633	2001
2002	818,000	"	"	"	"	"	"	"	(66,575 Ac	(68,916 Ac	11,969,633	2002
2003	818,000	"	"	"	"	"	"	"	Ft/Year)	Ft/Year)	11,969,633	2003
2004	9,610,000	"	"	"	"	"	"	"			20,761,633	2004
2005	19,575,000	"	"	"	"	"	"	"			30,726,633	2005
2006	5,446,000	110,000	370,000	"	"	113,685	10,510,235	75 MGD	64.5 MGD	66.8 MGD	18,934,920	2006
2007	5,442,000	"	"	"	"	"	"	"	(72,265 Ac	(74,887 Ac	18,930,920	2007
2008	5,442,000	"	"	"	"	"	"	"	Ft/Year)	Ft/Year)	18,930,920	2008
2009	60,696,000	"	"	"	"	"	"	"			74,184,920	2009
2010	72,399,000	"	"	"	"	"	"	"			85,887,920	2010
2011	12,421,500	58,000	2,440,000	"	"	732,774	16,398,440	100 MGD	92.8 MGD	96.9 MGD	34,435,714	2011
2012	12,721,500	"	"	"	"	"	"	"	(104,024 Ac Ft/Year)	(108,617 Ac Ft/Year)	34,735,714	2012

SOUTHWEST SUPPLY ALTERNATE NO. 3
RAW WATER SUPPLY BY GCWA (59.4 MGD) AND BY BRA (65.1 MGD)

YEAR	ANNUAL COSTS					CANAL TRANSPORT COST (GCWA)		AVAILABLE PLANT CAPACITY (ADF)	PROJECTED DEMANDS		TOTAL PROJECTED ANNUAL COSTS	YEAR
	CAPITAL (1) COSTS	RAW WATER SUPPLY - BRA		RAW WATER SUPPLY - GCWA			OPERATION & MAINTENANCE		WITH CONSERVATION	WITHOUT CONSERVATION		
		FUTURE - BRA	CURRENT - BRA	FUTURE-GCWA	CURRENT-GCWA							
2013	$16,180,500	$48,000	$2,817,000	$ -0-	$2,385,000	$ -0-	$16,398,440	100 MGD	98.0 MGD	103.5 MGD	$37,828,940	2013
2014	1,822,500	"	"	"	"	"	"	"	(109,804 Ac	(116,021 Ac	23,470,940	2014
2015	9,681,500	"	"	"	"	"	"	"	Ft/Year)	Ft/Year)	31,329,940	2015
2016	9,681,500	"	"	"	"	"	"	"			31,329,940	2016
2017	424,000	"	"	"	"	"	"	"			22,072,440	2017
2018	848,000	"	"	"	"	"	"	"			22,496,440	2018
2019	8,901,000	"	"		"	"	"	"			30,549,440	2019
2020	422,000	"	"	"	"	"	"	"			22,070,440	2020
2021	844,000	"	"	"	"	"	"	"	98.0 MGD	103.5 MGD	22,492,440	2021
2022	8,862,000	"	"	"	"	"	"	"	(109,804 Ac	(116,021 Ac	30,510,440	2022
2023	460,000	"	"	"	"	"	"	"	Ft/Year)	Ft/Year)	22,108,440	2023
2024	461,000	"	"	"	"	"	"	"			22,109,440	2024
2025	461,000	"	"	"	"	"	"	"			22,109,440	2025
2026	4,839,500	"	"	"	"	"	"	"			26,487,940	2026
2027	8,114,500	"	"	"	"	"	"	"			29,762,940	2027
2028	14,305,000	"	"	"	"	"	"	"			35,953,440	2028
2029	23,040,000	"	"	"	"	"	"	"			44,688,440	2029
2030	31,805,000	"	"	"	"	"	"	"			53,453,440	2030
2031	-	-0-	4,752,000	"	"	"	23,405,310	150 MGD	124.5 MGD	132.8 MGD	30,542,310	2031
2032	-	-0-	"	"	"	"	"	"	(139,490 Ac	(148,810 Ac	30,542,310	2032
			"				"	"	Ft/Year)	Ft/Year)		

TOTAL $1,187,863,223

(1) INCLUDES ENGINEERING, LAND ACQUISITION AND CONTINGENCIES.
(2) BASED ON FINAL BRAZOS RIVER AUTHORITY'S PROPOSAL.
(3) BRA SUPPLY COST BASED ON FOLLOWING: FUTURE: $0.005/1000 GALLONS
CURRENT: $0.20/1000 GALLONS
(4) GCWA SUPPLY COST BASED ON FOLLOWING: FUTURE: $0.05/1000 GALLONS
CURRENT: $0.11/1000 GALLONS
(5) ALLENS CREEK CONSTRUCTED IN BRA BASIN BY 2013.
(6) CANAL TRANSPORTATION COST BY GCWA IS BASED ON $19.86 PER ACRE-FOOT ($0.06/1000 GALLONS).
(ONLY FOR BRA WATER TRANSFERRED THROUGH GCWA CANAL)
(7) ANNUAL COST SHOWN IN THIS TABLE ARE TOTAL COSTS INCURRED EACH YEAR TO DEVELOP AND OPERATE
THE SYSTEM. THIS TABLE DOES NOT REFLECT ANNUAL EXPENDITURES AFTER AMORTIZATION INCURRED COST

ATTACHMENT NO. 4

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

PLAN OF FINANCING

BY: UNDERWOOD NEUHAUS & CO. INCORPORATED AND
MASTERSON & COMPANY, CO-FINANCIAL ADVISORS

WEST HARRIS COUNTY SURFACE WATER SUPPLY CORPORATION

Schedule of Capital Expenditures and Related Bond Sales

	Capital Expenditures	Bond Issue Principal Amount	Bond Issue Year Sold
1990	$ 8,778,000	13,180,000	1990
1991	1,604,000		
1992	1,640,000		
1993	12,948,000	35,670,000	1993
1994	19,732,000		
1995	49,058,000	56,235,000	1995
1998	656,500	8,390,000	1998
1999	7,195,500		
2000	25,066,000	28,735,000	2000
2001	767,000	2,540,000	2001
2002	818,000		
2003	818,000		
2004	9,610,000	13,300,000	2004
2005	19,575,000	24,620,000	2005
2006	5,446,000	17,235,000	2006
2007	5,442,000		
2008	5,442,000		
2009	60,696,000	83,955,000	2009
2010	72,399,000	91,040,000	2010
2011	12,421,500	17,185,000	2011
2012	12,721,500	16,000,000	2012
2013	16,180,500	20,335,000	2013
2014	1,822,500		
2015	9,681,500	22,170,000	2015
2016	9,681,500		
2017	424,000		
2018	848,000		
2019	8,901,000	11,325,000	2019
2020	422,000		
2021	844,000		

	Capital Expenditures	Bond Issue Principal Amount	Year Sold
2022	8,862,000	11,290,000	2022
2023	460,000		
2024	461,000		
2025	461,000		
2026	4,839,500	14,150,000	2026
2027	8,114,500		
2028	14,305,000	16,400,000	2028
2029	23,040,000	26,415,000	2029
2030	31,805,000	36,460,000	2030

B. CASH FLOW ANALYSIS OF ANNUAL EXPENDITURES VS. REVENUES

WEST HARRIS COUNTY
SURFACE WATER SUPPLY CORPORATION

CASH FLOW ANALYSIS OF ANNUAL EXPENDITURES AND REVENUES
(1989 - 2055)
Case A

Year	Debt Service(a)	Raw Water Costs	Operations & Maintenance	Total Expenditures	Total Revenues	Cumulative Balance	Cost of Water/ 1,000 Gallons
Phase I							
1989	$	$1,202,000		$1,202,000			
1990	527,200	1,202,000		1,729,200			
1991	1,217,600	1,202,000		2,419,600			
1992	1,169,520	1,202,000		2,371,520			
1993	2,547,040	1,202,000		3,749,040			
1994	4,291,360	1,202,000		5,493,360			
1995	6,406,680	1,202,000		7,608,680			
Phase II							
1996(b)	9,360,000	2,007,520	$5,212,428	16,579,948	$16,924,320	$ 344,372	$1.26
1997	9,153,904	2,007,520	5,212,428	16,373,852	16,924,320	894,840	1.26
1998	9,277,728	2,007,520	5,212,428	16,497,676	16,924,320	1,321,484	1.26
1999	9,687,824	2,007,520	5,212,428	16,907,772	16,924,320	1,338,032	1.26
2000	10,702,904	2,007,520	5,212,428	17,922,852	16,924,320	339,500	1.26
Phase III							
2001(c)	12,211,088	2,503,000	8,648,633	23,362,721	23,427,306	404,085	1.08
2002	12,338,288	2,503,000	8,648,633	23,489,921	23,427,306	341,470	1.08
2003	12,323,984	2,503,000	8,648,633	23,475,617	23,427,306	293,159	1.08
2004	10,671,776(h)	2,503,000	8,648,633	21,823,409	23,427,306	1,897,056	1.08
2005	12,195,072(i)	2,503,000	8,648,633	23,346,705	23,427,306	1,977,657	1.08
Phase IV-A							
2006(d)	15,752,872	2,978,685	10,510,235	29,241,792	29,668,149	2,404,014	1.26
2007	17,190,272	2,978,685	10,510,235	30,679,192	29,668,149	1,392,971	1.26
2008	17,131,232	2,978,685	10,510,235	30,620,152	29,668,149	440,968	1.26
2009	6,685,368(j)	2,978,685	10,510,235	20,174,288	29,668,149	9,934,829	1.26
2010	19,155,936(k)	2,978,685	10,510,235	32,644,856	29,668,149	6,958,122	1.26
Phase IV-B							
2011(e)	27,625,272(l)	5,615,774	16,398,440	49,639,486	49,146,155	6,464,791	1.45
2012	32,798,352(m)	5,615,774	16,398,440	54,812,566	49,146,155	818,380	1.45
Phase V							
2013(f)	35,488,488	5,250,000	16,398,440	57,136,928	58,674,772	2,356,224	1.64
2014	36,958,528	5,250,000	16,398,440	58,606,968	58,674,772	2,424,028	1.64
2015	36,600,848	5,250,000	16,398,440	58,249,288	58,674,772	2,849,512	1.64
2016	37,805,328	5,250,000	16,398,440	59,453,768	58,674,772	2,070,516	1.64
2017	37,805,728	5,250,000	16,398,440	59,454,168	58,674,772	1,291,120	1.64
2018	34,553,296	5,250,000	16,398,440	56,201,736	56,170,361	1,259,745	1.57
2019	35,051,464	5,250,000	16,398,440	56,699,904	56,170,361	730,202	1.57
2020	30,651,440	5,250,000	16,398,440	52,299,880	52,592,631	1,022,953	1.47
2021	30,821,216	5,250,000	16,398,440	52,469,656	52,592,631	1,145,928	1.47
2022	31,250,016	5,250,000	16,398,440	52,898,456	52,592,631	840,103	1.47
2023	31,087,120	5,250,000	16,398,440	52,735,560	52,592,631	697,174	1.47
2024	31,116,224	5,250,000	16,398,440	52,764,664	52,592,631	525,141	1.47
2025	28,519,152	5,250,000	16,398,440	50,167,592	51,877,085	2,234,634	1.44
2026	28,917,184	5,250,000	16,398,440	50,565,624	51,877,085	3,546,095	1.44
2027	29,631,824	5,250,000	16,398,440	51,280,264	51,877,085	4,142,916	1.44
2028	30,172,192	5,250,000	16,398,440	51,820,632	51,877,085	4,199,369	1.44
2029	30,716,504	5,250,000	16,398,440	52,364,944	51,877,085	3,711,510	1.44
2030	31,164,976	5,250,000	16,398,440	52,813,416	51,877,085	2,775,179	1.44
2031-2033(g)	31,543,835	7,137,000	23,405,310	62,086,145	59,539,238	228,272	1.31
2034-2039	15,268,469	7,137,000	23,405,310	45,810,779	45,904,298	321,791	1.01
2040-2046	9,830,168	7,137,000	23,405,310	40,372,478	40,450,322	805,225	0.69
2047-2055	7,964,188	7,137,000	23,405,310	38,506,498	38,632,350	931,077	0.35

(a) Annual Debt service requirements are net of interest and principal earnings transfered from the Reserve Fund to the Debt Service Fund.

(b) Initial year of delivery of water to the City of Houston.

(c) Initial delivery of water to Phase 2 Service Area.

(d) Initial delivery of water to Phase 3 Service Area.

(e) Initial delivery of water to Phase 4-A Service Area.

(f) Initial delivery of water to Phase 4-B Service Area.

(g) Initial delivery of water to Phase 5 Service Area.

(h) $2,128,000 in capitalized interest has been subtracted from the 2004 debt service requirement. Such amount is equal to the initial two years in interest payments on the Series 2004 bonds.

(i) $1,969,000 in capitalized interest has been subtracted from the 2005 debt service requirement. Such amount is equal to the initial year in interest payments on the Series 2005 bonds.

(j) $13,432,800 in capitalized interest has been subtracted from the 2009 debt service requirement. Such amount is equal to the initial two years interest payments on the Series 2009 bonds.

(k) $7,283,200 in capitalized interest has been subtracted from the 2010 debt service requirement. Such amount is equal to the initial year in interest payments on the Series 2010 bonds.

(l) $2,749,600 in capitalized interest has been subtracted from the 2011 debt service requirement. Such amount is equal to the initial two years in interest payments on the Series 2011 bonds.

(m) $1,280,000 in capitalized interest has been subtracted from the 2012 debt service requirement. Such amount is equal to the initial year in interest payments on the Series 2012 bonds.

(a) Annual Debt service requirements are net of interest and principal earnings transfered from the Reserve Fund to the Debt Service Fund.

(b) Initial year of delivery of water to the City of Houston.

(c) Initial delivery of water to Phase 2 Service Area.

(d) Initial delivery of water to Phase 3 Service Area.

(e) Initial delivery of water to Phase 4-A Service Area.

(f) Initial delivery of water to Phase 4-B Service Area.

(g) Initial delivery of water to Phase 5 Service Area.

(h) $2,128,000 in capitalized interest has been subtracted from the 2004 debt service requirement. Such amount is equal to the initial two years in interest payments on the Series 2004 bonds.

(i) $1,969,000 in capitalized interest has been subtracted from the 2005 debt service requirement. Such amount is equal to the initial year in interest payments on the Series 2005 bonds.

(j) $13,432,800 in capitalized interest has been subtracted from the 2009 debt service requirement. Such amount is equal to the initial two years interest payments on the Series 2009 bonds.

(k) $7,283,200 in capitalized interest has been subtracted from the 2010 debt service requirement. Such amount is equal to the initial year in interest payments on the Series 2010 bonds.

(l) $2,749,600 in capitalized interest has been subtracted from the 2011 debt service requirement. Such amount is equal to the initial two years in interest payments on the Series 2011 bonds.

(m) $1,280,000 in capitalized interest has been subtracted from the 2012 debt service requirement. Such amount is equal to the initial year in interest payments on the Series 2012 bonds.

C. AGGREGATED PRINCIPAL AND INTEREST OF TOTAL BOND SALES THROUGHOUT PLAN DEVELOPMENT

AGGREGATED PRINCIPAL AND INTEREST AMOUNTS

DEALNAME: WHCWAT1

11/05/88
6:57 PM

FISCAL YEAR	MATURING AMOUNT	INTEREST	TOTAL
1990	.00	527,200.00	527,200.00
1991	170,000.00	1,047,600.00	1,217,600.00
1992	185,000.00	984,520.00	1,169,520.00
1993	200,000.00	2,347,040.00	2,547,040.00
1994	685,000.00	3,606,360.00	4,291,360.00
1995	740,000.00	5,666,680.00	6,406,680.00
1996	1,535,000.00	7,825,080.00	9,360,080.00
1997	1,665,000.00	7,488,904.00	9,153,904.00
1998	1,800,000.00	7,477,728.00	9,277,728.00
1999	2,060,000.00	7,627,824.00	9,687,824.00
2000	2,235,000.00	8,467,904.00	10,702,904.00
2001	2,800,000.00	9,411,088.00	12,211,088.00
2002	3,060,000.00	9,278,288.00	12,338,288.00
2003	3,310,000.00	9,013,984.00	12,323,984.00
2004	3,590,000.00	9,209,776.00	12,799,776.00
2005	3,880,000.00	10,284,672.00	14,164,672.00
2006	4,210,000.00	11,542,872.00	15,752,872.00
2007	5,340,000.00	11,850,272.00	17,190,272.00
2008	5,790,000.00	11,341,232.00	17,131,232.00
2009	6,285,000.00	13,833,168.00	20,118,168.00
2010	6,790,000.00	19,649,136.00	26,439,136.00
2011	7,370,000.00	23,004,872.00	30,374,872.00
2012	10,590,000.00	23,488,352.00	34,078,352.00
2013	11,490,000.00	23,998,488.00	35,488,488.00
2014	13,210,000.00	23,748,528.00	36,958,528.00
2015	13,093,000.00	23,507,848.00	36,600,848.00
2016	14,515,000.00	23,290,328.00	37,805,328.00
2017	15,725,000.00	22,080,728.00	37,805,728.00
2018	13,733,000.00	20,820,296.00	34,553,296.00
2019	15,010,000.00	20,041,464.00	35,051,464.00
2020	11,205,600.00	19,445,840.00	30,651,440.00
2021	12,360,000.00	18,461,216.00	30,821,216.00
2022	13,410,000.00	17,840,016.00	31,250,016.00
2023	13,887,400.00	17,199,720.00	31,087,120.00
2024	15,075,000.00	16,041,224.00	31,116,224.00
2025	13,669,600.00	14,849,552.00	28,519,152.00
2026	14,677,400.00	14,239,784.00	28,917,184.00
2027	16,110,000.00	13,521,824.00	29,631,824.00
2028	17,450,000.00	12,722,192.00	30,172,192.00
2029	17,852,400.00	12,864,104.00	30,716,504.00
2030	17,430,000.00	13,734,976.00	31,164,976.00
2031	17,854,000.00	13,647,008.00	31,501,008.00
2032	19,410,000.00	12,156,448.00	31,566,448.00
2033	21,025,000.00	10,539,048.00	31,564,048.00
2034	14,809,400.00	9,105,672.00	23,915,072.00
2035	7,834,800.00	8,199,904.00	16,034,704.00
2036	7,198,600.00	7,598,568.00	14,797,168.00
2037	6,368,400.00	7,055,888.00	13,424,288.00
2038	5,086,000.00	6,597,712.00	11,683,712.00
2039	5,585,000.00	6,170,872.00	11,755,872.00

2040	3,997,200.00	5,787,584.00	9,784,784.00
2041	4,420,000.00	5,450,896.00	9,870,896.00
2042	4,795,000.00	5,082,296.00	9,877,296.00
2043	5,195,000.00	4,682,696.00	9,877,696.00
2044	4,575,000.00	4,291,896.00	8,866,896.00
2045	5,005,000.00	3,908,696.00	8,913,696.00
2046	5,425,000.00	3,491,496.00	8,916,496.00
2047	4,822,800.00	3,081,584.00	7,904,384.00
2048	5,270,000.00	2,677,872.00	7,947,872.00
2049	5,715,000.00	2,238,472.00	7,953,472.00
2050	6,185,000.00	1,762,472.00	7,947,472.00
2051	5,398,400.00	1,299,136.00	6,697,536.00
2052	5,895,000.00	847,400.00	6,742,400.00
2053	4,875,800.00	416,568.00	5,292,368.00
2054	2,899,400.00	105,560.00	3,004,960.00
2055	130,200.00-	5,208.00-	135,408.00-
TOTALS	513,708,000.00	669,573,216.00	1,183,281,216.00

		PRINCIPAL	
NEW01	13,180,000.00	13,180,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'90
NEW02	35,670,000.00	35,670,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'93
NEW03	56,235,000.00	56,235,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'95
NEW04	8,390,000.00	8,390,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'98
NEW05	28,735,000.00	28,735,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'00
NEW08	2,540,000.00	2,540,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'01
NEW09	13,300,000.00	13,300,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'04
NEW10	24,620,000.00	24,620,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'05
NEW11	17,235,000.00	17,235,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'06
NEW12	83,955,000.00	83,955,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'09
NEW13	91,040,000.00	91,040,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'10
NEW14	17,185,000.00	17,185,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'11
NEW15	16,000,000.00	16,000,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'12
NEW16	20,335,000.00	20,335,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'13
NEW17	22,170,000.00	22,170,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'15
NEW18	11,325,000.00	11,325,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'19
NEW19	11,290,000.00	11,290,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'22
NEW20	14,150,000.00	14,150,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'26
NEW21	16,400,000.00	16,400,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'28
NEW22	26,415,000.00	26,415,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'29
NEW23	36,460,000.00	36,460,000.00	W. HARRIS CO. SRFC. WAT. SUP. SER'30
NEW51	1,222,000.00-	1,222,000.00-	SERIES 1990 RESERVE FUND
NEW52	3,302,000.00-	3,302,000.00-	SERIES 1993 RESERVE FUND
NEW53	5,204,400.00-	5,204,000.00-	SERIES 1995 RESERVE FUND
NEW54	777,600.00-	778,000.00-	SERIES 1998 RESERVE FUND
NEW55	2,660,400.00-	2,660,000.00-	SERIES 2000 RESERVE FUND
NEW58	237,600.00-	238,000.00-	SERIES 2001 RESERVE FUND
NEW59	1,267,600.00-	1,268,000.00-	SERIES 2004 RESERVE FUND
NEW60	2,310,000.00-	2,310,000.00-	SERIES 2005 RESERVE FUND
NEW61	1,596,000.00-	1,596,000.00-	SERIES 2006 RESERVE FUND
NEW62	7,985,600.00-	7,986,000.00-	SERIES 2009 RESERVE FUND
NEW63	8,535,200.00-	8,535,000.00-	SERIES 2010 RESERVE FUND
NEW64	1,636,400.00-	1,636,000.00-	SERIES 2011 RESERVE FUND
NEW65	1,501,600.00-	1,502,000.00-	SERIES 2012 RESERVE FUND
NEW66	1,884,000.00-	1,884,000.00-	SERIES 2013 RESERVE FUND
NEW67	2,052,800.00-	2,053,000.00-	SERIES 2015 RESERVE FUND

NEW68	1,050,000.00-	1,050,000.00-	SERIES 2019 RESERVE FUND
NEW69	1,047,200.00-	1,047,000.00-	SERIES 2022 RESERVE FUND
NEW70	1,311,600.00-	1,312,000.00-	SERIES 2026 RESERVE FUND
NEW71	1,519,200.00-	1,519,000.00-	SERIES 2028 RESERVE FUND
NEW72	2,445,600.00-	2,446,000.00-	SERIES 2029 RESERVE FUND
NEW73	3,375,200.00-	3,375,000.00-	SERIES 2030 RESERVE FUND
TOTAL	513,708,000.00	513,707,000.00	

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWATI 08/30/88
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SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	13,180,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS...........................	296,875.62
EARNINGS ON RESERVE FUNDS................................	195,520.00

TOTAL SOURCES..	13,672,395.62

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	11,986,000.00
RESERVE FUND..	1,222,000.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	461,300.00
ROUNDING AMOUNT...	3,095.62

TOTAL USES OF FUNDS...	13,672,395.62

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

D. DEBT SERVICE SCHEDULES

INDIVIDUAL BOND SALES

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER 90

DEAL NAME: WHCWAT1
DEALTYPE: NEW   ISSUE DATE: 01/01/90 DELIVERY DATE: 01/01/90   3:17 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/90			527,200.00	527,200.00	527,200.00
01/01/91	170,000	8.000	527,200.00	697,200.00	.00
07/01/91			520,400.00	520,400.00	1,217,600.00
01/01/92	185,000	8.000	520,400.00	705,400.00	.00
07/01/92			513,000.00	513,000.00	1,218,400.00
01/01/93	200,000	8.000	513,000.00	713,000.00	.00
07/01/93			505,000.00	505,000.00	1,218,000.00
01/01/94	220,000	8.000	505,000.00	725,000.00	.00
07/01/94			496,200.00	496,200.00	1,221,200.00
01/01/95	235,000	8.000	496,200.00	731,200.00	.00
07/01/95			486,800.00	486,800.00	1,218,000.00
01/01/96	255,000	8.000	486,800.00	741,800.00	.00
07/01/96			476,600.00	476,600.00	1,218,400.00
01/01/97	280,000	8.000	476,600.00	756,600.00	.00
07/01/97			465,400.00	465,400.00	1,222,000.00
01/01/98	300,000	8.000	465,400.00	765,400.00	.00
07/01/98			453,400.00	453,400.00	1,218,800.00
01/01/99	325,000	8.000	453,400.00	778,400.00	.00
07/01/99			440,400.00	440,400.00	1,218,800.00
01/01/00	355,000	8.000	440,400.00	795,400.00	.00
07/01/00			426,200.00	426,200.00	1,221,600.00
01/01/01	385,000	8.000	426,200.00	811,200.00	.00
07/01/01			410,800.00	410,800.00	1,222,000.00
01/01/02	415,000	8.000	410,800.00	825,800.00	.00
07/01/02			394,200.00	394,200.00	1,220,000.00
01/01/03	450,000	8.000	394,200.00	844,200.00	.00
07/01/03			376,200.00	376,200.00	1,220,400.00
01/01/04	485,000	8.000	376,200.00	861,200.00	.00
07/01/04			356,800.00	356,800.00	1,218,000.00
01/01/05	525,000	8.000	356,800.00	881,800.00	.00
07/01/05			335,800.00	335,800.00	1,217,600.00
01/01/06	570,000	8.000	335,800.00	905,800.00	.00
07/01/06			313,000.00	313,000.00	1,218,800.00
01/01/07	620,000	8.000	313,000.00	933,000.00	.00
07/01/07			288,200.00	288,200.00	1,221,200.00
01/01/08	670,000	8.000	288,200.00	958,200.00	.00
07/01/08			261,400.00	261,400.00	1,219,600.00
01/01/09	725,000	8.000	261,400.00	986,400.00	.00
07/01/09			232,400.00	232,400.00	1,218,800.00
01/01/10	785,000	8.000	232,400.00	1,017,400.00	.00
07/01/10			201,000.00	201,000.00	1,218,400.00
01/01/11	850,000	8.000	201,000.00	1,051,000.00	.00
07/01/11			167,000.00	167,000.00	1,218,000.00
01/01/12	920,000	8.000	167,000.00	1,087,000.00	.00
07/01/12			130,200.00	130,200.00	1,217,200.00
01/01/13	1,000,000	8.000	130,200.00	1,130,200.00	.00
07/01/13			90,200.00	90,200.00	1,220,400.00
01/01/14	1,080,000	8.000	90,200.00	1,170,200.00	.00
07/01/14			47,000.00	47,000.00	1,217,200.00
01/01/15	1,175,000	8.000	47,000.00	1,222,000.00	1,222,000.00

TOTALS	13,180,000		17,829,600.00	31,009,600.00	31,009,600.00
ACC INT			.00	.00	.00
NET			17,829,600.00	31,009,600.00	31,009,600.00

AVERAGE LIFE:	16.910
BOND YEARS:	222,870.000
DURATION (@ 10%"):	8.203
AVERAGE COUPON:	8.000

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EXPENSES 08/30/88

DEALNAME: WHCWAT1 3:18 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	----------	----------	--------10.0	131800
2)	LEGAL EXPENSE	V	----------	----------	--------10.0	131800
3)	ISSUANCE EXPENSE	V	----------	----------	--------15.0	197700
4)			----------	----------	----------	0
5)			----------	----------	----------	0
6)			----------	----------	----------	0
7)			----------	----------	----------	0
8)			----------	----------	----------	0
9)			----------	----------	----------	0
10)			----------	----------	----------	0
11)			----------	----------	----------	0
12)			----------	----------	----------	0
13)			----------	----------	----------	0
	TOTALS		0	0	461300	461300

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT1

08/30/88
3:19 PM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS: CONSTRUCTION @ 7.000%	FUND EARNINGS: RESERVE @ 8.000%	FUND EARNINGS: CAP. INT. @ .000%	FUND EARNINGS: ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/90	8,778,000-	0	0	0	0	2,715,604	0
07/01/90	0	95,046	48,880	0	0	2,859,531	0
01/01/91	1,604,000-	100,084	48,880	0	0	1,404,494	0
07/01/91	0	49,157	48,880	0	0	1,502,531	0
01/01/92	1,604,000-	52,589	48,880	0	0	0	0
TOTALS	11,986,000-	296,876	195,520	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 11,493,604.38

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 1990 RESERVE FUND

DEALNAME: WHCWAT1 08/30/93
DEALTYPE: RES01 ISSUE DATE: 01/01/90 DELIVERY DATE: 01/01/90 3:20 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/90			48,880.00	48,880.00	48,880.00
01/01/91			48,880.00	48,880.00	.00
07/01/91			48,880.00	48,880.00	97,760.00
01/01/92			48,880.00	48,880.00	.00
07/01/92			48,880.00	48,880.00	97,760.00
01/01/93			48,880.00	48,880.00	.00
07/01/93			48,880.00	48,880.00	97,760.00
01/01/94			48,880.00	48,880.00	.00
07/01/94			48,880.00	48,880.00	97,760.00
01/01/95			48,880.00	48,880.00	.00
07/01/95			48,880.00	48,880.00	97,760.00
01/01/96			48,880.00	48,880.00	.00
07/01/96			48,880.00	48,880.00	97,760.00
01/01/97			48,880.00	48,880.00	.00
07/01/97			48,880.00	48,880.00	97,760.00
01/01/98			48,880.00	48,880.00	.00
07/01/98			48,880.00	48,880.00	97,760.00
01/01/99			48,880.00	48,880.00	.00
07/01/99			48,880.00	48,880.00	97,760.00
01/01/00			48,880.00	48,880.00	.00
07/01/00			48,880.00	48,880.00	97,760.00
01/01/01			48,880.00	48,880.00	.00
07/01/01			48,880.00	48,880.00	97,760.00
01/01/02			48,880.00	48,880.00	.00
07/01/02			48,880.00	48,880.00	97,760.00
01/01/03			48,880.00	48,880.00	.00
07/01/03			48,880.00	48,880.00	97,760.00
01/01/04			48,880.00	48,880.00	.00
07/01/04			48,880.00	48,880.00	97,760.00
01/01/05			48,880.00	48,880.00	.00
07/01/05			48,880.00	48,880.00	97,760.00
01/01/06			48,880.00	48,880.00	.00
07/01/06			48,880.00	48,880.00	97,760.00
01/01/07			48,880.00	48,880.00	.00
07/01/07			48,880.00	48,880.00	97,760.00
01/01/08			48,880.00	48,880.00	.00
07/01/08			48,880.00	48,880.00	97,760.00
01/01/09			48,880.00	48,880.00	.00
07/01/09			48,880.00	48,880.00	97,760.00
01/01/10			48,880.00	48,880.00	.00
07/01/10			48,880.00	48,880.00	97,760.00
01/01/11			48,880.00	48,880.00	.00
07/01/11			48,880.00	48,880.00	97,760.00
01/01/12			48,880.00	48,880.00	.00
07/01/12			48,880.00	48,880.00	97,760.00
01/01/13			48,880.00	48,880.00	.00
07/01/13			48,880.00	48,880.00	97,760.00
01/01/14			48,880.00	48,880.00	.00
07/01/14			48,880.00	48,880.00	97,760.00
01/01/15	1,222,000	8.000	48,880.00	1,270,880.00	1,270,880.00

TOTALS	1,222,000	2,444,000.00	3,666,000.00	3,666,000.00
ACC INT		.00	.00	.00
NET		2,444,000.00	3,666,000.00	3,666,000.00

AVERAGE LIFE:	25.000
BOND YEARS:	30,550.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT2

08/30/88
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SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	35,670,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS..........................	1,298,718.48
EARNINGS ON RESERVE FUNDS...............................	264,160.00

TOTAL SOURCES..	37,232,878.48

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	32,680,000.00
RESERVE FUND...	3,302,000.00
EXPENSES:	
OTHER ISSUANCE EXPENSES.................................	1,248,450.00
ROUNDING AMOUNT..	2,428.48

TOTAL USES OF FUNDS..	37,232,878.48

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER 93

DEALNAME: WHCWAT2 08/30/93
DEALTYPE: NEW ISSUE DATE: 01/01/93 DELIVERY DATE: 01/01/93 3:29 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/93			1,426,800.00	1,426,800.00	1,426,800.00
01/01/94	465,000	8.000	1,426,800.00	1,891,800.00	.00
07/01/94			1,408,200.00	1,408,200.00	3,300,000.00
01/01/95	505,000	8.000	1,408,200.00	1,913,200.00	.00
07/01/95			1,388,000.00	1,388,000.00	3,301,200.00
01/01/96	545,000	8.000	1,388,000.00	1,933,000.00	.00
07/01/96			1,366,200.00	1,366,200.00	3,299,200.00
01/01/97	590,000	8.000	1,366,200.00	1,956,200.00	.00
07/01/97			1,342,600.00	1,342,600.00	3,298,800.00
01/01/98	640,000	8.000	1,342,600.00	1,982,600.00	.00
07/01/98			1,317,000.00	1,317,000.00	3,299,600.00
01/01/99	695,000	8.000	1,317,000.00	2,012,000.00	.00
07/01/99			1,289,200.00	1,289,200.00	3,301,200.00
01/01/00	750,000	8.000	1,289,200.00	2,039,200.00	.00
07/01/00			1,259,200.00	1,259,200.00	3,298,400.00
01/01/01	815,000	8.000	1,259,200.00	2,074,200.00	.00
07/01/01			1,226,600.00	1,226,600.00	3,300,800.00
01/01/02	880,000	8.000	1,226,600.00	2,106,600.00	.00
07/01/02			1,191,400.00	1,191,400.00	3,298,000.00
01/01/03	955,000	8.000	1,191,400.00	2,146,400.00	.00
07/01/03			1,153,200.00	1,153,200.00	3,299,600.00
01/01/04	1,035,000	8.000	1,153,200.00	2,188,200.00	.00
07/01/04			1,111,800.00	1,111,800.00	3,300,000.00
01/01/05	1,120,000	8.000	1,111,800.00	2,231,800.00	.00
07/01/05			1,067,000.00	1,067,000.00	3,298,800.00
01/01/06	1,215,000	8.000	1,067,000.00	2,282,000.00	.00
07/01/06			1,018,400.00	1,018,400.00	3,300,400.00
01/01/07	1,315,000	8.000	1,018,400.00	2,333,400.00	.00
07/01/07			965,800.00	965,800.00	3,299,200.00
01/01/08	1,425,000	8.000	965,800.00	2,390,800.00	.00
07/01/08			908,800.00	908,800.00	3,299,600.00
01/01/09	1,545,000	8.000	908,800.00	2,453,800.00	.00
07/01/09			847,000.00	847,000.00	3,300,800.00
01/01/10	1,670,000	8.000	847,000.00	2,517,000.00	.00
07/01/10			780,200.00	780,200.00	3,297,200.00
01/01/11	1,810,000	8.000	780,200.00	2,590,200.00	.00
07/01/11			707,800.00	707,800.00	3,298,000.00
01/01/12	1,960,000	8.000	707,800.00	2,667,800.00	.00
07/01/12			629,400.00	629,400.00	3,297,200.00
01/01/13	2,125,000	8.000	629,400.00	2,754,400.00	.00
07/01/13			544,400.00	544,400.00	3,298,800.00
01/01/14	2,305,000	8.000	544,400.00	2,849,400.00	.00
07/01/14			452,200.00	452,200.00	3,301,600.00
01/01/15	2,495,000	8.000	452,200.00	2,947,200.00	.00
07/01/15			352,400.00	352,400.00	3,299,600.00
01/01/16	2,705,000	8.000	352,400.00	3,057,400.00	.00
07/01/16			244,200.00	244,200.00	3,301,600.00
01/01/17	2,930,000	8.000	244,200.00	3,174,200.00	.00
07/01/17			127,000.00	127,000.00	3,301,200.00
01/01/18	3,175,000	8.000	127,000.00	3,302,000.00	3,302,000.00

TOTALS	35,670,000		48,249,600.00	83,919,600.00	83,919,600.00
ACC INT			.00	.00	.00
NET			48,249,600.00	83,919,600.00	83,919,600.00

AVERAGE LIFE:	16.908
BOND YEARS:	603,120.000
DURATION (@ 10%"):	8.201
AVERAGE COUPON:	8.000

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E X P E N S E S

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DEALNAME: WHCWAI2

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	----------	----------	--------10.0	356700
2)	LEGAL EXPENSE	V	----------	----------	--------10.0	356700
3)	ISSUANCE EXPENSE	V	----------	----------	--------15.0	535050
4)			----------	----------	----------	0
5)			----------	----------	----------	0
6)			----------	----------	----------	0
7)			----------	----------	----------	0
8)			----------	----------	----------	0
9)			----------	----------	----------	0
10)			----------	----------	----------	0
11)			----------	----------	----------	0
12)			----------	----------	----------	0
13)			----------	----------	----------	0
	TOTALS		0	0	1248450	1248450

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT2

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DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS: CONSTRUCTION @ 7.000%	FUND EARNINGS: RESERVE @ 8.000%	FUND EARNINGS: CAP. INT. @ .000%	FUND EARNINGS: ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/93	12,948,000-	0	0	0	0	18,169,122	0
07/01/93	0	635,919	132,080	0	0	18,937,121	0
01/01/94	19,732,000-	662,799	132,080	0	0	0	0
TOTALS	32,680,000-	1,298,718	264,160	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 31,117,121.52

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 1990 RESERVE FUND

DEALNAME: WHCWAT2 08/30/88
DEALTYPE: RES01 ISSUE DATE: 01/01/93 DELIVERY DATE: 01/01/93 3:30 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/93			132,080.00	132,080.00	132,080.00
01/01/94			132,080.00	132,080.00	.00
07/01/94			132,080.00	132,080.00	264,160.00
01/01/95			132,080.00	132,080.00	.00
07/01/95			132,080.00	132,080.00	264,160.00
01/01/96			132,080.00	132,080.00	.00
07/01/96			132,080.00	132,080.00	264,160.00
01/01/97			132,080.00	132,080.00	.00
07/01/97			132,080.00	132,080.00	264,160.00
01/01/98			132,080.00	132,080.00	.00
07/01/98			132,080.00	132,080.00	264,160.00
01/01/99			132,080.00	132,080.00	.00
07/01/99			132,080.00	132,080.00	264,160.00
01/01/00			132,080.00	132,080.00	.00
07/01/00			132,080.00	132,080.00	264,160.00
01/01/01			132,080.00	132,080.00	.00
07/01/01			132,080.00	132,080.00	264,160.00
01/01/02			132,080.00	132,080.00	.00
07/01/02			132,080.00	132,080.00	264,160.00
01/01/03			132,080.00	132,080.00	.00
07/01/03			132,080.00	132,080.00	264,160.00
01/01/04			132,080.00	132,080.00	.00
07/01/04			132,080.00	132,080.00	264,160.00
01/01/05			132,080.00	132,080.00	.00
07/01/05			132,080.00	132,080.00	264,160.00
01/01/06			132,080.00	132,080.00	.00
07/01/06			132,080.00	132,080.00	264,160.00
01/01/07			132,080.00	132,080.00	.00
07/01/07			132,080.00	132,080.00	264,160.00
01/01/08			132,080.00	132,080.00	.00
07/01/08			132,080.00	132,080.00	264,160.00
01/01/09			132,080.00	132,080.00	.00
07/01/09			132,080.00	132,080.00	264,160.00
01/01/10			132,080.00	132,080.00	.00
07/01/10			132,080.00	132,080.00	264,160.00
01/01/11			132,080.00	132,080.00	.00
07/01/11			132,080.00	132,080.00	264,160.00
01/01/12			132,080.00	132,080.00	.00
07/01/12			132,080.00	132,080.00	264,160.00
01/01/13			132,080.00	132,080.00	.00
07/01/13			132,080.00	132,080.00	264,160.00
01/01/14			132,080.00	132,080.00	.00
07/01/14			132,080.00	132,080.00	264,160.00
01/01/15			132,080.00	132,080.00	.00
07/01/15			132,080.00	132,080.00	264,160.00
01/01/16			132,080.00	132,080.00	.00
07/01/16			132,080.00	132,080.00	264,160.00
01/01/17			132,080.00	132,080.00	.00
07/01/17			132,080.00	132,080.00	264,160.00
01/01/18	3,302,000	8.000	132,080.00	3,434,080.00	3,434,080.00

TOTALS	3,302,000		6,604,000.00	9,906,000.00	9,906,000.00
ACC INT			.00	.00	.00
NET			6,604,000.00	9,906,000.00	9,906,000.00

AVERAGE LIFE:	25.000
BOND YEARS:	82,550.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT3

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SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	56,235,000.00
TOTAL SOURCES..	56,235,000.00

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	49,058,000.00
RESERVE FUND...	5,204,400.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	1,968,225.00
ROUNDING AMOUNT..	4,375.00
TOTAL USES OF FUNDS......................................	56,235,000.00

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER 90

DEALNAME: WHCWAT3 08/30/88
DEALTYPE: NEW ISSUE DATE: 01/01/95 DELIVERY DATE: 01/01/95 3:48 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/95			2,249,400.00	2,249,400.00	2,249,400.00
01/01/96	735,000	8.000	2,249,400.00	2,984,400.00	.00
07/01/96			2,220,000.00	2,220,000.00	5,204,400.00
01/01/97	795,000	8.000	2,220,000.00	3,015,000.00	.00
07/01/97			2,188,200.00	2,188,200.00	5,203,200.00
01/01/98	860,000	8.000	2,188,200.00	3,048,200.00	.00
07/01/98			2,153,800.00	2,153,800.00	5,202,000.00
01/01/99	930,000	8.000	2,153,800.00	3,083,800.00	.00
07/01/99			2,116,600.00	2,116,600.00	5,200,400.00
01/01/00	1,010,000	8.000	2,116,600.00	3,126,600.00	.00
07/01/00			2,076,200.00	2,076,200.00	5,202,800.00
01/01/01	1,095,000	8.000	2,076,200.00	3,171,200.00	.00
07/01/01			2,032,400.00	2,032,400.00	5,203,600.00
01/01/02	1,185,000	8.000	2,032,400.00	3,217,400.00	.00
07/01/02			1,985,000.00	1,985,000.00	5,202,400.00
01/01/03	1,285,000	8.000	1,985,000.00	3,270,000.00	.00
07/01/03			1,933,600.00	1,933,600.00	5,203,600.00
01/01/04	1,390,000	8.000	1,933,600.00	3,323,600.00	.00
07/01/04			1,878,000.00	1,878,000.00	5,201,600.00
01/01/05	1,505,000	8.000	1,878,000.00	3,383,000.00	.00
07/01/05			1,817,800.00	1,817,800.00	5,200,800.00
01/01/06	1,630,000	8.000	1,817,800.00	3,447,800.00	.00
07/01/06			1,752,600.00	1,752,600.00	5,200,400.00
01/01/07	1,765,000	8.000	1,752,600.00	3,517,600.00	.00
07/01/07			1,682,000.00	1,682,000.00	5,199,600.00
01/01/08	1,915,000	8.000	1,682,000.00	3,597,000.00	.00
07/01/08			1,605,400.00	1,605,400.00	5,202,400.00
01/01/09	2,075,000	8.000	1,605,400.00	3,680,400.00	.00
07/01/09			1,522,400.00	1,522,400.00	5,202,800.00
01/01/10	2,245,000	8.000	1,522,400.00	3,767,400.00	.00
07/01/10			1,432,600.00	1,432,600.00	5,200,000.00
01/01/11	2,435,000	8.000	1,432,600.00	3,867,600.00	.00
07/01/11			1,335,200.00	1,335,200.00	5,202,800.00
01/01/12	2,635,000	8.000	1,335,200.00	3,970,200.00	.00
07/01/12			1,229,800.00	1,229,800.00	5,200,000.00
01/01/13	2,855,000	8.000	1,229,800.00	4,084,800.00	.00
07/01/13			1,115,600.00	1,115,600.00	5,200,400.00
01/01/14	3,095,000	8.000	1,115,600.00	4,210,600.00	.00
07/01/14			991,800.00	991,800.00	5,202,400.00
01/01/15	3,355,000	8.000	991,800.00	4,346,800.00	.00
07/01/15			857,600.00	857,600.00	5,204,400.00
01/01/16	3,630,000	8.000	857,600.00	4,487,600.00	.00
07/01/16			712,400.00	712,400.00	5,200,000.00
01/01/17	3,935,000	8.000	712,400.00	4,647,400.00	.00
07/01/17			555,000.00	555,000.00	5,202,400.00
01/01/18	4,260,000	8.000	555,000.00	4,815,000.00	.00
07/01/18			384,600.00	384,600.00	5,199,600.00
01/01/19	4,615,000	8.000	384,600.00	4,999,600.00	.00
07/01/19			200,000.00	200,000.00	5,199,600.00
01/01/20	5,000,000	8.000	200,000.00	5,200,000.00	5,200,000.00

TOTALS	56,235,000	76,056,000.00	132,291,000.00	132,291,000.00
ACC INT		.00	.00	.00
NET		76,056,000.00	132,291,000.00	132,291,000.00

AVERAGE LIFE:	16.906
BOND YEARS:	950,700.000
DURATION (@ 10%"):	8.201
AVERAGE COUPON:	8.000

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EXPENSES

DEALNAME: WHCWAT3

08/30/88
3:48 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	___________	___________	________10.0	562350
2)	LEGAL EXPENSE	V	___________	___________	________10.0	562350
3)	ISSUANCE EXPENSE	V	___________	___________	________15.0	843525
4)			___________	___________	___________	0
5)			___________	___________	___________	0
6)			___________	___________	___________	0
7)			___________	___________	___________	0
8)			___________	___________	___________	0
9)			___________	___________	___________	0
10)			___________	___________	___________	0
11)			___________	___________	___________	0
12)			___________	___________	___________	0
13)			___________	___________	___________	0
	TOTALS		0	0	1968225	1968225

V-EXP BASED ON ISSUE SIZE
D-INS EXP BASED ON TOTAL D/S
F-EXP IS A FIXED AMOUNT
C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT3 08/30/93
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		FUND EARNINGS					
DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/95	49,058,000-	0	0	0	0	0	0
TOTALS	49,058,000-	0	0	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 49,058,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 1990 RESERVE FUND

DEALNAME: WHCWAT3 03/30/88
DEALTYPE: RES01 ISSUE DATE: 01/01/95 DELIVERY DATE: 01/01/95 3:49 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/95			208,176.00	208,176.00	208,176.00
01/01/96			208,176.00	208,176.00	.00
07/01/96			208,176.00	208,176.00	416,352.00
01/01/97			208,176.00	208,176.00	.00
07/01/97			208,176.00	208,176.00	416,352.00
01/01/98			208,176.00	208,176.00	.00
07/01/98			208,176.00	208,176.00	416,352.00
01/01/99			208,176.00	208,176.00	.00
07/01/99			208,176.00	208,176.00	416,352.00
01/01/00			208,176.00	208,176.00	.00
07/01/00			208,176.00	208,176.00	416,352.00
01/01/01			208,176.00	208,176.00	.00
07/01/01			208,176.00	208,176.00	416,352.00
01/01/02			208,176.00	208,176.00	.00
07/01/02			208,176.00	208,176.00	416,352.00
01/01/03			208,176.00	208,176.00	.00
07/01/03			208,176.00	208,176.00	416,352.00
01/01/04			208,176.00	208,176.00	.00
07/01/04			208,176.00	208,176.00	416,352.00
01/01/05			208,176.00	208,176.00	.00
07/01/05			208,176.00	208,176.00	416,352.00
01/01/06			208,176.00	208,176.00	.00
07/01/06			208,176.00	208,176.00	416,352.00
01/01/07			208,176.00	208,176.00	.00
07/01/07			208,176.00	208,176.00	416,352.00
01/01/08			208,176.00	208,176.00	.00
07/01/08			208,176.00	208,176.00	416,352.00
01/01/09			208,176.00	208,176.00	.00
07/01/09			208,176.00	208,176.00	416,352.00
01/01/10			208,176.00	208,176.00	.00
07/01/10			208,176.00	208,176.00	416,352.00
01/01/11			208,176.00	208,176.00	.00
07/01/11			208,176.00	208,176.00	416,352.00
01/01/12			208,176.00	208,176.00	.00
07/01/12			208,176.00	208,176.00	416,352.00
01/01/13			208,176.00	208,176.00	.00
07/01/13			208,176.00	208,176.00	416,352.00
01/01/14			208,176.00	208,176.00	.00
07/01/14			208,176.00	208,176.00	416,352.00
01/01/15			208,176.00	208,176.00	.00
07/01/15			208,176.00	208,176.00	416,352.00
01/01/16			208,176.00	208,176.00	.00
07/01/16			208,176.00	208,176.00	416,352.00
01/01/17			208,176.00	208,176.00	.00
07/01/17			208,176.00	208,176.00	416,352.00
01/01/18			208,176.00	208,176.00	.00
07/01/18			208,176.00	208,176.00	416,352.00
01/01/19			208,176.00	208,176.00	.00
07/01/19			208,176.00	208,176.00	416,352.00
01/01/20	5,204,400	8.000	208,176.00	5,412,576.00	5,412,576.00

TOTALS	5,204,400		10,408,800.00	15,613,200.00	15,613,200.00
ACC INT			.00	.00	.00
NET			10,408,800.00	15,613,200.00	15,613,200.00

AVERAGE LIFE:	25.000
BOND YEARS:	130,110.000
DURATION (@ 10%*):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT4 09/19/88
8:42 AM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	8,390,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS............................	475,303.85
EARNINGS ON RESERVE FUNDS.................................	62,208.00

TOTAL SOURCES...	8,927,511.85

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	7,852,000.00
RESERVE FUND..	777,600.00
EXPENSES:	
OTHER ISSUANCE EXPENSES...................................	293,650.00
ROUNDING AMOUNT...	4,261.85

TOTAL USES OF FUNDS.......................................	8,927,511.85

NOTES:

EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %

EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER 98

DEALNAME: WHCWAT4 09/19/88
DEALTYPE: NEW ISSUE DATE: 01/01/98 DELIVERY DATE: 01/01/98 8:43 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/98			335,600.00	335,600.00	335,600.00
01/01/99	110,000	8.000	335,600.00	445,600.00	.00
07/01/99			331,200.00	331,200.00	776,800.00
01/01/00	120,000	8.000	331,200.00	451,200.00	.00
07/01/00			326,400.00	326,400.00	777,600.00
01/01/01	130,000	8.000	326,400.00	456,400.00	.00
07/01/01			321,200.00	321,200.00	777,600.00
01/01/02	140,000	8.000	321,200.00	461,200.00	.00
07/01/02			315,600.00	315,600.00	776,800.00
01/01/03	150,000	8.000	315,600.00	465,600.00	.00
07/01/03			309,600.00	309,600.00	775,200.00
01/01/04	165,000	8.000	309,600.00	474,600.00	.00
07/01/04			303,000.00	303,000.00	777,600.00
01/01/05	175,000	8.000	303,000.00	478,000.00	.00
07/01/05			296,000.00	296,000.00	774,000.00
01/01/06	190,000	8.000	296,000.00	486,000.00	.00
07/01/06			288,400.00	288,400.00	774,400.00
01/01/07	205,000	8.000	288,400.00	493,400.00	.00
07/01/07			280,200.00	280,200.00	773,600.00
01/01/08	225,000	8.000	280,200.00	505,200.00	.00
07/01/08			271,200.00	271,200.00	776,400.00
01/01/09	245,000	8.000	271,200.00	516,200.00	.00
07/01/09			261,400.00	261,400.00	777,600.00
01/01/10	265,000	8.000	261,400.00	526,400.00	.00
07/01/10			250,800.00	250,800.00	777,200.00
01/01/11	285,000	8.000	250,800.00	535,800.00	.00
07/01/11			239,400.00	239,400.00	775,200.00
01/01/12	310,000	8.000	239,400.00	549,400.00	.00
07/01/12			227,000.00	227,000.00	776,400.00
01/01/13	335,000	8.000	227,000.00	562,000.00	.00
07/01/13			213,600.00	213,600.00	775,600.00
01/01/14	365,000	8.000	213,600.00	578,600.00	.00
07/01/14			199,000.00	199,000.00	777,600.00
01/01/15	395,000	8.000	199,000.00	594,000.00	.00
07/01/15			183,200.00	183,200.00	777,200.00
01/01/16	425,000	8.000	183,200.00	608,200.00	.00
07/01/16			166,200.00	166,200.00	774,400.00
01/01/17	460,000	8.000	166,200.00	626,200.00	.00
07/01/17			147,800.00	147,800.00	774,000.00
01/01/18	500,000	8.000	147,800.00	647,800.00	.00
07/01/18			127,800.00	127,800.00	775,600.00
01/01/19	540,000	8.000	127,800.00	667,800.00	.00
07/01/19			106,200.00	106,200.00	774,000.00
01/01/20	585,000	8.000	106,200.00	691,200.00	.00
07/01/20			82,800.00	82,800.00	774,000.00
01/01/21	635,000	8.000	82,800.00	717,800.00	.00
07/01/21			57,400.00	57,400.00	775,200.00
01/01/22	690,000	8.000	57,400.00	747,400.00	.00
07/01/22			29,800.00	29,800.00	777,200.00
01/01/23	745,000	8.000	29,800.00	774,800.00	774,800.00

TOTALS	8,390,000	11,341,600.00	19,731,600.00	19,731,600.00
ACC INT		.00	.00	.00
NET		11,341,600.00	19,731,600.00	19,731,600.00

AVERAGE LIFE:	16.897
BOND YEARS:	141,770.000
DURATION (@ 10%"):	8.197
AVERAGE COUPON:	8.000

09/19/88 8:45 AM

E X P E N S E S

DEALNAME: WHCWAT4

09/19/88
8:45 AM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	----------	----------	--------10.0	83900
2)	LEGAL EXPENSE	V	----------	----------	--------10.0	83900
3)	ISSUANCE EXPENSE	V	----------	----------	--------15.0	125850
4)			----------	----------	----------	0
5)			----------	----------	----------	0
6)			----------	----------	----------	0
7)			----------	----------	----------	0
8)			----------	----------	----------	0
9)			----------	----------	----------	0
10)			----------	----------	----------	0
11)			----------	----------	----------	0
12)			----------	----------	----------	0
13)			----------	----------	----------	0
	TOTALS		0	0	293650	293650

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT4

09/19/88
8:45 AM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS: CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/98	656,500-	0	0	0	0	6,657,988	0
07/01/98	0	233,030	31,104	0	0	6,922,122	0
01/01/99	7,195,500-	242,274	31,104	0	0	0	0
TOTALS	7,852,000-	475,304	62,208	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 7,314,488.15

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 1998 RESERVE FUND

DEAL NAME: WHCWAT4 09/19/83
DEALTYPE: RES01 ISSUE DATE: 01/01/98 DELIVERY DATE: 01/01/98 8:48 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/98			31,104.00	31,104.00	31,104.00
01/01/99			31,104.00	31,104.00	.00
07/01/99			31,104.00	31,104.00	62,208.00
01/01/00			31,104.00	31,104.00	.00
07/01/00			31,104.00	31,104.00	62,209.00
01/01/01			31,104.00	31,104.00	.00
07/01/01			31,104.00	31,104.00	62,208.00
01/01/02			31,104.00	31,104.00	.00
07/01/02			31,104.00	31,104.00	62,208.00
01/01/03			31,104.00	31,104.00	.00
07/01/03			31,104.00	31,104.00	62,208.00
01/01/04			31,104.00	31,104.00	.00
07/01/04			31,104.00	31,104.00	62,208.00
01/01/05			31,104.00	31,104.00	.00
07/01/05			31,104.00	31,104.00	62,208.00
01/01/06			31,104.00	31,104.00	.00
07/01/06			31,104.00	31,104.00	62,208.00
01/01/07			31,104.00	31,104.00	.00
07/01/07			31,104.00	31,104.00	62,208.00
01/01/08			31,104.00	31,104.00	.00
07/01/08			31,104.00	31,104.00	62,208.00
01/01/09			31,104.00	31,104.00	.00
07/01/09			31,104.00	31,104.00	62,208.00
01/01/10			31,104.00	31,104.00	.00
07/01/10			31,104.00	31,104.00	62,208.00
01/01/11			31,104.00	31,104.00	.00
07/01/11			31,104.00	31,104.00	62,208.00
01/01/12			31,104.00	31,104.00	.00
07/01/12			31,104.00	31,104.00	62,208.00
01/01/13			31,104.00	31,104.00	.00
07/01/13			31,104.00	31,104.00	62,208.00
01/01/14			31,104.00	31,104.00	.00
07/01/14			31,104.00	31,104.00	62,208.00
01/01/15			31,104.00	31,104.00	.00
07/01/15			31,104.00	31,104.00	62,208.00
01/01/16			31,104.00	31,104.00	.00
07/01/16			31,104.00	31,104.00	62,208.00
01/01/17			31,104.00	31,104.00	.00
07/01/17			31,104.00	31,104.00	62,208.00
01/01/18			31,104.00	31,104.00	.00
07/01/18			31,104.00	31,104.00	62,208.00
01/01/19			31,104.00	31,104.00	.00
07/01/19			31,104.00	31,104.00	62,208.00
01/01/20			31,104.00	31,104.00	.00
07/01/20			31,104.00	31,104.00	62,208.00
01/01/21			31,104.00	31,104.00	.00
07/01/21			31,104.00	31,104.00	62,208.00
01/01/22			31,104.00	31,104.00	.00
07/01/22			31,104.00	31,104.00	62,208.00
01/01/23	777,600	8.000	31,104.00	808,704.00	808,704.00

TOTALS	777,600		1,555,200.00	2,332,800.00	2,332,800.00
ACC INT			.00	.00	.00
NET			1,555,200.00	2,332,800.00	2,332,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	19,440.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEAL NAME: WHCWAT5 09/19/88
9:34 AM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	28,735,000.00
TOTAL SOURCES..	28,735,000.00

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	25,066,000.00
RESERVE FUND...	2,660,400.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	1,005,725.00
ROUNDING AMOUNT..	2,875.00
TOTAL USES OF FUNDS..	28,735,000.00

NOTES:

EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %

EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'OO

DEALNAME: WHCWATS 09/19/88
DEALTYPE: NEW ISSUE DATE: 01/01/00 DELIVERY DATE: 01/01/00 9:34 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/00			1,149,400.00	1,149,400.00	1,149,400.00
01/01/01	375,000	8.000	1,149,400.00	1,524,400.00	.00
07/01/01			1,134,400.00	1,134,400.00	2,658,800.00
01/01/02	405,000	8.000	1,134,400.00	1,539,400.00	.00
07/01/02			1,118,200.00	1,118,200.00	2,657,600.00
01/01/03	435,000	8.000	1,118,200.00	1,553,200.00	.00
07/01/03			1,100,800.00	1,100,800.00	2,654,000.00
01/01/04	475,000	8.000	1,100,800.00	1,575,800.00	.00
07/01/04			1,081,800.00	1,081,800.00	2,657,600.00
01/01/05	515,000	8.000	1,081,800.00	1,596,800.00	.00
07/01/05			1,061,200.00	1,061,200.00	2,658,000.00
01/01/06	560,000	8.000	1,061,200.00	1,621,200.00	.00
07/01/06			1,038,800.00	1,038,800.00	2,660,000.00
01/01/07	605,000	8.000	1,038,800.00	1,643,800.00	.00
07/01/07			1,014,600.00	1,014,600.00	2,658,400.00
01/01/08	655,000	8.000	1,014,600.00	1,669,600.00	.00
07/01/08			988,400.00	988,400.00	2,658,000.00
01/01/09	710,000	8.000	988,400.00	1,698,400.00	.00
07/01/09			960,000.00	960,000.00	2,658,400.00
01/01/10	770,000	8.000	960,000.00	1,730,000.00	.00
07/01/10			929,200.00	929,200.00	2,659,200.00
01/01/11	835,000	8.000	929,200.00	1,764,200.00	.00
07/01/11			895,800.00	895,800.00	2,660,000.00
01/01/12	900,000	8.000	895,800.00	1,795,800.00	.00
07/01/12			859,800.00	859,800.00	2,655,600.00
01/01/13	980,000	8.000	859,800.00	1,839,800.00	.00
07/01/13			820,600.00	820,600.00	2,660,400.00
01/01/14	1,060,000	8.000	820,600.00	1,880,600.00	.00
07/01/14			778,200.00	778,200.00	2,658,800.00
01/01/15	1,150,000	8.000	778,200.00	1,928,200.00	.00
07/01/15			732,200.00	732,200.00	2,660,400.00
01/01/16	1,245,000	8.000	732,200.00	1,977,200.00	.00
07/01/16			682,400.00	682,400.00	2,659,600.00
01/01/17	1,345,000	8.000	682,400.00	2,027,400.00	.00
07/01/17			628,600.00	628,600.00	2,656,000.00
01/01/18	1,460,000	8.000	628,600.00	2,088,600.00	.00
07/01/18			570,200.00	570,200.00	2,658,800.00
01/01/19	1,580,000	8.000	570,200.00	2,150,200.00	.00
07/01/19			507,000.00	507,000.00	2,657,200.00
01/01/20	1,715,000	8.000	507,000.00	2,222,000.00	.00
07/01/20			438,400.00	438,400.00	2,660,400.00
01/01/21	1,855,000	8.000	438,400.00	2,293,400.00	.00
07/01/21			364,200.00	364,200.00	2,657,600.00
01/01/22	2,010,000	8.000	364,200.00	2,374,200.00	.00
07/01/22			283,800.00	283,800.00	2,658,000.00
01/01/23	2,180,000	8.000	283,800.00	2,463,800.00	.00
07/01/23			196,600.00	196,600.00	2,660,400.00
01/01/24	2,360,000	8.000	196,600.00	2,556,600.00	.00
07/01/24			102,200.00	102,200.00	2,658,800.00
01/01/25	2,555,000	8.000	102,200.00	2,657,200.00	2,657,200.00

TOTALS	28,735,000		38,873,600.00	67,608,600.00	67,608,600.00
ACC INT			.00	.00	.00
NET			38,873,600.00	67,608,600.00	67,608,600.00

AVERAGE LIFE:	16.910
BOND YEARS:	485,920.000
DURATION (@ 10%"):	8.202
AVERAGE COUPON:	8.000

09/19/88 9:35 AM

DEALNAME: WHCWATS

E X P E N S E S

09/19/88
9:35 AM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	287350
2)	LEGAL EXPENSE	V			10.0	287350
3)	ISSUANCE EXPENSE	V			15.0	431025
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	1005725	1005725

V-EXP BASED ON ISSUE SIZE — F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S — C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT5

09/19/88
9:35 AM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS: CONSTRUCTION @ 7.000%	FUND EARNINGS: RESERVE @ 8.000%	FUND EARNINGS: CAP. INT. @ .000%	FUND EARNINGS: ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/00	25,066,000-	0	0	0	0	0	0
TOTALS	25,066,000-	0	0	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 25,066,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2000 RESERVE FUND

DEALNAME: WHCWAT5 09/19/83
DEALTYPE: RES01 ISSUE DATE: 01/01/00 DELIVERY DATE: 01/01/00 9:36 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/00			106,416.00	106,416.00	106,416.00
01/01/01			106,416.00	106,416.00	.00
07/01/01			106,416.00	106,416.00	212,832.00
01/01/02			106,416.00	106,416.00	.00
07/01/02			106,416.00	106,416.00	212,832.00
01/01/03			106,416.00	106,416.00	.00
07/01/03			106,416.00	106,416.00	212,832.00
01/01/04			106,416.00	106,416.00	.00
07/01/04			106,416.00	106,416.00	212,832.00
01/01/05			106,416.00	106,416.00	.00
07/01/05			106,416.00	106,416.00	212,832.00
01/01/06			106,416.00	106,416.00	.00
07/01/06			106,416.00	106,416.00	212,832.00
01/01/07			106,416.00	106,416.00	.00
07/01/07			106,416.00	106,416.00	212,832.00
01/01/08			106,416.00	106,416.00	.00
07/01/08			106,416.00	106,416.00	212,832.00
01/01/09			106,416.00	106,416.00	.00
07/01/09			106,416.00	106,416.00	212,832.00
01/01/10			106,416.00	106,416.00	.00
07/01/10			106,416.00	106,416.00	212,832.00
01/01/11			106,416.00	106,416.00	.00
07/01/11			106,416.00	106,416.00	212,832.00
01/01/12			106,416.00	106,416.00	.00
07/01/12			106,416.00	106,416.00	212,832.00
01/01/13			106,416.00	106,416.00	.00
07/01/13			106,416.00	106,416.00	212,832.00
01/01/14			106,416.00	106,416.00	.00
07/01/14			106,416.00	106,416.00	212,832.00
01/01/15			106,416.00	106,416.00	.00
07/01/15			106,416.00	106,416.00	212,832.00
01/01/16			106,416.00	106,416.00	.00
07/01/16			106,416.00	106,416.00	212,832.00
01/01/17			106,416.00	106,416.00	.00
07/01/17			106,416.00	106,416.00	212,832.00
01/01/18			106,416.00	106,416.00	.00
07/01/18			106,416.00	106,416.00	212,832.00
01/01/19			106,416.00	106,416.00	.00
07/01/19			106,416.00	106,416.00	212,832.00
01/01/20			106,416.00	106,416.00	.00
07/01/20			106,416.00	106,416.00	212,832.00
01/01/21			106,416.00	106,416.00	.00
07/01/21			106,416.00	106,416.00	212,832.00
01/01/22			106,416.00	106,416.00	.00
07/01/22			106,416.00	106,416.00	212,832.00
01/01/23			106,416.00	106,416.00	.00
07/01/23			106,416.00	106,416.00	212,832.00
01/01/24			106,416.00	106,416.00	.00
07/01/24			106,416.00	106,416.00	212,832.00
01/01/25	2,660,400	8.000	106,416.00	2,766,816.00	2,766,816.00

TOTALS	2,660,400		5,320,800.00	7,981,200.00	7,981,200.00
ACC INT			.00	.00	.00
NET			5,320,800.00	7,981,200.00	7,981,200.00

AVERAGE LIFE:	25.000
BOND YEARS:	66,510.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT3 10/19/88
3:31 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	2,540,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS..........................	156,441.45
EARNINGS ON RESERVE FUNDS...............................	38,016.00
TOTAL SOURCES..	2,734,457.45

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	2,403,000.00
RESERVE FUND...	237,600.00
EXPENSES:	
OTHER ISSUANCE EXPENSES.................................	88,900.00
ROUNDING AMOUNT..	4,957.45
TOTAL USES OF FUNDS......................................	2,734,457.45

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'01

DEALNAME: WHCWATS 10/19/88
DEALTYPE: NEW ISSUE DATE: 01/01/01 DELIVERY DATE: 01/01/01 3:34 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/01			101,600.00	101,600.00	101,600.00
01/01/02	35,000	8.000	101,600.00	136,600.00	.00
07/01/02			100,200.00	100,200.00	236,800.00
01/01/03	35,000	8.000	100,200.00	135,200.00	.00
07/01/03			98,800.00	98,800.00	234,000.00
01/01/04	40,000	8.000	98,800.00	138,800.00	.00
07/01/04			97,200.00	97,200.00	236,000.00
01/01/05	40,000	8.000	97,200.00	137,200.00	.00
07/01/05			95,600.00	95,600.00	232,800.00
01/01/06	45,000	8.000	95,600.00	140,600.00	.00
07/01/06			93,800.00	93,800.00	234,400.00
01/01/07	45,000	8.000	93,800.00	138,800.00	.00
07/01/07			92,000.00	92,000.00	230,800.00
01/01/08	50,000	8.000	92,000.00	142,000.00	.00
07/01/08			90,000.00	90,000.00	232,000.00
01/01/09	60,000	8.000	90,000.00	150,000.00	.00
07/01/09			87,600.00	87,600.00	237,600.00
01/01/10	60,000	8.000	87,600.00	147,600.00	.00
07/01/10			85,200.00	85,200.00	232,800.00
01/01/11	70,000	8.000	85,200.00	155,200.00	.00
07/01/11			82,400.00	82,400.00	237,600.00
01/01/12	75,000	8.000	82,400.00	157,400.00	.00
07/01/12			79,400.00	79,400.00	236,800.00
01/01/13	80,000	8.000	79,400.00	159,400.00	.00
07/01/13			76,200.00	76,200.00	235,600.00
01/01/14	85,000	8.000	76,200.00	161,200.00	.00
07/01/14			72,800.00	72,800.00	234,000.00
01/01/15	95,000	8.000	72,800.00	167,800.00	.00
07/01/15			69,000.00	69,000.00	236,800.00
01/01/16	100,000	8.000	69,000.00	169,000.00	.00
07/01/16			65,000.00	65,000.00	234,000.00
01/01/17	110,000	8.000	65,000.00	175,000.00	.00
07/01/17			60,600.00	60,600.00	235,600.00
01/01/18	120,000	8.000	60,600.00	180,600.00	.00
07/01/18			55,800.00	55,800.00	236,400.00
01/01/19	130,000	8.000	55,800.00	185,800.00	.00
07/01/19			50,600.00	50,600.00	236,400.00
01/01/20	140,000	8.000	50,600.00	190,600.00	.00
07/01/20			45,000.00	45,000.00	235,600.00
01/01/21	150,000	8.000	45,000.00	195,000.00	.00
07/01/21			39,000.00	39,000.00	234,000.00
01/01/22	165,000	8.000	39,000.00	204,000.00	.00
07/01/22			32,400.00	32,400.00	236,400.00
01/01/23	180,000	8.000	32,400.00	212,400.00	.00
07/01/23			25,200.00	25,200.00	237,600.00
01/01/24	195,000	8.000	25,200.00	220,200.00	.00
07/01/24			17,400.00	17,400.00	237,600.00
01/01/25	210,000	8.000	17,400.00	227,400.00	.00
07/01/25			9,000.00	9,000.00	236,400.00
01/01/26	225,000	8.000	9,000.00	234,000.00	234,000.00

TOTALS	2,540,000		3,443,600.00	5,983,600.00	5,983,600.00
ACC INT			.00	.00	.00
NET			3,443,600.00	5,983,600.00	5,983,600.00

AVERAGE LIFE:	16.947
BOND YEARS:	43,045.000
DURATION (@ 10%"):	8.212
AVERAGE COUPON:	8.000

E X P E N S E S

DEALNAME: WHCWAT3 — 10/19/88 3:35 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	___________	___________	________10.0	25400
2)	LEGAL EXPENSE	V	___________	___________	________10.0	25400
3)	ISSUANCE EXPENSE	V	___________	___________	________15.0	38100
4)			___________	___________	___________	0
5)			___________	___________	___________	0
6)			___________	___________	___________	0
7)			___________	___________	___________	0
8)			___________	___________	___________	0
9)			___________	___________	___________	0
10)			___________	___________	___________	0
11)			___________	___________	___________	0
12)			___________	___________	___________	0
13)			___________	___________	___________	0
			===========	===========	===========	===========
	TOTALS		0	0	88900	88900

V-EXP BASED ON ISSUE SIZE — F-EXP IS A FIXED AMOUNT

D-INS EXP BASED ON TOTAL D/S — C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWATS   10/19/88
3:35 PM

		----FUND EARNINGS----					
DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP.INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/01	767,000-	0	0	0	0	1,441,543	0
07/01/01	0	50,454	9,504	0	0	1,501,501	0
01/01/02	818,000-	52,553	9,504	0	0	745,557	0
07/01/02	0	26,094	9,504	0	0	781,156	0
01/01/03	818,000-	27,340	9,504	0	0	0	0
TOTALS	2,403,000-	156,441	38,016	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 2,208,542.55

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2001 RESERVE FUND

10/19/88

DEALNAME: WHCWAT8
DEALTYPE: RES01 ISSUE DATE: 01/01/01 DELIVERY DATE: 01/01/01 3:38 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/01			9,504.00	9,504.00	9,504.00
01/01/02			9,504.00	9,504.00	.00
07/01/02			9,504.00	9,504.00	19,008.00
01/01/03			9,504.00	9,504.00	.00
07/01/03			9,504.00	9,504.00	19,008.00
01/01/04			9,504.00	9,504.00	.00
07/01/04			9,504.00	9,504.00	19,008.00
01/01/05			9,504.00	9,504.00	.00
07/01/05			9,504.00	9,504.00	19,008.00
01/01/06			9,504.00	9,504.00	.00
07/01/06			9,504.00	9,504.00	19,008.00
01/01/07			9,504.00	9,504.00	.00
07/01/07			9,504.00	9,504.00	19,008.00
01/01/08			9,504.00	9,504.00	.00
07/01/08			9,504.00	9,504.00	19,008.00
01/01/09			9,504.00	9,504.00	.00
07/01/09			9,504.00	9,504.00	19,008.00
01/01/10			9,504.00	9,504.00	.00
07/01/10			9,504.00	9,504.00	19,008.00
01/01/11			9,504.00	9,504.00	.00
07/01/11			9,504.00	9,504.00	19,008.00
01/01/12			9,504.00	9,504.00	.00
07/01/12			9,504.00	9,504.00	19,008.00
01/01/13			9,504.00	9,504.00	.00
07/01/13			9,504.00	9,504.00	19,008.00
01/01/14			9,504.00	9,504.00	.00
07/01/14			9,504.00	9,504.00	19,008.00
01/01/15			9,504.00	9,504.00	.00
07/01/15			9,504.00	9,504.00	19,008.00
01/01/16			9,504.00	9,504.00	.00
07/01/16			9,504.00	9,504.00	19,008.00
01/01/17			9,504.00	9,504.00	.00
07/01/17			9,504.00	9,504.00	19,008.00
01/01/18			9,504.00	9,504.00	.00
07/01/18			9,504.00	9,504.00	19,008.00
01/01/19			9,504.00	9,504.00	.00
07/01/19			9,504.00	9,504.00	19,008.00
01/01/20			9,504.00	9,504.00	.00
07/01/20			9,504.00	9,504.00	19,008.00
01/01/21			9,504.00	9,504.00	.00
07/01/21			9,504.00	9,504.00	19,008.00
01/01/22			9,504.00	9,504.00	.00
07/01/22			9,504.00	9,504.00	19,008.00
01/01/23			9,504.00	9,504.00	.00
07/01/23			9,504.00	9,504.00	19,008.00
01/01/24			9,504.00	9,504.00	.00
07/01/24			9,504.00	9,504.00	19,008.00
01/01/25			9,504.00	9,504.00	.00
07/01/25			9,504.00	9,504.00	19,008.00
01/01/26	237,600	8.000	9,504.00	247,104.00	247,104.00

TOTALS	237,600	475,200.00	712,800.00	712,800.00
ACC INT		.00	.00	.00
NET		475,200.00	712,800.00	712,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	5,940.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT?

10/20/83
5:33 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS.......................................	13,300,000.00
FUND EARNINGS:	
EARNINGS ON CAPITALIZED INTEREST FUND....................	173,921.86

TOTAL SOURCES..	13,473,921.86

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	9,610,000.00
RESERVE FUND..	1,267,600.00
CAPITALIZED INTEREST FUND:	
FUNDED FROM BOND PROCEEDS................................	1,954,078.14
FUNDED FROM CAP INT EARNINGS.............................	173,921.86
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	465,500.00
ROUNDING AMOUNT...	2,821.86

TOTAL USES OF FUNDS.......................................	13,473,921.86

NOTES:

EARNINGS RATE ON THE CAPITALIZED INTEREST FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %
INTEREST IS TO BE CAPITALIZED TO 01/01/06

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER/04

10/20/88

DEALNAME: WHCWAT9
DEALTYPE: NEW   ISSUE DATE: 01/01/04 DELIVERY DATE: 01/01/04   5:33 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/04			532,000.00	532,000.00	532,000.00
01/01/05			532,000.00	532,000.00	.00
07/01/05			532,000.00	532,000.00	1,064,000.00
01/01/06			532,000.00	532,000.00	.00
07/01/06			532,000.00	532,000.00	1,064,000.00
01/01/07	210,000	8.000	532,000.00	742,000.00	.00
07/01/07			523,600.00	523,600.00	1,265,600.00
01/01/08	225,000	8.000	523,600.00	748,600.00	.00
07/01/08			514,600.00	514,600.00	1,263,200.00
01/01/09	245,000	8.000	514,600.00	759,600.00	.00
07/01/09			504,800.00	504,800.00	1,264,400.00
01/01/10	265,000	8.000	504,800.00	769,800.00	.00
07/01/10			494,200.00	494,200.00	1,264,000.00
01/01/11	290,000	8.000	494,200.00	784,200.00	.00
07/01/11			482,600.00	482,600.00	1,266,800.00
01/01/12	310,000	8.000	482,600.00	792,600.00	.00
07/01/12			470,200.00	470,200.00	1,262,800.00
01/01/13	340,000	8.000	470,200.00	810,200.00	.00
07/01/13			456,600.00	456,600.00	1,266,800.00
01/01/14	365,000	8.000	456,600.00	821,600.00	.00
07/01/14			442,000.00	442,000.00	1,263,600.00
01/01/15	395,000	8.000	442,000.00	837,000.00	.00
07/01/15			426,200.00	426,200.00	1,263,200.00
01/01/16	430,000	8.000	426,200.00	856,200.00	.00
07/01/16			409,000.00	409,000.00	1,265,200.00
01/01/17	465,000	8.000	409,000.00	874,000.00	.00
07/01/17			390,400.00	390,400.00	1,264,400.00
01/01/18	505,000	8.000	390,400.00	895,400.00	.00
07/01/18			370,200.00	370,200.00	1,265,600.00
01/01/19	545,000	8.000	370,200.00	915,200.00	.00
07/01/19			348,400.00	348,400.00	1,263,600.00
01/01/20	590,000	8.000	348,400.00	938,400.00	.00
07/01/20			324,800.00	324,800.00	1,263,200.00
01/01/21	640,000	8.000	324,800.00	964,800.00	.00
07/01/21			299,200.00	299,200.00	1,264,000.00
01/01/22	695,000	8.000	299,200.00	994,200.00	.00
07/01/22			271,400.00	271,400.00	1,265,600.00
01/01/23	755,000	8.000	271,400.00	1,026,400.00	.00
07/01/23			241,200.00	241,200.00	1,267,600.00
01/01/24	815,000	8.000	241,200.00	1,056,200.00	.00
07/01/24			208,600.00	208,600.00	1,264,800.00
01/01/25	885,000	8.000	208,600.00	1,093,600.00	.00
07/01/25			173,200.00	173,200.00	1,266,800.00
01/01/26	955,000	8.000	173,200.00	1,128,200.00	.00
07/01/26			135,000.00	135,000.00	1,263,200.00
01/01/27	1,035,000	8.000	135,000.00	1,170,000.00	.00
07/01/27			93,600.00	93,600.00	1,263,600.00
01/01/28	1,125,000	8.000	93,600.00	1,218,600.00	.00
07/01/28			48,600.00	48,600.00	1,267,200.00
01/01/29	1,215,000	8.000	48,600.00	1,263,600.00	1,263,600.00

TOTALS	13,300,000		18,448,800.00	31,748,800.00	31,748,800.00
ACC INT			.00	.00	.00
NET			18,448,800.00	31,748,800.00	31,748,800.00

AVERAGE LIFE:	17.339
BOND YEARS:	230,610.000
DURATION (@ 10%"):	8.419
AVERAGE COUPON:	8.000

10/20/88 5:34 PM

EXPENSES

10/20/88
5:34 PM

DEALNAME: WHCWAT9

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	133000
2)	LEGAL EXPENSE	V			10.0	133000
3)	ISSUANCE EXPENSE	V			15.0	199500
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	465500	465500

V-EXP BASED ON ISSUE SIZE　　F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S　　C-SAME AS D LESS CAP. INT.

S020150

DEALNAME: WHOWAT?

10/20/88
5:34 PM

DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ 7.000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
		FUND EARNINGS					
01/01/04	9,610,000-	0	0	0	0	0	1,954,078
07/01/04	0	0	0	68,393	0	0	1,490,471
01/01/05	0	0	0	52,166	0	0	1,010,637
07/01/05	0	0	0	35,372	0	0	514,010
01/01/06	0	0	0	17,990	0	0	0-
07/01/06	0	0	0	0	0	0	0-
TOTALS	9,610,000-	0	0	173,922	0		

CONSTRUCTION FUND BEGINNING BALANCE = 9,610,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2004 RESERVE FUND

DEALNAME: WHCWAT9 10/20/88
DEALTYPE: RES01 ISSUE DATE: 01/01/04 DELIVERY DATE: 01/01/04 5:35 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/04			50,704.00	50,704.00	50,704.00
01/01/05			50,704.00	50,704.00	.00
07/01/05			50,704.00	50,704.00	101,408.00
01/01/06			50,704.00	50,704.00	.00
07/01/06			50,704.00	50,704.00	101,408.00
01/01/07			50,704.00	50,704.00	.00
07/01/07			50,704.00	50,704.00	101,408.00
01/01/08			50,704.00	50,704.00	.00
07/01/08			50,704.00	50,704.00	101,408.00
01/01/09			50,704.00	50,704.00	.00
07/01/09			50,704.00	50,704.00	101,408.00
01/01/10			50,704.00	50,704.00	.00
07/01/10			50,704.00	50,704.00	101,408.00
01/01/11			50,704.00	50,704.00	.00
07/01/11			50,704.00	50,704.00	101,408.00
01/01/12			50,704.00	50,704.00	.00
07/01/12			50,704.00	50,704.00	101,408.00
01/01/13			50,704.00	50,704.00	.00
07/01/13			50,704.00	50,704.00	101,408.00
01/01/14			50,704.00	50,704.00	.00
07/01/14			50,704.00	50,704.00	101,408.00
01/01/15			50,704.00	50,704.00	.00
07/01/15			50,704.00	50,704.00	101,408.00
01/01/16			50,704.00	50,704.00	.00
07/01/16			50,704.00	50,704.00	101,408.00
01/01/17			50,704.00	50,704.00	.00
07/01/17			50,704.00	50,704.00	101,408.00
01/01/18			50,704.00	50,704.00	.00
07/01/18			50,704.00	50,704.00	101,408.00
01/01/19			50,704.00	50,704.00	.00
07/01/19			50,704.00	50,704.00	101,408.00
01/01/20			50,704.00	50,704.00	.00
07/01/20			50,704.00	50,704.00	101,408.00
01/01/21			50,704.00	50,704.00	.00
07/01/21			50,704.00	50,704.00	101,408.00
01/01/22			50,704.00	50,704.00	.00
07/01/22			50,704.00	50,704.00	101,408.00
01/01/23			50,704.00	50,704.00	.00
07/01/23			50,704.00	50,704.00	101,408.00
01/01/24			50,704.00	50,704.00	.00
07/01/24			50,704.00	50,704.00	101,408.00
01/01/25			50,704.00	50,704.00	.00
07/01/25			50,704.00	50,704.00	101,408.00
01/01/26			50,704.00	50,704.00	.00
07/01/26			50,704.00	50,704.00	101,408.00
01/01/27			50,704.00	50,704.00	.00
07/01/27			50,704.00	50,704.00	101,408.00
01/01/28			50,704.00	50,704.00	.00
07/01/28			50,704.00	50,704.00	101,408.00
01/01/29	1,267,600	8.000	50,704.00	1,318,304.00	1,318,304.00

TOTALS	1,267,600		2,535,200.00	3,802,800.00	3,802,800.00
ACC INT			.00	.00	.00
NET			2,535,200.00	3,802,800.00	3,802,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	31,690.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT10 10/20/88 5:38 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS.......................................	24,620,000.00
FUND EARNINGS:	
EARNINGS ON CAPITALIZED INTEREST FUND....................	98,781.08
TOTAL SOURCES..	24,718,781.08

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	19,575,000.00
RESERVE FUND...	2,310,000.00
CAPITALIZED INTEREST FUND:	
FUNDED FROM BOND PROCEEDS................................	1,870,818.92
FUNDED FROM CAP INT EARNINGS.............................	98,781.08
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	861,700.00
ROUNDING AMOUNT..	2,481.08
TOTAL USES OF FUNDS..	24,718,781.08

NOTES:
EARNINGS RATE ON THE CAPITALIZED INTEREST FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %
INTEREST IS TO BE CAPITALIZED TO 01/01/06

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'05

10/20/88

DEALNAME: WHCWAT10
DEALTYPE: NEW   ISSUE DATE: 01/01/05   DELIVERY DATE: 01/01/05   5:38 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/05			984,800.00	984,800.00	984,800.00
01/01/06			984,800.00	984,800.00	.00
07/01/06			984,800.00	984,800.00	1,969,600.00
01/01/07	350,000	8.000	984,800.00	1,334,800.00	.00
07/01/07			970,800.00	970,800.00	2,305,600.00
01/01/08	380,000	8.000	970,800.00	1,350,800.00	.00
07/01/08			955,600.00	955,600.00	2,306,400.00
01/01/09	415,000	8.000	955,600.00	1,370,600.00	.00
07/01/09			939,000.00	939,000.00	2,309,600.00
01/01/10	445,000	8.000	939,000.00	1,384,000.00	.00
07/01/10			921,200.00	921,200.00	2,305,200.00
01/01/11	485,000	8.000	921,200.00	1,406,200.00	.00
07/01/11			901,800.00	901,800.00	2,308,000.00
01/01/12	525,000	8.000	901,800.00	1,426,800.00	.00
07/01/12			880,800.00	880,800.00	2,307,600.00
01/01/13	570,000	8.000	880,800.00	1,450,800.00	.00
07/01/13			858,000.00	858,000.00	2,308,800.00
01/01/14	615,000	8.000	858,000.00	1,473,000.00	.00
07/01/14			833,400.00	833,400.00	2,306,400.00
01/01/15	670,000	8.000	833,400.00	1,503,400.00	.00
07/01/15			806,600.00	806,600.00	2,310,000.00
01/01/16	725,000	8.000	806,600.00	1,531,600.00	.00
07/01/16			777,600.00	777,600.00	2,309,200.00
01/01/17	785,000	8.000	777,600.00	1,562,600.00	.00
07/01/17			746,200.00	746,200.00	2,308,800.00
01/01/18	850,000	8.000	746,200.00	1,596,200.00	.00
07/01/18			712,200.00	712,200.00	2,308,400.00
01/01/19	920,000	8.000	712,200.00	1,632,200.00	.00
07/01/19			675,400.00	675,400.00	2,307,600.00
01/01/20	995,000	8.000	675,400.00	1,670,400.00	.00
07/01/20			635,600.00	635,600.00	2,306,000.00
01/01/21	1,080,000	8.000	635,600.00	1,715,600.00	.00
07/01/21			592,400.00	592,400.00	2,308,000.00
01/01/22	1,170,000	8.000	592,400.00	1,762,400.00	.00
07/01/22			545,600.00	545,600.00	2,308,000.00
01/01/23	1,265,000	8.000	545,600.00	1,810,600.00	.00
07/01/23			495,000.00	495,000.00	2,305,600.00
01/01/24	1,375,000	8.000	495,000.00	1,870,000.00	.00
07/01/24			440,000.00	440,000.00	2,310,000.00
01/01/25	1,485,000	8.000	440,000.00	1,925,000.00	.00
07/01/25			380,600.00	380,600.00	2,305,600.00
01/01/26	1,610,000	8.000	380,600.00	1,990,600.00	.00
07/01/26			316,200.00	316,200.00	2,306,800.00
01/01/27	1,745,000	8.000	316,200.00	2,061,200.00	.00
07/01/27			246,400.00	246,400.00	2,307,600.00
01/01/28	1,890,000	8.000	246,400.00	2,136,400.00	.00
07/01/28			170,800.00	170,800.00	2,307,200.00
01/01/29	2,050,000	8.000	170,800.00	2,220,800.00	.00
07/01/29			88,800.00	88,800.00	2,309,600.00
01/01/30	2,220,000	8.000	88,800.00	2,308,800.00	2,308,800.00

TOTALS	24,620,000		33,719,200.00	58,339,200.00	58,339,200.00
ACC INT			.00	.00	.00
NET			33,719,200.00	58,339,200.00	58,339,200.00

AVERAGE LIFE:	17.120
BOND YEARS:	421,490.000
DURATION (@ 10%"):	8.313
AVERAGE COUPON:	8.000

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EXPENSES

DEALNAME: WHCWAT10

10/20/88
5:38 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	246200
2)	LEGAL EXPENSE	V			10.0	246200
3)	ISSUANCE EXPENSE	V			15.0	369300
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	861700	861700

V-EXP BASED ON ISSUE SIZE   F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S   C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT10 10/20/88
5:38 PM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ 7.000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/05	19,575,000-	0	0	0	0	0	1,870,819
07/01/05	0	0	0	65,479	0	0	951,498
01/01/06	0	0	0	33,302	0	0	0-
07/01/06	0	0	0	0	0	0	0-
TOTALS	19,575,000-	0	0	98,781	0		

CONSTRUCTION FUND BEGINNING BALANCE = 19,575,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2005 RESERVE FUND

10/20/08

DEALNAME: WHCWAT10
DEALTYPE: RES01 ISSUE DATE: 01/01/05 DELIVERY DATE: 01/01/05 5:40 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/05			92,400.00	92,400.00	92,400.00
01/01/06			92,400.00	92,400.00	.00
07/01/06			92,400.00	92,400.00	184,800.00
01/01/07			92,400.00	92,400.00	.00
07/01/07			92,400.00	92,400.00	184,800.00
01/01/08			92,400.00	92,400.00	.00
07/01/08			92,400.00	92,400.00	184,800.00
01/01/09			92,400.00	92,400.00	.00
07/01/09			92,400.00	92,400.00	184,800.00
01/01/10			92,400.00	92,400.00	.00
07/01/10			92,400.00	92,400.00	184,800.00
01/01/11			92,400.00	92,400.00	.00
07/01/11			92,400.00	92,400.00	184,800.00
01/01/12			92,400.00	92,400.00	.00
07/01/12			92,400.00	92,400.00	184,800.00
01/01/13			92,400.00	92,400.00	.00
07/01/13			92,400.00	92,400.00	184,800.00
01/01/14			92,400.00	92,400.00	.00
07/01/14			92,400.00	92,400.00	184,800.00
01/01/15			92,400.00	92,400.00	.00
07/01/15			92,400.00	92,400.00	184,800.00
01/01/16			92,400.00	92,400.00	.00
07/01/16			92,400.00	92,400.00	184,800.00
01/01/17			92,400.00	92,400.00	.00
07/01/17			92,400.00	92,400.00	184,800.00
01/01/18			92,400.00	92,400.00	.00
07/01/18			92,400.00	92,400.00	184,800.00
01/01/19			92,400.00	92,400.00	.00
07/01/19			92,400.00	92,400.00	184,800.00
01/01/20			92,400.00	92,400.00	.00
07/01/20			92,400.00	92,400.00	184,800.00
01/01/21			92,400.00	92,400.00	.00
07/01/21			92,400.00	92,400.00	184,800.00
01/01/22			92,400.00	92,400.00	.00
07/01/22			92,400.00	92,400.00	184,800.00
01/01/23			92,400.00	92,400.00	.00
07/01/23			92,400.00	92,400.00	184,800.00
01/01/24			92,400.00	92,400.00	.00
07/01/24			92,400.00	92,400.00	184,800.00
01/01/25			92,400.00	92,400.00	.00
07/01/25			92,400.00	92,400.00	184,800.00
01/01/26			92,400.00	92,400.00	.00
07/01/26			92,400.00	92,400.00	184,800.00
01/01/27			92,400.00	92,400.00	.00
07/01/27			92,400.00	92,400.00	184,800.00
01/01/28			92,400.00	92,400.00	.00
07/01/28			92,400.00	92,400.00	184,800.00
01/01/29			92,400.00	92,400.00	.00
07/01/29			92,400.00	92,400.00	184,800.00
01/01/30	2,310,000	8.000	92,400.00	2,402,400.00	2,402,400.00

TOTALS	2,310,000		4,620,000.00	6,930,000.00	6,930,000.00
ACC INT			.00	.00	.00
NET			4,620,000.00	6,930,000.00	6,930,000.00

AVERAGE LIFE:	25.000
BOND YEARS:	57,750.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: 'WHCWAT11

10/19/88
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SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	17,235,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS...........................	1,040,575.54
EARNINGS ON RESERVE FUNDS................................	255,360.00
TOTAL SOURCES..	18,530,935.54

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	16,330,000.00
RESERVE FUND...	1,596,000.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	603,225.00
ROUNDING AMOUNT..	1,710.54
TOTAL USES OF FUNDS......................................	18,530,935.54

NOTES:

EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %

EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'06

DEALNAME: WHCWAT11 10/19/88
DEALTYPE: NEW ISSUE DATE: 01/01/06 DELIVERY DATE: 01/01/06 4:39 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/06			689,400.00	689,400.00	689,400.00
01/01/07	225,000	8.000	689,400.00	914,400.00	.00
07/01/07			680,400.00	680,400.00	1,594,800.00
01/01/08	245,000	8.000	680,400.00	925,400.00	.00
07/01/08			670,600.00	670,600.00	1,596,000.00
01/01/09	265,000	8.000	670,600.00	935,600.00	.00
07/01/09			660,000.00	660,000.00	1,595,600.00
01/01/10	285,000	8.000	660,000.00	945,000.00	.00
07/01/10			648,600.00	648,600.00	1,593,600.00
01/01/11	310,000	8.000	648,600.00	958,600.00	.00
07/01/11			636,200.00	636,200.00	1,594,800.00
01/01/12	335,000	8.000	636,200.00	971,200.00	.00
07/01/12			622,800.00	622,800.00	1,594,000.00
01/01/13	365,000	8.000	622,800.00	987,800.00	.00
07/01/13			608,200.00	608,200.00	1,596,000.00
01/01/14	395,000	8.000	608,200.00	1,003,200.00	.00
07/01/14			592,400.00	592,400.00	1,595,600.00
01/01/15	425,000	8.000	592,400.00	1,017,400.00	.00
07/01/15			575,400.00	575,400.00	1,592,800.00
01/01/16	460,000	8.000	575,400.00	1,035,400.00	.00
07/01/16			557,000.00	557,000.00	1,592,400.00
01/01/17	500,000	8.000	557,000.00	1,057,000.00	.00
07/01/17			537,000.00	537,000.00	1,594,000.00
01/01/18	540,000	8.000	537,000.00	1,077,000.00	.00
07/01/18			515,400.00	515,400.00	1,592,400.00
01/01/19	585,000	8.000	515,400.00	1,100,400.00	.00
07/01/19			492,000.00	492,000.00	1,592,400.00
01/01/20	635,000	8.000	492,000.00	1,127,000.00	.00
07/01/20			466,600.00	466,600.00	1,593,600.00
01/01/21	690,000	8.000	466,600.00	1,156,600.00	.00
07/01/21			439,000.00	439,000.00	1,595,600.00
01/01/22	745,000	8.000	439,000.00	1,184,000.00	.00
07/01/22			409,200.00	409,200.00	1,593,200.00
01/01/23	810,000	8.000	409,200.00	1,219,200.00	.00
07/01/23			376,800.00	376,800.00	1,596,000.00
01/01/24	875,000	8.000	376,800.00	1,251,800.00	.00
07/01/24			341,800.00	341,800.00	1,593,600.00
01/01/25	950,000	8.000	341,800.00	1,291,800.00	.00
07/01/25			303,800.00	303,800.00	1,595,600.00
01/01/26	1,025,000	8.000	303,800.00	1,328,800.00	.00
07/01/26			262,800.00	262,800.00	1,591,600.00
01/01/27	1,115,000	8.000	262,800.00	1,377,800.00	.00
07/01/27			218,200.00	218,200.00	1,596,000.00
01/01/28	1,205,000	8.000	218,200.00	1,423,200.00	.00
07/01/28			170,000.00	170,000.00	1,593,200.00
01/01/29	1,305,000	8.000	170,000.00	1,475,000.00	.00
07/01/29			117,800.00	117,800.00	1,592,800.00
01/01/30	1,415,000	8.000	117,800.00	1,532,800.00	.00
07/01/30			61,200.00	61,200.00	1,594,000.00
01/01/31	1,530,000	8.000	61,200.00	1,591,200.00	1,591,200.00

TOTALS	17,235,000	23,305,200.00	40,540,200.00	40,540,200.00
ACC INT		.00	.00	.00
NET		23,305,200.00	40,540,200.00	40,540,200.00

AVERAGE LIFE:	16.903
BOND YEARS:	291,315.000
DURATION (@ 10%"):	8.199
AVERAGE COUPON:	8.000

EXPENSES

DEALNAME: WHCWAT11

10/19/88
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	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	172350
2)	LEGAL EXPENSE	V			10.0	172350
3)	ISSUANCE EXPENSE	V			15.0	258525
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	603225	603225

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT11

10/19/88
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DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/06	5,446,000-	0	0	0	0	9,588,064	0
07/01/06	0	335,582	63,840	0	0	9,987,487	0
01/01/07	5,442,000-	349,562	63,840	0	0	4,958,889	0
07/01/07	0	173,561	63,840	0	0	5,196,290	0
01/01/08	5,442,000-	181,870	63,840	0	0	0	0
TOTALS	16,330,000-	1,040,576	255,360	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 15,034,064.46

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2006 RESERVE FUND

10/19/88

DEALNAME: WHCWAT11
DEALTYPE: RES01 ISSUE DATE: 01/01/06 DELIVERY DATE: 01/01/06 4:40 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/06			63,840.00	63,840.00	63,840.00
01/01/07			63,840.00	63,840.00	.00
07/01/07			63,840.00	63,840.00	127,680.00
01/01/08			63,840.00	63,840.00	.00
07/01/08			63,840.00	63,840.00	127,680.00
01/01/09			63,840.00	63,840.00	.00
07/01/09			63,840.00	63,840.00	127,680.00
01/01/10			63,840.00	63,840.00	.00
07/01/10			63,840.00	63,840.00	127,680.00
01/01/11			63,840.00	63,840.00	.00
07/01/11			63,840.00	63,840.00	127,680.00
01/01/12			63,840.00	63,840.00	.00
07/01/12			63,840.00	63,840.00	127,680.00
01/01/13			63,840.00	63,840.00	.00
07/01/13			63,840.00	63,840.00	127,680.00
01/01/14			63,840.00	63,840.00	.00
07/01/14			63,840.00	63,840.00	127,680.00
01/01/15			63,840.00	63,840.00	.00
07/01/15			63,840.00	63,840.00	127,680.00
01/01/16			63,840.00	63,840.00	.00
07/01/16			63,840.00	63,840.00	127,680.00
01/01/17			63,840.00	63,840.00	.00
07/01/17			63,840.00	63,840.00	127,680.00
01/01/18			63,840.00	63,840.00	.00
07/01/18			63,840.00	63,840.00	127,680.00
01/01/19			63,840.00	63,840.00	.00
07/01/19			63,840.00	63,840.00	127,680.00
01/01/20			63,840.00	63,840.00	.00
07/01/20			63,840.00	63,840.00	127,680.00
01/01/21			63,840.00	63,840.00	.00
07/01/21			63,840.00	63,840.00	127,680.00
01/01/22			63,840.00	63,840.00	.00
07/01/22			63,840.00	63,840.00	127,680.00
01/01/23			63,840.00	63,840.00	.00
07/01/23			63,840.00	63,840.00	127,680.00
01/01/24			63,840.00	63,840.00	.00
07/01/24			63,840.00	63,840.00	127,680.00
01/01/25			63,840.00	63,840.00	.00
07/01/25			63,840.00	63,840.00	127,680.00
01/01/26			63,840.00	63,840.00	.00
07/01/26			63,840.00	63,840.00	127,680.00
01/01/27			63,840.00	63,840.00	.00
07/01/27			63,840.00	63,840.00	127,680.00
01/01/28			63,840.00	63,840.00	.00
07/01/28			63,840.00	63,840.00	127,680.00
01/01/29			63,840.00	63,840.00	.00
07/01/29			63,840.00	63,840.00	127,680.00
01/01/30			63,840.00	63,840.00	.00
07/01/30			63,840.00	63,840.00	127,680.00
01/01/31	1,596,000	8.000	63,840.00	1,659,840.00	1,659,840.00

TOTALS	1,596,000		3,192,000.00	4,788,000.00	4,788,000.00
ACC INT			.00	.00	.00
NET			3,192,000.00	4,788,000.00	4,788,000.00

AVERAGE LIFE:	25.000
BOND YEARS:	39,900,000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT12

10/20/88
5:43 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	83,955,000.00
FUND EARNINGS:	
EARNINGS ON CAPITALIZED INTEREST FUND....................	1,097,865.40
TOTAL SOURCES...	85,052,865.40

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	60,696,000.00
RESERVE FUND..	7,985,600.00
CAPITALIZED INTEREST FUND:	
FUNDED FROM BOND PROCEEDS................................	12,334,934.60
FUNDED FROM CAP INT EARNINGS............................	1,097,865.40
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	2,938,425.00
ROUNDING AMOUNT...	40.40
TOTAL USES OF FUNDS...	85,052,865.40

NOTES:

EARNINGS RATE ON THE CAPITALIZED INTEREST FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %
INTEREST IS TO BE CAPITALIZED TO 01/01/11

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'09

DEALNAME: WHCWAT12 10/20/88
DEALTYPE: NEW ISSUE DATE: 01/01/09 DELIVERY DATE: 01/01/09 5:43 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/09			3,358,200.00	3,358,200.00	3,358,200.00
01/01/10			3,358,200.00	3,358,200.00	.00
07/01/10			3,358,200.00	3,358,200.00	6,716,400.00
01/01/11			3,358,200.00	3,358,200.00	.00
07/01/11			3,358,200.00	3,358,200.00	6,716,400.00
01/01/12	1,320,000	8.000	3,358,200.00	4,678,200.00	.00
07/01/12			3,305,400.00	3,305,400.00	7,983,600.00
01/01/13	1,430,000	8.000	3,305,400.00	4,735,400.00	.00
07/01/13			3,248,200.00	3,248,200.00	7,983,600.00
01/01/14	1,550,000	8.000	3,248,200.00	4,798,200.00	.00
07/01/14			3,186,200.00	3,186,200.00	7,984,400.00
01/01/15	1,675,000	8.000	3,186,200.00	4,861,200.00	.00
07/01/15			3,119,200.00	3,119,200.00	7,980,400.00
01/01/16	1,815,000	8.000	3,119,200.00	4,934,200.00	.00
07/01/16			3,046,600.00	3,046,600.00	7,980,800.00
01/01/17	1,970,000	8.000	3,046,600.00	5,016,600.00	.00
07/01/17			2,967,800.00	2,967,800.00	7,984,400.00
01/01/18	2,130,000	8.000	2,967,800.00	5,097,800.00	.00
07/01/18			2,882,600.00	2,882,600.00	7,980,400.00
01/01/19	2,310,000	8.000	2,882,600.00	5,192,600.00	.00
07/01/19			2,790,200.00	2,790,200.00	7,982,800.00
01/01/20	2,505,000	8.000	2,790,200.00	5,295,200.00	.00
07/01/20			2,690,000.00	2,690,000.00	7,985,200.00
01/01/21	2,710,000	8.000	2,690,000.00	5,400,000.00	.00
07/01/21			2,581,600.00	2,581,600.00	7,981,600.00
01/01/22	2,940,000	8.000	2,581,600.00	5,521,600.00	.00
07/01/22			2,464,000.00	2,464,000.00	7,985,600.00
01/01/23	3,180,000	8.000	2,464,000.00	5,644,000.00	.00
07/01/23			2,336,800.00	2,336,800.00	7,980,800.00
01/01/24	3,445,000	8.000	2,336,800.00	5,781,800.00	.00
07/01/24			2,199,000.00	2,199,000.00	7,980,800.00
01/01/25	3,735,000	8.000	2,199,000.00	5,934,000.00	.00
07/01/25			2,049,600.00	2,049,600.00	7,983,600.00
01/01/26	4,045,000	8.000	2,049,600.00	6,094,600.00	.00
07/01/26			1,887,800.00	1,887,800.00	7,982,400.00
01/01/27	4,385,000	8.000	1,887,800.00	6,272,800.00	.00
07/01/27			1,712,400.00	1,712,400.00	7,985,200.00
01/01/28	4,750,000	8.000	1,712,400.00	6,462,400.00	.00
07/01/28			1,522,400.00	1,522,400.00	7,984,800.00
01/01/29	5,145,000	8.000	1,522,400.00	6,667,400.00	.00
07/01/29			1,316,600.00	1,316,600.00	7,984,000.00
01/01/30	5,575,000	8.000	1,316,600.00	6,891,600.00	.00
07/01/30			1,093,600.00	1,093,600.00	7,985,200.00
01/01/31	6,040,000	8.000	1,093,600.00	7,133,600.00	.00
07/01/31			852,000.00	852,000.00	7,985,600.00
01/01/32	6,540,000	8.000	852,000.00	7,392,000.00	.00
07/01/32			590,400.00	590,400.00	7,982,400.00
01/01/33	7,085,000	8.000	590,400.00	7,675,400.00	.00
07/01/33			307,000.00	307,000.00	7,982,400.00
01/01/34	7,675,000	8.000	307,000.00	7,982,000.00	7,982,000.00

TOTALS	83,955,000	116,448,000.00	200,403,000.00	200,403,000.00
ACC INT		.00	.00	.00
NET		116,448,000.00	200,403,000.00	200,403,000.00

AVERAGE LIFE:	17.338
BOND YEARS:	1,455,600,000
DURATION (@ 10%"):	8.418
AVERAGE COUPON:	8.000

EXPENSES

DEALNAME: WHCWAT12

10/20/88
5:44 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	839550
2)	LEGAL EXPENSE	V			10.0	839550
3)	ISSUANCE EXPENSE	V			15.0	1259325
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	2938425	2938425

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEBT SERVICE SCHEDULE
SERIES 2009 RESERVE FUND

10/20/88

DEALNAME: WHCWAT12
DEALTYPE: RES01 ISSUE DATE: 01/01/09 DELIVERY DATE: 01/01/09 5:45 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/09			319,424.00	319,424.00	319,424.00
01/01/10			319,424.00	319,424.00	.00
07/01/10			319,424.00	319,424.00	638,848.00
01/01/11			319,424.00	319,424.00	.00
07/01/11			319,424.00	319,424.00	638,848.00
01/01/12			319,424.00	319,424.00	.00
07/01/12			319,424.00	319,424.00	638,848.00
01/01/13			319,424.00	319,424.00	.00
07/01/13			319,424.00	319,424.00	638,848.00
01/01/14			319,424.00	319,424.00	.00
07/01/14			319,424.00	319,424.00	638,848.00
01/01/15			319,424.00	319,424.00	.00
07/01/15			319,424.00	319,424.00	638,848.00
01/01/16			319,424.00	319,424.00	.00
07/01/16			319,424.00	319,424.00	638,848.00
01/01/17			319,424.00	319,424.00	.00
07/01/17			319,424.00	319,424.00	638,848.00
01/01/18			319,424.00	319,424.00	.00
07/01/18			319,424.00	319,424.00	638,848.00
01/01/19			319,424.00	319,424.00	.00
07/01/19			319,424.00	319,424.00	638,848.00
01/01/20			319,424.00	319,424.00	.00
07/01/20			319,424.00	319,424.00	638,848.00
01/01/21			319,424.00	319,424.00	.00
07/01/21			319,424.00	319,424.00	638,848.00
01/01/22			319,424.00	319,424.00	.00
07/01/22			319,424.00	319,424.00	638,848.00
01/01/23			319,424.00	319,424.00	.00
07/01/23			319,424.00	319,424.00	638,848.00
01/01/24			319,424.00	319,424.00	.00
07/01/24			319,424.00	319,424.00	638,848.00
01/01/25			319,424.00	319,424.00	.00
07/01/25			319,424.00	319,424.00	638,848.00
01/01/26			319,424.00	319,424.00	.00
07/01/26			319,424.00	319,424.00	638,848.00
01/01/27			319,424.00	319,424.00	.00
07/01/27			319,424.00	319,424.00	638,848.00
01/01/28			319,424.00	319,424.00	.00
07/01/28			319,424.00	319,424.00	638,848.00
01/01/29			319,424.00	319,424.00	.00
07/01/29			319,424.00	319,424.00	638,848.00
01/01/30			319,424.00	319,424.00	.00
07/01/30			319,424.00	319,424.00	638,848.00
01/01/31			319,424.00	319,424.00	.00
07/01/31			319,424.00	319,424.00	638,848.00
01/01/32			319,424.00	319,424.00	.00
07/01/32			319,424.00	319,424.00	638,848.00
01/01/33			319,424.00	319,424.00	.00
07/01/33			319,424.00	319,424.00	638,848.00
01/01/34	7,985,600	8.000	319,424.00	8,305,024.00	8,305,024.00

TOTALS	7,985,600		15,971,200.00	23,956,800.00	23,956,800.00
ACC INT			.00	.00	.00
NET			15,971,200.00	23,956,800.00	23,956,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	199,640.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WUCWAT13 10/20/08 5:58 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	91,040,000.00
FUND EARNINGS:	
EARNINGS ON CAPITALIZED INTEREST FUND...................	365,273.33
TOTAL SOURCES..	91,405,273.33

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	72,399,000.00
RESERVE FUND...	8,535,200.00
CAPITALIZED INTEREST FUND:	
FUNDED FROM BOND PROCEEDS................................	6,917,926.67
FUNDED FROM CAP INT EARNINGS.............................	365,273.33
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	3,186,400.00
ROUNDING AMOUNT..	1,473.33
TOTAL USES OF FUNDS..	91,405,273.33

NOTES:

EARNINGS RATE ON THE CAPITALIZED INTEREST FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %
INTEREST IS TO BE CAPITALIZED TO 01/01/11

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'10

10/20/88

DEALNAME: WHCWAT13
DEALTYPE: NEW ISSUE DATE: 01/01/10 DELIVERY DATE: 01/01/10 5:59 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/10			3,641,600.00	3,641,600.00	3,641,600.00
01/01/11			3,641,600.00	3,641,600.00	.00
07/01/11			3,641,600.00	3,641,600.00	7,283,200.00
01/01/12	1,300,000	8.000	3,641,600.00	4,941,600.00	.00
07/01/12			3,589,600.00	3,589,600.00	8,531,200.00
01/01/13	1,410,000	8.000	3,589,600.00	4,999,600.00	.00
07/01/13			3,533,200.00	3,533,200.00	8,532,800.00
01/01/14	1,530,000	8.000	3,533,200.00	5,063,200.00	.00
07/01/14			3,472,000.00	3,472,000.00	8,535,200.00
01/01/15	1,655,000	8.000	3,472,000.00	5,127,000.00	.00
07/01/15			3,405,800.00	3,405,800.00	8,532,800.00
01/01/16	1,795,000	8.000	3,405,800.00	5,200,800.00	.00
07/01/16			3,334,000.00	3,334,000.00	8,534,800.00
01/01/17	1,940,000	8.000	3,334,000.00	5,274,000.00	.00
07/01/17			3,256,400.00	3,256,400.00	8,530,400.00
01/01/18	2,105,000	8.000	3,256,400.00	5,361,400.00	.00
07/01/18			3,172,200.00	3,172,200.00	8,533,600.00
01/01/19	2,280,000	8.000	3,172,200.00	5,452,200.00	.00
07/01/19			3,081,000.00	3,081,000.00	8,533,200.00
01/01/20	2,470,000	8.000	3,081,000.00	5,551,000.00	.00
07/01/20			2,982,200.00	2,982,200.00	8,533,200.00
01/01/21	2,675,000	8.000	2,982,200.00	5,657,200.00	.00
07/01/21			2,875,200.00	2,875,200.00	8,532,400.00
01/01/22	2,900,000	8.000	2,875,200.00	5,775,200.00	.00
07/01/22			2,759,200.00	2,759,200.00	8,534,400.00
01/01/23	3,140,000	8.000	2,759,200.00	5,899,200.00	.00
07/01/23			2,633,600.00	2,633,600.00	8,532,800.00
01/01/24	3,400,000	8.000	2,633,600.00	6,033,600.00	.00
07/01/24			2,497,600.00	2,497,600.00	8,531,200.00
01/01/25	3,685,000	8.000	2,497,600.00	6,182,600.00	.00
07/01/25			2,350,200.00	2,350,200.00	8,532,800.00
01/01/26	3,990,000	8.000	2,350,200.00	6,340,200.00	.00
07/01/26			2,190,600.00	2,190,600.00	8,530,800.00
01/01/27	4,325,000	8.000	2,190,600.00	6,515,600.00	.00
07/01/27			2,017,600.00	2,017,600.00	8,533,200.00
01/01/28	4,685,000	8.000	2,017,600.00	6,702,600.00	.00
07/01/28			1,830,200.00	1,830,200.00	8,532,800.00
01/01/29	5,075,000	8.000	1,830,200.00	6,905,200.00	.00
07/01/29			1,627,200.00	1,627,200.00	8,532,400.00
01/01/30	5,500,000	8.000	1,627,200.00	7,127,200.00	.00
07/01/30			1,407,200.00	1,407,200.00	8,534,400.00
01/01/31	5,955,000	8.000	1,407,200.00	7,362,200.00	.00
07/01/31			1,169,000.00	1,169,000.00	8,531,200.00
01/01/32	6,455,000	8.000	1,169,000.00	7,624,000.00	.00
07/01/32			910,800.00	910,800.00	8,534,800.00
01/01/33	6,990,000	8.000	910,800.00	7,900,800.00	.00
07/01/33			631,200.00	631,200.00	8,532,000.00
01/01/34	7,575,000	8.000	631,200.00	8,206,200.00	.00
07/01/34			328,200.00	328,200.00	8,534,400.00
01/01/35	8,205,000	8.000	328,200.00	8,533,200.00	8,533,200.00

TOTALS	91,040,000	124,674,800.00	215,714,800.00	215,714,800.00
ACC INT		.00	.00	.00
NET		124,674,800.00	215,714,800.00	215,714,800.00

AVERAGE LIFE:	17.118
BOND YEARS:	1,558,435.000
DURATION (@ 10%"):	8.312
AVERAGE COUPON:	8.000

10/20/88 5:59 PM

EXPENSES

DEALNAME: WHCWAT13

10/20/88
5:59 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	----------	----------	---------10.0	910400
2)	LEGAL EXPENSE	V	----------	----------	---------10.0	910400
3)	ISSUANCE EXPENSE	V	----------	----------	---------15.0	1365600
4)			----------	----------	----------	0
5)			----------	----------	----------	0
6)			----------	----------	----------	0
7)			----------	----------	----------	0
8)			----------	----------	----------	0
9)			----------	----------	----------	0
10)			----------	----------	----------	0
11)			----------	----------	----------	0
12)			----------	----------	----------	0
13)			----------	----------	----------	0
	TOTALS		0	0	3186400	3186400

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT13

10/20/88
5:52 PM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 3.000%	CAP.INT. @ 7.000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/10	72,399,000-	0	0	0	0	0	6,917,927
07/01/10	0	0	0	242,127	0	0	3,518,454
01/01/11	0	0	0	123,146	0	0	0
07/01/11	0	0	0	0	0	0	0
TOTALS	72,399,000-	0	0	365,273	0		

CONSTRUCTION FUND BEGINNING BALANCE = 72,399,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2010 RESERVE FUND

DEALNAME: WHCWAT13 10/20/88
DEALTYPE: RES01 ISSUE DATE: 01/01/10 DELIVERY DATE: 01/01/10 6:00 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/10			341,408.00	341,408.00	341,408.00
01/01/11			341,408.00	341,408.00	.00
07/01/11			341,408.00	341,408.00	682,816.00
01/01/12			341,408.00	341,408.00	.00
07/01/12			341,408.00	341,408.00	682,816.00
01/01/13			341,408.00	341,408.00	.00
07/01/13			341,408.00	341,408.00	682,816.00
01/01/14			341,408.00	341,408.00	.00
07/01/14			341,408.00	341,408.00	682,816.00
01/01/15			341,408.00	341,408.00	.00
07/01/15			341,408.00	341,408.00	682,816.00
01/01/16			341,408.00	341,408.00	.00
07/01/16			341,408.00	341,408.00	682,816.00
01/01/17			341,408.00	341,408.00	.00
07/01/17			341,408.00	341,408.00	682,816.00
01/01/18			341,408.00	341,408.00	.00
07/01/18			341,408.00	341,408.00	682,816.00
01/01/19			341,408.00	341,408.00	.00
07/01/19			341,408.00	341,408.00	682,816.00
01/01/20			341,408.00	341,408.00	.00
07/01/20			341,408.00	341,408.00	682,816.00
01/01/21			341,408.00	341,408.00	.00
07/01/21			341,408.00	341,408.00	682,816.00
01/01/22			341,408.00	341,408.00	.00
07/01/22			341,408.00	341,408.00	682,816.00
01/01/23			341,408.00	341,408.00	.00
07/01/23			341,408.00	341,408.00	682,816.00
01/01/24			341,408.00	341,408.00	.00
07/01/24			341,408.00	341,408.00	682,816.00
01/01/25			341,408.00	341,408.00	.00
07/01/25			341,408.00	341,408.00	682,816.00
01/01/26			341,408.00	341,408.00	.00
07/01/26			341,408.00	341,408.00	682,816.00
01/01/27			341,408.00	341,408.00	.00
07/01/27			341,408.00	341,408.00	682,816.00
01/01/28			341,408.00	341,408.00	.00
07/01/28			341,408.00	341,408.00	682,816.00
01/01/29			341,408.00	341,408.00	.00
07/01/29			341,408.00	341,408.00	682,816.00
01/01/30			341,408.00	341,408.00	.00
07/01/30			341,408.00	341,408.00	682,816.00
01/01/31			341,408.00	341,408.00	.00
07/01/31			341,408.00	341,408.00	682,816.00
01/01/32			341,408.00	341,408.00	.00
07/01/32			341,408.00	341,408.00	682,816.00
01/01/33			341,408.00	341,408.00	.00
07/01/33			341,408.00	341,408.00	682,816.00
01/01/34			341,408.00	341,408.00	.00
07/01/34			341,408.00	341,408.00	682,816.00
01/01/35	8,535,200	8.000	341,408.00	8,876,608.00	8,876,608.00

TOTALS	8,535,200		17,070,400.00	25,605,600.00	25,605,600.00
ACC INT			.00	.00	.00
NET			17,070,400.00	25,605,600.00	25,605,600.00

AVERAGE LIFE:	25.000
BOND YEARS:	213,380.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT14

10/20/88
6:02 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	17,185,000.00
FUND EARNINGS:	
EARNINGS ON CAPITALIZED INTEREST FUND...................	224,725.35

TOTAL SOURCES..	17,409,725.35

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	12,421,500.00
RESERVE FUND...	1,636,400.00
CAPITALIZED INTEREST FUND:	
FUNDED FROM BOND PROCEEDS...............................	2,524,874.65
FUNDED FROM CAP INT EARNINGS............................	224,725.35
EXPENSES:	
OTHER ISSUANCE EXPENSES.................................	601,475.00
ROUNDING AMOUNT..	750.35

TOTAL USES OF FUNDS......................................	17,409,725.35

NOTES:
EARNINGS RATE ON THE CAPITALIZED INTEREST FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %
INTEREST IS TO BE CAPITALIZED TO 01/01/13

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'11

DEALNAME: WHCWAT14 10/20/88
DEALTYPE: NEW ISSUE DATE: 01/01/11 DELIVERY DATE: 01/01/11 6:03 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/11			687,400.00	687,400.00	687,400.00
01/01/12			687,400.00	687,400.00	.00
07/01/12			687,400.00	687,400.00	1,374,800.00
01/01/13			687,400.00	687,400.00	.00
07/01/13			687,400.00	687,400.00	1,374,800.00
01/01/14	270,000	8.000	687,400.00	957,400.00	.00
07/01/14			676,600.00	676,600.00	1,634,000.00
01/01/15	295,000	8.000	676,600.00	971,600.00	.00
07/01/15			664,800.00	664,800.00	1,636,400.00
01/01/16	315,000	8.000	664,800.00	979,800.00	.00
07/01/16			652,200.00	652,200.00	1,632,000.00
01/01/17	345,000	8.000	652,200.00	997,200.00	.00
07/01/17			638,400.00	638,400.00	1,635,600.00
01/01/18	370,000	8.000	638,400.00	1,008,400.00	.00
07/01/18			623,600.00	623,600.00	1,632,000.00
01/01/19	405,000	8.000	623,600.00	1,028,600.00	.00
07/01/19			607,400.00	607,400.00	1,636,000.00
01/01/20	435,000	8.000	607,400.00	1,042,400.00	.00
07/01/20			590,000.00	590,000.00	1,632,400.00
01/01/21	475,000	8.000	590,000.00	1,065,000.00	.00
07/01/21			571,000.00	571,000.00	1,636,000.00
01/01/22	515,000	8.000	571,000.00	1,086,000.00	.00
07/01/22			550,400.00	550,400.00	1,636,400.00
01/01/23	555,000	8.000	550,400.00	1,105,400.00	.00
07/01/23			528,200.00	528,200.00	1,633,600.00
01/01/24	600,000	8.000	528,200.00	1,128,200.00	.00
07/01/24			504,200.00	504,200.00	1,632,400.00
01/01/25	650,000	8.000	504,200.00	1,154,200.00	.00
07/01/25			478,200.00	478,200.00	1,632,400.00
01/01/26	705,000	8.000	478,200.00	1,183,200.00	.00
07/01/26			450,000.00	450,000.00	1,633,200.00
01/01/27	765,000	8.000	450,000.00	1,215,000.00	.00
07/01/27			419,400.00	419,400.00	1,634,400.00
01/01/28	830,000	8.000	419,400.00	1,249,400.00	.00
07/01/28			386,200.00	386,200.00	1,635,600.00
01/01/29	895,000	8.000	386,200.00	1,281,200.00	.00
07/01/29			350,400.00	350,400.00	1,631,600.00
01/01/30	970,000	8.000	350,400.00	1,320,400.00	.00
07/01/30			311,600.00	311,600.00	1,632,000.00
01/01/31	1,055,000	8.000	311,600.00	1,366,600.00	.00
07/01/31			269,400.00	269,400.00	1,636,000.00
01/01/32	1,140,000	8.000	269,400.00	1,409,400.00	.00
07/01/32			223,800.00	223,800.00	1,633,200.00
01/01/33	1,235,000	8.000	223,800.00	1,458,800.00	.00
07/01/33			174,400.00	174,400.00	1,633,200.00
01/01/34	1,340,000	8.000	174,400.00	1,514,400.00	.00
07/01/34			120,800.00	120,800.00	1,635,200.00
01/01/35	1,450,000	8.000	120,800.00	1,570,800.00	.00
07/01/35			62,800.00	62,800.00	1,633,600.00
01/01/36	1,570,000	8.000	62,800.00	1,632,800.00	1,632,800.00

TOTALS	17,185,000		23,832,000.00	41,017,000.00	41,017,000.00
ACC INT			.00	.00	.00
NET			23,832,000.00	41,017,000.00	41,017,000.00

AVERAGE LIFE:	17.335
BOND YEARS:	297,900.000
DURATION (@ 10%"):	8.418
AVERAGE COUPON:	8.000

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E X P E N S E S

DEALNAME: WHCWAT14

10/20/88
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	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	171850
2)	LEGAL EXPENSE	V			10.0	171850
3)	ISSUANCE EXPENSE	V			15.0	257775
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	601475	601475

V-EXP BASED ON ISSUE SIZE
D-INS EXP BASED ON TOTAL D/S

F-EXP IS A FIXED AMOUNT
C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT14

10/20/88
6:04 PM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ 7.000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/11	12,421,500-	0	0	0	0	0	2,524,875
07/01/11	0	0	0	88,371	0	0	1,925,845
01/01/12	0	0	0	67,405	0	0	1,305,850
07/01/12	0	0	0	45,705	0	0	664,155
01/01/13	0	0	0	23,245	0	0	0-
07/01/13	0	0	0	0	0	0	0-
TOTALS	12,421,500-	0	0	224,725	0		

CONSTRUCTION FUND BEGINNING BALANCE = 12,421,500.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2011 RESERVE FUND

10/20/88

DEALNAME: WHCWAT14
DEALTYPE: RES01 ISSUE DATE: 01/01/11 DELIVERY DATE: 01/01/11 6:04 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/11			65,456.00	65,456.00	65,456.00
01/01/12			65,456.00	65,456.00	.00
07/01/12			65,456.00	65,456.00	130,912.00
01/01/13			65,456.00	65,456.00	.00
07/01/13			65,456.00	65,456.00	130,912.00
01/01/14			65,456.00	65,456.00	.00
07/01/14			65,456.00	65,456.00	130,912.00
01/01/15			65,456.00	65,456.00	.00
07/01/15			65,456.00	65,456.00	130,912.00
01/01/16			65,456.00	65,456.00	.00
07/01/16			65,456.00	65,456.00	130,912.00
01/01/17			65,456.00	65,456.00	.00
07/01/17			65,456.00	65,456.00	130,912.00
01/01/18			65,456.00	65,456.00	.00
07/01/18			65,456.00	65,456.00	130,912.00
01/01/19			65,456.00	65,456.00	.00
07/01/19			65,456.00	65,456.00	130,912.00
01/01/20			65,456.00	65,456.00	.00
07/01/20			65,456.00	65,456.00	130,912.00
01/01/21			65,456.00	65,456.00	.00
07/01/21			65,456.00	65,456.00	130,912.00
01/01/22			65,456.00	65,456.00	.00
07/01/22			65,456.00	65,456.00	130,912.00
01/01/23			65,456.00	65,456.00	.00
07/01/23			65,456.00	65,456.00	130,912.00
01/01/24			65,456.00	65,456.00	.00
07/01/24			65,456.00	65,456.00	130,912.00
01/01/25			65,456.00	65,456.00	.00
07/01/25			65,456.00	65,456.00	130,912.00
01/01/26			65,456.00	65,456.00	.00
07/01/26			65,456.00	65,456.00	130,912.00
01/01/27			65,456.00	65,456.00	.00
07/01/27			65,456.00	65,456.00	130,912.00
01/01/28			65,456.00	65,456.00	.00
07/01/28			65,456.00	65,456.00	130,912.00
01/01/29			65,456.00	65,456.00	.00
07/01/29			65,456.00	65,456.00	130,912.00
01/01/30			65,456.00	65,456.00	.00
07/01/30			65,456.00	65,456.00	130,912.00
01/01/31			65,456.00	65,456.00	.00
07/01/31			65,456.00	65,456.00	130,912.00
01/01/32			65,456.00	65,456.00	.00
07/01/32			65,456.00	65,456.00	130,912.00
01/01/33			65,456.00	65,456.00	.00
07/01/33			65,456.00	65,456.00	130,912.00
01/01/34			65,456.00	65,456.00	.00
07/01/34			65,456.00	65,456.00	130,912.00
01/01/35			65,456.00	65,456.00	.00
07/01/35			65,456.00	65,456.00	130,912.00
01/01/36	1,636,400	8.000	65,456.00	1,701,856.00	1,701,856.00

TOTALS	1,636,400	3,272,800.00	4,909,200.00	4,909,200.00
ACC INT		.00	.00	.00
NET		3,272,800.00	4,909,200.00	4,909,200.00

AVERAGE LIFE:	25.000
BOND YEARS:	40,910.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT15 10/20/88
6:07 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	16,000,000.00
FUND EARNINGS:	
EARNINGS ON CAPITALIZED INTEREST FUND....................	64,195.66

TOTAL SOURCES..	16,064,195.66

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	12,721,500.00
RESERVE FUND...	1,501,600.00
CAPITALIZED INTEREST FUND:	
FUNDED FROM BOND PROCEEDS................................	1,215,804.34
FUNDED FROM CAP INT EARNINGS.............................	64,195.66
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	560,000.00
ROUNDING AMOUNT..	1,095.66

TOTAL USES OF FUNDS..	16,064,195.66

NOTES:

EARNINGS RATE ON THE CAPITALIZED INTEREST FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %
INTEREST IS TO BE CAPITALIZED TO 01/01/13

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'12

10/20/88

DEALNAME: WHCWAT15
DEALTYPE: NEW ISSUE DATE: 01/01/12 DELIVERY DATE: 01/01/12 6:07 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/12			640,000.00	640,000.00	640,000.00
01/01/13			640,000.00	640,000.00	.00
07/01/13			640,000.00	640,000.00	1,280,000.00
01/01/14	230,000	8.000	640,000.00	870,000.00	.00
07/01/14			630,800.00	630,800.00	1,500,800.00
01/01/15	250,000	8.000	630,800.00	880,800.00	.00
07/01/15			620,800.00	620,800.00	1,501,600.00
01/01/16	270,000	8.000	620,800.00	890,800.00	.00
07/01/16			610,000.00	610,000.00	1,500,800.00
01/01/17	290,000	8.000	610,000.00	900,000.00	.00
07/01/17			598,400.00	598,400.00	1,498,400.00
01/01/18	315,000	8.000	598,400.00	913,400.00	.00
07/01/18			585,800.00	585,800.00	1,499,200.00
01/01/19	340,000	8.000	585,800.00	925,800.00	.00
07/01/19			572,200.00	572,200.00	1,498,000.00
01/01/20	370,000	8.000	572,200.00	942,200.00	.00
07/01/20			557,400.00	557,400.00	1,499,600.00
01/01/21	400,000	8.000	557,400.00	957,400.00	.00
07/01/21			541,400.00	541,400.00	1,498,800.00
01/01/22	435,000	8.000	541,400.00	976,400.00	.00
07/01/22			524,000.00	524,000.00	1,500,400.00
01/01/23	470,000	8.000	524,000.00	994,000.00	.00
07/01/23			505,200.00	505,200.00	1,499,200.00
01/01/24	510,000	8.000	505,200.00	1,015,200.00	.00
07/01/24			484,800.00	484,800.00	1,500,000.00
01/01/25	550,000	8.000	484,800.00	1,034,800.00	.00
07/01/25			462,800.00	462,800.00	1,497,600.00
01/01/26	600,000	8.000	462,800.00	1,062,800.00	.00
07/01/26			438,800.00	438,800.00	1,501,600.00
01/01/27	650,000	8.000	438,800.00	1,088,800.00	.00
07/01/27			412,800.00	412,800.00	1,501,600.00
01/01/28	700,000	8.000	412,800.00	1,112,800.00	.00
07/01/28			384,800.00	384,800.00	1,497,600.00
01/01/29	760,000	8.000	384,800.00	1,144,800.00	.00
07/01/29			354,400.00	354,400.00	1,499,200.00
01/01/30	825,000	8.000	354,400.00	1,179,400.00	.00
07/01/30			321,400.00	321,400.00	1,500,800.00
01/01/31	890,000	8.000	321,400.00	1,211,400.00	.00
07/01/31			285,800.00	285,800.00	1,497,200.00
01/01/32	965,000	8.000	285,800.00	1,250,800.00	.00
07/01/32			247,200.00	247,200.00	1,498,000.00
01/01/33	1,045,000	8.000	247,200.00	1,292,200.00	.00
07/01/33			205,400.00	205,400.00	1,497,600.00
01/01/34	1,135,000	8.000	205,400.00	1,340,400.00	.00
07/01/34			160,000.00	160,000.00	1,500,400.00
01/01/35	1,230,000	8.000	160,000.00	1,390,000.00	.00
07/01/35			110,800.00	110,800.00	1,500,800.00
01/01/36	1,330,000	8.000	110,800.00	1,440,800.00	.00
07/01/36			57,600.00	57,600.00	1,498,400.00
01/01/37	1,440,000	8.000	57,600.00	1,497,600.00	1,497,600.00

TOTALS	16,000,000	21,905,200.00	37,905,200.00	37,905,200.00
ACC INT		.00	.00	.00
NET		21,905,200.00	37,905,200.00	37,905,200.00

AVERAGE LIFE:	17.113
BOND YEARS:	273,815.000
DURATION (@ 10%"):	8.310
AVERAGE COUPON:	8.000

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		EXPENSES			10/20/88
DEALNAME: WHCWAT15					6:07 PM
	FIXED OR	----TIC IMPROVEMENT---		NOT	TOTAL
EXPENSE ITEMS	VARIABLE	REFUNDING	ESCROW	RECOVERABLE	AMOUNT
1) FINANCIAL ADVISOR	V			10.0	160000
2) LEGAL EXPENSE	V			10.0	160000
3) ISSUANCE EXPENSE	V			15.0	240000
4)					0
5)					0
6)					0
7)					0
8)					0
9)					0
10)					0
11)					0
12)					0
13)					0
TOTALS		0	0	560000	560000

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

S020150

DEALNAME: WHCWAT15

10/20/88
6:07 PM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP.INT. @ 7.000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/12	12,721,500-	0	0	0	0	0	1,215,804
07/01/12	0	0	0	42,553	0	0	618,357
01/01/13	0	0	0	21,643	0	0	0-
07/01/13	0	0	0	0	0	0	0-
TOTALS	12,721,500-	0	0	64,196	0		

CONSTRUCTION FUND BEGINNING BALANCE = 12,721,500.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2012 RESERVE FUND

10/20/88

DEALNAME: WHCWAT15
DEALTYPE: RES01 ISSUE DATE: 01/01/12 DELIVERY DATE: 01/01/12 6:08 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/12			60,064.00	60,064.00	60,064.00
01/01/13			60,064.00	60,064.00	.00
07/01/13			60,064.00	60,064.00	120,128.00
01/01/14			60,064.00	60,064.00	.00
07/01/14			60,064.00	60,064.00	120,128.00
01/01/15			60,064.00	60,064.00	.00
07/01/15			60,064.00	60,064.00	120,128.00
01/01/16			60,064.00	60,064.00	.00
07/01/16			60,064.00	60,064.00	120,128.00
01/01/17			60,064.00	60,064.00	.00
07/01/17			60,064.00	60,064.00	120,128.00
01/01/18			60,064.00	60,064.00	.00
07/01/18			60,064.00	60,064.00	120,128.00
01/01/19			60,064.00	60,064.00	.00
07/01/19			60,064.00	60,064.00	120,128.00
01/01/20			60,064.00	60,064.00	.00
07/01/20			60,064.00	60,064.00	120,128.00
01/01/21			60,064.00	60,064.00	.00
07/01/21			60,064.00	60,064.00	120,128.00
01/01/22			60,064.00	60,064.00	.00
07/01/22			60,064.00	60,064.00	120,128.00
01/01/23			60,064.00	60,064.00	.00
07/01/23			60,064.00	60,064.00	120,128.00
01/01/24			60,064.00	60,064.00	.00
07/01/24			60,064.00	60,064.00	120,128.00
01/01/25			60,064.00	60,064.00	.00
07/01/25			60,064.00	60,064.00	120,128.00
01/01/26			60,064.00	60,064.00	.00
07/01/26			60,064.00	60,064.00	120,128.00
01/01/27			60,064.00	60,064.00	.00
07/01/27			60,064.00	60,064.00	120,128.00
01/01/28			60,064.00	60,064.00	.00
07/01/28			60,064.00	60,064.00	120,128.00
01/01/29			60,064.00	60,064.00	.00
07/01/29			60,064.00	60,064.00	120,128.00
01/01/30			60,064.00	60,064.00	.00
07/01/30			60,064.00	60,064.00	120,128.00
01/01/31			60,064.00	60,064.00	.00
07/01/31			60,064.00	60,064.00	120,128.00
01/01/32			60,064.00	60,064.00	.00
07/01/32			60,064.00	60,064.00	120,128.00
01/01/33			60,064.00	60,064.00	.00
07/01/33			60,064.00	60,064.00	120,128.00
01/01/34			60,064.00	60,064.00	.00
07/01/34			60,064.00	60,064.00	120,128.00
01/01/35			60,064.00	60,064.00	.00
07/01/35			60,064.00	60,064.00	120,128.00
01/01/36			60,064.00	60,064.00	.00
07/01/36			60,064.00	60,064.00	120,128.00
01/01/37	1,501,600	8.000	60,064.00	1,561,664.00	1,561,664.00

TOTALS	1,501,600		3,003,200.00	4,504,800.00	4,504,800.00
ACC INT			.00	.00	.00
NET			3,003,200.00	4,504,800.00	4,504,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	37,540.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT16

10/21/88
9:20 AM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	20,335,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS............................	113,617.71
EARNINGS ON RESERVE FUNDS.................................	150,720.00
TOTAL SOURCES...	20,599,337.71

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	18,003,000.00
RESERVE FUND..	1,884,000.00
EXPENSES:	
OTHER ISSUANCE EXPENSES...................................	711,725.00
ROUNDING AMOUNT...	612.71
TOTAL USES OF FUNDS.......................................	20,599,337.71

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'13

DEALNAME: WHCWAT16 10/21/88
DEALTYPE: NEW ISSUE DATE: 01/01/13 DELIVERY DATE: 01/01/13 9:21 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/13			813,400.00	813,400.00	813,400.00
01/01/14	265,000	8.000	813,400.00	1,078,400.00	.00
07/01/14			802,800.00	802,800.00	1,881,200.00
01/01/15	285,000	8.000	802,800.00	1,087,800.00	.00
07/01/15			791,400.00	791,400.00	1,879,200.00
01/01/16	310,000	8.000	791,400.00	1,101,400.00	.00
07/01/16			779,000.00	779,000.00	1,880,400.00
01/01/17	335,000	8.000	779,000.00	1,114,000.00	.00
07/01/17			765,600.00	765,600.00	1,879,600.00
01/01/18	365,000	8.000	765,600.00	1,130,600.00	.00
07/01/18			751,000.00	751,000.00	1,881,600.00
01/01/19	395,000	8.000	751,000.00	1,146,000.00	.00
07/01/19			735,200.00	735,200.00	1,881,200.00
01/01/20	425,000	8.000	735,200.00	1,160,200.00	.00
07/01/20			718,200.00	718,200.00	1,878,400.00
01/01/21	465,000	8.000	718,200.00	1,183,200.00	.00
07/01/21			699,600.00	699,600.00	1,882,800.00
01/01/22	505,000	8.000	699,600.00	1,204,600.00	.00
07/01/22			679,400.00	679,400.00	1,884,000.00
01/01/23	545,000	8.000	679,400.00	1,224,400.00	.00
07/01/23			657,600.00	657,600.00	1,882,000.00
01/01/24	590,000	8.000	657,600.00	1,247,600.00	.00
07/01/24			634,000.00	634,000.00	1,881,600.00
01/01/25	640,000	8.000	634,000.00	1,274,000.00	.00
07/01/25			608,400.00	608,400.00	1,882,400.00
01/01/26	690,000	8.000	608,400.00	1,298,400.00	.00
07/01/26			580,800.00	580,800.00	1,879,200.00
01/01/27	750,000	8.000	580,800.00	1,330,800.00	.00
07/01/27			550,800.00	550,800.00	1,881,600.00
01/01/28	810,000	8.000	550,800.00	1,360,800.00	.00
07/01/28			518,400.00	518,400.00	1,879,200.00
01/01/29	880,000	8.000	518,400.00	1,398,400.00	.00
07/01/29			483,200.00	483,200.00	1,881,600.00
01/01/30	955,000	8.000	483,200.00	1,438,200.00	.00
07/01/30			445,000.00	445,000.00	1,883,200.00
01/01/31	1,035,000	8.000	445,000.00	1,480,000.00	.00
07/01/31			403,600.00	403,600.00	1,883,600.00
01/01/32	1,120,000	8.000	403,600.00	1,523,600.00	.00
07/01/32			358,800.00	358,800.00	1,882,400.00
01/01/33	1,210,000	8.000	358,800.00	1,568,800.00	.00
07/01/33			310,400.00	310,400.00	1,879,200.00
01/01/34	1,315,000	8.000	310,400.00	1,625,400.00	.00
07/01/34			257,800.00	257,800.00	1,883,200.00
01/01/35	1,425,000	8.000	257,800.00	1,682,800.00	.00
07/01/35			200,800.00	200,800.00	1,883,600.00
01/01/36	1,540,000	8.000	200,800.00	1,740,800.00	.00
07/01/36			139,200.00	139,200.00	1,880,000.00
01/01/37	1,670,000	8.000	139,200.00	1,809,200.00	.00
07/01/37			72,400.00	72,400.00	1,881,600.00
01/01/38	1,810,000	8.000	72,400.00	1,882,400.00	1,882,400.00

TOTALS	20,335,000		27,513,600.00	47,848,600.00	47,848,600.00
ACC INT			.00	.00	.00
NET			27,513,600.00	47,848,600.00	47,848,600.00

AVERAGE LIFE:	16.913
BOND YEARS:	343,920.000
DURATION (@ 10%"):	8.203
AVERAGE COUPON:	8.000

EXPENSES 10/21/88 9:22 AM

DEALNAME: WHCWAT16

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	203350
2)	LEGAL EXPENSE	V			10.0	203350
3)	ISSUANCE EXPENSE	V			15.0	305025
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	711725	711725

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT16

10/21/88
9:22 AM

		FUND EARNINGS					
DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP.INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/13	16,180,500-	0	0	0	0	1,558,162	0
07/01/13	0	54,536	75,360	0	0	1,688,058	0
01/01/14	1,822,500-	59,082	75,360	0	0	0	0
TOTALS	18,003,000-	113,618	150,720	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 17,738,662.29

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2013 RESERVE FUND

DEALNAME: WHCWAT16 10/21/98
DEALTYPE: RES01 ISSUE DATE: 01/01/13 DELIVERY DATE: 01/01/13 9:22 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/13			75,360.00	75,360.00	75,360.00
01/01/14			75,360.00	75,360.00	.00
07/01/14			75,360.00	75,360.00	150,720.00
01/01/15			75,360.00	75,360.00	.00
07/01/15			75,360.00	75,360.00	150,720.00
01/01/16			75,360.00	75,360.00	.00
07/01/16			75,360.00	75,360.00	150,720.00
01/01/17			75,360.00	75,360.00	.00
07/01/17			75,360.00	75,360.00	150,720.00
01/01/18			75,360.00	75,360.00	.00
07/01/18			75,360.00	75,360.00	150,720.00
01/01/19			75,360.00	75,360.00	.00
07/01/19			75,360.00	75,360.00	150,720.00
01/01/20			75,360.00	75,360.00	.00
07/01/20			75,360.00	75,360.00	150,720.00
01/01/21			75,360.00	75,360.00	.00
07/01/21			75,360.00	75,360.00	150,720.00
01/01/22			75,360.00	75,360.00	.00
07/01/22			75,360.00	75,360.00	150,720.00
01/01/23			75,360.00	75,360.00	.00
07/01/23			75,360.00	75,360.00	150,720.00
01/01/24			75,360.00	75,360.00	.00
07/01/24			75,360.00	75,360.00	150,720.00
01/01/25			75,360.00	75,360.00	.00
07/01/25			75,360.00	75,360.00	150,720.00
01/01/26			75,360.00	75,360.00	.00
07/01/26			75,360.00	75,360.00	150,720.00
01/01/27			75,360.00	75,360.00	.00
07/01/27			75,360.00	75,360.00	150,720.00
01/01/28			75,360.00	75,360.00	.00
07/01/28			75,360.00	75,360.00	150,720.00
01/01/29			75,360.00	75,360.00	.00
07/01/29			75,360.00	75,360.00	150,720.00
01/01/30			75,360.00	75,360.00	.00
07/01/30			75,360.00	75,360.00	150,720.00
01/01/31			75,360.00	75,360.00	.00
07/01/31			75,360.00	75,360.00	150,720.00
01/01/32			75,360.00	75,360.00	.00
07/01/32			75,360.00	75,360.00	150,720.00
01/01/33			75,360.00	75,360.00	.00
07/01/33			75,360.00	75,360.00	150,720.00
01/01/34			75,360.00	75,360.00	.00
07/01/34			75,360.00	75,360.00	150,720.00
01/01/35			75,360.00	75,360.00	.00
07/01/35			75,360.00	75,360.00	150,720.00
01/01/36			75,360.00	75,360.00	.00
07/01/36			75,360.00	75,360.00	150,720.00
01/01/37			75,360.00	75,360.00	.00
07/01/37			75,360.00	75,360.00	150,720.00
01/01/38	1,884,000	8.000	75,360.00	1,959,360.00	1,959,360.00

TOTALS	1,884,000		3,768,000.00	5,652,000.00	5,652,000.00
ACC INT			.00	.00	.00
NET			3,768,000.00	5,652,000.00	5,652,000.00

AVERAGE LIFE:	25.000
BOND YEARS:	47,100.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT17 10/21/88
9:27 AM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS.......................................	22,170,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS...........................	801,242.25
EARNINGS ON RESERVE FUNDS................................	492,672.00

TOTAL SOURCES..	23,463,914.25

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	20,635,000.00
RESERVE FUND..	2,052,800.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	775,950.00
ROUNDING AMOUNT...	164.25

TOTAL USES OF FUNDS.......................................	23,463,914.25

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SREC. WAT. SUP. SER'15

10/21/88

DEALNAME: WHCWAT17
DEALTYPE: NEW ISSUE DATE: 01/01/15 DELIVERY DATE: 01/01/15 9:27 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/15			886,800.00	886,800.00	886,800.00
01/01/16	290,000	8.000	886,800.00	1,176,800.00	.00
07/01/16			875,200.00	875,200.00	2,052,000.00
01/01/17	315,000	8.000	875,200.00	1,190,200.00	.00
07/01/17			862,600.00	862,600.00	2,052,800.00
01/01/18	340,000	8.000	862,600.00	1,202,600.00	.00
07/01/18			849,000.00	849,000.00	2,051,600.00
01/01/19	365,000	8.000	849,000.00	1,214,000.00	.00
07/01/19			834,400.00	834,400.00	2,048,400.00
01/01/20	400,000	8.000	834,400.00	1,234,400.00	.00
07/01/20			818,400.00	818,400.00	2,052,800.00
01/01/21	430,000	8.000	818,400.00	1,248,400.00	.00
07/01/21			801,200.00	801,200.00	2,049,600.00
01/01/22	465,000	8.000	801,200.00	1,266,200.00	.00
07/01/22			782,600.00	782,600.00	2,048,800.00
01/01/23	505,000	8.000	782,600.00	1,287,600.00	.00
07/01/23			762,400.00	762,400.00	2,050,000.00
01/01/24	550,000	8.000	762,400.00	1,312,400.00	.00
07/01/24			740,400.00	740,400.00	2,052,800.00
01/01/25	595,000	8.000	740,400.00	1,335,400.00	.00
07/01/25			716,600.00	716,600.00	2,052,000.00
01/01/26	645,000	8.000	716,600.00	1,361,600.00	.00
07/01/26			690,800.00	690,800.00	2,052,400.00
01/01/27	695,000	8.000	690,800.00	1,385,800.00	.00
07/01/27			663,000.00	663,000.00	2,048,800.00
01/01/28	755,000	8.000	663,000.00	1,418,000.00	.00
07/01/28			632,800.00	632,800.00	2,050,800.00
01/01/29	820,000	8.000	632,800.00	1,452,800.00	.00
07/01/29			600,000.00	600,000.00	2,052,800.00
01/01/30	885,000	8.000	600,000.00	1,485,000.00	.00
07/01/30			564,600.00	564,600.00	2,049,600.00
01/01/31	960,000	8.000	564,600.00	1,524,600.00	.00
07/01/31			526,200.00	526,200.00	2,050,800.00
01/01/32	1,040,000	8.000	526,200.00	1,566,200.00	.00
07/01/32			484,600.00	484,600.00	2,050,800.00
01/01/33	1,125,000	8.000	484,600.00	1,609,600.00	.00
07/01/33			439,600.00	439,600.00	2,049,200.00
01/01/34	1,220,000	8.000	439,600.00	1,659,600.00	.00
07/01/34			390,800.00	390,800.00	2,050,400.00
01/01/35	1,320,000	8.000	390,800.00	1,710,800.00	.00
07/01/35			338,000.00	338,000.00	2,048,800.00
01/01/36	1,430,000	8.000	338,000.00	1,768,000.00	.00
07/01/36			280,800.00	280,800.00	2,048,800.00
01/01/37	1,550,000	8.000	280,800.00	1,830,800.00	.00
07/01/37			218,800.00	218,800.00	2,049,600.00
01/01/38	1,680,000	8.000	218,800.00	1,898,800.00	.00
07/01/38			151,600.00	151,600.00	2,050,400.00
01/01/39	1,820,000	8.000	151,600.00	1,971,600.00	.00
07/01/39			78,800.00	78,800.00	2,050,400.00
01/01/40	1,970,000	8.000	78,800.00	2,048,800.00	2,048,800.00

TOTALS	22,170,000		29,980,000.00	52,150,000.00	52,150,000.00
ACC INT			.00	.00	.00
NET			29,980,000.00	52,150,000.00	52,150,000.00

AVERAGE LIFE:	16.903
BOND YEARS:	374,750.000
DURATION (@ 10%"):	8.200
AVERAGE COUPON:	8.000

EXPENSES

10/21/88
9:27 AM

DEALNAME: WHCWAT17

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	___________	____________	________10.0	221700
2)	LEGAL EXPENSE	V	___________	____________	________10.0	221700
3)	ISSUANCE EXPENSE	V	___________	____________	________15.0	332550
4)			___________	____________	____________	0
5)			___________	____________	____________	0
6)			___________	____________	____________	0
7)			___________	____________	____________	0
8)			___________	____________	____________	0
9)			___________	____________	____________	0
10)			___________	____________	____________	0
11)			___________	____________	____________	0
12)			___________	____________	____________	0
13)			___________	____________	____________	0
			===========	===========	===========	===========
	TOTALS		0	0	775950	775950

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT17

10/21/88
9:28 AM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/15	9,681,500-	0	0	0	0	9,659,586	0
07/01/15	0	338,086	82,112	0	0	10,079,783	0
01/01/16	9,681,500-	352,792	82,112	0	0	833,188	0
07/01/16	0	29,162	82,112	0	0	944,461	0
01/01/17	424,000-	33,056	82,112	0	0	635,629	0
07/01/17	0	22,247	82,112	0	0	739,988	0
01/01/18	848,000-	25,900	82,112	0	0	0	0
TOTALS	20,635,000-	801,242	492,672	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 19,341,085.75

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2015 RESERVE FUND

DEALNAME: WHCWAT17 10/21/08
DEALTYPE: RES01 ISSUE DATE: 01/01/15 DELIVERY DATE: 01/01/15 9:28 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/15			82,112.00	82,112.00	82,112.00
01/01/16			82,112.00	82,112.00	.00
07/01/16			82,112.00	82,112.00	164,224.00
01/01/17			82,112.00	82,112.00	.00
07/01/17			82,112.00	82,112.00	164,224.00
01/01/18			82,112.00	82,112.00	.00
07/01/18			82,112.00	82,112.00	164,224.00
01/01/19			82,112.00	82,112.00	.00
07/01/19			82,112.00	82,112.00	164,224.00
01/01/20			82,112.00	82,112.00	.00
07/01/20			82,112.00	82,112.00	164,224.00
01/01/21			82,112.00	82,112.00	.00
07/01/21			82,112.00	82,112.00	164,224.00
01/01/22			82,112.00	82,112.00	.00
07/01/22			82,112.00	82,112.00	164,224.00
01/01/23			82,112.00	82,112.00	.00
07/01/23			82,112.00	82,112.00	164,224.00
01/01/24			82,112.00	82,112.00	.00
07/01/24			82,112.00	82,112.00	164,224.00
01/01/25			82,112.00	82,112.00	.00
07/01/25			82,112.00	82,112.00	164,224.00
01/01/26			82,112.00	82,112.00	.00
07/01/26			82,112.00	82,112.00	164,224.00
01/01/27			82,112.00	82,112.00	.00
07/01/27			82,112.00	82,112.00	164,224.00
01/01/28			82,112.00	82,112.00	.00
07/01/28			82,112.00	82,112.00	164,224.00
01/01/29			82,112.00	82,112.00	.00
07/01/29			82,112.00	82,112.00	164,224.00
01/01/30			82,112.00	82,112.00	.00
07/01/30			82,112.00	82,112.00	164,224.00
01/01/31			82,112.00	82,112.00	.00
07/01/31			82,112.00	82,112.00	164,224.00
01/01/32			82,112.00	82,112.00	.00
07/01/32			82,112.00	82,112.00	164,224.00
01/01/33			82,112.00	82,112.00	.00
07/01/33			82,112.00	82,112.00	164,224.00
01/01/34			82,112.00	82,112.00	.00
07/01/34			82,112.00	82,112.00	164,224.00
01/01/35			82,112.00	82,112.00	.00
07/01/35			82,112.00	82,112.00	164,224.00
01/01/36			82,112.00	82,112.00	.00
07/01/36			82,112.00	82,112.00	164,224.00
01/01/37			82,112.00	82,112.00	.00
07/01/37			82,112.00	82,112.00	164,224.00
01/01/38			82,112.00	82,112.00	.00
07/01/38			82,112.00	82,112.00	164,224.00
01/01/39			82,112.00	82,112.00	.00
07/01/39			82,112.00	82,112.00	164,224.00
01/01/40	2,052,800	8.000	82,112.00	2,134,912.00	2,134,912.00

TOTALS	2,052,800		4,105,600.00	6,158,400.00	6,158,400.00
ACC INT			.00	.00	.00
NET			4,105,600.00	6,158,400.00	6,158,400.00

AVERAGE LIFE:	25.000
BOND YEARS:	51,320.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT18 10/21/88 9:59 AM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	11,325,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS...........................	122,830.57
EARNINGS ON RESERVE FUNDS................................	168,000.00
TOTAL SOURCES...	11,615,830.57

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	10,167,000.00
RESERVE FUND..	1,050,000.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	396,375.00
ROUNDING AMOUNT...	2,455.57
TOTAL USES OF FUNDS...	11,615,830.57

NOTES:

EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %

EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER 19

10/21/88

DEALNAME: WHCWAT18
DEALTYPE: NEW   ISSUE DATE: 01/01/19 DELIVERY DATE: 01/01/19   9:59 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/19			453,000.00	453,000.00	453,000.00
01/01/20	145,000	8.000	453,000.00	598,000.00	.00
07/01/20			447,200.00	447,200.00	1,045,200.00
01/01/21	155,000	8.000	447,200.00	602,200.00	.00
07/01/21			441,000.00	441,000.00	1,043,200.00
01/01/22	175,000	8.000	441,000.00	616,000.00	.00
07/01/22			434,000.00	434,000.00	1,050,000.00
01/01/23	185,000	8.000	434,000.00	619,000.00	.00
07/01/23			426,600.00	426,600.00	1,045,600.00
01/01/24	205,000	8.000	426,600.00	631,600.00	.00
07/01/24			418,400.00	418,400.00	1,050,000.00
01/01/25	220,000	8.000	418,400.00	638,400.00	.00
07/01/25			409,600.00	409,600.00	1,048,000.00
01/01/26	240,000	8.000	409,600.00	649,600.00	.00
07/01/26			400,000.00	400,000.00	1,049,600.00
01/01/27	260,000	8.000	400,000.00	660,000.00	.00
07/01/27			389,600.00	389,600.00	1,049,600.00
01/01/28	280,000	8.000	389,600.00	669,600.00	.00
07/01/28			378,400.00	378,400.00	1,048,000.00
01/01/29	305,000	8.000	378,400.00	683,400.00	.00
07/01/29			366,200.00	366,200.00	1,049,600.00
01/01/30	330,000	8.000	366,200.00	696,200.00	.00
07/01/30			353,000.00	353,000.00	1,049,200.00
01/01/31	355,000	8.000	353,000.00	708,000.00	.00
07/01/31			338,800.00	338,800.00	1,046,800.00
01/01/32	385,000	8.000	338,800.00	723,800.00	.00
07/01/32			323,400.00	323,400.00	1,047,200.00
01/01/33	420,000	8.000	323,400.00	743,400.00	.00
07/01/33			306,600.00	306,600.00	1,050,000.00
01/01/34	455,000	8.000	306,600.00	761,600.00	.00
07/01/34			288,400.00	288,400.00	1,050,000.00
01/01/35	490,000	8.000	288,400.00	778,400.00	.00
07/01/35			268,800.00	268,800.00	1,047,200.00
01/01/36	530,000	8.000	268,800.00	798,800.00	.00
07/01/36			247,600.00	247,600.00	1,046,400.00
01/01/37	575,000	8.000	247,600.00	822,600.00	.00
07/01/37			224,600.00	224,600.00	1,047,200.00
01/01/38	625,000	8.000	224,600.00	849,600.00	.00
07/01/38			199,600.00	199,600.00	1,049,200.00
01/01/39	675,000	8.000	199,600.00	874,600.00	.00
07/01/39			172,600.00	172,600.00	1,047,200.00
01/01/40	730,000	8.000	172,600.00	902,600.00	.00
07/01/40			143,400.00	143,400.00	1,046,000.00
01/01/41	790,000	8.000	143,400.00	933,400.00	.00
07/01/41			111,800.00	111,800.00	1,045,200.00
01/01/42	860,000	8.000	111,800.00	971,800.00	.00
07/01/42			77,400.00	77,400.00	1,049,200.00
01/01/43	930,000	8.000	77,400.00	1,007,400.00	.00
07/01/43			40,200.00	40,200.00	1,047,600.00
01/01/44	1,005,000	8.000	40,200.00	1,045,200.00	1,045,200.00

TOTALS	11,325,000	15,320,400.00	26,645,400.00	26,645,400.00
ACC INT		.00	.00	.00
NET		15,320,400.00	26,645,400.00	26,645,400.00

AVERAGE LIFE:	16.910
BOND YEARS:	191,505.000
DURATION (@ 10%"):	8.204
AVERAGE COUPON:	8.000

10/21/88 10:00 AM

E X P E N S E S

10/21/88
10:00 AM

DEALNAME: WHCWAT13

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V			10.0	113250
2)	LEGAL EXPENSE	V			10.0	113250
3)	ISSUANCE EXPENSE	V			15.0	169875
4)						0
5)						0
6)						0
7)						0
8)						0
9)						0
10)						0
11)						0
12)						0
13)						0
	TOTALS		0	0	396375	396375

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT18

10/21/88
10:00 AM

		FUND EARNINGS					
DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP.INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/19	8,901,000-	0	0	0	0	975,169	0
07/01/19	0	34,131	42,000	0	0	1,051,300	0
01/01/20	422,000-	36,796	42,000	0	0	708,096	0
07/01/20	0	24,783	42,000	0	0	774,879	0
01/01/21	844,000-	27,121	42,000	0	0	0	0
TOTALS	10,167,000-	122,831	168,000	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 9,876,169.43

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2019 RESERVE FUND

10/21/98

DEALNAME: WHCWAT18
DEALTYPE: RES01 ISSUE DATE: 01/01/19 DELIVERY DATE: 01/01/19 10:00 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/19			42,000.00	42,000.00	42,000.00
01/01/20			42,000.00	42,000.00	.00
07/01/20			42,000.00	42,000.00	84,000.00
01/01/21			42,000.00	42,000.00	.00
07/01/21			42,000.00	42,000.00	84,000.00
01/01/22			42,000.00	42,000.00	.00
07/01/22			42,000.00	42,000.00	84,000.00
01/01/23			42,000.00	42,000.00	.00
07/01/23			42,000.00	42,000.00	84,000.00
01/01/24			42,000.00	42,000.00	.00
07/01/24			42,000.00	42,000.00	84,000.00
01/01/25			42,000.00	42,000.00	.00
07/01/25			42,000.00	42,000.00	84,000.00
01/01/26			42,000.00	42,000.00	.00
07/01/26			42,000.00	42,000.00	84,000.00
01/01/27			42,000.00	42,000.00	.00
07/01/27			42,000.00	42,000.00	84,000.00
01/01/28			42,000.00	42,000.00	.00
07/01/28			42,000.00	42,000.00	84,000.00
01/01/29			42,000.00	42,000.00	.00
07/01/29			42,000.00	42,000.00	84,000.00
01/01/30			42,000.00	42,000.00	.00
07/01/30			42,000.00	42,000.00	84,000.00
01/01/31			42,000.00	42,000.00	.00
07/01/31			42,000.00	42,000.00	84,000.00
01/01/32			42,000.00	42,000.00	.00
07/01/32			42,000.00	42,000.00	84,000.00
01/01/33			42,000.00	42,000.00	.00
07/01/33			42,000.00	42,000.00	84,000.00
01/01/34			42,000.00	42,000.00	.00
07/01/34			42,000.00	42,000.00	84,000.00
01/01/35			42,000.00	42,000.00	.00
07/01/35			42,000.00	42,000.00	84,000.00
01/01/36			42,000.00	42,000.00	.00
07/01/36			42,000.00	42,000.00	84,000.00
01/01/37			42,000.00	42,000.00	.00
07/01/37			42,000.00	42,000.00	84,000.00
01/01/38			42,000.00	42,000.00	.00
07/01/38			42,000.00	42,000.00	84,000.00
01/01/39			42,000.00	42,000.00	.00
07/01/39			42,000.00	42,000.00	84,000.00
01/01/40			42,000.00	42,000.00	.00
07/01/40			42,000.00	42,000.00	84,000.00
01/01/41			42,000.00	42,000.00	.00
07/01/41			42,000.00	42,000.00	84,000.00
01/01/42			42,000.00	42,000.00	.00
07/01/42			42,000.00	42,000.00	84,000.00
01/01/43			42,000.00	42,000.00	.00
07/01/43			42,000.00	42,000.00	84,000.00
01/01/44	1,050,000	8.000	42,000.00	1,092,000.00	1,092,000.00

TOTALS	1,050,000	2,100,000.00	3,150,000.00	3,150,000.00
ACC INT		.00	.00	.00
NET		2,100,000.00	3,150,000.00	3,150,000.00

AVERAGE LIFE:	25.000
BOND YEARS:	26,250.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT19

10/21/88
10:10 AM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	11,290,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS...........................	147,700.84
EARNINGS ON RESERVE FUNDS................................	251,328.00

TOTAL SOURCES..	11,689,028.84

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	10,244,000.00
RESERVE FUND...	1,047,200.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	395,150.00
ROUNDING AMOUNT..	2,678.84

TOTAL USES OF FUNDS......................................	11,689,028.84

NOTES:

EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'22

DEALNAME: WHCWAT19 10/21/88
DEALTYPE: NEW ISSUE DATE: 01/01/22 DELIVERY DATE: 01/01/22 10:11 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/22			451,600.00	451,600.00	451,600.00
01/01/23	150,000	8.000	451,600.00	601,600.00	.00
07/01/23			445,600.00	445,600.00	1,047,200.00
01/01/24	155,000	8.000	445,600.00	600,600.00	.00
07/01/24			439,400.00	439,400.00	1,040,000.00
01/01/25	170,000	8.000	439,400.00	609,400.00	.00
07/01/25			432,600.00	432,600.00	1,042,000.00
01/01/26	185,000	8.000	432,600.00	617,600.00	.00
07/01/26			425,200.00	425,200.00	1,042,800.00
01/01/27	200,000	8.000	425,200.00	625,200.00	.00
07/01/27			417,200.00	417,200.00	1,042,400.00
01/01/28	220,000	8.000	417,200.00	637,200.00	.00
07/01/28			408,400.00	408,400.00	1,045,600.00
01/01/29	240,000	8.000	408,400.00	648,400.00	.00
07/01/29			398,800.00	398,800.00	1,047,200.00
01/01/30	260,000	8.000	398,800.00	658,800.00	.00
07/01/30			388,400.00	388,400.00	1,047,200.00
01/01/31	280,000	8.000	388,400.00	668,400.00	.00
07/01/31			377,200.00	377,200.00	1,045,600.00
01/01/32	300,000	8.000	377,200.00	677,200.00	.00
07/01/32			365,200.00	365,200.00	1,042,400.00
01/01/33	330,000	8.000	365,200.00	695,200.00	.00
07/01/33			352,000.00	352,000.00	1,047,200.00
01/01/34	355,000	8.000	352,000.00	707,000.00	.00
07/01/34			337,800.00	337,800.00	1,044,800.00
01/01/35	385,000	8.000	337,800.00	722,800.00	.00
07/01/35			322,400.00	322,400.00	1,045,200.00
01/01/36	415,000	8.000	322,400.00	737,400.00	.00
07/01/36			305,800.00	305,800.00	1,043,200.00
01/01/37	450,000	8.000	305,800.00	755,800.00	.00
07/01/37			287,800.00	287,800.00	1,043,600.00
01/01/38	490,000	8.000	287,800.00	777,800.00	.00
07/01/38			268,200.00	268,200.00	1,046,000.00
01/01/39	530,000	8.000	268,200.00	798,200.00	.00
07/01/39			247,000.00	247,000.00	1,045,200.00
01/01/40	575,000	8.000	247,000.00	822,000.00	.00
07/01/40			224,000.00	224,000.00	1,046,000.00
01/01/41	620,000	8.000	224,000.00	844,000.00	.00
07/01/41			199,200.00	199,200.00	1,043,200.00
01/01/42	675,000	8.000	199,200.00	874,200.00	.00
07/01/42			172,200.00	172,200.00	1,046,400.00
01/01/43	730,000	8.000	172,200.00	902,200.00	.00
07/01/43			143,000.00	143,000.00	1,045,200.00
01/01/44	790,000	8.000	143,000.00	933,000.00	.00
07/01/44			111,400.00	111,400.00	1,044,400.00
01/01/45	855,000	8.000	111,400.00	966,400.00	.00
07/01/45			77,200.00	77,200.00	1,043,600.00
01/01/46	925,000	8.000	77,200.00	1,002,200.00	.00
07/01/46			40,200.00	40,200.00	1,042,400.00
01/01/47	1,005,000	8.000	40,200.00	1,045,200.00	1,045,200.00

TOTALS	11,290,000	15,275,600.00	26,565,600.00	26,565,600.00
ACC INT		.00	.00	.00
NET		15,275,600.00	26,565,600.00	26,565,600.00

AVERAGE LIFE:	16.913
BOND YEARS:	190,945.000
DURATION (@ 10%"):	8.204
AVERAGE COUPON:	8.000

10/21/88 10:11 AM

DEALNAME: WHCWAT19		EXPENSES			10/21/88 10:11 AM
EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1) FINANCIAL ADVISOR	V			10.0	112900
2) LEGAL EXPENSE	V			10.0	112900
3) ISSUANCE EXPENSE	V			15.0	169350
4)					0
5)					0
6)					0
7)					0
8)					0
9)					0
10)					0
11)					0
12)					0
13)					0
TOTALS		0	0	395150	395150

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT19

10/21/08
10:11 AM

DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
		FUND EARNINGS					
01/01/22	8,862,000-	0	0	0	0	982,971	0
07/01/22	0	34,404	41,888	0	0	1,059,263	0
01/01/23	460,000-	37,074	41,888	0	0	678,225	0
07/01/23	0	23,738	41,888	0	0	743,851	0
01/01/24	461,000-	26,035	41,888	0	0	350,774	0
07/01/24	0	12,277	41,888	0	0	404,939	0
01/01/25	461,000-	14,173	41,888	0	0	0	0
TOTALS	10,244,000-	147,701	251,328	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 9,844,971.16

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2022 RESERVE FUND

10/21/88

DEALNAME: WHCWAT1?
DEALTYPE: RES01 ISSUE DATE: 01/01/22 DELIVERY DATE: 01/01/22 10:12 AM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/22			41,888.00	41,888.00	41,888.00
01/01/23			41,888.00	41,888.00	.00
07/01/23			41,888.00	41,888.00	83,776.00
01/01/24			41,888.00	41,888.00	.00
07/01/24			41,888.00	41,888.00	83,776.00
01/01/25			41,888.00	41,888.00	.00
07/01/25			41,888.00	41,888.00	83,776.00
01/01/26			41,888.00	41,888.00	.00
07/01/26			41,888.00	41,888.00	83,776.00
01/01/27			41,888.00	41,888.00	.00
07/01/27			41,888.00	41,888.00	83,776.00
01/01/28			41,888.00	41,888.00	.00
07/01/28			41,888.00	41,888.00	83,776.00
01/01/29			41,888.00	41,888.00	.00
07/01/29			41,888.00	41,888.00	83,776.00
01/01/30			41,888.00	41,888.00	.00
07/01/30			41,888.00	41,888.00	83,776.00
01/01/31			41,888.00	41,888.00	.00
07/01/31			41,888.00	41,888.00	83,776.00
01/01/32			41,888.00	41,888.00	.00
07/01/32			41,888.00	41,888.00	83,776.00
01/01/33			41,888.00	41,888.00	.00
07/01/33			41,888.00	41,888.00	83,776.00
01/01/34			41,888.00	41,888.00	.00
07/01/34			41,888.00	41,888.00	83,776.00
01/01/35			41,888.00	41,888.00	.00
07/01/35			41,888.00	41,888.00	83,776.00
01/01/36			41,888.00	41,888.00	.00
07/01/36			41,888.00	41,888.00	83,776.00
01/01/37			41,888.00	41,888.00	.00
07/01/37			41,888.00	41,888.00	83,776.00
01/01/38			41,888.00	41,888.00	.00
07/01/38			41,888.00	41,888.00	83,776.00
01/01/39			41,888.00	41,888.00	.00
07/01/39			41,888.00	41,888.00	83,776.00
01/01/40			41,888.00	41,888.00	.00
07/01/40			41,888.00	41,888.00	83,776.00
01/01/41			41,888.00	41,888.00	.00
07/01/41			41,888.00	41,888.00	83,776.00
01/01/42			41,888.00	41,888.00	.00
07/01/42			41,888.00	41,888.00	83,776.00
01/01/43			41,888.00	41,888.00	.00
07/01/43			41,888.00	41,888.00	83,776.00
01/01/44			41,888.00	41,888.00	.00
07/01/44			41,888.00	41,888.00	83,776.00
01/01/45			41,888.00	41,888.00	.00
07/01/45			41,888.00	41,888.00	83,776.00
01/01/46			41,888.00	41,888.00	.00
07/01/46			41,888.00	41,888.00	83,776.00
01/01/47	1,047,200	8.000	41,888.00	1,089,088.00	1,089,088.00

TOTALS	1,047,200		2,094,400.00	3,141,600.00	3,141,600.00
ACC INT			.00	.00	.00
NET			2,094,400.00	3,141,600.00	3,141,600.00

AVERAGE LIFE:	25.000
BOND YEARS:	26,180.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT20 | 10/24/88 6:20 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS.......................................	14,150,000.00
FUND EARNINGS:	
EARNINGS ON CONSTRUCTION FUNDS...........................	536,259.66
EARNINGS ON RESERVE FUNDS................................	104,928.00
TOTAL SOURCES...	14,791,187.66

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	12,984,000.00
RESERVE FUND..	1,311,600.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	495,250.00
ROUNDING AMOUNT...	337.66
TOTAL USES OF FUNDS.......................................	14,791,187.66

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SREC. WAT. SUP. SER'26

DEALNAME: WHCWAT20 10/24/88
DEALTYPE: NEW ISSUE DATE: 01/01/26 DELIVERY DATE: 01/01/26 6:21 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/26			566,000.00	566,000.00	566,000.00
01/01/27	185,000	8.000	566,000.00	751,000.00	.00
07/01/27			558,600.00	558,600.00	1,309,600.00
01/01/28	200,000	8.000	558,600.00	758,600.00	.00
07/01/28			550,600.00	550,600.00	1,309,200.00
01/01/29	215,000	8.000	550,600.00	765,600.00	.00
07/01/29			542,000.00	542,000.00	1,307,600.00
01/01/30	230,000	8.000	542,000.00	772,000.00	.00
07/01/30			532,800.00	532,800.00	1,304,800.00
01/01/31	250,000	8.000	532,800.00	782,800.00	.00
07/01/31			522,800.00	522,800.00	1,305,600.00
01/01/32	275,000	8.000	522,800.00	797,800.00	.00
07/01/32			511,800.00	511,800.00	1,309,600.00
01/01/33	300,000	8.000	511,800.00	811,800.00	.00
07/01/33			499,800.00	499,800.00	1,311,600.00
01/01/34	325,000	8.000	499,800.00	824,800.00	.00
07/01/34			486,800.00	486,800.00	1,311,600.00
01/01/35	350,000	8.000	486,800.00	836,800.00	.00
07/01/35			472,800.00	472,800.00	1,309,600.00
01/01/36	380,000	8.000	472,800.00	852,800.00	.00
07/01/36			457,600.00	457,600.00	1,310,400.00
01/01/37	410,000	8.000	457,600.00	867,600.00	.00
07/01/37			441,200.00	441,200.00	1,308,800.00
01/01/38	445,000	8.000	441,200.00	886,200.00	.00
07/01/38			423,400.00	423,400.00	1,309,600.00
01/01/39	480,000	8.000	423,400.00	903,400.00	.00
07/01/39			404,200.00	404,200.00	1,307,600.00
01/01/40	520,000	8.000	404,200.00	924,200.00	.00
07/01/40			383,400.00	383,400.00	1,307,600.00
01/01/41	565,000	8.000	383,400.00	948,400.00	.00
07/01/41			360,800.00	360,800.00	1,309,200.00
01/01/42	610,000	8.000	360,800.00	970,800.00	.00
07/01/42			336,400.00	336,400.00	1,307,200.00
01/01/43	665,000	8.000	336,400.00	1,001,400.00	.00
07/01/43			309,800.00	309,800.00	1,311,200.00
01/01/44	720,000	8.000	309,800.00	1,029,800.00	.00
07/01/44			281,000.00	281,000.00	1,310,800.00
01/01/45	780,000	8.000	281,000.00	1,061,000.00	.00
07/01/45			249,800.00	249,800.00	1,310,800.00
01/01/46	845,000	8.000	249,800.00	1,094,800.00	.00
07/01/46			216,000.00	216,000.00	1,310,800.00
01/01/47	915,000	8.000	216,000.00	1,131,000.00	.00
07/01/47			179,400.00	179,400.00	1,310,400.00
01/01/48	990,000	8.000	179,400.00	1,169,400.00	.00
07/01/48			139,800.00	139,800.00	1,309,200.00
01/01/49	1,075,000	8.000	139,800.00	1,214,800.00	.00
07/01/49			96,800.00	96,800.00	1,311,600.00
01/01/50	1,160,000	8.000	96,800.00	1,256,800.00	.00
07/01/50			50,400.00	50,400.00	1,307,200.00
01/01/51	1,260,000	8.000	50,400.00	1,310,400.00	1,310,400.00

TOTALS	14,150,000	19,148,000.00	33,298,000.00	33,298,000.00
ACC INT		.00	.00	.00
NET		19,148,000.00	33,298,000.00	33,298,000.00

AVERAGE LIFE:	16.915
BOND YEARS:	239,350.000
DURATION (@ 10%"):	8.204
AVERAGE COUPON:	8.000

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EXPENSES

DEALNAME: WHCWAT20

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	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	__________	__________	________10.0	141500
2)	LEGAL EXPENSE	V	__________	__________	________10.0	141500
3)	ISSUANCE EXPENSE	V	__________	__________	________15.0	212250
4)			__________	__________	__________	0
5)			__________	__________	__________	0
6)			__________	__________	__________	0
7)			__________	__________	__________	0
8)			__________	__________	__________	0
9)			__________	__________	__________	0
10)			__________	__________	__________	0
11)			__________	__________	__________	0
12)			__________	__________	__________	0
13)			__________	__________	__________	0
	TOTALS		0	0	495250	495250

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT20

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		----FUND EARNINGS----					
DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP.INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/26	4,839,500-	0	0	0	0	7,503,312	0
07/01/26	0	262,616	52,464	0	0	7,818,392	0
01/01/27	8,144,500-	273,644	52,464	0	0	0	0
TOTALS	12,984,000-	536,260	104,928	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 12,342,812.34

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2026 RESERVE FUND

DEALNAME: WHCWAT20
DEALTYPE: RES01 ISSUE DATE: 01/01/26 DELIVERY DATE: 01/01/26 6:22 PM 10/24/08

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/26			52,464.00	52,464.00	52,464.00
01/01/27			52,464.00	52,464.00	.00
07/01/27			52,464.00	52,464.00	104,928.00
01/01/28			52,464.00	52,464.00	.00
07/01/28			52,464.00	52,464.00	104,928.00
01/01/29			52,464.00	52,464.00	.00
07/01/29			52,464.00	52,464.00	104,928.00
01/01/30			52,464.00	52,464.00	.00
07/01/30			52,464.00	52,464.00	104,928.00
01/01/31			52,464.00	52,464.00	.00
07/01/31			52,464.00	52,464.00	104,928.00
01/01/32			52,464.00	52,464.00	.00
07/01/32			52,464.00	52,464.00	104,928.00
01/01/33			52,464.00	52,464.00	.00
07/01/33			52,464.00	52,464.00	104,928.00
01/01/34			52,464.00	52,464.00	.00
07/01/34			52,464.00	52,464.00	104,928.00
01/01/35			52,464.00	52,464.00	.00
07/01/35			52,464.00	52,464.00	104,928.00
01/01/36			52,464.00	52,464.00	.00
07/01/36			52,464.00	52,464.00	104,928.00
01/01/37			52,464.00	52,464.00	.00
07/01/37			52,464.00	52,464.00	104,928.00
01/01/38			52,464.00	52,464.00	.00
07/01/38			52,464.00	52,464.00	104,928.00
01/01/39			52,464.00	52,464.00	.00
07/01/39			52,464.00	52,464.00	104,928.00
01/01/40			52,464.00	52,464.00	.00
07/01/40			52,464.00	52,464.00	104,928.00
01/01/41			52,464.00	52,464.00	.00
07/01/41			52,464.00	52,464.00	104,928.00
01/01/42			52,464.00	52,464.00	.00
07/01/42			52,464.00	52,464.00	104,928.00
01/01/43			52,464.00	52,464.00	.00
07/01/43			52,464.00	52,464.00	104,928.00
01/01/44			52,464.00	52,464.00	.00
07/01/44			52,464.00	52,464.00	104,928.00
01/01/45			52,464.00	52,464.00	.00
07/01/45			52,464.00	52,464.00	104,928.00
01/01/46			52,464.00	52,464.00	.00
07/01/46			52,464.00	52,464.00	104,928.00
01/01/47			52,464.00	52,464.00	.00
07/01/47			52,464.00	52,464.00	104,928.00
01/01/48			52,464.00	52,464.00	.00
07/01/48			52,464.00	52,464.00	104,928.00
01/01/49			52,464.00	52,464.00	.00
07/01/49			52,464.00	52,464.00	104,928.00
01/01/50			52,464.00	52,464.00	.00
07/01/50			52,464.00	52,464.00	104,928.00
01/01/51	1,311,600	8.000	52,464.00	1,364,064.00	1,364,064.00

TOTALS	1,311,600	2,623,200.00	3,934,800.00	3,934,800.00
ACC INT		.00	.00	.00
NET		2,623,200.00	3,934,800.00	3,934,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	32,790.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEAL NAME: WHCWAT21

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SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	16,400,000.00
TOTAL SOURCES..	16,400,000.00

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	14,305,000.00
RESERVE FUND...	1,519,200.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	574,000.00
ROUNDING AMOUNT..	1,800.00
TOTAL USES OF FUNDS..	16,400,000.00

NOTES:

EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'28

DEALNAME: WHCWAT21 10/24/88
DEALTYPE: NEW ISSUE DATE: 01/01/28 DELIVERY DATE: 01/01/28 6:34 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/28			656,000.00	656,000.00	656,000.00
01/01/29	215,000	8.000	656,000.00	871,000.00	.00
07/01/29			647,400.00	647,400.00	1,518,400.00
01/01/30	230,000	8.000	647,400.00	877,400.00	.00
07/01/30			638,200.00	638,200.00	1,515,600.00
01/01/31	250,000	8.000	638,200.00	888,200.00	.00
07/01/31			628,200.00	628,200.00	1,516,400.00
01/01/32	270,000	8.000	628,200.00	898,200.00	.00
07/01/32			617,400.00	617,400.00	1,515,600.00
01/01/33	295,000	8.000	617,400.00	912,400.00	.00
07/01/33			605,600.00	605,600.00	1,518,000.00
01/01/34	320,000	8.000	605,600.00	925,600.00	.00
07/01/34			592,800.00	592,800.00	1,518,400.00
01/01/35	345,000	8.000	592,800.00	937,800.00	.00
07/01/35			579,000.00	579,000.00	1,516,800.00
01/01/36	375,000	8.000	579,000.00	954,000.00	.00
07/01/36			564,000.00	564,000.00	1,518,000.00
01/01/37	405,000	8.000	564,000.00	969,000.00	.00
07/01/37			547,800.00	547,800.00	1,516,800.00
01/01/38	440,000	8.000	547,800.00	987,800.00	.00
07/01/38			530,200.00	530,200.00	1,518,000.00
01/01/39	475,000	8.000	530,200.00	1,005,200.00	.00
07/01/39			511,200.00	511,200.00	1,516,400.00
01/01/40	515,000	8.000	511,200.00	1,026,200.00	.00
07/01/40			490,600.00	490,600.00	1,516,800.00
01/01/41	560,000	8.000	490,600.00	1,050,600.00	.00
07/01/41			468,200.00	468,200.00	1,518,800.00
01/01/42	605,000	8.000	468,200.00	1,073,200.00	.00
07/01/42			444,000.00	444,000.00	1,517,200.00
01/01/43	655,000	8.000	444,000.00	1,099,000.00	.00
07/01/43			417,800.00	417,800.00	1,516,800.00
01/01/44	710,000	8.000	417,800.00	1,127,800.00	.00
07/01/44			389,400.00	389,400.00	1,517,200.00
01/01/45	770,000	8.000	389,400.00	1,159,400.00	.00
07/01/45			358,600.00	358,600.00	1,518,000.00
01/01/46	835,000	8.000	358,600.00	1,193,600.00	.00
07/01/46			325,200.00	325,200.00	1,518,800.00
01/01/47	900,000	8.000	325,200.00	1,225,200.00	.00
07/01/47			289,200.00	289,200.00	1,514,400.00
01/01/48	975,000	8.000	289,200.00	1,264,200.00	.00
07/01/48			250,200.00	250,200.00	1,514,400.00
01/01/49	1,060,000	8.000	250,200.00	1,310,200.00	.00
07/01/49			207,800.00	207,800.00	1,518,000.00
01/01/50	1,145,000	8.000	207,800.00	1,352,800.00	.00
07/01/50			162,000.00	162,000.00	1,514,800.00
01/01/51	1,245,000	8.000	162,000.00	1,407,000.00	.00
07/01/51			112,200.00	112,200.00	1,519,200.00
01/01/52	1,345,000	8.000	112,200.00	1,457,200.00	.00
07/01/52			58,400.00	58,400.00	1,515,600.00
01/01/53	1,460,000	8.000	58,400.00	1,518,400.00	1,518,400.00

TOTALS	16,400,000	22,182,800.00	38,582,800.00	38,582,800.00
ACC INT		.00	.00	.00
NET		22,182,800.00	38,582,800.00	38,582,800.00

AVERAGE LIFE:	16.908
BOND YEARS:	277,285.000
DURATION (@ 10%"):	8.201
AVERAGE COUPON:	8.000

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EXPENSES

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DEALNAME: WHCWAT21

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	___________	___________	________10.0	164000
2)	LEGAL EXPENSE	V	___________	___________	________10.0	164000
3)	ISSUANCE EXPENSE	V	___________	___________	________15.0	246000
4)			___________	___________	___________	0
5)			___________	___________	___________	0
6)			___________	___________	___________	0
7)			___________	___________	___________	0
8)			___________	___________	___________	0
9)			___________	___________	___________	0
10)			___________	___________	___________	0
11)			___________	___________	___________	0
12)			___________	___________	___________	0
13)			___________	___________	___________	0
	TOTALS		0	0	574000	574000

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT21

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DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/28	14,305,000-	0	0	0	0	0	0
TOTALS	14,305,000-	0	0	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 14,305,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2028 RESERVE FUND

DEALNAME: WHCWAT21 10/24/88
DEALTYPE: RES01 ISSUE DATE: 01/01/28 DELIVERY DATE: 01/01/28 6:35 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/28			60,768.00	60,768.00	60,768.00
01/01/29			60,768.00	60,768.00	.00
07/01/29			60,768.00	60,768.00	121,536.00
01/01/30			60,768.00	60,768.00	.00
07/01/30			60,768.00	60,768.00	121,536.00
01/01/31			60,768.00	60,768.00	.00
07/01/31			60,768.00	60,768.00	121,536.00
01/01/32			60,768.00	60,768.00	.00
07/01/32			60,768.00	60,768.00	121,536.00
01/01/33			60,768.00	60,768.00	.00
07/01/33			60,768.00	60,768.00	121,536.00
01/01/34			60,768.00	60,768.00	.00
07/01/34			60,768.00	60,768.00	121,536.00
01/01/35			60,768.00	60,768.00	.00
07/01/35			60,768.00	60,768.00	121,536.00
01/01/36			60,768.00	60,768.00	.00
07/01/36			60,768.00	60,768.00	121,536.00
01/01/37			60,768.00	60,768.00	.00
07/01/37			60,768.00	60,768.00	121,536.00
01/01/38			60,768.00	60,768.00	.00
07/01/38			60,768.00	60,768.00	121,536.00
01/01/39			60,768.00	60,768.00	.00
07/01/39			60,768.00	60,768.00	121,536.00
01/01/40			60,768.00	60,768.00	.00
07/01/40			60,768.00	60,768.00	121,536.00
01/01/41			60,768.00	60,768.00	.00
07/01/41			60,768.00	60,768.00	121,536.00
01/01/42			60,768.00	60,768.00	.00
07/01/42			60,768.00	60,768.00	121,536.00
01/01/43			60,768.00	60,768.00	.00
07/01/43			60,768.00	60,768.00	121,536.00
01/01/44			60,768.00	60,768.00	.00
07/01/44			60,768.00	60,768.00	121,536.00
01/01/45			60,768.00	60,768.00	.00
07/01/45			60,768.00	60,768.00	121,536.00
01/01/46			60,768.00	60,768.00	.00
07/01/46			60,768.00	60,768.00	121,536.00
01/01/47			60,768.00	60,768.00	.00
07/01/47			60,768.00	60,768.00	121,536.00
01/01/48			60,768.00	60,768.00	.00
07/01/48			60,768.00	60,768.00	121,536.00
01/01/49			60,768.00	60,768.00	.00
07/01/49			60,768.00	60,768.00	121,536.00
01/01/50			60,768.00	60,768.00	.00
07/01/50			60,768.00	60,768.00	121,536.00
01/01/51			60,768.00	60,768.00	.00
07/01/51			60,768.00	60,768.00	121,536.00
01/01/52			60,768.00	60,768.00	.00
07/01/52			60,768.00	60,768.00	121,536.00
01/01/53	1,519,200	8.000	60,768.00	1,579,968.00	1,579,968.00

TOTALS	1,519,200		3,038,400.00	4,557,600.00	4,557,600.00
ACC INT			.00	.00	.00
NET			3,038,400.00	4,557,600.00	4,557,600.00

AVERAGE LIFE:	25.000
BOND YEARS:	37,980.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT22 10/24/88
6:40 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS..	26,415,000.00
TOTAL SOURCES..	26,415,000.00

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	23,040,000.00
RESERVE FUND...	2,445,600.00
EXPENSES:	
OTHER ISSUANCE EXPENSES..................................	924,525.00
ROUNDING AMOUNT..	4,875.00
TOTAL USES OF FUNDS..	26,415,000.00

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'29

DEALNAME: WHCWAT22 10/24/98
DEALTYPE: NEW ISSUE DATE: 01/01/29 DELIVERY DATE: 01/01/29 6:40 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/29			1,056,600.00	1,056,600.00	1,056,600.00
01/01/30	345,000	8.000	1,056,600.00	1,401,600.00	.00
07/01/30			1,042,800.00	1,042,800.00	2,444,400.00
01/01/31	375,000	8.000	1,042,800.00	1,417,800.00	.00
07/01/31			1,027,800.00	1,027,800.00	2,445,600.00
01/01/32	405,000	8.000	1,027,800.00	1,432,800.00	.00
07/01/32			1,011,600.00	1,011,600.00	2,444,400.00
01/01/33	435,000	8.000	1,011,600.00	1,446,600.00	.00
07/01/33			994,200.00	994,200.00	2,440,800.00
01/01/34	475,000	8.000	994,200.00	1,469,200.00	.00
07/01/34			975,200.00	975,200.00	2,444,400.00
01/01/35	515,000	8.000	975,200.00	1,490,200.00	.00
07/01/35			954,600.00	954,600.00	2,444,800.00
01/01/36	555,000	8.000	954,600.00	1,509,600.00	.00
07/01/36			932,400.00	932,400.00	2,442,000.00
01/01/37	600,000	8.000	932,400.00	1,532,400.00	.00
07/01/37			908,400.00	908,400.00	2,440,800.00
01/01/38	650,000	8.000	908,400.00	1,558,400.00	.00
07/01/38			882,400.00	882,400.00	2,440,800.00
01/01/39	705,000	8.000	882,400.00	1,587,400.00	.00
07/01/39			854,200.00	854,200.00	2,441,600.00
01/01/40	765,000	8.000	854,200.00	1,619,200.00	.00
07/01/40			823,600.00	823,600.00	2,442,800.00
01/01/41	830,000	8.000	823,600.00	1,653,600.00	.00
07/01/41			790,400.00	790,400.00	2,444,000.00
01/01/42	900,000	8.000	790,400.00	1,690,400.00	.00
07/01/42			754,400.00	754,400.00	2,444,800.00
01/01/43	975,000	8.000	754,400.00	1,729,400.00	.00
07/01/43			715,400.00	715,400.00	2,444,800.00
01/01/44	1,055,000	8.000	715,400.00	1,770,400.00	.00
07/01/44			673,200.00	673,200.00	2,443,600.00
01/01/45	1,145,000	8.000	673,200.00	1,818,200.00	.00
07/01/45			627,400.00	627,400.00	2,445,600.00
01/01/46	1,240,000	8.000	627,400.00	1,867,400.00	.00
07/01/46			577,800.00	577,800.00	2,445,200.00
01/01/47	1,340,000	8.000	577,800.00	1,917,800.00	.00
07/01/47			524,200.00	524,200.00	2,442,000.00
01/01/48	1,455,000	8.000	524,200.00	1,979,200.00	.00
07/01/48			466,000.00	466,000.00	2,445,200.00
01/01/49	1,575,000	8.000	466,000.00	2,041,000.00	.00
07/01/49			403,000.00	403,000.00	2,444,000.00
01/01/50	1,705,000	8.000	403,000.00	2,108,000.00	.00
07/01/50			334,800.00	334,800.00	2,442,800.00
01/01/51	1,850,000	8.000	334,800.00	2,184,800.00	.00
07/01/51			260,800.00	260,800.00	2,445,600.00
01/01/52	2,000,000	8.000	260,800.00	2,260,800.00	.00
07/01/52			180,800.00	180,800.00	2,441,600.00
01/01/53	2,170,000	8.000	180,800.00	2,350,800.00	.00
07/01/53			94,000.00	94,000.00	2,444,800.00
01/01/54	2,350,000	8.000	94,000.00	2,444,000.00	2,444,000.00

TOTALS	26,415,000		35,732,000.00	62,147,000.00	62,147,000.00
ACC INT			.00	.00	.00
NET			35,732,000.00	62,147,000.00	62,147,000.00

AVERAGE LIFE:	16.909
BOND YEARS:	446,650.000
DURATION (@ 10%"):	8.201
AVERAGE COUPON:	8.000

10/24/88 6:41 PM

EXPENSES

DEALNAME: WHCWAT22 10/24/88 6:41 PM

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT--- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	----------	----------	--------10.0	264150
2)	LEGAL EXPENSE	V	----------	----------	--------10.0	264150
3)	ISSUANCE EXPENSE	V	----------	----------	--------15.0	396225
4)			----------	----------	----------	0
5)			----------	----------	----------	0
6)			----------	----------	----------	0
7)			----------	----------	----------	0
8)			----------	----------	----------	0
9)			----------	----------	----------	0
10)			----------	----------	----------	0
11)			----------	----------	----------	0
12)			----------	----------	----------	0
13)			----------	----------	----------	0
	TOTALS		0	0	924525	924525

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT22

10/24/88
6:41 PM

		FUND EARNINGS					
DATES	CONSTRUCTION DRAWDOWN	CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP.INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP.INT. FUND BAL
01/01/29	23,040,000-	0	0	0	0	0	0
TOTALS	23,040,000-	0	0	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 23,040,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2029 RESERVE FUND

10/24/88

DEALNAME: WHCWAT22
DEALTYPE: RES01 ISSUE DATE: 01/01/29 DELIVERY DATE: 01/01/29 6:43 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/29			97,824.00	97,824.00	97,824.00
01/01/30			97,824.00	97,824.00	.00
07/01/30			97,824.00	97,824.00	195,648.00
01/01/31			97,824.00	97,824.00	.00
07/01/31			97,824.00	97,824.00	195,648.00
01/01/32			97,824.00	97,824.00	.00
07/01/32			97,824.00	97,824.00	195,648.00
01/01/33			97,824.00	97,824.00	.00
07/01/33			97,824.00	97,824.00	195,648.00
01/01/34			97,824.00	97,824.00	.00
07/01/34			97,824.00	97,824.00	195,648.00
01/01/35			97,824.00	97,824.00	.00
07/01/35			97,824.00	97,824.00	195,648.00
01/01/36			97,824.00	97,824.00	.00
07/01/36			97,824.00	97,824.00	195,648.00
01/01/37			97,824.00	97,824.00	.00
07/01/37			97,824.00	97,824.00	195,648.00
01/01/38			97,824.00	97,824.00	.00
07/01/38			97,824.00	97,824.00	195,648.00
01/01/39			97,824.00	97,824.00	.00
07/01/39			97,824.00	97,824.00	195,648.00
01/01/40			97,824.00	97,824.00	.00
07/01/40			97,824.00	97,824.00	195,648.00
01/01/41			97,824.00	97,824.00	.00
07/01/41			97,824.00	97,824.00	195,648.00
01/01/42			97,824.00	97,824.00	.00
07/01/42			97,824.00	97,824.00	195,648.00
01/01/43			97,824.00	97,824.00	.00
07/01/43			97,824.00	97,824.00	195,648.00
01/01/44			97,824.00	97,824.00	.00
07/01/44			97,824.00	97,824.00	195,648.00
01/01/45			97,824.00	97,824.00	.00
07/01/45			97,824.00	97,824.00	195,648.00
01/01/46			97,824.00	97,824.00	.00
07/01/46			97,824.00	97,824.00	195,648.00
01/01/47			97,824.00	97,824.00	.00
07/01/47			97,824.00	97,824.00	195,648.00
01/01/48			97,824.00	97,824.00	.00
07/01/48			97,824.00	97,824.00	195,648.00
01/01/49			97,824.00	97,824.00	.00
07/01/49			97,824.00	97,824.00	195,648.00
01/01/50			97,824.00	97,824.00	.00
07/01/50			97,824.00	97,824.00	195,648.00
01/01/51			97,824.00	97,824.00	.00
07/01/51			97,824.00	97,824.00	195,648.00
01/01/52			97,824.00	97,824.00	.00
07/01/52			97,824.00	97,824.00	195,648.00
01/01/53			97,824.00	97,824.00	.00
07/01/53			97,824.00	97,824.00	195,648.00
01/01/54	2,445,600	8.000	97,824.00	2,543,424.00	2,543,424.00

TOTALS	2,445,600	4,891,200.00	7,336,800.00	7,336,800.00
ACC INT		.00	.00	.00
NET		4,891,200.00	7,336,800.00	7,336,800.00

AVERAGE LIFE:	25.000
BOND YEARS:	61,140.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000

ESTIMATED SOURCES AND USES OF FUNDS

DEALNAME: WHCWAT23

10/24/89
6:49 PM

SOURCES OF FUNDS:

BOND ISSUE PROCEEDS......................................	36,460,000.00
TOTAL SOURCES..	36,460,000.00

USES OF FUNDS:

GROSS CONSTRUCTION COSTS	31,805,000.00
RESERVE FUND...	3,375,200.00
EXPENSES:	
OTHER ISSUANCE EXPENSES................................	1,276,100.00
ROUNDING AMOUNT..	3,700.00
TOTAL USES OF FUNDS......................................	36,460,000.00

NOTES:
EARNINGS RATE ON THE CONSTRUCTION FUND IS ESTIMATED AT 7.000 %
EARNINGS RATE ON THE RESERVE FUND IS ESTIMATED AT 8.000 %

DEBT SERVICE SCHEDULE
W. HARRIS CO. SRFC. WAT. SUP. SER'30

DEALNAME: WHCWAT23 10/24/80
DEALTYPE: NEW ISSUE DATE: 01/01/30 DELIVERY DATE: 01/01/30 6:50 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/30			1,458,400.00	1,458,400.00	1,458,400.00
01/01/31	475,000	8.000	1,458,400.00	1,933,400.00	.00
07/01/31			1,439,400.00	1,439,400.00	3,372,800.00
01/01/32	515,000	8.000	1,439,400.00	1,954,400.00	.00
07/01/32			1,418,800.00	1,418,800.00	3,373,200.00
01/01/33	555,000	8.000	1,418,800.00	1,973,800.00	.00
07/01/33			1,396,600.00	1,396,600.00	3,370,400.00
01/01/34	605,000	8.000	1,396,600.00	2,001,600.00	.00
07/01/34			1,372,400.00	1,372,400.00	3,374,000.00
01/01/35	655,000	8.000	1,372,400.00	2,027,400.00	.00
07/01/35			1,346,200.00	1,346,200.00	3,373,600.00
01/01/36	710,000	8.000	1,346,200.00	2,056,200.00	.00
07/01/36			1,317,800.00	1,317,800.00	3,374,000.00
01/01/37	770,000	8.000	1,317,800.00	2,087,800.00	.00
07/01/37			1,287,000.00	1,287,000.00	3,374,800.00
01/01/38	830,000	8.000	1,287,000.00	2,117,000.00	.00
07/01/38			1,253,800.00	1,253,800.00	3,370,800.00
01/01/39	900,000	8.000	1,253,800.00	2,153,800.00	.00
07/01/39			1,217,800.00	1,217,800.00	3,371,600.00
01/01/40	975,000	8.000	1,217,800.00	2,192,800.00	.00
07/01/40			1,178,800.00	1,178,800.00	3,371,600.00
01/01/41	1,055,000	8.000	1,178,800.00	2,233,800.00	.00
07/01/41			1,136,600.00	1,136,600.00	3,370,400.00
01/01/42	1,145,000	8.000	1,136,600.00	2,281,600.00	.00
07/01/42			1,090,800.00	1,090,800.00	3,372,400.00
01/01/43	1,240,000	8.000	1,090,800.00	2,330,800.00	.00
07/01/43			1,041,200.00	1,041,200.00	3,372,000.00
01/01/44	1,345,000	8.000	1,041,200.00	2,386,200.00	.00
07/01/44			987,400.00	987,400.00	3,373,600.00
01/01/45	1,455,000	8.000	987,400.00	2,442,400.00	.00
07/01/45			929,200.00	929,200.00	3,371,600.00
01/01/46	1,580,000	8.000	929,200.00	2,509,200.00	.00
07/01/46			866,000.00	866,000.00	3,375,200.00
01/01/47	1,710,000	8.000	866,000.00	2,576,000.00	.00
07/01/47			797,600.00	797,600.00	3,373,600.00
01/01/48	1,850,000	8.000	797,600.00	2,647,600.00	.00
07/01/48			723,600.00	723,600.00	3,371,200.00
01/01/49	2,005,000	8.000	723,600.00	2,728,600.00	.00
07/01/49			643,400.00	643,400.00	3,372,000.00
01/01/50	2,175,000	8.000	643,400.00	2,818,400.00	.00
07/01/50			556,400.00	556,400.00	3,374,800.00
01/01/51	2,355,000	8.000	556,400.00	2,911,400.00	.00
07/01/51			462,200.00	462,200.00	3,373,600.00
01/01/52	2,550,000	8.000	462,200.00	3,012,200.00	.00
07/01/52			360,200.00	360,200.00	3,372,400.00
01/01/53	2,765,000	8.000	360,200.00	3,125,200.00	.00
07/01/53			249,600.00	249,600.00	3,374,800.00
01/01/54	2,995,000	8.000	249,600.00	3,244,600.00	.00
07/01/54			129,800.00	129,800.00	3,374,400.00
01/01/55	3,245,000	8.000	129,800.00	3,374,800.00	3,374,800.00

TOTALS	36,460,000		49,322,000.00	85,782,000.00	85,782,000.00
ACC INT			.00	.00	.00
NET			49,322,000.00	85,782,000.00	85,782,000.00

AVERAGE LIFE:	16.910
BOND YEARS:	616,525.000
DURATION (@ 10%"):	8.202
AVERAGE COUPON:	8.000

EXPENSES 10/24/88 6:50 PM

DEALNAME: WHCWAT23

	EXPENSE ITEMS	FIXED OR VARIABLE	----TIC IMPROVEMENT---- REFUNDING	ESCROW	NOT RECOVERABLE	TOTAL AMOUNT
1)	FINANCIAL ADVISOR	V	__________	__________	________10.0	364600
2)	LEGAL EXPENSE	V	__________	__________	________10.0	364600
3)	ISSUANCE EXPENSE	V	__________	__________	________15.0	546900
4)			__________	__________	__________	0
5)			__________	__________	__________	0
6)			__________	__________	__________	0
7)			__________	__________	__________	0
8)			__________	__________	__________	0
9)			__________	__________	__________	0
10)			__________	__________	__________	0
11)			__________	__________	__________	0
12)			__________	__________	__________	0
13)			__________	__________	__________	0
	TOTALS		0	0	1276100	1276100

V-EXP BASED ON ISSUE SIZE F-EXP IS A FIXED AMOUNT
D-INS EXP BASED ON TOTAL D/S C-SAME AS D LESS CAP. INT.

DEALNAME: WHCWAT23

10/24/88
6:50 PM

DATES	CONSTRUCTION DRAWDOWN	FUND EARNINGS CONSTRUCTION @ 7.000%	RESERVE @ 8.000%	CAP. INT. @ .000%	ACCRUED INT @ 7.000%	CONSTRUCTION FUND BAL	CAP. INT. FUND BAL
01/01/90	31,805,000-	0	0	0	0	0	0
TOTALS	31,805,000-	0	0	0	0		

CONSTRUCTION FUND BEGINNING BALANCE = 31,805,000.00

CONSTRUCTION FUND EARNINGS FLOW TO CONSTRUCTION FUND
CAPITALIZED INTEREST EARNINGS FLOW TO CONSTRUCTION FUND
RESERVE FUND EARNINGS FLOW TO CONSTRUCTION FUND

DEBT SERVICE SCHEDULE
SERIES 2030 RESERVE FUND

DEALNAME: WHCWAT23 10/24/88
DEALTYPE: RES01 ISSUE DATE: 01/01/30 DELIVERY DATE: 01/01/30 6:51 PM

DATE	PRINCIPAL	COUPON	INTEREST	TOTAL	ANNUAL
07/01/30			135,008.00	135,008.00	135,008.00
01/01/31			135,008.00	135,008.00	.00
07/01/31			135,008.00	135,008.00	270,016.00
01/01/32			135,008.00	135,008.00	.00
07/01/32			135,008.00	135,008.00	270,016.00
01/01/33			135,008.00	135,008.00	.00
07/01/33			135,008.00	135,008.00	270,016.00
01/01/34			135,008.00	135,008.00	.00
07/01/34			135,008.00	135,008.00	270,016.00
01/01/35			135,008.00	135,008.00	.00
07/01/35			135,008.00	135,008.00	270,016.00
01/01/36			135,008.00	135,008.00	.00
07/01/36			135,008.00	135,008.00	270,016.00
01/01/37			135,008.00	135,008.00	.00
07/01/37			135,008.00	135,008.00	270,016.00
01/01/38			135,008.00	135,008.00	.00
07/01/38			135,008.00	135,008.00	270,016.00
01/01/39			135,008.00	135,008.00	.00
07/01/39			135,008.00	135,008.00	270,016.00
01/01/40			135,008.00	135,008.00	.00
07/01/40			135,008.00	135,008.00	270,016.00
01/01/41			135,008.00	135,008.00	.00
07/01/41			135,008.00	135,008.00	270,016.00
01/01/42			135,008.00	135,008.00	.00
07/01/42			135,008.00	135,008.00	270,016.00
01/01/43			135,008.00	135,008.00	.00
07/01/43			135,008.00	135,008.00	270,016.00
01/01/44			135,008.00	135,008.00	.00
07/01/44			135,008.00	135,008.00	270,016.00
01/01/45			135,008.00	135,008.00	.00
07/01/45			135,008.00	135,008.00	270,016.00
01/01/46			135,008.00	135,008.00	.00
07/01/46			135,008.00	135,008.00	270,016.00
01/01/47			135,008.00	135,008.00	.00
07/01/47			135,008.00	135,008.00	270,016.00
01/01/48			135,008.00	135,008.00	.00
07/01/48			135,008.00	135,008.00	270,016.00
01/01/49			135,008.00	135,008.00	.00
07/01/49			135,008.00	135,008.00	270,016.00
01/01/50			135,008.00	135,008.00	.00
07/01/50			135,008.00	135,008.00	270,016.00
01/01/51			135,008.00	135,008.00	.00
07/01/51			135,008.00	135,008.00	270,016.00
01/01/52			135,008.00	135,008.00	.00
07/01/52			135,008.00	135,008.00	270,016.00
01/01/53			135,008.00	135,008.00	.00
07/01/53			135,008.00	135,008.00	270,016.00
01/01/54			135,008.00	135,008.00	.00
07/01/54			135,008.00	135,008.00	270,016.00
01/01/55	3,375,200	8.000	135,008.00	3,510,208.00	3,510,208.00

TOTALS	3,375,200	6,750,400.00	10,125,600.00	10,125,600.00
ACC INT		.00	.00	.00
NET		6,750,400.00	10,125,600.00	10,125,600.00

AVERAGE LIFE:	25.000
BOND YEARS:	84,380.000
DURATION (@ 10%"):	9.913
AVERAGE COUPON:	8.000