DRAFT

REGIONAL WATER RESOURCES PLAN

recommended by the

JOINT COMMITTEE ON WATER RESOURCES

of the

San Antonio City Council

and the

Edwards Underground Water District

Board of Directors

July, 1988

JOINT COMMITTEE ON WATER RESOURCES

City of San Antonio **Edwards Underground Water District**

July, 1988

To the Citizens of the Edwards Aquifer Region:

After many months of hard work, discussion, and negotiation, we are pleased to present this Regional Water Resources Plan for your consideration. We have undertaken a precedent-setting effort, for the Edwards Region is the first in Texas to attempt to manage our water resources so comprehensively.

The delicate balance between urban development, agricultural production, and the environment has become a concern in many areas across the nation. However, the spirit of compromise which underlies this plan has enabled us to recognize our interdependence and to share equally in the region's burdens and benefits.

We commend this Regional Water Resources Plan to you, our constituents, as our best effort. We do not pretend that it is a "perfect" plan. However, we believe that its principles will enable us to chart a course into a new century, and to provide the highest possible quality of life for future generations.

Sincerely,

Henry Cisneros

Robert C. Hasslocher

Henry G. Cisneros
Mayor
City of San Antonio

Robert C. Hasslocher
Chairman
Edwards Underground Water District

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- Greater San Antonio Builders Association
- Joint Committee of the Greater San Antonio Chamber of Commerce, North San Antonio Chamber of Commerce, and National Association of Industrial and Office Parks
- Interfaith Alliance of Communities Organized for Public Service, Metropolitan Congregational Alliance, and East Side Alliance
- Medina Valley Protection Association

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EXECUTIVE SUMMARY

BACKGROUND

This plan deals with water resources in the region consisting of Uvalde, Medina, Bexar, Comal and Hays Counties. It presents a policy framework for water resources planning between 1990-2040 and lays out the next steps for implementation. It is the product of a unique joint planning effort by the City of San Antonio and the Edwards Underground Water District.

The precise beginning of any planning process is difficult to identify because many past decisions may have led up to initiation of the current plan. Sometime in the 1970s it became evident that a water resources plan for San Antonio must be developed within a larger regional context. It also became evident that this would require a regional consensus which did not then exist on the policies and actions that would be needed to implement the plan.

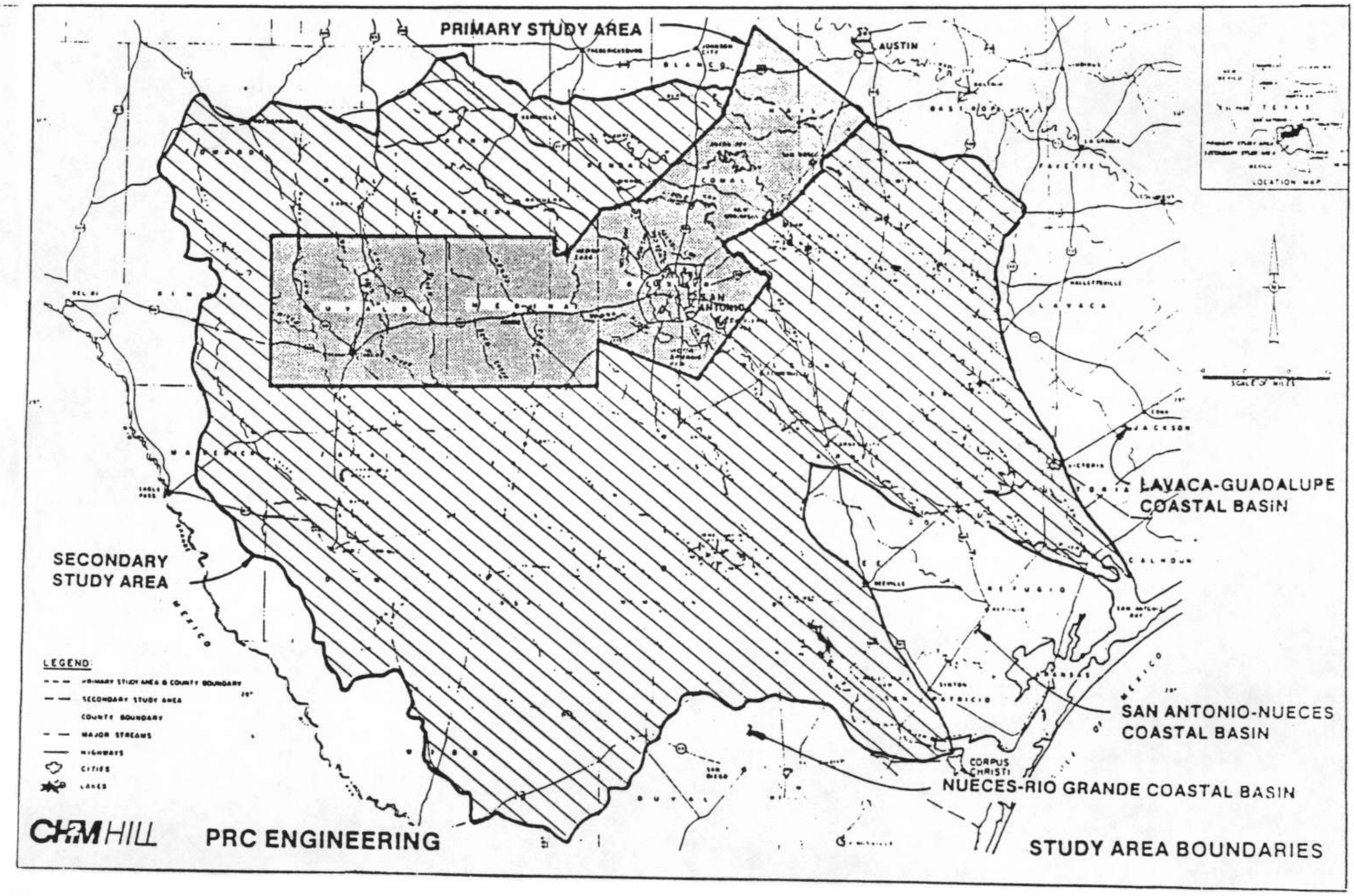
Regional Water Resources Study, 1983-1986

The realization of the need for a regional consensus led to an agreement between the City of San Antonio and the Edwards Underground Water District in November 1983 to develop this plan. The Memorandum of Understanding between these two agencies initiated a joint study of long range water needs and supply alternatives. Every effort was made to insure that the full range of issues was explored and that all interests were represented in the process. The resulting San Antonio Regional Water Resources Study (Figure E-1) was published in April 1986.

The Regional Water Resources Study identified the components that would constitute a regional water resources plan. It assembled data on future water demands and possible alternative sources, and analyzed the impacts of each alternative. It also suggested alternative implementation strategies.

One of the implementation recommendations was the formation of an Implementation Advisory Task Force. The objectives of the IATF were to learn about the issues, to educate others in the region, and to develop a consensus on policy recommendations to be considered by the District and the City. The IATF met throughout the summer and fall of 1986 and submitted its policy recommendations to the Joint Sponsors in December 1986.

Figure E-1
Primary and Secondary Study Areas of the
San Antonio Regional Water Resources Study



Joint Committee, Spring 1987

At this point, two considerations were uppermost in the minds of the City Council and the Edwards District Board of Directors: (1) to provide adequate regional representation in the development of the plan; and (2) to create a workable decision-making process to ensure consensus on policy. These goals were accomplished by the appointment of a Joint Committee on Water Resources, representing both policymaking bodies. The Committee initially consisted of five members of City Council and five members of the Edwards Board of Directors, co-chaired by the Chairman of the Board and the Mayor of the City.

The Joint Committee met each week through the spring of 1987 to consider policy issues systematically. Discussions continued at these meetings until consensus was reached. Not all of the policy recommendations submitted by the IATF were adopted exactly as submitted, nor were all issues resolved. However, three extremely important elements of a Regional Water Resources Plan resulted from this effort.

First, a Joint Resolution was developed and adopted by the City Council and the Edwards Board of Directors in March 1987. This Resolution described the principles and policies accepted up to that point. The key policy held that the aquifer should not be overdrafted during periods of average rainfall, in order to ensure natural flows at Comal and San Marcos Springs.

The Joint Resolution was intended to inform the Legislature on the region's efforts and progress in developing a regional plan, and to obtain approval of the program as state policy. It was submitted to the Legislature in the 1987 session, but it was not passed due to the press of time and the emphasis on efforts to pass related legislation on drought management.

Second, the Joint Committee reached consensus on the immediate need for a plan to manage a regional drought emergency. Therefore the Joint Resolution contained a policy statement that the Edwards District would seek legislative authority to develop and implement a Drought Management Plan. An amendment to the Edwards District enabling statute was developed, submitted and approved by the Legislature as House Bill 1942. Since then, the Edwards District has been developing the Drought Management Plan in a separate process from this long range planning program.

Third, the Joint Committee found that its format and procedures facilitated the development of consensus. They fostered the mutual trust and respect necessary to the negotiation and consensus building process. The Committee therefore agreed to continue addressing policy issues in this forum until all issues were negotiated and agreed upon, including both water quality and quantity measures.

<u>City Council Committee on the Aquifer, Summer 1987</u>

Development of the plan was continued throughout the summer of 1987 by a committee of the City Council examining water quality protection issues. The groundwork for this activity was established by the Joint Committee in its policy statement number one:

> One of the ultimate goals of the Edwards aquifer region is to maintain the aquifer's current high water quality. With technical assistance from the Edwards Underground Water District, cities in the region will adopt ordinances in 1987 for water quality protection to prevent degradation by contamination of sensitive areas of the aquifer. The ordinances will cover matters including but not limited to: using, producing, transporting or storing hazardous materials by commercial activities; assuring the integrity of sewer lines; protecting caves and sinkholes.

A zoning request for a new shopping mall on the aquifer recharge zone precipitated a controversy over the adequacy of regulations to protect the aquifer's water quality. The result was a public hearing and the formation of the City Council Committee on the Aquifer.

This committee designated four "intervenor" groups to ensure that all views were considered in the course of its work. These represented environmentalist and community-based organizations, and the chambers of commerce and development industries. The committee heard from experts on each issue, along with questions and comments from the intervenors, at weekly meetings through the summer.

In September 1987, the Council Committee completed its report, <u>The Edwards Aquifer: Perspectives for Local and Regional Action.</u> The central policy statement was an unambiguous commitment: All policy should be based on a principle of no degradation in groundwater quality. Acceptance of this principle led the

Committee to examine potential sources of contamination along with procedures for dealing with them.

One possible major source of contamination was waste discharges or leaks from sewer lines and septic tanks. The Committee recommended improved specifications for sewer line construction and new controls on septic tanks.

Another concern was the storage and transportation of hazardous materials. A major recommendation was to encourage the Texas Water Commission to amend the Edwards Aquifer Rules to regulate more stringently the storage of hazardous materials. Another was to work for legislation authorizing cities to establish transportation routes through their jurisdictions for hazardous materials shipments.

The Committee recommended a new methodology for review of the Water Pollution Abatement Plans which are required by the Texas Water Commission as a condition for development. The City was urged to amend its zoning ordinance to withhold approval of a zoning change until TWC had previously approved the WPAP.

Still another recommendation was the development of an enhanced mapping process to identify sensitive recharge features such as caves, sinkholes and faults. This information would be useful to both the regulators and those being regulated.

The report was adopted by a unanimous Council and endorsed by the Edwards Board of Directors. Implementation is being carried out according to a specific timetable. These actions have laid to rest the concern that water quality issues had to be considered first, before the quantity issues could be resolved.

CURRENT PLAN DEVELOPMENT PROCESS

Joint Committee, Fall 1987

The Joint Committee reconvened and modified its structure in October, 1987. The representation of the Edwards District was expanded to include one member of the Board from each of the District's five counties, along with the Board Chairman as Committee Co-chair. The City Council refreshed the selection of its five appointees, with the Mayor remaining as the other Co-chair. The Committee was then expanded to include one representative of each of the three river authorities in the region--the San Antonio, Guadalupe-Blanco, and Nueces -- in order to increase the representation of downstream user interests. The intervenor process established by the City Council Committee was also instituted to enhance the level of citizen participation.

Since then the Joint Committee has gone through two distinct steps in the current phase of plan development. The first was a re-examination of the assumptions, results and conclusions of the Regional Water Resources Study. In this stage the Committee came to understand the complex interrelationships among recharge to the aquifer, pumping demands, flows downstream in the Guadalupe and San Antonio River Basins, conservation and resulting demand reductions, wastewater reuse and its effect on water availability, the development of surface water supplies, and the necessity of a reasonable cost recovery mechanism. This resulted in a reaffirmation of the principles adopted in the spring 1987 Joint Resolution.

Development of the Planning Model, 1988

The second step has involved a series of policy decisions. The Committee realized that policy on one plan component could not be made in isolation from other issues. The Committee also came to understand that a large number of alternatives were available for selection as policy.

A tool in the form of a "planning model" was developed (Table E-1.) A planning model in this sense presents numbers in an accounting framework for analysis of alternatives. The numbers in the model represent possible policy choices and they highlight the implications of choosing different values. Thus the Committee could quickly see the effect of using different numbers for groundwater withdrawals, conservation goals, wastewater reuse and surface water development, under both average and assumed drought conditions. The Committee steadily refined and adjusted its targets so that the impacts were as positive as possible for all categories of users in the region.

Table E-1
Planning Model

Water Demands and Sources to Meet Demands
Based on Average Rainfall Conditions
(Acre-feet per year)

Plan Component	Year 2000	2010	2020	2040
(1) Average Recharge	608,000	608,000	608,000	608,000
(2) Projected Demand	506,000	564,000	650,000	870,000
(3) (a) Groundwater Withdrawal	450,000	450,000	450,000	450,000
(b) Allowance for Springflows	158,000	158,000	158,000	158,000
(4) Conservation (10% of Demand)	50,600	56,400	65,000	87,000
(5) Reuse (Net Available after River Release and Evaporation)	37,000	59,000	83,000	131,000
(6) Subtotal: Groundwater Withdrawal + Conservation + Reuse - Demand (3a+4+5-2)	31,600	1,400	-52,000	-202,000
(7) Surface Water				
(a) Canyon	14,000	14,000	14,000	14,000
(b) Applewhite	50,000	50,000	50,000	50,000
(c) Cibolo		30,000	30,000	30,000
(d) Cuero I		141,000	141,000	141,000
(e) Cuero II			24,000	24,000
(f) Surface Subtotal	64,000	235,000	259,000	259,000
(8) Net Balance: Groundwater Withdrawal + Conservation + Reuse + Surface Water - Demand (3a+4+5+7f-2)	95,600	236,400	207,000	57,000

In refining the Planning Model, the Joint Committee arrived at policy recommendations on the following plan components:

1. Quantity of aquifer recharge to be assumed;
2. Projected future regional water demand;
3. Withdrawals of aquifer groundwater;
4. Conservation programs;
5. Wastewater reuse and downstream flows;
6. Surface water projects; and
7. Financing approaches.

The following section discusses each element of the Planning Model and the Committee's rationale for the recommended policy.

1. AQUIFER RECHARGE

Policy

The long term annual average recharge for the period of record, 608,000 acre-feet per year, is used throughout the planning period to represent average conditions.

Artificial recharge may help to sustain aquifer water levels in the long run, but it is not likely to become a major factor in the region's water budget.

Discussion

This policy, taken in conjunction with the groundwater withdrawal policy, reflects the overarching principle of no long term overdraft of the aquifer. For the purposes of this plan, overdraft is defined as a discharge of groundwater from the aquifer by pumping and springflows at an average rate which is greater than the long term average annual recharge.

Annual recharge is a value calculated using specific measurements and formulas. Actual recharge has varied from a low of 43,000 acre-feet in 1956 to a high of 2,003,600 acre-feet in 1987 (Table E-2.) This variation reflects the region's history of alternating between periods of abundant rainfall and periods of painful drought.

Table E-2
Edwards Aquifer Data Summary, 1934-1987

Year	Annual Rainfall (inches) Uvalde	San Antonio	San Marcos	Recharge*	Discharges* Wells	Springs	Total	Change in Storage Since 1933*	Year-End J-17 Well Level AMSL
1934	16.42	27.65	35.67	179.6	101.9	336.0	437.9	-258.3	669
1935	41.15	42.93	41.09	1258.2	103.7	415.9	519.6	480.3	680
1936	24.18	34.11	33.48	909.6	112.7	485.5	598.2	791.7	682
1937	17.88	26.07	28.05	400.7	120.2	451.0	571.2	621.2	678
1938	13.62	23.26	28.17	432.7	120.1	437.7	557.8	496.1	674
1939	25.30	18.83	18.59	399.0	118.9	313.9	432.8	462.2	668
1940	27.46	30.79	43.57	308.8	120.1	296.5	416.6	354.5	671
1941	31.52	26.34	48.41	850.7	136.8	464.4	601.2	604.0	677
1942	19.12	38.46	44.65	557.8	144.6	450.1	594.7	567.1	680
1943	19.77	20.51	25.45	273.1	149.1	390.2	539.3	300.9	669
1944	33.00	33.19	47.42	560.9	147.3	420.1	567.4	294.4	670
1945	22.37	30.46	-	527.8	153.3	461.5	614.8	207.4	673
1946	24.91	45.17	52.24	556.1	155.0	428.9	583.9	179.6	680
1947	22.67	17.32	27.53	422.6	167.0	426.5	593.5	8.7	668
1948	18.31	23.64	-	178.3	168.7	281.9	450.6	-263.6	657
1949	34.42	40.81	36.22	508.1	179.4	300.4	479.8	-235.3	664
1950	18.27	19.86	21.10	200.2	193.8	272.9	466.7	-501.8	656
1951	16.06	24.44	30.88	139.9	209.7	215.9	425.6	-787.5	646
1952	18.24	26.24	39.91	275.5	215.4	209.5	424.9	-936.9	645
1953	18.34	17.56	33.39	167.6	229.8	238.5	468.3	-1237.6	646
1954	15.87	13.70	13.42	162.1	246.2	178.1	424.3	-1499.8	637
1955	20.34	18.18	26.44	192.0	261.0	127.8	388.8	-1696.6	626
1956	9.29	14.31	18.37	43.7	321.1	69.8	390.9	-2043.8	626
1957	39.30	48.83	46.51	1142.6	237.3	219.2	456.5	-1357.7	653
1958	39.03	39.69	39.08	1711.2	219.3	398.2	617.5	-264.0	678
1959	31.51	24.50	43.47	690.4	234.5	384.5	619.0	-192.6	675
1960	23.98	29.76	45.48	824.8	227.1	428.3	655.4	-23.2	679
1961	26.26	26.47	30.02	717.1	228.2	455.3	683.5	10.4	676
1962	14.12	23.90	28.47	239.4	267.9	321.1	589.0	-339.2	666
1963	16.70	18.65	19.90	170.7	276.4	239.6	516.0	-684.5	653
1964	22.30	31.88	30.27	413.2	260.2	213.8	474.0	-745.3	653
1965	26.21	36.72	45.00	623.5	256.1	322.8	578.9	-700.7	669
1966	20.87	21.42	27.12	615.2	255.9	315.3	571.2	-656.7	657
1967	20.10	29.09	26.41	466.5	341.3	216.1	557.4	-747.6	660
1968	25.20	30.39	37.13	884.7	251.7	408.3	660.0	-522.9	670
1969	33.33	31.41	36.59	610.5	307.5	351.2	658.7	-571.1	670
1970	13.59	22.74	32.30	661.6	329.4	397.7	727.1	-636.6	663
1971	31.01	31.80	31.10	925.3	406.8	272.7	679.5	-390.8	674
1972	15.49	31.48	31.90	756.4	371.3	375.8	747.1	-381.5	673
1973	30.85	52.28	47.91	1486.5	310.4	527.6	838.0	267.0	690
1974	30.94	37.00	42.42	658.5	377.4	483.8	861.2	64.3	682
1975	24.92	25.67	48.64	973.0	327.8	540.4	868.2	169.1	676
1976	45.62	39.13	47.46	894.1	349.5	503.9	853.4	209.8	693
1977	19.91	29.64	27.69	952.0	380.6	580.3	960.9	200.9	684
1978	18.65	35.99	33.08	502.5	431.8	375.5	807.3	-103.9	679
1979	32.35	36.64	38.74	1117.8	391.5	523.0	914.5	99.4	680
1980	23.05	24.23	29.56	406.4	491.1	328.3	819.4	-313.6	669
1981	28.24	36.37	49.62	1448.4	387.1	407.3	794.4	340.4	679
1982	23.25	22.96	35.29	417.7	453.1	333.3	786.4	-28.3	667
1983	26.81	26.06	36.95	420.1	418.5	301.6	720.1	-32.3	653
1984	17.65	25.95	35.29	197.9	529.8	172.5	702.3	-832.7	648
1985	28.49	40.31	35.29	1003.3	522.5	334.0	856.5	-685.9	673
1986	29.59	42.76	40.50	1153.7	429.3	405.3	834.6	-366.7	685
1987	36.85	37.22	37.94	2003.6	-	-			685

*Thousands of acre-feet per year.

If groundwater discharges exceed average recharge for a number of years, we know that two things <u>will</u> happen as consequences:

(1) Water elevations throughout the region will decline.

(2) Pumping costs will increase.

Two other things also <u>may</u> happen:

(3) In some areas, particularly along the northern edge of the recharge zone, wells may cease producing water entirely.

(4) Poor quality water may move into the portion of the aquifer that now yields good quality water.

The Joint Committee recognized the wide variation in annual recharge. Therefore the Committee developed its general policy recommendations in the context of average conditions, and then superimposed the consequences of drought levels of recharge on the Planning Model to adjust its policy recommendations.

The difference in the Planning Model between average recharge and the total pumping withdrawal from the aquifer is reserved for natural springflows at Comal and San Marcos Springs. It is estimated that a discharge on the order of 150,000 acre-feet per year is the minimum needed to maintain the springs' unique environments in a healthy state. It is also necessary to consider the water rights of the downstream surface water users in the Guadalupe River Basin.

Policy for periods of relatively abundant rainfall is discussed in the section below on Groundwater Withdrawal.

Response to a regional drought emergency will be governed by the Edwards District's separate Drought Management Plan. Significant reductions in water use will be required during drought periods.

2. PROJECTED FUTURE WATER DEMAND

Policy

The water demand projections developed in the Regional Water Resources Study are used for the purposes of this plan.

Discussion

The Regional Water Resources Study provided population and water demand projections for the region through 2040. These projections are:

Table E-3
Projected Regional Population and Water Demand, 1990-2040

	1990	2000	2010	2020	2040
Population	1,360,000	1,640,000	1,950,000	2,330,000	3,290,000
Water Demand (acre-feet/year)	450,000	506,000	564,000	650,000	870,000

Changing these projections slightly would not alter the policy outcomes significantly. A conscious policy to limit regional growth is not likely in the foreseeable future. Therefore the projected water demand assumes that population growth will occur, that it is acceptable, and that it should be planned for.

3. GROUNDWATER WITHDRAWAL

Policy

The amount of water withdrawn from the aquifer by new users, and increases in withdrawals by existing users, will both be regulated. This process will recognize the historic rights of all users to pump the amounts they have used in previous years. Over time, as new sources of water are developed and as irrigation rights are purchased for retirement or transferred to other uses, the total amount pumped will be gradually reduced to a goal of preserving 150,000 acre-feet per year in natural springflows. This means a pumping goal of 450,000 acre-feet, or approximately 75% of the average annual recharge.

Owners of irrigated agricultural land will be entitled to pump the actual amount they need to grow crops on the number of acres that were irrigated in any year between 1979-1995. They will have flexibility in applying this right to specific acres. Non-irrigation users will be entitled to the maximum amount actually pumped in any year between 1979-1995. The transition period to 1995 will allow new historic rights to be established.

Use of water in excess of historic rights will be subject to a withdrawal fee to offset the cost of other water supplies. This fee will be higher for low priority uses such as seasonal lawn watering and lower for high priority uses such as cropland irrigation and industrial purposes.

During periods of relative abundance, additional water withdrawals may be permitted, depending on conditions in the

aquifer. During periods of drought, withdrawals from the aquifer will be governed by the Regional Drought Management Plan.

The Edwards District will organize a market in water rights. The principal means to reduce groundwater withdrawals to the long run target will be an active policy of retiring water rights through voluntary purchases, substitution of new water resources, and transfers in the water rights market.

Implementation of the groundwater withdrawal policy will be closely tied to the development of alternative water supplies, including conservation, reuse, and surface water development.

Discussion

The Regional Water Resources Study identified four basic sources of water which could be included in the regional water plan: the aquifer, conservation, wastewater reuse, and surface water projects. The most fundamental policy issue is how much water will be withdrawn from the aquifer.

The recommended policy for groundwater use is rooted in the decision that the aquifer must not be overdrafted on a sustained basis and that springflow and other environmental needs will be recognized. In implementing this principle, the groundwater withdrawal policy attempts to protect all of the varied user interests in the aquifer.

Once the decision is made that groundwater withdrawals must be limited, the amount of the limit becomes the very next policy issue. If this amount is set relatively high, less protection is afforded to environmental water needs and downstream users. If it is set low, more water must be developed from other sources. The amount used as a planning/target value also influences legal and financial policies.

The Joint Committee considered possible target values ranging from 425,000 acre-feet per year (the amount recommended in the 1984 Texas Water Plan) to 525,000 acre-feet (the approximate maximum historic experience.) After analyzing the impacts of various combinations in the Planning Model, the Committee chose a <u>target</u> withdrawal limit of 450,000 acre-feet/year for <u>average</u> recharge conditions. This value represents a balance between the reality of current pumping conditions and the need to provide protection to springflows, instream water needs, and bay and estuary freshwater inflows. The value is <u>not</u> an initial "allocation" amount, but a target value to be reached over an indefinite time.

In effect, all existing water rights are "grandfathered" at historic pumping amounts. New growth is then made to bear the cost of the additional supplies it will require.

The development of a market in water rights is an important safety valve in the plan. Sale or lease of groundwater rights would allow water to shift easily and efficiently from one use to another in response to market incentives. As irrigation rights are converted to non-irrigation uses, they would be limited to 1.5 acre-feet per previously irrigated acre. This conversion ratio is an essential mechanism to gradually reduce the existing rights toward the long run target.

The entire regulatory mechanism will automatically terminate by law if satisfactory progress is not made in developing additional water supplies to serve the region's growth.

4. CONSERVATION

Policy

Conservation is to be treated as a source of water, with a goal of reducing total regional water demand by 10% by the year 2000. This will be achieved by a combination of measures including:

- Public and school education programs to develop wise water use practices;
- Restructuring water rates to encourage conservation through increasing block rates, seasonal peak rates and excess use penalties;
- Institution of leak detection programs by the water purveyors;
- Building code amendments to require installation of water conserving fixtures and appliances in all new construction;
- Ordinances requiring retrofit of existing structures with water conserving devices upon sale or structural remodeling;

- **Ordinances and education programs to reduce the use of water in urban landscape irrigation;**
- **Retrofitting of public facilities with water conserving fixtures and more efficient landscape irrigation.**

Significant effort will be made to increase this goal in the future.

Discussion

In a major departure from "traditional" water planning, demand management -- conservation -- is treated as a source of water. The Committee recognized that a gallon of water saved is equal to a gallon of new water supply.

With this principle established, the next policy question was to determine how much could be saved and by what means. The Committee considered an array of possible programs which would produce estimated savings ranging from 2% to 13.5% (Table E-4.) After evaluating the costs of each option, the Committee agreed that a goal of 10% was ambitious but achievable. This is shown in the table as Revised Alternative 2C.

Table E-4

ELEMENTS OF ALTERNATIVE WATER CONSERVATION PROGRAMS

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
	Education		Education, Resale Ordinances, Govt Audits			Education, Resale Ordinance Active Govt Replacement	
SUPPORTIVE PROGRAMS							
Public information/education	X	X	X	X	X	X	X
School education	X	X	X	X	X	X	X
Pricing:							
Increasing rate blocks		X	X	X	X	X	X
Seasonal rate blocks			X	X	X	X	X
Penalty charges				X	X	X	X
Leak detection		X	X	X	X	X	X

NOTE: Pricing alternatives may encourage voluntary retrofit device installation, low water use landscaping and installation of water conserving devices in new construction.

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
DEVICES FOR NEW CONSTRUCTION							
Low flush toilets	X	X	X	X	X	X	X
Low flow shower heads	X	X	X	X	X	X	X
Pipe insulation		X	X	X	X	X	X
Pressure regulation			X	X	X	X	X
Faucet aerator				X	X	X	X
Water efficient appliances							
Dishwashers	X	X	X	X	X	X	X
Washing machine					X	X	X
*Gray water systems					X		X

* Gray water systems or internal residential recycle systems may not be compatible with system wide reuse plan

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
RETROFIT DEVICES FOR EXISTING HOUSING							
Displacement bottles	X	X					
Shower flow restrictors		X	X	X	X	X	X
Toilet dams			X	X	X	X	X
Pressure regulation				X	X	X	X
Faucet aerators					X	X	X
Pipe insulation					X	X	X
Replacement toilets					X		X
URBAN LANDSCAPE IRRIGATION							
Reduced watering	X	X	X	X	X	X	X
Irrigation scheduling		X	X	X	X	X	X
Low water use landscape			X	X	X	X	X
Low volume sprinkers				X	X	X	X
Moisture sensing valve-controller					X	X	X

Table E-4 (cont.)

Water Conservation Opportunity	ALTERNATIVE PROGRAMS 1A	1B	2A	2B	REVISED 2C	3A	3B
PUBLIC FACILITY RETROFIT							
Toilet dams	X	X	X	X	X	X	X
Faucet aerators		X	X	X	X	X	X
Automatic faucets			X	X	X	X	X
Shower flow restrictors				X			
Low flow showers					X	X	X
Public facility landscape maint					X		
MANUFACTURING							
Recirculation of cooling water	X	X	X	X	X	X	X
Reuse of cooling process water		X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
Efficient landscape irrigation			X	X	X	X	X
Low water using fixtures				X	X	X	X
Process modifications					X	X	X
AGRICULTURE							
Irrigation system evaluations	X	X	X	X	X	X	X
Irrigation scheduling	X	X	X	X	X	X	X
Laser leveling		X	X	X	X	X	X
Furrow diking			X	X	X	X	X
Low energy precision application				X	X	X	X
Surge flow irrigation					X	X	X
Drip & low volume irrigation						X	X
Brush management							X
ENERGY GENERATION							
Recirculation of cooling water	X	X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
In system treatment			X	X	X	X	X

* Energy Generation and Manufacturing reuse systems may not be compatible with system wide reuse plans.

The goal of reducing total regional water demand by 10% translates into the following decreases from the demands projected by the Regional Water Resources Study:

Table E-5
Regional Water Conservation Goals, 2000-2040
(Acre-feet per year)

Year	2000	2010	2020	2040
Amount Conserved	50,600	56,400	65,000	87,000

The amounts which would be saved and the costs of each element in the recommended program are shown in Table E-6. Additional conservation reductions in the agricultural, industrial and steam electric generating sectors are also expected as the result of stream discharge requirements and economic pressures.

Table E-6

COSTS AND SAVINGS OF RECOMMENDED CONSERVATION PROGRAMS

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
SUPPORTIVE PROGRAMS (all residents yr 2000)								
Public Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
School Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	$0	$0	Policy Change
Seas. Block	2.0 gpcd		1,636,373	100%	3,666	$0	$0	Policy Change
Penalty	.5 gpcd		1,636,373	10%	91	$0	$0	Policy Change
Leak Detection Programs		$3000/mile		100%	600	$150,000	$250	Maint Policy
NEW CONSTRUCTION (housing units constructed between 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3,106	$0	$0	Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2,081	$0	$0	Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621	$0	$0	Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621	$99,400	$1600	Ordinance
Pres Regulation	3.0 gpcd	$70.00	277,270	50%	465	$17,700	$380	Ordinance
Faucet Aerator	.5 gpcd	$2.00	277,270	100%	155	$7,300	$470	Ordinance
WE Washing Mach	5.0 gpcd	$70.00	277,270	75%	1,164	$66,000	$570	Ordinance
Gray Water Sys.	______	______	277,270	voluntary			______	Incentive
Landscape Measures for New Construction (housing units constructed between 1990 and 2000)								
LW Landscape	24.0 gpcd	$2000/home	277,270	75%	5,591	$10,903,000	$19,500	Ordinance
LW Irrig	13.0 gpcd	$1500/home	277,270	75%	3,028	$8,236,000	$27,200	Ordinance
M. Sensors	5.0 gpcd	$1200/home	277,270	75%	1,164	$6,600,000	$56,700	Ordinance
RETROFIT DEVICES (housing units built before 1990)								
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	50%	5,100	$6,000	$12	Retrofit Ord.
Toilet Dams	4.5 gpcd	$10.00	1,359,103	50%	3,430	$48,000	$140	Retrofit Ord.
Pressure Regul.	3.0 gpcd	$70.00	1,359,103	50%	2,280	$87,000	$380	Retrofit Ord.
Faucet Aerators	.5 gpcd	$2.00	1,359,103	50%	380	$18,000	$470	Retrofit Ord.
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	15%	115	$9,000	$820	Retrofit Ord.
Repl Toilets	10. gpcd	$300	1,359,103	25%	3,806	$339,000	$890	Retrofit Ord.
Landscape Irrigation (housing units constructed before 1990)								
Watering Prg	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
Irrig Sched	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
PUBLIC FACILITY RETROFIT (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%	700	$9,800	$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%	50	$2,000	$380	Govt Replace
Auto Faucet		$25.00		100%	50	$5,000	$900	Govt Replace
LF Showers	1.5 gpm	$15.00		100%	325	$2,000	$60	Govt Replace
Public Facility Landscapes (all public facilities)								
Irrig Sched	20% reduction in seasonal UAF water			100%	2,500	$25,000	$10	Maint Policy

5. WASTEWATER REUSE AND DOWNSTREAM FLOWS

Policy

The City of San Antonio should develop a program to reuse wastewater as a substitute for other supplies. New "water factories" should meet at least 20,000 acre-feet per year of the regional water demand in non-potable uses by the year 2000. The effluents of the existing regional advanced secondary treatment plants should be further treated to a quality allowing discharge into area cooling lakes. The amounts not sold for non-potable uses and not needed in the lakes should be treated to drinking water standards and added to the city's water supply.

This program must be managed to maintain a minimum flow in the San Antonio River of 55,000 acre-feet per year as measured at the Falls City gauge. It must also be managed to allow 46,000 acre-feet per year in evaporation at the City Public Service cooling lakes.

Local economic development agencies should encourage new water using industries to locate near the projected "water factories" in order to provide a market for the reused water.

Other wastewater producers in the region should also explore the potential to promote reuse within their service areas.

Discussion

The City of San Antonio proposes to treat its wastewater to a level sufficient to allow for indirect reuse in nonpotable purposes of 20,000 acre-feet per year by the year 2000.

The first project would involve construction of a new "water factory" near San Antonio International Airport to treat the wastewater generated in the upper Salado Creek watershed. This facility is expected to produce 4000 acre-feet per year in 1995, rising to 40,000 acre-feet by 2040. The effluent from this plant would substitute for pumping from the aquifer to create the flow of the San Antonio River through downtown and to irrigate downstream golf courses.

A related project would transfer the effluent from the existing Salado Creek Wastewater Treatment Plant to a new Water Renovation Center next to Braunig Lake. Here the nutrients would be removed and further treatment provided to allow reuse in area lakes. An estimated 24,000 acre-feet would thus be available to improve the water quality of Braunig Lake. A water treatment plant adjacent to the Water Renovation Center could then treat the improved lake water to drinking water standards. Allowing for 7000 acre-feet in evaporation consumption, this would provide an additional 17,000 acre-feet per year for reuse.

Additional water factories would be built in the upper Leon Creek and Medina River watersheds. Their effluents would be targeted for industrial reuse opportunities along Leon Creek, Apache Creek, the San Antonio River, and the Medina River below Applewhite Reservoir. The effluents from the existing Leon Creek and Dos Rios plants would also be transferred to the Water Renovation Center for release to the cooling lakes. Ultimately the water treatment plant could be expanded to treat 63,000 acre-feet of lake water to drinking water standards.

Table E-7 summarizes the wastewater volumes generated and available for reuse from each project. Figure E-2 shows the entire program schematically.

Data developed by the San Antonio River Authority suggest that a minimum flow of 55,000 acre-feet per year is needed in the San Antonio River to satisfy surface water rights and prevent environmental damage downstream from the city. Since there may be no natural flow in the river during a drought, the City may have to release this amount from its wastewater treatment system.

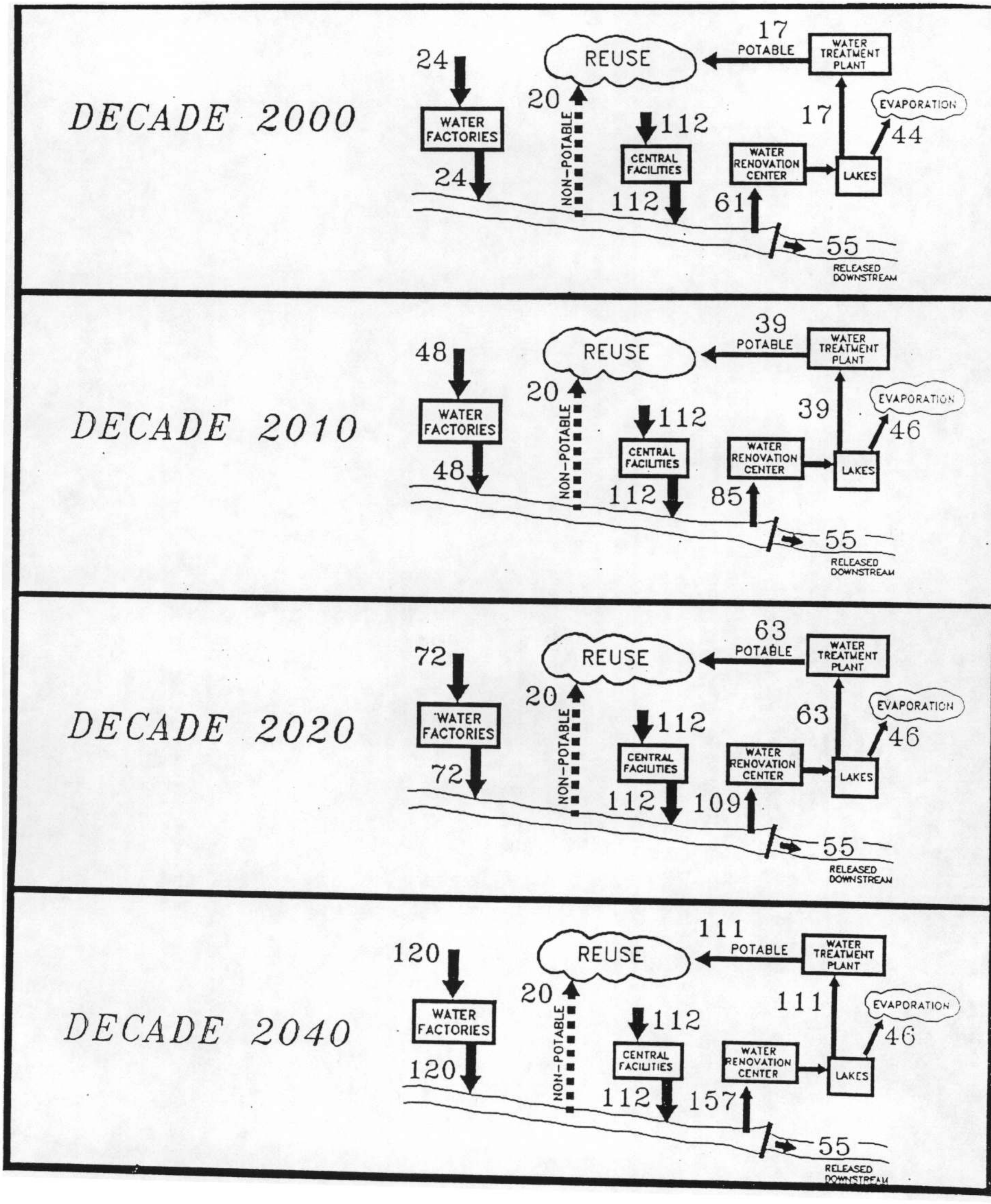
Under current City Public Service plans, the cooling lakes will also consume 46,000 acre-feet per year in evaporation. This water is now diverted from the San Antonio River. A plan needs to be developed to manage lake releases in order to reduce the dissolved solids in Braunig Lake.

Marketing the output of these new facilities is also an important consideration. The initial target for indirect reuse of 20,000 acre-feet by the year 2000 is a bare minimum. Under the City's projections of wastewater availability, the City's treatment plants may be capable of producing 131,000 acre-feet by 2040. This would save the expense of the additional treatment needed to take this water all the way to drinking water standards.

Table E-7
Wastewater Volumes Generated and Available for Reuse, 1995-2040
(Acre-feet per year)

	1995	2000	2010	2020	2030	2040
WASTEWATER GENERATED						
Water Factories						
Northeast	4,000	8,000	16,000	24,000	32,000	40,000
Northwest	4,000	8,000	16,000	24,000	32,000	40,000
Far West	4,000	8,000	16,000	24,000	32,000	40,000
Subtotal	12,000	24,000	48,000	72,000	96,000	120,000
Existing Treatment Plants						
Salado Creek	24,000	24,000	24,000	24,000	24,000	24,000
Leon Creek	24,000	24,000	24,000	24,000	24,000	24,000
Dos Rios	64,000	64,000	64,000	64,000	64,000	64,000
Subtotal	112,000	112,000	112,000	112,000	112,000	112,000
Gross Total Generated	124,000	136,000	160,000	184,000	208,000	232,000
OTHER USES						
Braunig Lake Evaporation	7,000	7,000	7,000	7,000	7,000	7,000
Calaveras Lake Evaporation	37,000	37,000	39,000	39,000	39,000	39,000
Downstream River Releases	55,000	55,000	55,000	55,000	55,000	55,000
Total Committed to Other Uses	99,000	99,000	101,000	101,000	101,000	101,000
NET TOTAL AVAILABLE FOR REUSE	25,000	37,000	59,000	83,000	107,000	131,000

Figure E-2
Schematic Summary of Proposed San Antonio
Wastewater Reuse Management Strategy, 2000 - 2040



6. SURFACE WATER PROJECTS

Policy

The Applewhite Reservoir project should be developed with all due speed. It should be reconfigured to defer indefinitely the Leon Creek Diversion. An improved wildlife mitigation plan should also be developed.

Permitting should be initiated for the Cibolo, Cuero I and Cuero II projects in order to protect the region from a severe drought after the year 2000.

Discussion

Under average rainfall conditions, additional sources of water will clearly be needed by 2010. Without surface water, the Planning Model (Table E-1, page 10) shows a deficit beyond 2010 even after the effects of significant conservation and reuse programs. A drought of any serious magnitude would hasten the onset of a crisis (Table E-8.)

Table E-8
Planning Model Projections for Year 2000
Under Alternative Drought Conditions

	Average Condition	Mild Drought	Historic Drought
1. Recharge	608,000	350,000	180,000
2. Projected Demand	506,000	500,940	519,156
3. Allocation	450,000	405,000	350,000
4. Conservation	50,600		
5. Drought Reduction		22,770	68,310
6. Reuse	37,000	34,000	32,500
Total (3+4+5+6-2)	31,600	-39,170	-68,346

Possible surface water projects have been identified for many years. These are shown in Figure E-3 and compared in Table E-9.

By their nature, these projects have a long lead time. Planning, permitting, design, construction and filling can easily take 10 or 20 years. Therefore they must be initiated as soon as possible.

Applewhite is the only project which can be completed before the year 2000. Design and permitting are virtually complete, but there are concerns over the effects of the Leon Creek Diversion and the wildlife mitigation plan. Therefore the Joint Committee recommended that this project be completed with changes in design configuration and planned mitigation.

The Cibolo and Cuero Projects should be initiated for planning design and permitting purposes in order to reduce the impacts of a severe drought beyond the year 2000.

Figure E-3
Possible Surface Reservoir Locations,
San Antonio and Guadalupe River Basins

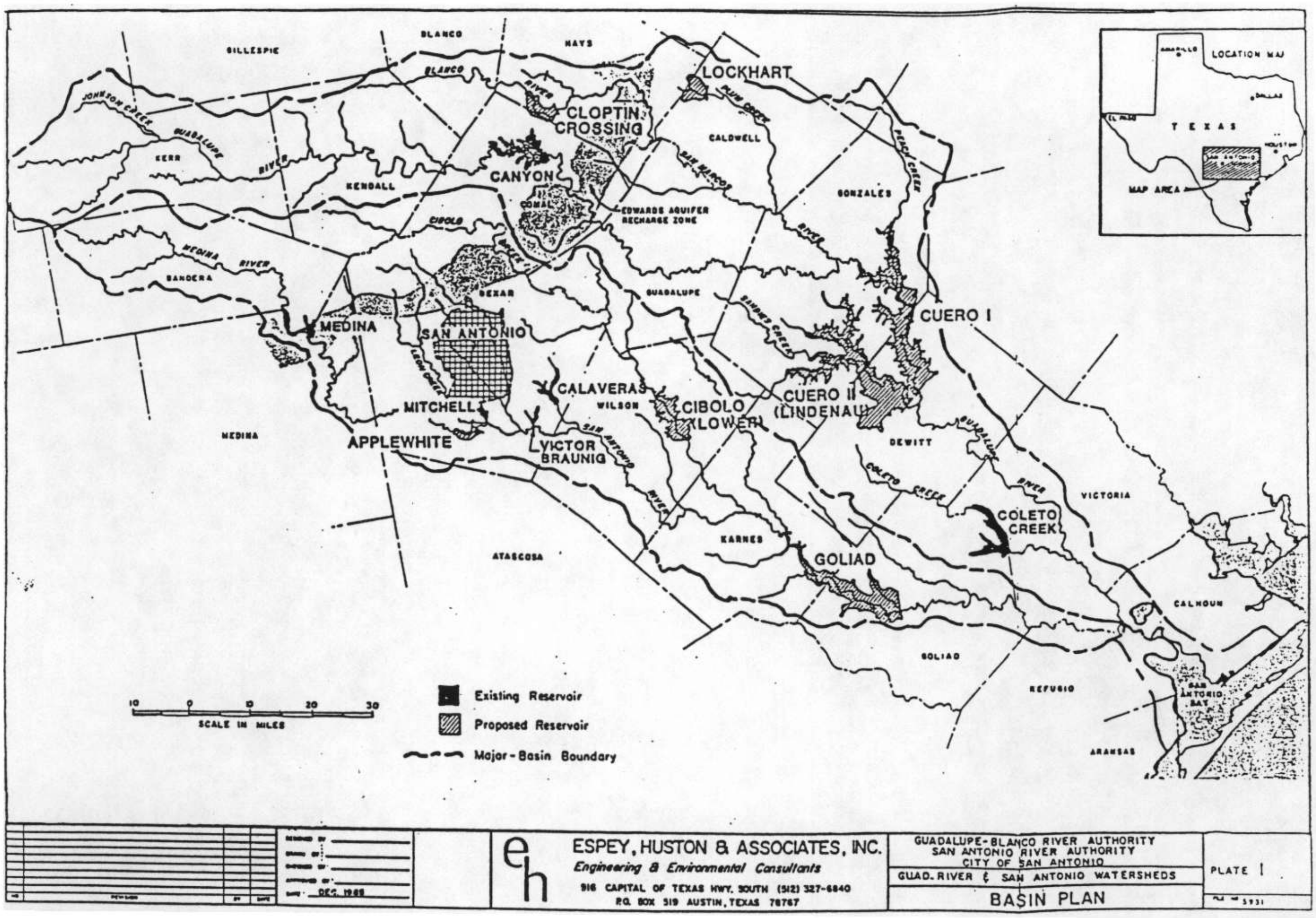


Table E-9

Comparative Summary of Possible Surface Water Projects

PROJECT	COSTS ($ mil. 1988) Capital	O & M	DEVELOPMENT TIME (Years) Optimistic	Nominal	Pessimistic	PROJECT YIELD (KAF/YR) Average	Mild Drought	Severe Drought	Cost/ Ac-Ft
Applewhite	113.0	1.2	6	7	8	50	40	12	$2,260
Cibolo	258.0	2.5	13	20	27	30	30	30	$8,600
Cuero I	457.0	7.4	12	17	23	141	141	141	$3,241
Cuero II (Stand Alone)	398.0	8.2	8	12	17	80	80	80	$4,975
Cuero II (Incremental)	398.0	8.2	8	11	14	24	24	24	$16,583

7. FINANCE

Policy

The costs of these plan components should be met as follows:

- **The Edwards Underground Water District's ad valorem property tax should fund implementation of the groundwater withdrawal policy and the conservation program.**
- **Sewer use charges should fund the wastewater reuse program.**
- **Water purveyor rates areawide, water availability charges (hook-up fees), and groundwater withdrawal fees during times of relative abundance, all should fund surface water development.**

Discussion

From the beginning of the planning process, the cost of implementing these recommendations was known to be high. Using water directly out of the aquifer is inexpensive, so any change would be relatively costly. The issue of "who pays and how much?" has been at the heart of the difficulty in developing a regional water plan for many years.

An equitable groundwater withdrawal policy is essential to the solution of this problem. No one can be expected to pay for additional supplies willingly if others can escape this cost entirely. The essence of the groundwater withdrawal policy is to limit the use of aquifer water to the amount the aquifer can provide. Thereafter the growth which requires additional supplies will pay the costs of those supplies.

The total public sector costs of the recommended programs are detailed in Table E-10. These costs include operating and maintenance expenses and annual debt service. The financing period for each project was based on a financing program developed by each responsible agency.

Table E-10
Plan Component Project Costs by Year, 1990-2040
($ millions - 1988)

PROJECT	CAPITAL COST	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
GROUNDWATER WITHDRAWAL	3.0																	
Debt Service		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	3.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION	0.0																	
Debt Service																		
Operation & Maint.		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	0.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE																		
WATER FACTORIES	140.0																	
Debt Service		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Operation & Maint.		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total	140.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	10.6	10.6	10.6	10.6	10.6	10.6	10.6
SALADO CREEK WWTP	28.0																	
Debt Service		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	28.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
LEON CREEK WWTP	28.0																	
Debt Service												2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	28.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3
DOS RIOS WWTP	11.0																	
Debt Service												1.1	1.1	1.1	1.1	1.1	1.1	1.1
Operation & Maint.		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	11.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
REUSE SUBTOTAL	207.0	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	23.8	23.8	23.8	23.8	23.8	23.8	23.8
SURFACE WATER																		
CANYON	0.0																	
Debt Service																		
Operation & Maint.																		
Total	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	2.1	2.1	2.1	2.1	2.1	2.1	2.1
APPLEWHITE	113.0																	
Debt Service		1.0	3.2	5.9	7.8	9.1	9.3	9.3	9.3	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Operation & Maint.		0.0	0.0	0.0	0.5	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	113.0	1.0	3.2	5.9	8.3	10.3	10.5	10.5	10.5	10.5	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
CIBOLO	258.0																	
Debt Service													23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Total	258.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I	457.0																	
Debt Service												31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	457.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II	398.0																	
Debt Service																		
Operation & Maint.																		
Total	398.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TREATMENT PLANTS	241.3																	
Debt Service		0.1	0.3	0.8	1.8	2.6	5.3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	9.5	9.5
Operation & Maint.						1.1	1.1	1.1	1.1	1.1	1.1	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Total	241.3	0.1	0.3	0.8	1.8	3.7	6.4	7.1	7.1	7.1	7.1	9.4	9.4	9.4	9.4	9.4	12.9	12.9
SURFACE SUBTOTAL	1,467.3	3.7	6.1	9.3	12.7	16.6	19.5	20.2	20.2	20.2	20.1	62.2	86.7	86.7	86.7	86.7	90.2	90.2
TOTAL REGIONAL COST	1,677.3	18.4	20.8	24.0	27.4	31.3	34.2	34.9	34.9	34.9	34.8	88.6	113.1	113.1	113.1	113.1	116.6	116.6

Table E-10 (cont.)
Plan Component Project Costs by Year, 1990-2040
($ millions - 1988)

PROJECT	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GROUNDWATER WITHDRAWAL																			
Debt Service	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION																			
Debt Service																			
Operation & Maint.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE																			
WATER FACTORIES																			
Debt Service	5.6	5.6	5.6	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Operation & Maint.	5.0	5.0	5.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	10.0	10.0	10.0	10.0	10.0	10.0
Total	10.6	10.6	10.6	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	18.4	18.4	18.4	18.4	18.4	18.4
SALADO CREEK WWTP																			
Debt Service	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8						
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	2.5	2.5	2.5	2.5	2.5	2.5
LEON CREEK WWTP																			
Debt Service	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
DOS RIOS WWTP																			
Debt Service	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Operation & Maint.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
REUSE SUBTOTAL	23.8	23.8	23.8	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	28.8	28.8	28.8	28.8	28.8	28.8
SURFACE WATER																			
CANYON																			
Debt Service																			
Operation & Maint.																			
Total	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.8	2.8	2.8	2.8	2.8	2.8
APPLEWHITE																			
Debt Service	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	8.4	8.4
Operation & Maint.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	9.6	9.6
CIBOLO																			
Debt Service	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I																			
Debt Service	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II																			
Debt Service														26.3	26.3	26.3	26.3	26.3	26.3
Operation & Maint.				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.2	8.2	8.2	8.2	8.2	8.2
Total	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	34.5	34.5	34.5	34.5	34.5	34.5
TREATMENT PLANTS																			
Debt Service	9.5	9.5	9.5	10.4	10.4	10.4	10.4	10.4	14.3	14.3	14.3	14.3	14.3	15.3	15.3	15.3	15.3	15.3	15.0
Operation & Maint.	3.4	3.4	3.4	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	10.1	10.1	10.1	10.1	10.1	10.1
Total	12.9	12.9	12.9	16.9	16.9	16.9	16.9	16.9	20.8	20.8	20.8	20.8	20.8	25.4	25.4	25.4	25.4	25.4	25.1
SURFACE SUBTOTAL	90.2	90.2	90.2	95.2	95.2	95.2	95.2	95.2	99.1	99.1	99.1	99.1	99.1	137.9	137.9	137.9	137.9	137.1	136.8
TOTAL REGIONAL COST	116.6	116.6	116.6	126.9	126.9	126.9	126.9	126.9	130.8	130.8	130.8	130.8	130.8	169.3	169.3	169.3	169.3	168.5	168.2

Table E-10 (cont.)
Plan Component Project Costs by Year, 1990-2040
($ millions - 1988)

PROJECT	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
GROUNDWATER WITHDRAWAL															
Debt Service	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION															
Debt Service															
Operation & Maint.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE															
WATER FACTORIES															
Debt Service	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	0.0
Operation & Maint.	10.0	10.0	10.0	10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	15.0
Total	18.4	18.4	18.4	18.4	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	15.0
SALADO CREEK WWTP															
Debt Service															
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
LEON CREEK WWTP															
Debt Service	2.8	2.8	2.8	2.8											
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
DOS RIOS WWTP															
Debt Service	1.1	1.1	1.1	1.1											
Operation & Maint.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	2.6	2.6	2.6	2.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
REUSE SUBTOTAL	28.8	28.8	28.8	28.8	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	21.5
SURFACE WATER															
CANYON															
Debt Service															
Operation & Maint.															
Total	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
APPLEWHITE															
Debt Service	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Operation & Maint.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
CIBOLO															
Debt Service	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I															
Debt Service	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II															
Debt Service	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Operation & Maint.	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Total	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
TREATMENT PLANTS															
Debt Service	15.0	15.0	15.0	15.0	12.2	12.2	12.2	12.2	12.2	19.1	19.1	19.1	19.1	19.1	21.6
Operation & Maint.	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	19.1
Total	25.1	25.1	25.1	25.1	22.3	22.3	22.3	22.3	22.3	29.2	29.2	29.2	29.2	29.2	40.7
SURFACE SUBTOTAL	136.8	136.8	136.8	136.8	134.0	134.0	134.0	134.0	134.0	140.9	140.9	140.9	140.9	140.9	152.4
TOTAL REGIONAL COST	168.2	168.2	168.2	168.2	164.0	164.0	164.0	164.0	164.0	170.9	170.9	170.9	170.9	170.9	176.5

The Joint Committee considered a wide range of possible funding sources (Table E-11.) For each one it considered whether the burden would fall on existing users or only on new growth, whether new legislation would be needed to implement it, and whether it would contribute to the goal of conservation. The Committee also considered which plan component each revenue source could most logically finance, and whether it could meet the full costs of that component.

Table E-11
Comparative Analysis of Possible Revenue Sources

Revenue Source	Potential Revenue	Administering Entity	Method of Cost Recovery	Sector Affected	All Users or New Growth	Approval Required	Impact on Conservation	Applicable Program	Able to Meet Full Costs?
EUWD Property Tax	$.01 increase = $3,822,701	E.U.W.D.	Land Value	Entire Region	All	Referendum	None	Groundwater Mgmt Conservation	Yes Yes
Well Permit Fees	$1000/well/year	E.U.W.D.	Growth	Irrigators, Municipal & Industrial	Growth	State Legislation	None	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Well Pumpage Fees	@$.01/1000 gal. (= $3.26/AF) 100,000 AF = $325,850	E.U.W.D.	Water Consumption	Irrigators, Municipal & Industrial	All	State Legislation	Positive	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Water Rates	$.01/100 cu ft = $970,000	Water Purveyors	Water Consumption	Municipal & Industrial	All	City Ordinances TWC Approval State Legislation	Positive	Conservation Surface Water	Yes Yes
Sewer Rates	$.01/100 cu ft = $660,666 (San Antonio)	City of San Antonio	Water Consumption	Municipal & Industrial	All (San Antonio)	City Ordinance	Positive	Reuse	Yes
Recreation Fees	Not determined	River Authorities and Cities	User Fee	Facility Users	All	None	None	Surface Water	No
Water Availability Hook-up Charge	$1000/dwelling unit equivalent	Water Purveyors	Growth	Municipal & Industrial	Growth	City Ordinances State Legislation	None	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Sales Tax	Not determined	State	Economic Activity	Entire Region	All	State Legislation Referendum	None	Surface Water	No
State/Federal Aid	Not determined	Cities Water Purveyors River Authorities E.U.W.D	N/A	N/A	N/A	None	None	Reuse Surface Water	No No

IMPLEMENTATION

It is crucial that this plan be implemented as a regionwide program. The Edwards District should administer the groundwater withdrawal policy and manage the conservation programs because of their regionwide impacts. It should provide technical assistance to municipalities in developing conservation ordinances and facility retrofit programs. It should also assist water purveyors in developing leak detection programs and restructuring their rates to encourage conservation. To do this the District must have adequate funding, staffing, and capital equipment.

Other agencies should take part in the operation of the remaining plan components as they are implemented. The City of San Antonio should be responsible for the wastewater reuse program. The City Water Board, San Antonio River Authority and Guadalupe-Blanco River Authority should be the contracting agencies for the proposed reservoirs.

Action will be needed in the 1989 session of the Texas Legislature to authorize the groundwater withdrawal policy. This is the key to implementing the entire plan. Other legislative initiatives such as new fees are for consideration in the future.

Once the region achieves consensus for this legislation, implementation efforts must be made equally on the conservation, reuse and surface water components. If one of these is less successful than intended, then the other programs must make up the difference. An early start on the modified Applewhite

Reservoir project is also essential to establish momentum in creating supplemental water supplies.

Ultimately, everyone in the region has a major stake in the success of this plan. Each agency, and each individual consumer, must recognize that we all depend on the same Edwards Aquifer. It is a common resource with a finite capacity. If the region is to continue to grow and prosper, we must act upon this knowledge now.

PART I

BACKGROUND

REGIONAL WATER PLANNING HISTORY AND PROCESS

A plan like this does not fall out of thin air. In fact, this document is only the latest stage in a planning process which extends back more than 50 years. This experience has helped present-day policymakers continually to improve the process for reaching these regional planning decisions.

Early Planning Efforts, 1930s-1970s

The real origin of regional water planning in this part of Texas was in the drought of the 1930s. That is when the U.S. Geological Survey and other agencies began collecting streamflow statistics and related data on the Edwards formation.

The geology of various reservoir sites in the region was evaluated in the 1930s and 1940s. Many now familiar project names, including Canyon, Applewhite, and Cuero, began entering the regional water vocabulary.

In 1952, the City of San Antonio adopted a Master Plan which included a recommendation that the City participate in the construction of Canyon Lake.[1] Subsequent action by the City Water Board resulted in lawsuits which were not finally resolved by the Texas Supreme Court until 1966. The Court found that the City of San Antonio was authorized to purchase Canyon Lake water.

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[1]Appendix A is a chronology of events from this point though 1987.

In the 1950s the region and the state experienced the most severe drought on record. One of the most important outcomes of that drought was the creation by the Legislature of the Edwards Underground Water District in 1959. The District was given the responsibility for safeguarding the quality of the aquifer water supply. It has also constructed a number of recharge dams to temporarily impound stormwater runoff and thus to increase the quantity of recharge.

City Planning Efforts, 1975-1982

Safeguarding the quality of aquifer water became a major issue during the 1970s. In 1975 the San Antonio City Council approved a request for rezoning to permit the development of a regional shopping mall over the recharge zone. Concerns over possible pollution of the aquifer, both from stormwater run-off and from induced development in the area, caused a general public uproar. The memory of that battle directly influenced the development of this plan more than a decade later.

Community-based organizations and local environmentalists launched a petition drive to force a referendum on the issue. In the spring of 1976, the citizens voted overwhelmingly to reverse the zoning decision, but an appellate court later held that zoning could not be decided by this process. City Council commissioned the firm of Metcalf and Eddy to study whether the mall would endanger the aquifer. In the meantime, the City imposed a moratorium on development over the recharge zone, and soon confronted a multi-million dollar lawsuit filed by developers. Eventually the Metcalf and Eddy Study was broadened into an analysis of development risks and potentials in the recharge zone generally.[1] The moratorium was lifted when a new ordinance in September 1977 recognized "vested rights" for projects already in process, but the mall itself was never built.

In the middle of this struggle, in May, 1976, the San Antonio City Council also rejected a proposed contract with the Guadalupe-Blanco River Authority to purchase water from Canyon Lake. This left the City without a clear plan for additional supplies to supplement pumping of the aquifer by the City Water Board. Therefore the next year the Council established a Water Resources Task Force composed of the City Planning Commission, a Citizens Advisory Committee and a Technical Advisory Committee.

The Task Force reported to City Council in 1979. It made three principal recommendations:

(1) Implement a water conservation program to limit per capita consumption to 180 gallons per day;

(2) Acquire 50,000 acre feet of water per year from, in order of priority, the Upper Guadalupe River Basin, the Applewhite project, or the Cibolo project; and

(3) Establish a Conservancy District of some type to implement a "Total Management Plan."

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[1]Metcalf & Eddy, Inc., Elbert Hooper, and Philip E. LaMoreaux, Edwards Aquifer Study, Phase I & II, 6 vols., May 1979.

Since Council had already declined the GBRA contract, in July 1979 it directed the City Water Board to proceed with the Applewhite project.

In 1982 Council asked the City Planning Commission to form an ad hoc committee to review water planning issues. That group recommended a detailed study of water needs and sources for the entire region. It proposed that the City of San Antonio and the Edwards Underground Water District undertake this task jointly. The committee reasoned that a jointly sponsored study would be more sensitive to all segments of the region's population. They also recognized that neither agency had the staff expertise or other resources needed to do this planning alone. This was the real origin of the current planning effort.

Memorandum of Understanding, 1983

As a result of the ad hoc committee report, in November, 1983, the City of San Antonio and the Edwards Underground Water District entered into an historic Memorandum of Understanding (Appendix B.) The "MOU" began the development of a study design on regional water resource issues and alternatives. The objectives of the study were

> to provide sufficient information and make recommendations about regional water resource issues and alternatives:
>
> 1) to enable reasonable people to make responsible decisions concerning public and private investments in the water resources of the region,

2) to insure that those decisions are consistent with regional economic development and environmental integrity, and,

3) to inspire long-term confidence in these decisions.

The first step in the process was the creation of a nine member Technical Advisory Committee (TAC), staffed by the City and the District as Joint Sponsors. The MOU specified that the TAC members be experts in water resource management, resource economics, agricultural economics, investment analysis, environmental analysis, water law, public policy, and project management. In addition, the membership represented the diversity of both geographic and water user interests in the region.

The MOU required the study to include:

a) Preparation of demand forecasts which consider demographic and economic variables;

b) Examination of future water and wastewater conservation and reuse programs that could be initiated and that impact on water demand;

c) Determination of the capacity and availability of water in the Aquifer;

d) Review of long-range water management plans;

e) Analysis of institutional, economic, financial, investment and legal aspects of these water management plans;

f) Formulation of alternative water supply plans; and

g) Evaluation, comparison and presentation of these alternatives.

Technical assistance was made available by the San Antonio City Water Board, the Nueces, San Antonio, and Guadalupe-Blanco

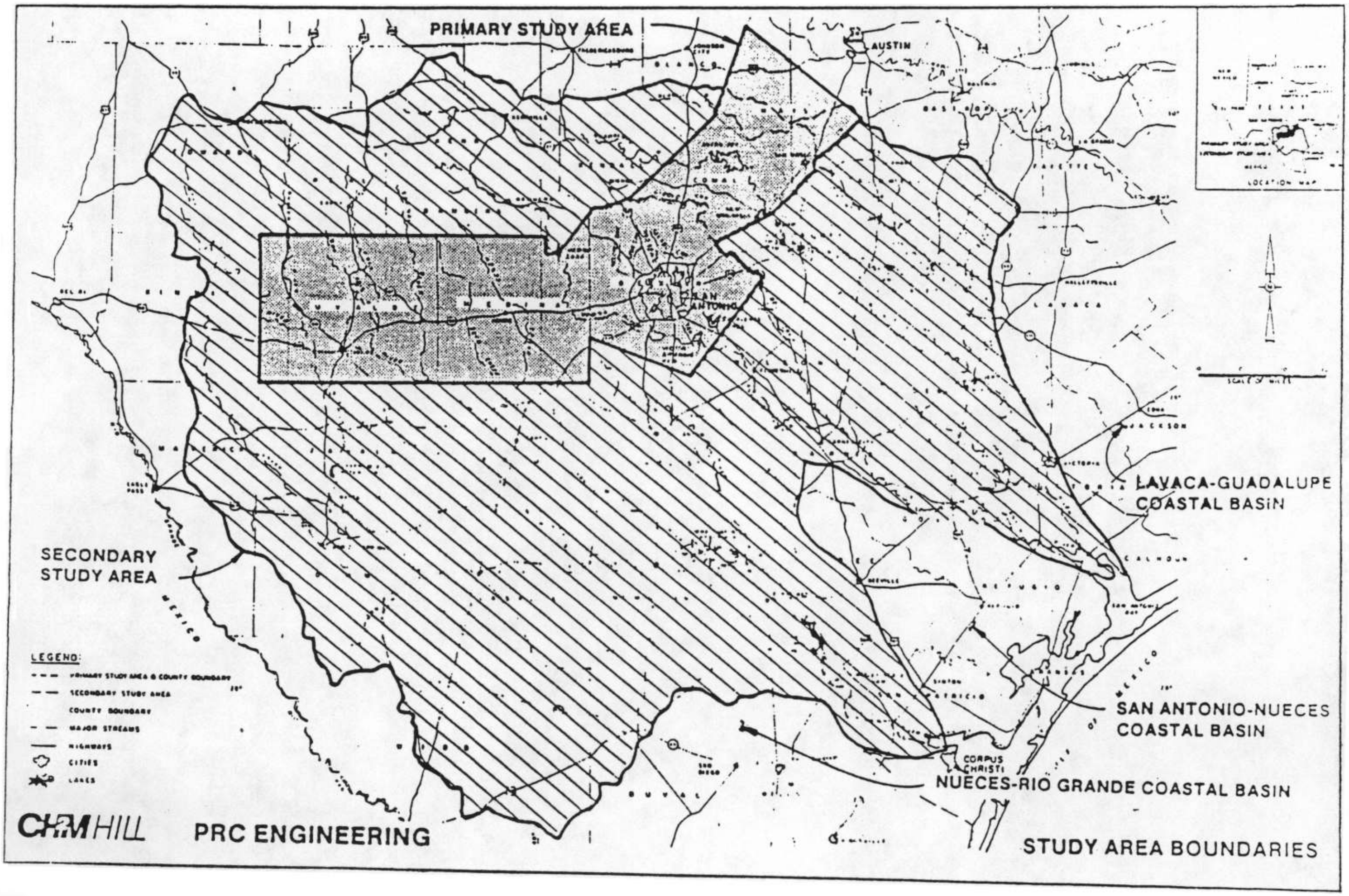
River Authorities, the (then) Texas Department of Water Resources, and the U. S. Geological Survey. The entire process was designed to ensure objectivity and independence in order to give credibility to the results.

Regional Water Resources Study, 1984-1986

Work on the San Antonio Regional Water Resources Study began in the fall of 1984. The TAC prepared a study design, solicited and reviewed proposals, recommended consultants, monitored their work, and reported to the Edwards Board and the City Council at several stages in the process. The study took two years to complete.

The Regional Water Resources Study examined regional water issues in two regions. A Primary Study Area was defined to include the area within the Edwards District (Uvalde, Medina, Bexar, Comal and Hays Counties.) A Secondary Study Area included the rest of the Nueces, San Antonio and Guadalupe River Basins (Figure B-1.) The designation of these areas reflected the level of detail in the information presented, and did not imply a different degree of importance. What was important was that the study acknowledged the significance of the entire hydrologic unit.

Figure B-1
Primary and Secondary Study Areas of the
San Antonio Regional Water Resources Study

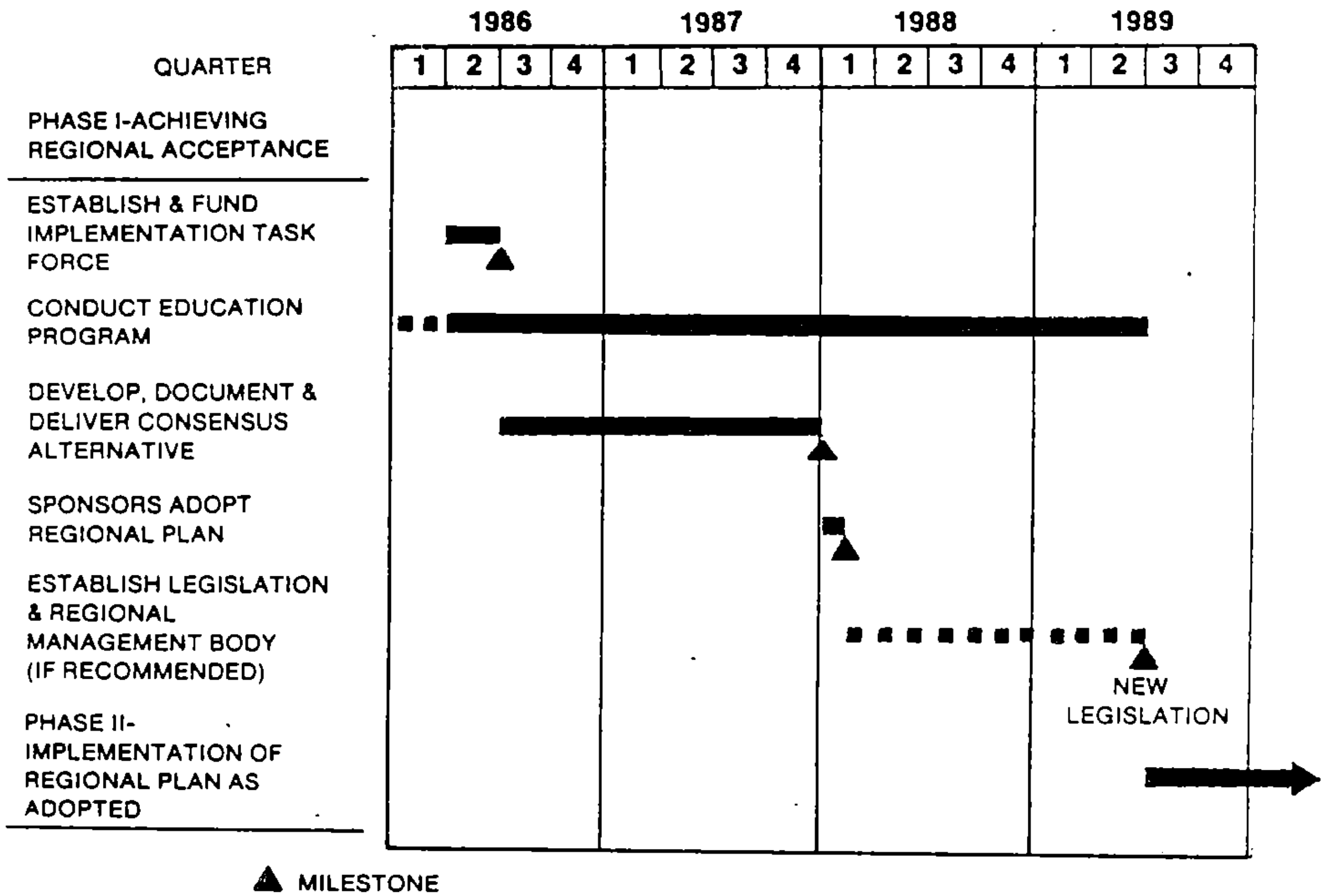


Since so much work had been done on these issues in the past, very little new data had to be developed. The real need was for a systematic compilation of existing information, and-- most important -- independent analysis and verification.

The Regional Water Resources Study was completed in March, 1986, and forwarded to the District and the City in April. The Study itself was not intended to be a "plan." It was an analysis of alternative policies, projects, and programs. The process initiated by the MOU required regional decisionmakers to consider these alternatives and to reach consensus on which option would then become the basis for a plan.

The study also recommended an action schedule for the implementation process (Figure B-2.) While adherence to this schedule is not critical, it is worth noting that the process to date is reasonably in line with the timing proposed in that study.

Figure B-2
Implementation Schedule Recommended by the
San Antonio Regional Water Resources Study



Implementation Advisory Task Force, 1986

In order for the decisionmakers to agree, a common understanding of the issues and options had to be achieved throughout the region. The District and the City therefore created an Implementation Advisory Task Force (IATF) in April, 1986. The purpose of the IATF was:

> to make available and to disseminate information to the public and decision makers on the Regional Water Resource Study and to develop a regional consensus of future regional actions needed.

The IATF included a 26 member Citizens Advisory Group (CAG.) One member of this group was appointed by each of the 15 members of the Edwards District Board of Directors and one by each of the 11 members of the San Antonio City Council. The appointees represented the broadest possible range of interests and perspectives.

The IATF spent countless hours reviewing the Regional Study, developing a public information program, and discussing the issues with organizations and small groups throughout the region. They then began a process of reaching their own consensus on the issues. Subcommittees were formed, with every member given the opportunity to serve on as many subcommittees as they chose. The entire CAG membership debated and finally reached consensus on practically each word of the subcommittees' recommendations. The effort was time consuming and difficult. Ultimately it was successful because of the members' willingness to understand and respect each other's concerns and perspectives. The result of their efforts was a set of policy recommendations submitted to the District Board and City Council in December, 1986 (Appendix C.)

Joint Committee on Water Resources, Spring 1987

To implement the IATF's recommendations, the Edwards Board and the City Council agreed to form a Joint Committee on Water Resources. Originally this consisted of five members of the Edwards Board and five members of the Council, with the Board Chairman and the Mayor as co-chairs of the Committee.

The Joint Committee met weekly throughout the spring of 1987 to address the issues of water resource policy. This was an unprecedented effort to resolve fundamental conflicts among divergent interests which all depend on a common resource. Discussions continued at these meetings until consensus was reached. Not all of the policy recommendations submitted by the CAG were adopted exactly as submitted, nor were all issues resolved. However, three extremely important elements of the Regional Water Resources Plan resulted from this effort.

First, a Joint Resolution was developed and adopted by the Council and the Edwards Directors in March 1987 (Appendix D.) It described the principles and policies accepted up to that point, including both quantity and quality issues. The key policy statement held that the aquifer should not be overdrafted during periods of average rainfall, in order to guarantee natural flows at Comal and San Marcos Springs.

The Resolution was intended to inform the Legislature of the region's efforts and progress in developing the plan. It was also designed to be adopted as a Joint Legislative Resolution, expressing the Legislature's approval of the program as state policy. It was submitted to the Legislature in the 1987 session, but it was not passed because of the press of time and the emphasis on efforts to pass drought management legislation.

Second, the Joint Committee reached consensus on the need for procedures to manage a regional drought emergency. Therefore the Joint Resolution included a policy statement that the Edwards District would seek legislative authority to develop, implement and enforce a Drought Management Plan. To be effective, this legislation would need to give the District the power to register wells and monitor well pumpage. The drought management plan would minimize drawdown of the water table, prevent waste, and protect the aquifer as a groundwater resource. An amendment to the District's enabling statute was developed, and approved by the Legislature as House Bill 1942 (Appendix E.)

HB 1942 requires the Edwards District to adopt a Drought Management Plan by September 1, 1988. The plan must include objective definitions of a drought in various stages of severity, and the conservation and enforcement measures that will be imposed in response.

Since this Act was passed, the District has been developing the Drought Management Plan in a separate process from this document. It released a draft for public comment in March 1988 and conducted a series of public hearings throughout the region in May. If the District fails to adopt the plan by the September deadline, the Texas Water Commission must impose its own plan.

The Act also changed the membership of the Edwards District Board of Directors, and provided a means by which a county could vote itself out of the District. Beginning in 1989, Bexar County will elect six members to the Board while each of the other four counties will continue to elect three members. In effect, this gives equal representation to each of the three basic constellations of interest in the region: the irrigation farming communities in the west; the recreation and downstream user interests who depend on the springs in the east; and metropolitan San Antonio in the middle. The legislation also allows for a petition and referendum process to determine whether a county should withdraw from the District.

Third, the Joint Committee found that its format and procedures facilitated the development of consensus. They fostered the mutual trust and respect necessary to the negotiation and consensus building process. The Committee therefore agreed to continue addressing policy issues in this forum until all of them were negotiated and agreed upon, including both water quality and quantity issues.

City Council Committee on the Aquifer, Summer 1987

Development of the plan by the Joint Committee was interrupted, however, in May 1987. Before further consensus could be reached in this forum, City Council was faced with a zoning case to permit another mall over the recharge zone. Council approved the rezoning, and once again this precipitated a controversy over protection of the aquifer. The result was a public hearing on the general issues of aquifer protection and formation of the City Council Committee on the Aquifer.

The Joint Resolution had said in its first policy statement:

> With technical assistance from the Edwards Underground Water District, cities in the region will adopt ordinances in 1987 for water quality protection to prevent degradation by contamination of sensitive areas of the aquifer. The ordinances will cover matters including, but not limited to: using, producing, transporting or storing hazardous materials by commercial activities; assuring the integrity of sewer lines; protecting caves and sinkholes.

The Committee was given the task of developing strategies to meet this mandate. To guarantee citizen participation, four "intervenor" groups were designated: two each representing environmental and community-based organizations, and two representing the business community and development industries.

The Committee met through the summer of 1987. The process was formally structured to allow elected representatives to debate issues and action plans alongside technical experts and affected interest groups. Each meeting included presentations by experts and formal questions and comments by the intervenors. This process became a model for subsequent Joint Committee discussions.

In September, 1987, the Committee produced a series of specific recommendations on the full range of these issues.[1] The recommendations were addressed to the City Council, other municipalities, the Edwards District, the Texas Water Commission and other agencies.

The central policy statement was an unambiguous commitment: All policy would be based on a principle of no degradation in the quality of the aquifer water supply. Acceptance of this principle led the Committee to examine potential sources of contamination and procedures for dealing with them.

One possible major source of contamination was waste discharges or leaks from sewer lines and septic tanks. The Committee recommended improved specifications for sewer line construction and new controls on septic tanks.

Another concern was the storage and transportation of hazardous materials. A major recommendation on this topic encouraged the Texas Water Commission to amend the Edwards Aquifer Rules to include more stringent regulations for hazardous materials storage. Another was to work for legislation authorizing cities to establish transportation routes for hazardous materials through their jurisdictions.

The Committee recommended a new methodology for review of the Water Pollution Abatement Plans which are required by the Texas Water Commission as a condition of development. The City

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[1] City Council Committee on the Aquifer, The Edwards Aquifer: Perspectives for Local and Regional Action, September 1987.

was urged to amend its zoning ordinance to withhold approval of a zoning change until TWC had previously approved the WPAP.

Still another recommendation was the development of an enhanced mapping process to identify sensitive recharge features such as caves, sinkholes and faults. This information would be useful to both the regulators and those being regulated.

Along with its recommendations, the Committee proposed a series of specific action programs for implementation by each affected agency. These are being carried out according to a detailed timetable included in the report. As a by-product, the Committee process also notably strengthened the daily working relationships between the staffs of the agencies involved.

The report was adopted by a unanimous Council and endorsed by the Edwards Board of Directors. It laid to rest the concern that water quality issues had to be considered first, before the quantity issues could be resolved. Therefore the Joint Committee reconvened in October, 1987, to continue addressing the issues which remained from the spring program.

Plan Development, Fall 1987

When the Joint Committee reconvened, it made several adjustments in its structure and process. First the representation of the Edwards Board was increased from five to six members, with one from each county along with the Board Chairman as Committee Co-Chair. The City also refreshed the selection of its five

Council members, with the Mayor remaining among these five as the other Co-Chair.

The members also recognized that the scope of a truly regional water plan must involve the three affected river authorities. Accordingly the Committee was expanded to include one representative each from the San Antonio, the Guadalupe-Blanco, and the Nueces River Authority. This structure better represented the interests of downstream surface water users among users and water purveyors in the region.

Finally, the Committee instituted the intervenor process which had been developed by the City Council Committee. The intervenors represented the same constituencies. Bringing their viewpoints to the table for consideration by the Committee added confidence in the emerging product.

The major elements of the plan were then debated, and decisions were reached and progressively refined in a systematic process. Initially, several work sessions were spent re-examining the assumptions, results and conclusions of the Regional Water Resources Study and other reports. Each member came to understand the data more completely by examining the analytical procedures which lay behind these studies. This produced a reaffirmation of the principles and policies adopted in the spring of 1987 as the Joint Resolution.

The Committee collectively described its understanding of the issues in a paper entitled "A Regional Water Resource Perspective" (Appendix F.) This paper described the interrelationships among:

- recharge to the aquifer,
- pumping demand on the aquifer,
- flows downstream in the Guadalupe and San Antonio River Basins,
- conservation and resulting demand reductions,
- water reuse and its effects on water availability, and
- the development of surface water supplies.

It also explored the need for a reasonable cost recovery mechanism.

Development of the Planning Model, 1988

The second step involved a series of policy decisions. The Committee realized that policy on one issue could not be made in isolation from the others. Policy development therefore began with a "butcher paper" work session, in which a table was devised showing average recharge, projected total demand, a possible groundwater withdrawal limit, and the resulting deficits in future decades (Table B-1.)

Table B-1
Initial Planning Matrix, December 8, 1987
(Acre-feet per year)

	2000	2020	2040
(1) Average Recharge	608,000	608,000	608,000
(2) Projected Demand	506,000	650,000	866,000
(3) Groundwater Withdrawal	425,000	425,000	425,000
(4) Net Deficit (3-2)	-81,000	-225,000	-441,000

The groundwater withdrawals considered ranged from 425,000 to 500,000 acre-feet per year.

A matrix was then developed to include the effects of conservation programs and possible levels of wastewater reuse. Conservation goals of 5%, 10% and 17% were calculated. Reuse was examined by considering releases downstream of 30,000, 90,000 and 120,000 acre-feet per year. Initially the effect of conservation was assigned either to the river release or to the amount available for reuse. The result was a minimum of 72 different policy combinations.

Many more could have been developed, but this was already too many to comprehend. The Committee chose to analyze a representative set of ten combinations selected according to their positive, negative, and neutral impacts on the user groups (Figure B-3.) Each one appeared to involve a technically feasible groundwater withdrawal limit and to meet conservation and wastewater reuse goals.

The policies which produced the most positive results with the fewest negative impacts on any segment of the region were options that were essentially neutral for all user groups. These two (#5 and #7) were selected for further analysis.

Figure B-3

Matrix of Alternative Policies and Impacts

Alternatives					Impacts																	
	Groundwater		Release	Impact	Irrigators			Metro Cities			Other Cities			Springs			Guadalupe			S.A. River		
#	Withdrawal	Conservation	to River	of Cons	G	C	R	G	C	R	G	C	R	G	C	R	G	C	R	G	C	R
1	425,000	17%	90,000	Reuse	-	-	0	=	=	=	=	=	0	+	+	0	+	+	0	0	0	0
2	425,000	10%	90,000	Reuse	-	0	0	=	-	=	=	-	0	+	+	0	+	+	0	0	0	0
3	500,000	10%	30,000	River	+	0	0	+	-	+	+	-	0	=	+	0	=	+	0	0	-	=
4	500,000	5%	30,000	River	+	0	0	+	0	+	+	0	0	=	-	0	=	-	0	0	0	-
5	475,000	10%	90,000	River	0	0	0	0	-	0	0	-	0	-	+	0	-	+	0	0	-	0
6	475,000	10%	90,000	Reuse	0	0	0	0	-	=	0	-	0	-	+	0	-	+	0	0	0	0
7	450,000	10%	90,000	River	0	0	0	-	-	0	-	-	0	0	+	0	0	+	0	0	-	0
8	450,000	17%	90,000	River	0	-	0	-	=	-	-	=	0	0	++	0	0	++	0	0	=	-
9	475,000	10%	30,000	River	0	0	0	0	-	++	0	-	0	-	+	0	-	+	0	0	-	=
10	475,000	10%	30,000	Reuse	0	0	0	0	-	+	0	-	0	-	+	0	-	+	0	0	0	-

LEGEND

G = Groundwater Withdrawal Limit
C = Conservation
R = Reuse

IMPACT KEY

++ very positive
+ positive
0 neutral
- negative
= very negative

The initial planning matrix became the Committee's "Planning Model" (Table B-2.) A planning model in this sense presents numbers in an accounting framework for analysis of alternatives. The numbers in the model represent possible policy choices and they highlight the implications of choosing different values. Thus the Committee could quickly see the effect of using different numbers for groundwater withdrawals, conservation goals, wastewater reuse and surface water development. These effects could be analyzed under average recharge conditions and with numbers representing an assumed drought severity.

Table B-2
Planning Model

Water Demands and Sources to Meet Demands
Based on Average Rainfall Conditions
(Acre-feet per year)

Plan Component	Year 2000	2010	2020	2040
(1) Average Recharge	608,000	608,000	608,000	608,000
(2) Projected Demand	506,000	564,000	650,000	870,000
(3) (a) Groundwater Withdrawal	450,000	450,000	450,000	450,000
(b) Allowance for Springflows	158,000	158,000	158,000	158,000
(4) Conservation (10% of Demand)	50,600	56,400	65,000	87,000
(5) Reuse (Net Available after River Release and Evaporation)	37,000	59,000	83,000	131,000
(6) Subtotal: Groundwater Withdrawal + Conservation + Reuse - Demand (3a+4+5-2)	31,600	1,400	-52,000	-202,000
(7) Surface Water				
(a) Canyon	14,000	14,000	14,000	14,000
(b) Applewhite	50,000	50,000	50,000	50,000
(c) Cibolo		30,000	30,000	30,000
(d) Cuero I		141,000	141,000	141,000
(e) Cuero II			24,000	24,000
(f) Surface Subtotal	64,000	235,000	259,000	259,000
(8) Net Balance: Groundwater Withdrawal + Conservation + Reuse + Surface Water - Demand (3a+4+5+7f-2)	95,600	236,400	207,000	57,000

To complete this model, the Committee had to make policy decisions on the following plan components:

1. Quantity of aquifer recharge to be assumed;
2. Projected future regional water demand;
3. Groundwater withdrawal levels from the aquifer;
4. Conservation goals;
5. Reuse quantities and downstream flows; and
6. Surface water development.

Along with agreed assumptions on recharge and demand, the Committee had to develop a recommended program to achieve the target values. It also had to develop a financing program to implement these recommendations, and to consider the legislative and institutional changes which the total program would require.

At the conclusion of this process, in late June 1988, the Committee submitted its complete draft plan to a panel of outside experts for review and comment. Because of the importance of this plan to the future of the region, the Committee wanted to be sure that the plan would withstand technical scrutiny and that it reflected the best professional advice available. This technical panel consisted of Dr. Jay Lehr, Executive Director of the National Water Well Association, Ms. Kathleen Ferris, formerly with the Arizona Department of Water Resources, Mr. Steve Stagner, of the Texas Water Alliance, Dr. Daniel Luecke, from the Environmental Defense Fund, and Commissioner Jim Buck Wynne, of the Texas Water Commission. The panel met with Committee members in two sessions to critique each element of the plan. Their comments are on file with the Edwards District.

Outline of the Following Chapters

The next part of this report discusses the development of each of the plan components in order. Each chapter first reviews the background data and the available options which the Committee considered. It then explains the policy considerations and concludes with the Committee's recommendations.

The following part explores financial and institutional issues. One chapter discusses possible financing mechanisms and describes the recommended financing program. The last chapter discusses institutional considerations and lays out the recommended work program to implement the plan.

PART II

PLAN COMPONENTS

RECHARGE AND DEMAND ASSUMPTIONS

AVAILABLE RECHARGE QUANTITY

Background

The Edwards Aquifer is the sole source of water for approximately 1.3 million people throughout the region. It serves all of metropolitan San Antonio, along with New Braunfels, San Marcos, Hondo, Uvalde and other cities. It provides irrigation water in Uvalde and Medina counties. It is the source of Comal and San Marcos Springs, which sustain unique environments. The springs also contribute substantially to the Guadalupe River and its downstream water uses.

The Edwards Aquifer is unique in this part of the world because it recharges rapidly from rainfall, surface runoff and streamflows crossing the recharge zone. Recharge is thus a direct function of rainfall in the drainage area. Figure A-1 and Table A-1 show the annual rainfall, aquifer recharge and discharge from the early 1930s through 1985. Table A-2 shows the detail of aquifer recharge by drainage basin from 1934 through 1982.

FIGURE A-1.
ANNUAL RAINFALL AT SAN ANTONIO, 1930-1985, AND
ANNUAL RECHARGE TO THE EDWARDS AQUIFER, 1934-1985

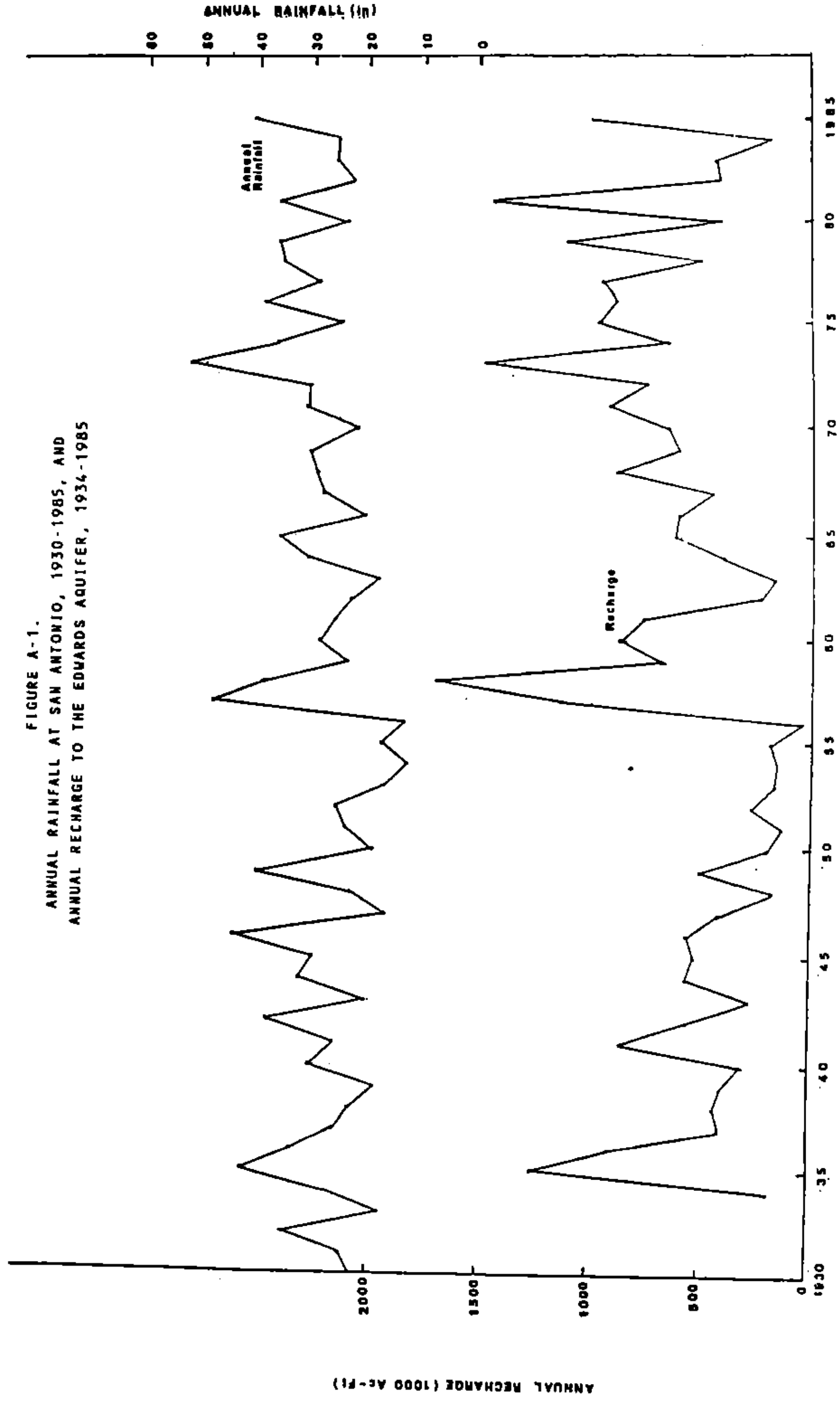

Table A-1
Edwards Aquifer Data Summary, 1934-1987

Year	Annual Rainfall (inches) Uvalde	San Antonio	San Marcos	Recharge*	Discharges* Wells	Springs	Total	Change in Storage Since 1933*	Year-End J-17 Well Level AMSL
1934	16.42	27.65	35.67	179.6	101.9	336.0	437.9	-258.3	669
1935	41.15	42.93	41.09	1258.2	103.7	415.9	519.6	480.3	680
1936	24.18	34.11	33.48	909.6	112.7	485.5	598.2	791.7	682
1937	17.88	26.07	28.05	400.7	120.2	451.0	571.2	621.2	678
1938	13.62	23.26	28.17	432.7	120.1	437.7	557.8	496.1	674
1939	25.30	18.83	18.59	399.0	118.9	313.9	432.8	462.2	668
1940	27.46	30.79	43.57	308.8	120.1	296.5	416.6	354.5	671
1941	31.52	26.34	48.41	850.7	136.8	464.4	601.2	604.0	677
1942	19.12	38.46	44.65	557.8	144.6	450.1	594.7	567.1	680
1943	19.77	20.51	25.45	273.1	149.1	390.2	539.3	300.9	669
1944	33.00	33.19	47.42	560.9	147.3	420.1	567.4	294.4	670
1945	22.37	30.46	-	527.8	153.3	461.5	614.8	207.4	673
1946	24.91	45.17	52.24	556.1	155.0	428.9	583.9	179.6	680
1947	22.67	17.32	27.53	422.6	167.0	426.5	593.5	8.7	668
1948	18.31	23.64	-	178.3	168.7	281.9	450.6	-263.6	657
1949	34.42	40.81	36.22	508.1	179.4	300.4	479.8	-235.3	664
1950	18.27	19.86	21.10	200.2	193.8	272.9	466.7	-501.8	656
1951	16.06	24.44	30.88	139.9	209.7	215.9	425.6	-787.5	646
1952	18.24	26.24	39.91	275.5	215.4	209.5	424.9	-936.9	645
1953	18.34	17.56	33.39	167.6	229.8	238.5	468.3	-1237.6	646
1954	15.87	13.70	13.42	162.1	246.2	178.1	424.3	-1499.8	637
1955	20.34	18.18	26.44	192.0	261.0	127.8	388.8	-1696.6	626
1956	9.29	14.31	18.37	43.7	321.1	69.8	390.9	-2043.8	626
1957	39.30	48.83	46.51	1142.6	237.3	219.2	456.5	-1357.7	653
1958	39.03	39.69	39.08	1711.2	219.3	398.2	617.5	-264.0	678
1959	31.51	24.50	43.47	690.4	234.5	384.5	619.0	-192.6	675
1960	23.98	29.76	45.48	824.8	227.1	428.3	655.4	-23.2	679
1961	26.26	26.47	30.02	717.1	228.2	455.3	683.5	10.4	676
1962	14.12	23.90	28.47	239.4	267.9	321.1	589.0	-339.2	666
1963	16.70	18.65	19.90	170.7	276.4	239.6	516.0	-684.5	653
1964	22.30	31.88	30.27	413.2	260.2	213.8	474.0	-745.3	653
1965	26.21	36.72	45.00	623.5	256.1	322.8	578.9	-700.7	669
1966	20.87	21.42	27.12	615.2	255.9	315.3	571.2	-656.7	657
1967	20.10	29.09	26.41	466.5	341.3	216.1	557.4	-747.6	660
1968	25.20	30.39	37.13	884.7	251.7	408.3	660.0	-522.9	670
1969	33.33	31.41	36.59	610.5	307.5	351.2	658.7	-571.1	670
1970	13.59	22.74	32.30	661.6	329.4	397.7	727.1	-636.6	663
1971	31.01	31.80	31.10	925.3	406.8	272.7	679.5	-390.8	674
1972	15.49	31.48	31.90	756.4	371.3	375.8	747.1	-381.5	673
1973	30.85	52.28	47.91	1486.5	310.4	527.6	838.0	267.0	690
1974	30.94	37.00	42.42	658.5	377.4	483.8	861.2	64.3	682
1975	24.92	25.67	48.64	973.0	327.8	540.4	868.2	169.1	676
1976	45.62	39.13	47.46	894.1	349.5	503.9	853.4	209.8	693
1977	19.91	29.64	27.69	952.0	380.6	580.3	960.9	200.9	684
1978	18.65	35.99	33.08	502.5	431.8	375.5	807.3	-103.9	679
1979	32.35	36.64	38.74	1117.8	391.5	523.0	914.5	99.4	680
1980	23.05	24.23	29.56	406.4	491.1	328.3	819.4	-313.6	669
1981	28.24	36.37	49.62	1448.4	387.1	407.3	794.4	340.4	679
1982	23.25	22.96	35.29	417.7	453.1	333.3	786.4	-28.3	667
1983	26.81	26.06	36.95	420.1	418.5	301.6	720.1	-32.3	653
1984	17.65	25.95	35.29	197.9	529.8	172.5	702.3	-832.7	648
1985	28.49	40.31	35.29	1003.3	522.5	334.0	856.5	-685.9	673
1986	29.59	42.76	40.50	1153.7	429.3	405.3	834.6	-366.7	685
1987	36.85	37.22	37.94	2003.6	-	-			685

*Thousands of acre-feet per year.

Table A-2
Calculated Annual Recharge to the Edwards Aquifer
by Drainage Basin, 1934-1982
(Thousands of acre-feet per year)

Calendar year	Nueces-West Nueces River basin	Frio-Dry Frio River basin[1]	Sabinal River basin[1]	Area between Sabinal River and Medina River basins[1]	Medina Lake	Area between Cibolo Creek and Medina River basins[1]	Cibolo-Dry Comal Creek basin	Blanco River basin[1]	Total
1934	8.6	27.9	7.5	19.9	46.5	21.0	28.4	19.8	179.6
1935	411.3	192.3	56.6	166.2	71.1	138.2	182.7	39.8	1,258.2
1936	176.5	157.4	43.5	142.9	91.6	108.9	146.1	42.7	909.6
1937	28.8	75.7	21.5	61.3	80.5	47.8	63.9	21.2	400.7
1938	63.5	69.3	20.9	54.1	65.5	46.2	76.8	36.4	432.7
1939	227.0	49.5	17.0	33.1	42.4	9.3	9.6	11.1	399.0
1940	50.4	60.3	23.8	56.6	38.8	29.3	30.8	18.8	308.8
1941	89.9	151.8	50.6	139.0	54.1	116.3	191.2	57.8	850.7
1942	103.5	95.1	34.0	84.4	51.7	66.9	93.6	28.6	557.8
1943	36.5	42.3	11.1	33.8	41.5	29.5	58.3	20.1	273.1
1944	64.1	76.0	24.8	74.3	50.5	72.5	152.5	46.2	560.9
1945	47.3	71.1	30.8	78.6	54.8	79.6	129.9	35.7	527.8
1946	80.9	54.2	16.5	52.0	51.4	105.1	155.3	40.7	556.1
1947	72.4	77.7	16.7	45.2	44.0	55.5	79.5	31.6	422.6
1948	41.1	25.6	26.0	20.2	14.8	17.5	19.9	13.2	178.3
1949	166.0	86.1	31.5	70.3	33.0	41.8	55.9	23.5	508.1
1950	41.5	35.5	13.3	27.0	23.6	17.3	24.6	17.4	200.2
1951	18.3	28.4	7.3	26.4	21.1	15.3	12.6	10.6	139.9
1952	27.9	15.7	3.2	30.2	25.4	50.1	102.3	20.7	275.5
1953	21.4	15.1	3.2	4.4	36.2	20.1	42.3	24.9	167.6
1954	61.3	31.6	7.1	11.9	25.3	4.2	10.0	10.7	162.1
1955	128.0	22.1	0.6	7.7	16.5	4.3	3.3	9.5	192.0
1956	15.6	4.2	1.6	3.6	6.3	2.0	2.2	8.2	43.7
1957	108.6	133.6	65.4	129.5	55.6	175.6	397.9	76.4	1,142.6
1958	266.7	300.0	223.8	294.9	95.5	190.9	268.7	70.7	1,711.2
1959	109.6	158.9	61.6	96.7	94.7	57.4	77.9	33.6	690.4
1960	88.7	128.1	64.9	127.0	104.0	89.7	160.0	62.4	824.8
1961	85.2	151.3	57.4	105.4	88.3	69.3	110.8	49.4	717.1
1962	47.4	46.6	4.3	23.5	57.3	16.7	24.7	18.9	239.4
1963	39.7	27.0	5.0	10.3	41.9	9.3	21.3	16.2	170.7
1964	126.1	57.1	16.3	61.3	43.3	35.8	51.1	22.2	413.2
1965	97.9	83.0	23.2	104.0	54.6	78.8	115.3	66.7	623.6
1966	169.2	134.0	37.7	78.2	50.5	44.5	66.5	34.6	615.2
1967	82.2	137.9	30.4	64.8	44.7	30.2	57.3	19.0	466.5
1968	130.8	176.0	66.4	198.7	59.9	83.1	120.5	49.3	884.7
1969	119.7	113.8	30.7	84.2	55.4	60.2	99.9	46.6	610.5
1970	112.6	141.9	35.4	81.6	68.0	68.8	113.8	39.5	661.6
1971	263.4	212.4	39.2	155.6	68.7	81.4	82.4	22.2	925.3
1972	108.4	144.6	49.0	154.6	87.9	74.3	104.2	33.4	756.4
1973	190.6	256.9	123.9	286.4	97.6	237.2	211.7	82.2	1,486.5
1974	91.1	135.7	36.1	115.3	96.2	68.1	76.9	39.1	658.5
1975	71.8	143.6	47.9	195.9	93.4	138.8	195.7	85.9	973.0
1976	150.7	238.6	68.2	182.0	94.5	47.9	54.3	57.9	894.1
1977	102.9	193.0	62.7	159.5	77.7	97.9	191.6	66.7	952.0
1978	69.8	73.1	30.9	103.7	76.7	49.6	72.4	26.3	502.5
1979	128.4	201.4	68.6	203.1	89.4	85.4	266.3	75.2	1,117.8
1980	58.6	85.6	42.6	25.3	88.3	18.8	55.4	31.8	406.4
1981	205.0	365.2	105.6	252.1	91.3	165.0	196.8	67.3	1,448.4
1982	19.4	123.4	21.0	90.9	76.8	22.6	40.1	23.5	417.7
AVERAGE	102.6	110.8	38.5	94.4	60.0	65.2	100.2	36.8	[2]608.4

[1] Includes recharge from gaged and ungaged areas within the basin.
[2] Average totals may not be identical because of rounding procedures.

Data collected for over 50 years indicate that the aquifer has a long-term average recharge of approximately 608,000 acre-feet per year. It is important to emphasize that this is a long term average. In this region, periods of abundant rainfall alternate with periods of painful drought. Actual recharge has varied from a low of 43,000 acre-feet in 1956 to a high of 2,004,000 acre-feet in 1987. In the past three years, even with higher than average recharge, the year-end level of the J-17 index well at Fort Sam Houston has not risen significantly, because of the increase in pumping discharge.

It is possible to increase aquifer recharge to some degree by artificial means. The Edwards Underground Water District has constructed a number of recharge dams for this purpose. These dams temporarily impound stormwater runoff, to increase the amount which enters the aquifer through faults and sinkholes along a drainage course. Medina Lake also adds an average of 40,000 acre-feet per year through this kind of mechanism.[1] While this strategy can help sustain aquifer levels in the long run, recharge dams can make no significant contribution to the region's water supply during a drought.

Besides the annual recharge, the aquifer also contains an estimated 15 million acre-feet of water in storage. Therefore the amount used in any year can substantially exceed the volume

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[1]This amount varies with the level of the lake, and it is already included in the 608,000 acre-foot average.

of recent recharge. The excess of pumping and springflow over current recharge is referred to as "overdraft" of the aquifer.

Short-term overdraft is a normal condition during any dry spell. It is not a great concern, if the deficit which accumulates in this period is small enough to be immediately replenished during the next rainy season.

If groundwater discharges by pumping and springflow exceed the average recharge, however, then the aquifer is being "mined." When this happens for a period of years, we know that two things will happen as consequences:

(1) Water elevations throughout the region will decline.

(2) Pumping costs will increase.

Two other things also may happen:

(3) In some areas, particularly along the northern edge of the recharge zone, wells may cease producing water entirely.

(4) Poor quality water may move into the portion of the aquifer that now yields good quality water.

Besides all of the human needs which the aquifer serves, the springs in the eastern counties deserve special consideration. In the absence of any pumping, in the long run aquifer recharge would be exactly balanced by natural discharges from springs. As pumping has increased, San Pedro and San Antonio Springs, both in San Antonio, have flowed only intermittently since early in this century. As a result, the San Antonio River which flows through the city's downtown tourist district actually rises from a pump station in Brackenridge Park.

Today Comal and San Marcos Springs account for almost all of the region's natural springflows. These springs support unique ecological communities which depend on the constant temperature and quality of the aquifer water. They also contribute 25% of the average base flow in the Guadalupe River, and a larger fraction during periods of drought.

Comal Springs will cease to flow when the water elevation in the index (J-17) well reaches approximately 620 feet above mean sea level. San Marcos Springs will cease to flow when the index well reaches 575 feet AMSL.

It may be possible to replace the natural flow from the springs by pumping, at least for short time periods. However, there is a danger of salt water intrusion if this pumping continues excessively.

It is estimated that a discharge on the order of 150,000 acre-feet per year is the minimum needed to support the springs' environments in a healthy state. It is also necessary to consider the water rights of the downstream surface water users along the Guadalupe River.

If the aquifer could meet all of the demands placed upon it, there would be no need for this plan. The aquifer provides outstanding quality water at extremely low cost. Unfortunately, the region's economic development is increasing water demands beyond the aquifer's sustainable yield. In the near future, demand will exceed the average annual recharge permanently.

Recommendations

In the first round of Joint Committee meetings, in the spring of 1987, the Committee agreed on the most fundamental policy in this entire plan:

> Management of the Edwards Aquifer [will] be based upon recharge rates and annual withdrawal limits sufficient to insure natural flow at Comal and San Marcos Springs during periods of average rainfall.

For short, this is referred to as a policy of "no overdraft of the aquifer under average conditions."

The Committee therefore had to define the recharge rate which would meet this description. The historic annual average recharge for the period of record (1934 to 1982), 608,000 acre-feet per year, is used throughout the planning period to represent average rainfall conditions.

The Joint Committee also recognized the wide variation in annual recharge. It developed its planning model using average recharge as the baseline condition. Substituting another level of recharge would then allow the Committee to examine the consequences for various categories of water uses, and to adjust its policy recommendations in response.

The use of this average in the planning model implies that artificial recharge will not add significantly to the region's water supplies. This policy does not preclude such efforts. It merely recognizes that artificial recharge is not likely to become a major factor in the region's water budget.

The difference in the Planning Model between average recharge and groundwater pumping withdrawal is reserved for the springs and downstream water users. Therefore this policy also does not guarantee natural springflows during periods of drought. Response to a regional drought emergency will be governed by the Edwards District's separate Drought Management Plan.

PROJECTED POPULATION AND FUTURE WATER DEMAND

Background

Population projections serve as the basis for projected water demands. The Regional Water Resources Study provided population and water demand projections for the region through 2040 (Table A-2.)

Table A-3
Projected Regional Population and Water Demand, 1990-2040

	1990	2000	2010	2020	2040
Population	1,360,000	1,640,000	1,950,000	2,330,000	3,290,000
Water Demand (acre-feet/year)	450,000	506,000	564,000	650,000	870,000

Population projections are frequently a source of debate during the development of a plan. Individuals and interest groups believe that slightly different population projections would produce substantially different policy outcomes. Generally this is not the case unless a policy decision is made to consciously limit growth. The Regional Water Resources Study made a best effort to project regional water demand using the assumption that population growth would continue.

Recommendation

The water demand projections developed in the Regional Water Resources Study will used for the purposes of the plan. This assumes that population growth will occur, that it is acceptable, and it should be planned for.

GROUNDWATER WITHDRAWAL POLICY

BACKGROUND

Texas law has traditionally treated groundwater rights differently from surface water. Underground water in the aquifer has been subject to "free capture." That is, a landowner has traditionally had the right to drill a well and pump unlimited amounts of water for any beneficial use. In general there is no mechanism to recognize the rights of "downstream" users analogous to downstream surface water rights. Thus a landowner is under no obligation to recognize the impact of pumping on others who depend on the same underground water resource.

The physical nature of the Edwards Aquifer also encourages landowners in the region to drill ever deeper and bigger wells in order to satisfy possibly limitless water demands. There is no incentive for one user to unilaterally limit groundwater pumping, because the remaining users will continue to increase their pumping without restriction. There is no reason for anyone to assume the extra cost of using alternative supplies as long as others can avoid these costs without effort.

Consequences of Present Policies

In the fall of 1987 the Joint Committee described the relationships among water users under present policies in a background paper, "A Regional Water Resource Perspective" (Appendix F.) These relationships can be summarized as follows:

- At present, <u>all</u> pumpers have the right to pump unlimited quantities of water from the aquifer, even if other landowners will be injured.

- Cities share with irrigators the right to pump without restriction, even to the extent of using all of the available water in the aquifer.

- Cities in the San Antonio metropolitan area have the capacity to pump significantly greater volumes of water than irrigators. Thus they have a potentially greater influence on the water levels in the aquifer.

- Springflows and the downstream users in the Guadalupe River Basin depend on whatever aquifer water remains after pumping by the cities and the irrigators.

- The downstream users in the San Antonio River Basin depend on the water discharged into the San Antonio River as treated wastewater by the metropolitan cities. This amount increases or decreases depending upon the decision by these cities to discharge this water.

- The downstream Nueces River Basin users depend on natural rainfall for water.

- The water rights of downstream Nueces Basin users limit the ability of upstream, downstream-Guadalupe and San Antonio Basin users, irrigators and cities to divert significantly larger quantities of rainfall in the Nueces River Basin to recharge.

The physical consequences of a continuation of present policies include the following:

- As water levels in the aquifer decline, the flow of Comal and San Marcos Springs will be interrupted and will eventually cease entirely. This will destroy the habitat and natural environment of the river systems in the area which depend on the springflows. Aquatic life, including federally protected endangered species, in the springs and rivers will be harmed or become extinct. This impact will extend to the bays and estuaries.

- The loss of springflows will also damage the economies of New Braunfels, San Marcos, and all of the downstream communities in the Guadalupe Basin. Less water will be available to dilute the wastewater return flows which enter the Guadalupe River from municipalities and farming areas in the river's drainage area. This will seriously degrade the water quality in the downstream Guadalupe Basin.

- Lowered water levels in the aquifer will increase the risks of progressive degradation of water quality in the aquifer itself. This may occur either as a result of saline water intrusion or by contamination from surface land uses.

- More treated wastewater will be discharged from the metropolitan area as a result of increased population and increased per capita consumption. This could make more water available in the Downstream San Antonio Basin. This effect would be limited if this wastewater is diverted to other consumptive uses.

- Some municipalities, especially those along the northern and southern boundaries of the aquifer, will face limited water availability because of declining water quality or water level.

- Cities and irrigators will both face higher energy costs as a result of pumping from lowered water levels. The irrigators will be less able than the cities to pay these increased costs.

Policy Development, 1986-87

Back in 1986 the Regional Water Resources Study suggested that the present policies permitting unrestricted pumping of the aquifer would undoubtedly be changed in the future. The Study concluded that the only real questions were when the policy changes would occur, what form they would take, and at what level of government they would be initiated. The report recommended that the best approach would be to initiate the policy changes through a cooperative effort on the regional level:

> A cooperative approach by all of the principal parties in the area in the development and implementation of a regional surface water and groundwater management program before a severe drought or a serious water shortage occurs would be the most desirable method. This should produce a more balanced program, developed from the ground up with all affected interests having a say, rather than a program developed in a crisis atmosphere which might tend to be imposed from the top down with less opportunity for all voices to be heard.

The Edwards District and the City of San Antonio recognized the validity of the "bottom-up" approach when they created the Implementation Advisory Task Force. The IATF's subsequent policy recommendations on groundwater management confirmed this approach (Appendix C.)

By the spring of 1987, the IATF's recommendations had evolved into the Joint Resolution which was discussed in the previous chapter. After extensive discussions in the Joint Committee, the outlines of a consensus began to emerge. The Policy Statements in the Joint Resolution recommended the implementation of an "allocation" system of groundwater regulation and the enactment of new laws to provide for conjunctive management of surface and groundwater:

> There must be new laws to allow conjunctive management of surface and groundwater to provide for optimal use of water in the primary and secondary areas of the Region.
>
> Allocation of groundwater should be accomplished as a part of a comprehensive regional water plan that must include programs of conservation, reuse and surface water development.
>
> ° Allocation policy will require the establishment of maximum amounts that may be pumped from wells. The allocations system must be carefully designed and carried out to achieve the following:
>
> - protection of water quality
> - protection of the economic stability of the region by an assurance of the water supply
> - protection of the environmental values of the region
> - protection of spring flow and downstream water availability
> - prevention of overdraft of the Edwards Aquifer
> - recognition of historic uses and users
> - provision for markets for the purchase, lease or trade of groundwater rights.

The policies proposed in the Joint Resolution were intended to ensure the availability of water throughout the region:

° Current irrigators, water purveyors and other groundwater users would have quantified groundwater rights. They would be limited to pumping historic amounts, but they would have greater assurance that water levels would be maintained under average conditions. They would also have extended water availability under drought conditions. The ability to buy or sell groundwater rights would be established.

- Downstream Guadalupe Basin users and those who depend on the springs would have greater assurance that this water would be available under average conditions. They would also have extended availability during a drought.

- New water demands by cities and irrigators would have to be met from conservation, reuse, surface water and water rights markets, at higher costs.

- Downstream San Antonio Basin users would still depend on the amount of treated wastewater released by cities in the metropolitan area. This amount would vary depending on the cities' growth, conservation, reuse, and diversion to other consumptive uses. For this reason the Committee later established a minimum required volume for release.

- Irrigators and other groundwater users who wish to exceed their allocations would have to pay the costs of developing new water supplies.

Policy Refinement, 1988

During most of the Joint Committee's discussions, the policy for management and use of the aquifer was commonly called the "Allocation Policy." The term "allocation," however, was an unfortunate and misleading choice of words. It implies the assignment of portions of a fixed value to various users, when in fact this was not the issue. The real issue has been the role which groundwater pumping withdrawals should play in meeting the total regional water demand. This could have been better described as "Groundwater Management," "Pumping Limitations," or "Recognition of Historic Rights."

Policy for the management and use of the aquifer is central to the development of a Comprehensive Regional Water Resources Plan. The groundwater withdrawal policy is rooted in the fundamental decision that the aquifer will not be overdrafted on a sustained basis, and that springflow and other environmental needs will be recognized. In implementing this principle, the policy attempts to protect all of the varied user interests in the aquifer.

The Joint Committee considered a range of possible values for a pumping withdrawal limit. The lowest value considered was 425,000 acre-feet per year, which was the amount recommended by the Texas Water Plan in 1984. This amount, however, assumed an average annual recharge rate of 575,000 acre-feet per year. As noted in the preceding chapter, later data suggests an actual long-term average of 608,000 acre-feet per year.

The highest amount actually pumped so far has been 529,000 acre-feet, in 1984. This established the maximum limit considered.

Within this range, the Joint Committee analyzed the effect of various possible limits on general categories of users, environmental needs and other policy considerations (Figure B-3, page 63.) This analysis indicated that withdrawal amounts of 450,000 to 475,000 acre-feet per year were optimal for the greatest majority of users.

Once the decision is made to establish a target withdrawal limit, several other policy issues must be addressed: the amount of the pumping limit; how this limit is to be achieved; and how the process will be implemented during periods of relative abundance and during periods of drought.

The initial plan which the Committee considered would have immediately imposed an absolute limit, say 475,000 acre-feet, to be proportionately "allocated" among all existing users. The Committee hesitated to impose an absolute cap which would have to be met immediately, however. Regardless of the amount chosen, this approach would be disruptive to all existing users. It seemed impractical to ask them to roll their use back to levels they reached before 1984. The legislation needed to implement this would not be politically viable.

The Committee also considered an approach based on full recognition of existing users' right to pump without limit. They rejected this because extending present unrestricted pumping rights in perpetuity would eventually reduce the springflows in the eastern counties.

Instead, the Committee chose to recognize initially existing users at historic pumping levels. They established a long-term target withdrawal limit of 75% of average annual recharge (approximately 450,000 acre-feet per year) for average conditions. When achieved, this would leave approximately 150,000 acre-feet for natural springflows, or roughly the minimum which is estimated to be needed for environmental reasons.

It is important to emphasize that this is not an initial "allocation" limit, but a target value to be reached over an indefinite period of time. The value selected represents a balance between the reality of current pumping demands and the need to provide protection to springflows, instream water needs, and bay and estuary freshwater inflows.

The initial process would grandfather all existing groundwater users at their historic pumping levels. The total amount of these grandfathered rights will be determined in 1995, when a transition period in which new historic rights may be established will expire. The Committee's recommendation specifically provides that irrigated agriculture may take the amount actually needed to grow crops on the number of acres irrigated in the years before initiation of the groundwater withdrawal policy.

Next the Committee had to develop a way to move from this historic plateau back down to the long run target. It considered and rejected as unworkable the idea of imposing an across-the-board percentage rollback on all users over a period of years. Instead it proposed to retire increasing amounts of historic pumping rights by voluntary purchases as new water resources are developed. Any entity in the region would be able to participate in the pumping rights transfer and retirement programs. The Committee also developed a mechanism to retire existing grandfathered pumping rights automatically as the use of land changes.

The Committee was also sensitive to the plight of existing dryland farmers who would be reluctant to give up their historic right to irrigate with groundwater, and other users who may be planning expansion under existing laws. Therefore it recommended that the "historic period" for determination of groundwater rights include a seven year transition period in which new rights could be established.

The Committee also had to develop policy for periods of above average recharge. Since the aquifer cannot store current recharge permanently, the law of nature is "use it or lose it." It makes no sense <u>not</u> to use the surplus when one is available beyond all the previously recognized needs. Therefore the Committee developed a procedure to create <u>conditional</u> water rights permits -- depending on conditions such as recent rainfall, recharge, springflows, and the level of water in the aquifer.

The Committee did not develop specific policy to manage a drought. Under House Bill 1942 the Edwards District is already developing the regional Drought Management Plan in a separate process. This plan seeks the following goals:

- To protect human health and safety;
- To protect the water quality in the aquifer;
- To share the hardships of a drought equitably;
- To minimize disruption in the region's economy, in order to protect jobs;
- To minimize the length of time Comal Springs will be dry, in order to protect downstream water rights; and
- To prevent San Marcos Springs from going dry, in order to protect downstream rights and maintain the aquatic ecosystem.

The law requires the plan to contain objective definitions of a drought in various stages of severity and to detail the measures which will be enforced in order to reduce water consumption. The plan will require substantial reductions in water use during a drought emergency.

Finally the Committee recognized the need for flexibility in the assignment of groundwater withdrawal rights among users. This requires the development of a market in water rights. Sale or lease of groundwater pumping rights would allow water to shift easily and efficiently from one use to another in response to market incentives. This is an important safety valve in a system which would otherwise be frozen into its pattern at a specific time. It is also an essential part of the mechanism to gradually reduce existing rights toward the long run target as land uses change.

RECOMMENDATIONS

Because the groundwater withdrawal policy will require an amendment to the Edwards District's enabling act, the Joint Committee developed this Plan Component in the form of a proposal for the new legislation. This ensured that everyone would know precisely what was being proposed, and thus avoid any controversies which might arise from misunderstanding.

Once this proposal is approved by the Edwards District Board of Directors and the San Antonio City Council, it will be translated into a draft Act of the Legislature. The two governing bodies will then work with the state legislators from the region to have the bill introduced and passed in the 1989 session of the Legislature.

This section summarizes the proposal. The complete "Proposed Method for Legislation for Groundwater Management within the Edwards Underground Water District" begins on page 99.

The essence of the Act would authorize the Edwards Underground Water District to develop and implement a Comprehensive Groundwater Resources Plan for the Edwards District. The plan would enable the District to manage the region's underground water resources.

The Act would set a long-term goal of maintaining the average annual pumping withdrawal at 75% of the aquifer's average annual recharge. It would establish a policy to achieve this goal through three mechanisms: (1) systematic retirement of existing groundwater pumping rights by voluntary purchases from willing sellers; (2) reduction of pumping rights as the District develops new water resources to offset them; and (3) creation of a program of water rights transfers. The Act would not provide for the reduction of any existing groundwater rights except as the result of purchase for retirement, substitution of other water, or transfer of the rights as described below.

In order to implement the plan, the Act would authorize the Edwards District to register wells and to issue water rights certificates and withdrawal permits throughout the District. All wells would have to be registered, but generally only those wells capable of producing more than 100,000 gallons per day would be subject to certificate requirements. Wells which supply the domestic needs of 10 or fewer households and livestock wells with a capacity of no more than 100,000 gallons per day would be exempt from the requirement of certification. Irrigation wells which draw water from shallow aquifers (for example, the Leona Gravels) or water with an average dissolved solids concentration of over 1000 parts per million (mg/l) would also be exempt from the Act.

Initially, the certification procedure would require the District to determine only the validity of the amount and use of the water claimed as an historic right. This would be established by the applicant's records and by data available from the

Agricultural Stabilization and Conservation Service, hydrologic surveys, or other appropriate sources. The Act would provide for a public hearing on the application and an appeals procedure.

All users of underground water would be required to report their actual withdrawals to the District each year. The District would furnish and install the meters for all unmetered users who are required to obtain certificates.

Assuming the Act is effective September 1, 1989, historic rights for irrigation uses would be based on the maximum number of acres actually irrigated in any year between January 1, 1979 and December 31, 1995. An irrigation right would not be expressed as a set volume of water. Instead it would be defined as "the amount of water actually needed for growing and incidental processing of crops" on the number of acres with this historic right. The irrigation right would be appurtenant to each acre, and the certificate would be filed with the deed records. When irrigated land is sold, the irrigation right could either be transferred with it or sold separately.

A landowner would have flexibility in applying the irrigation right. A farmer could substitute previously unirrigated acreage for the actual cropland acres which established the right. An owner could also sell or lease irrigation rights to a non-irrigation user at a rate of 1.5 acre-feet per acre of irrigation right. In this case, the farmer might either irrigate any remaining acreage with the full amount needed on only those acres, or continue to irrigate an entire tract subject to an overall limit of 1.5 acre-feet per acre of rights remaining.

For non-irrigation uses, the historic right would be the maximum amount actually pumped in any year between 1979 and 1995. This amount would be stated in the certificate. An increase established during the transition period (January 1, 1988 to December 31, 1995) would have to be justified, for example by data showing population growth or increased industrial production.

The Edwards District would also establish the market in water rights. This would allow purchase of rights from existing users by other existing or new users, purchase by the District for resale, and purchase by any public or private entity in order to retire the rights.

Irrigation rights could be leased or sold subject to these limitations:

- any transfer of an irrigation right from one acre to another would be the entire irrigation right on that acre;
- rights would transfer from irrigation to non-irrigation uses at a rate of 1.5 acre-feet per previously irrigated acre; and
- irrigation rights established between 1988 and 1995 could not be transferred to non-irrigation uses, in order to prevent speculation in these rights.

Non-irrigation rights would be transferrable in whole or in part. Again in order to prevent speculation, non-irrigation rights established between 1988-1995 could not be transferred.

The Plan would also authorize the Edwards District to issue conditional user permits. These would allow the holder to pump a certain amount of groundwater subject to conditions in the aquifer such as current rainfall, recharge, pumping demand and springflows. Each year the District would determine how much additional pumping could be authorized in this manner. Conditional user permits would require the payment of both a permit fee and a withdrawal fee. They would be issued for periods of up to ten years and they would not be transferable.

An important principle in the proposed Act would link groundwater management with the development of new water supplies. The Comprehensive Groundwater Resources Plan would provide for the phased development of conservation and wastewater reuse programs, surface water projects, and retirement of existing groundwater rights. Each year the District would determine how much additional water has been developed or is projected to become available from these sources, and how much groundwater the existing certificate holders would like to sell or lease. As this additional water becomes available, the District would facilitate the transfer of groundwater rights to take best advantage of the new supplies.

The cost of these additional water supplies would be met by user fees. These fees should be higher for low priority uses, such as seasonal lawn watering, and lower for high priority uses, such as crop irrigation and industrial purposes.

New irrigation users would be permitted after 1995, up to a total average withdrawal for irrigation purposes (including historic irrigation rights transferred to non-irrigation uses) of 200,000 acre-feet per year. These new irrigation users would be charged a withdrawal fee equal to the cost of water conservation programs, as estimated by the District. When the average total withdrawal for irrigation exceeds 200,000 acre-feet, new irrigators after 1995 would have to buy or lease water rights in the water rights market. All new non-irrigation users permitted after 1995 would also have to buy or lease the water rights. Thus new users in effect would pay the full actual cost of alternative water supplies, as the water purveyors make these new supplies available to their customers.

The plan would also place emphasis on regional conservation programs. It would require municipalities throughout the region to enact water conservation ordinances by the end of 1989. It would also require water purveyors to restructure their rates to encourage conservation.

The Edwards District would provide technical assistance to other agencies in developing local conservation plans. The District would monitor and enforce measures to prevent waste, such as the use of tail-water return systems in certain irrigation systems. It would also work with all users to encourage efficient water use practices and to ensure maximum use of water conservation technologies.

In general the owner of a groundwater right would retain the benefit of any water saved through conservation or reuse, either for expansion or for sale in the water rights market. However, 50% of the water saved by a conservation project would be retired from the recognized groundwater rights if the District pays for the project.

The District would re-examine the plan periodically with the aid of a panel similar to the Joint Committee which developed this document. The panel would consider:

- the maximum amount of water permitted to all users and the actual amount withdrawn from the aquifer each year;
- the implementation and actual results of conservation and reuse programs;
- progress toward the completion of surface water projects;
- the institutional arrangements for implementing the plan, including overall management and the financing of the plan components.

The review panel would recommend any amendments to the plan which may be needed to achieve the long-term management goal.

The law would provide that the entire process will automatically be terminated unless satisfactory progress is made in conservation, reuse, and surface water development by the end of 1995. Specific requirements will include continuing compliance with water conservation programs, permitting of wastewater reuse projects by the City of San Antonio, the beginning of actual construction on Applewhite Reservoir, and submission of permits to the Texas Water Commission for Cibolo and Cuero Reservoirs.

The full text of the "Proposed Method for Legislation for Groundwater Management within the Edwards Underground Water District" is reprinted below. The following chapters in this report -- the "Plan Components" on conservation, reuse, and surface water development -- are the groundwork on which those elements of the plan will be based.

PROPOSED METHOD FOR LEGISLATION FOR
GROUNDWATER MANAGEMENT WITHIN
THE EDWARDS UNDERGROUND WATER DISTRICT

Prepared for Joint Committee on Water Resources

[DRAFT OF JULY 8, 1988]

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[DRAFT OF JULY 8, 1988]

PROPOSED METHOD FOR LEGISLATION FOR
GROUNDWATER MANAGEMENT WITHIN
THE EDWARDS UNDERGROUND WATER DISTRICT

SECTION 1. ASSUMPTIONS.

1.1 *Groundwater Management Plan.*

Legislation will be enacted (the *"Act"*) to provide statutory authorization for the development and implementation by the Edwards Underground Water District (the *"District"*) of a Comprehensive Groundwater Resources Plan (the *"Plan"*). The Plan will provide for the management by the District of groundwater resources within the District.

1.2 *Management Goal.*

The Management Goal of the Plan is to maintain the average annual withdrawal from the Aquifer at 75% of the average annual recharge. It is intended that the District will have primary responsibility for implementing measures to achieve the Management Goal over a period of time. The methods to be used by the District to achieve the Management Goal will be the systematic retirement of groundwater rights through purchase from willing sellers (expressly excluding condemnation for this purpose) and the reduction of permitted amounts, offset by the substitution of new water resources developed by the District. In addition, the District will establish and oversee a program of transfer of water rights.

1.3 *Administration.*

The Act will provide certain statutory amendments authorizing the District to receive, review and approve applications for certificates and permits recognizing withdrawal rights, to issue certificates and permits, to maintain a central registry for certificates and permits and to regulate and administer related matters.

1.4 *Exemptions.*

Generally, wells used to supply the domestic needs of ten (10) or fewer households and wells used to provide water for livestock purposes with the capacity to produce not more than 100,000 gallons per day will not be subject to the certificate requirements of this Act. Such wells will, however, be subject to registration.

1.5 *Waste.*

The District will monitor and enforce measures to prevent waste. An example of such measures is tail-water return systems for certain irrigation systems.

1.6 *Drought Management Plan.*

The Plan assumes that a District Drought Management Plan as provided in Section 10 of Article 8280-219, as amended, is in effect. The Draft Drought Management Plan which has been proposed to comply with the statutory requirements contains the following goals:

- Protect human health and safety.
- Protect water quality in the Edwards Aquifer.
- Share the impact or hardships caused by droughts.
- Minimize disruption of the economic interest of the region, including the agricultural sector, so that employment and jobs are protected.
- Minimize the length of time Comal Springs will be dry in order to protect downstream water rights and preserve economic opportunities.
- Prevent San Marcos Springs from going dry in order to protect downstream rights, maintain the aquatic ecosystem, and preserve economic opportunities.

1.7 *Conservation Required.*

The Plan assumes that water conservation measures will be in effect. By December 31, 1989, (1) ordinances will be enacted to require conservation measures; (2) water rates will be adjusted to encourage conservation; and (3) the District will require efficient use practices for all users.

SECTION II. CERTIFICATE PROVISIONS OF THE PLAN.

2.1 *Historic Period.*

Assuming that the legislation is effective September 1, 1989, the historic period for both irrigation and non-irrigation users will be from January 1, 1979, to December 31, 1995.

2.2 *Irrigation Users.*

2.2.1 *Irrigation Right.*

The irrigation right is the right to use the amount of water actually needed for growing and incidental processing of crops on those cropland acres that are subject to irrigation during the historic period, provided waste does not occur.

2.2.2 *Appurtenant.*

The irrigation right is appurtenant to each acre and will be recognized in a certificate issued to the owner of the land and filed in the deed records.

2.2.3 *Substitution.*

Cropland acres with no irrigation rights may be substituted for cropland acres with irrigation rights.

2.2.4 *Flexible Use.*

The irrigator will have flexibility in applying the irrigation right. For example, if a farmer has 100 irrigated acres and decides to transfer (pursuant to Section 2.4.1) the irrigation right appurtenant to 50 of those acres to a water purveyor, then the farmer may choose either:

1) to irrigate the remaining 50 acres with the amount of water actually needed to grow crops on such 50 acres;

or

2) to continue to irrigate the entire 100 acres with water withdrawn pursuant to the right appurtenant to the remaining 50 acres; provided that the maximum available for irrigation under those circumstances shall be 75 acre feet (1.5 acre feet x 50 acres).

2.2.5 *Sale or Conveyance of Land.*

When irrigated land is sold or conveyed, the irrigation right may be transferred with the land or transferred separately pursuant to Section 2.4.1.

2.2.6 *Exemptions.*

2.2.6.1 *Bad Water Wells.*

Water withdrawn from irrigation wells with an average total dissolved solids concentration in excess of 1000 ppm (mg/l) shall be exempt from the Act.

2.2.6.2 *Shallow Aquifers.*

Water withdrawn from wells not completed in the Edwards and associated limestone aquifers, in particular the Leona Gravels, shall be exempt from the Act.

2.3 *Non-Irrigation Users.*

A non-irrigation user will be issued a certificate to withdraw each year the maximum amount of water used during any year of the historic period, January 1, 1979, to December 31, 1995. If the maximum amount pumped in any year occurs in a year between January 1, 1988, to December 31, 1995, then the applicant must justify any increase over the maximum amount pumped in any year from January 1, 1979, to December 31, 1987. Such justification shall include data showing increases in population or production. During periods of abundance, conditional user certificates pursuant to Section 2.6 will be available.

2.4 *Water Rights Transfers.*

The District shall establish a system for the transfer of water rights. Such transfer of water rights shall include (i) purchase from existing users by other existing users or new users; (ii) purchase by the District for eventual resale to other existing users or new users; and (iii) purchase for retirement.

2.4.1 *Transfer of Irrigation Rights.*

The Plan will allow transfer of the irrigation rights appurtenant to irrigated cropland acres by lease or grant subject to the following:

a. A transfer to another acre for irrigation shall be the entire irrigation right.

b. A transfer to non-irrigation uses shall be limited to the 1.5 acre feet per acre.

c. A transfer to non-irrigation uses will not be allowed for those irrigation rights certificated during the period from January 1, 1988, to December 31, 1995.

2.4.2 *Transfer of Non-Irrigation Rights.*

The Plan will allow the transfer of a non-irrigation right in whole or in part. Transfer will not be allowed for those non-irrigation rights recognized during the period from January 1, 1988 to December 31, 1995.

2.5 *Purchase of Water Rights.*

Any person, including a governmental body, shall be authorized to purchase water rights for retirement or resale.

2.6 *Conditional User Permits.*

The Plan shall allow new users and existing users who desire additional water after the historic period to apply to the District for a conditional user permit. The District may approve or disapprove any application for a conditional user permit. The Plan shall require the payment of both a permit fee and a withdrawal fee by such users. The conditional user permit may be granted for a period not to exceed ten years and shall allow the holder thereof to pump a certain amount of groundwater subject to various conditions in the Aquifer. The conditional user permit shall not be transferable.

SECTION III. NEW WATER.

3.1 *New Water Resources.*

In order to accomplish the Management Goal, the Plan shall provide for the phased development of conservation and reuse of existing water resources, the implementation of surface water projects and the retirement of existing groundwater rights.

3.2 *Water for New Users.*

New users after December 31, 1995, may withdraw water pursuant to transfer of rights from existing certificate holders. As existing certificate holders implement conservation, reuse and surface water, they may desire to transfer by sale or lease some of their groundwater rights. The Plan shall provide that the District will annually determine the amount of groundwater available for such transfer. Each such annual determination shall take into account (i) the amount of groundwater which existing certificate holders desire to transfer; (ii) the amount of new water resources in place; and (iii) the amount of water projected to be available from commitments for the development of new water resources.

Example: The City of Castroville may desire to purchase 1,000 acre feet to furnish water to its increased customer base. The City of San Antonio may desire to sell 1,000 acre feet as the City has recently completed a surface water project and has water to sell. The price for the 1,000 acre feet will take into account the price of developing, treating and delivering the surface water although Castroville will never actually pump surface water. Instead, the City of San Antonio will transfer 1,000 acre feet of its groundwater certificate to the City of Castroville and replace the 1,000 acre feet with surface water.

3.3 *Payment for New Water Resources.*

New water resources will be financed by user fees. The District will encourage water purveyors to adopt structured rates so that user fees shall be higher for low priority uses and lower for high priority uses. For example, certain seasonal usage, such as lawn watering, will have a low priority and will be subject to higher rates. Irrigation and industrial uses will have a higher priority.

3.3.1 *New Irrigation Users Permitted after 1995.*

The fees charged for permits for new irrigation users permitted after December 31, 1995, shall be equivalent to the cost of conservation measures, as determined by the District from available data, provided that the average total withdrawal for irrigation in the District does not exceed 200,000 acre feet. (For the purpose of calculating the 200,000 acre feet, water rights transferred from irrigation to non-irrigation use will be included.) When at such time on or after December 31, 1995, the average total withdrawal for irrigation exceeds 200,000 acre feet, then new irrigation users will purchase or lease water rights.

3.3.2 *New Non-Irrigation Users Permitted After 1995.*

New non-irrigation users after December 31, 1995, will purchase or lease water rights.

3.4 *Conservation and Reuse.*

Water saved through conservation or reuse shall be retained by the person implementing such conservation or reuse and shall be available to such person for expansion, transfer or retirement. Such persons may include individuals and public bodies. If the District uses its funds to pay for a user's conservation measures, including hardware and installation, then fifty percent (50%) of any water saved as a result of such measures shall be retired by the District. The other fifty percent (50%) shall be retained by the user.

SECTION IV. ADMINISTRATION.

4.1 *Certificate and Permit Application.*

The District will administer certificate and permit applications and approvals pursuant to procedures established by statute and by rules promulgated by the District. Such procedures shall include, but not be limited to, the filing of sworn statements by applicants containing such information in such form as shall be determined by the District to be necessary to make a determination as to the validity of the amount and use of water claimed; the holding of public hearings; and a procedure for appeals.

4.2 *Approval of Application for Withdrawal Certificates.*

The District shall hold hearings upon applications filed. Such hearings may be waived by the applicant if no other interested parties object.

4.2.1 *Non-Irrigation Certificates.*

At each hearing, the District shall determine from evidence presented by the applicant and other interested parties, from hydrologic surveys and from other relevant data available to the District, whether the amount claimed is accurate. If so, and if the District finds that waste will not occur, the District shall approve the application and issue a withdrawal certificate.

4.2.2 *Irrigation Certificates.*

In order to determine which acres were irrigated cropland during the historic period, the District shall consider evidence presented by the applicant and data available from the Agricultural Stabilization and Conservation Service and other relevant sources.

4.3 *Annual Reporting.*

The District will keep records of actual withdrawals based on annual reports submitted by all users. The District will furnish and install meters for all unmetered users who are required to obtain certificates.

SECTION V. REVIEW AND ADJUSTMENT OF PLAN.

The Plan will provide for a system of review by panel consisting of six members of the District board, five members of the San Antonio City Council and the chairman or his designee of the Guadalupe-Blanco River Authority, the Nueces River Authority, and the San Antonio River Authority. The Review Panel shall consider and recommend amendments to the Plan, if any, which are necessary to achieve the Management Goal. The panel shall consider the following matters, among others:

(1) Maximum amount of water permitted to all users and actual amount withdrawn during each year.

(2) Review and adjustment of the Management Goal.

(3) Institutional arrangements for implementation of the Plan, including overall management of the Plan and financial contributions.

(4) Implementation and actual results of conservation measures.

(5) Implementation and actual results of reuse measures.

(6) The initiation of and progress toward completion of surface water projects.

This legislation will not provide for reduction of certificates, other than reductions because of transfers or retirement or substitutions by the District of other water resources.

SECTION VI. *AUTOMATIC TERMINATION.*

The legislation will provide that the Plan will automatically terminate unless the following conditions exist on December 31, 1995:

(1) Conservation -- There will be continuing compliance with water conservation requirements;

(2) Reuse -- Specific sewage treatment plants, as discussed in the Joint Committee Report, will be permitted;

(3) Surface water -- Construction shall have commenced for the Applewhite Reservoir, and permits shall have been submitted to the Texas Water Commission for Cuero and Cibolo Reserviors; and

(4) Drought Management Plan -- The Drought Management Plan complying with Section 10 of Article 8280-219, as amended, will be in effect.

WATER CONSERVATION

BACKGROUND

Conservation is a real source of water, just as much as wastewater reuse or the development of surface reservoirs. Each gallon saved from an existing use is an additional gallon made available for new uses.

In essence, conservation means managing a resource so that it lasts longer and is used more productively than it would be without management. It also means reducing waste to a minimum. Improvements in water use efficiency can extend the use of the aquifer resource, maintain aquifer water levels above critical elevations, reduce costs to the user, reduce the energy needed for pumping, treatment and distribution, and in some cases they can reduce the cost of sewage treatment.

Water conservation can be accomplished through economic or programmatic measures. Economic measures are actions taken to reduce water demand. They may be the result of "natural" market forces in that water users will respond to rising costs by voluntarily changing their water use habits and installing more water-efficient equipment. Programmatic conservation involves deliberate programs to increase the efficiency of water use and to limit wasteful uses. These may include education and information programs to encourage more efficient water use behaviors as well as mandatory building code requirements to increase the efficiency of water use within structures. Economic and programmatic measures should be carefully integrated to provide all water users with the information, the incentives and the means to change their water use patterns.

To evaluate conservation fairly, it must be assessed on an equal economic and institutional basis with other potential water resources. The value of water conserved, per acre-foot, is equal to the cost of producing that additional acre-foot by other means such as reuse or surface water reservoirs.

Measured by this standard, water conservation has some major advantages over other sources of additional supply. It has a short lead time, and it can be acquired in small increments. Once a program has been designed and tested, it can be quickly scaled up or down. Because a lengthy period of site approval and licensing is not involved in design and construction, conservation programs can be quickly and easily modified to respond to changing conditions. Conservation does not place additional demands on other resources such as energy for pumping, or impose loss of productive lands by inundation.

The City of San Antonio and the Edwards Underground Water District each have a history of involvement in water conservation programs. In 1980 San Antonio amended its building code to reduce wastewater flows. This has proven useful in conserving water, and so the City is currently considering additional amendments for lavatory and kitchen faucets and showerheads.

In 1981 the Edwards District purchased equipment to evaluate the efficiency of agricultural irrigation, in order to provide irrigators with better information on conserving water. The District is also currently sponsoring agricultural irrigation research at the Texas Agricultural Experiment Station in Uvalde.

In 1984, the District and the City co-sponsored "Operation Water Conservation" in response to the drought of 1982-84. This was primarily a voluntary and public information program to reduce water use and thus maintain water elevations in the aquifer. The program also involved the water utilities and other municipalities within the region. The City of San Antonio, Edwards Underground Water District, San Antonio River Authority and Texas Agricultural Extension Service also constructed a xeriscape demonstration garden in 1984 at the San Antonio Botanical Center.

In June of 1988, the Joint Committee convened a "Conservation Summit Meeting" in San Antonio. This involved about 130 people including elected officials and staff from the federal, state, regional and local governments, and public and private water purveyors. The attendees assessed local attitudes toward water conservation, discussed the elements of possible conservation programs, and developed means to stimulate further initiatives.

These water conservation efforts have been reasonably effective in reducing water demand. More needs to be done, however, if the region is to achieve long term water resource goals.

CONSERVATION OPTIONS

Table C-1 presents a list of possible long range water conservation opportunities. These are described in the following paragraphs.

Table C-1
Possible Water Conservation Practices

GENERAL APPLICATION	PUBLIC FACILITIES
Public Education	Building Retrofit Devices
School Education	Efficient Landscape Irrigation
Pricing:	
Increasing Block Rates	**MANUFACTURING/INDUSTRIAL**
Seasonal Block Rates	
Excess Use Penalties	Recirculation of Cooling Water
	Reuse of Cooling Process Water
Leak Detection	Reuse of Treated Wastewater
	Low Water Using Fixtures
	Process Modifications
DEVICES FOR NEW CONSTRUCTION	Efficient Landscape Irrigation
Low-Flush Toilets	
Low-Flow Shower Heads	**AGRICULTURE**
Faucet Aerators	
Water-Efficient Appliances	Drip and Low Volume Irrigation
Pipe Insulation	Low Energy Precision Application
Pressure Regulators	
Air-Assisted Showers	Surge Irrigation
Air-Water Toilets	Irrigation Scheduling
Dual Water Systems	Laser Leveling
	Furrow Diking
	Brush Management
RETROFIT DEVICES	
Toilet Displacement Bottles	**STEAM ELECTRIC GENERATION**
Toilet Dams	
Replacement Low-Flush Toilets	Recirculation of Cooling Water
Shower Flow Restrictors	Reuse of Treated Wastewater
Low-Flow Shower Heads	In-System Treatment
Faucet Aerators	
Water-Efficient Appliances	
Pipe Insulation	
Pressure Regulators	
URBAN LANDSCAPE IRRIGATION	
Reduced Watering	
Xeriscape Planting	
Low Volume Sprinklers	
Irrigation Scheduling	
Moisture Sensing Valve Controllers	
Plumbing & Landscaping Ordinances	

Supportive Programs of General Application

Two types of programs would apply generally throughout the region. On the demand side, public and school education/ information programs would promote awareness of water as a limited natural resource, and help develop wise water use habits among the region's population. On the supply side, water utilities can directly encourage voluntary conservation by restructuring the prices they charge their customers. They can also improve their own system operations, to control the loss of water from leaks in their distribution systems.

- PUBLIC INFORMATION AND EDUCATION. Public information programs could include brochures, bill inserts, exhibits, films, a speakers bureau, public service announcements and advertising to educate residents about their water supply and to encourage conservation.

- SCHOOL PROGRAMS. Schools could promote wise water use habits beginning at the elementary level. These programs could follow students through high school, with a change of focus at that level to appreciation of water as a limited natural resource. Activities could include teacher training, films, development of specific education materials about the Edwards Aquifer, aquifer exhibits in public places, a speakers bureau, and annual contests.

- INCREASING BLOCK RATE PRICING: In an increasing block rate structure, the unit price of water increases as use increases. The "blocks" of the rate structure are designed so that for most customers, the last unit of consumption is billed at the highest rate they reach. This increases a customer's incentive to conserve. The upper block rates could be equal to the marginal cost of water conservation programs, reuse programs or surface water development. The overall rate structure could be designed to include lifeline rates for low income customers, and to make long term revenue equal to average long run costs.

- SEASONAL BLOCK RATE PRICING: Seasonal pricing involves charging more for water in summer months, when demand is high, and less in the winter when demand is low. Seasonal pricing is based on the assumption that water systems must be sized to meet peak summer demands. Therefore the additional cost of the extra system capacity for peak summer demands should be recovered through higher summer water rates.

  Seasonal pricing can be implemented alongside increasing block rates. In this combination, the increasing block rate would be based on the market cost of the water itself, including the costs of production, conservation and reuse programs, and surface water development. The seasonal rate would be an adjustment in the summer months based on the cost of extra system capacity.

- EXCESS USE PENALTY: An excess use penalty would be a penalty imposed on the water consumer when water use increases by more than a certain percentage of a defined amount such as average monthly use, or previous monthly use. This would reinforce the effect of seasonal peak rates, and it would be an especially powerful incentive to control leaks and other wasteful use.

- LEAK DETECTION. Water distribution systems all have unavoidable and undiscoverable leakage. Even a well constructed system is likely to have undiscoverable losses such as these: one drop per second from each joint, five drops per second from each hydrant and stop valve, and three drops per second from each service pipe, including tap and unit cock. Given the typical distribution network, unavoidable and undiscoverable leakage is estimated to be between 2500 and 3000 gallons per mile per day. A leak detection and prevention program would involve a water purveyor's keeping accurate records of internal water usage and reporting unaccounted-for water. These programs should reduce the unaccounted-for water losses associated with water main breaks.

A program to detect and repair leaks in individual homes could also be instituted, as a logical extension of this strategy.

Devices for New Construction

- EFFICIENT FIXTURES AND APPLIANCES. A variety of more water-efficient fixtures and appliances are available. Amendments to local building codes could require them in new construction. This equipment includes low flow and ultra-low flow toilets, low flow shower heads, faucet aerators, water-efficient dishwashers and washing machines, hot water pipe insulation, and pressure reducing valves at the water meters. The fixture water use requirements are as follows:

Ultra-low flush toilet:	1.5 gal/flush
Low flow showerhead:	2.0 gal/minute
Faucet with aerators	3.0 gal/minute
Conserving washing machine	42.0 gal/load
Conserving dishwasher	8.5 gal/load

With the exception of the ultra-low flow toilets, the cost of these water conserving devices is similar to common fixtures and appliances. Installation of the ultra-low flow toilets could be encouraged by discounts on new water connection fees. As additional reduced flow plumbing fixtures become more readily available (for example, air-assisted showers and air-water toilets), the existing plumbing code could be amended to require them in new construction.

- DUAL-WATER SYSTEMS. Dual or "gray water" systems use filtered wastewater for toilet flushing and landscape irrigation. They could be encouraged through an incentive program such as a discount on water connection fees. It is estimated that gray water systems could reduce residential water requirements by 25%.

Retrofit Devices

- Many of the devices proposed for new construction could also be retrofitted in existing housing. Ordinances could require their installation upon sale of the house or major structural remodeling. The simplest devices (including toilet dams, shower flow restrictors, pipe insulation, and faucet aerators), could be distributed to existing residents by the water utilities or municipalities. Rebates on purchase of ultra-low flow toilets could encourage the replacement of existing 5-6 gallon per flush models. The same principle could also be applied to other water-using appliances. The amount which could be saved by these programs would depend on their market penetration in comparison with pre-1980 building code requirements.

- PRESSURE REDUCTION. It is likely that the region has areas where excessive water pressure can be reduced without affecting the health, safety or welfare of users. A program under this heading would identify these areas and install pressure reducing valves.

Urban Landscape Irrigation

- PHYSICAL DEVELOPMENT. New developments could be required by ordinance to restrict the amount of lawn area as a percentage of their total landscaped area. They could be required to incorporate low water use plant materials (xeriscape design) and low volume irrigation systems such as drip or low flow technologies. Moisture sensors such as tensiometers could also be required as valve controllers.

- EDUCATION PROGRAMS. Programs could also be developed to promote the efficient irrigation of existing landscapes and to encourage the use of low water using plants through education. These programs could include xeriscape demonstration gardens, brochures, efficient lawn watering education programs, a daily soil moisture and irrigation information program, and landscape seminars and conferences.

Public Facilities

- BUILDING RETROFIT. Public facilities such as offices, parks, schools, and airports could retrofit toilets with water dams or the equivalent, and install faucet aerators, automatic closing faucets and shower flow restrictors.

- LANDSCAPE IRRIGATION. Public facility landscape irrigation programs could consist of educational programs for facility managers and adoption of landscape management practices similar to those developed in the private sector. A feasible goal might be a 20% reduction in public facility irrigation consumption.

Manufacturing/industrial

- A variety of opportunities exist for water conservation in the manufacturing/industrial sector. These include process modifications, recirculation and reuse of cooling water, reuse of treated wastewater, and the use of water conserving fixtures throughout plant areas.
- More efficient landscape irrigation can also be achieved in the industrial sector.

Many of these practices have already taken hold as a result of economic pressures and stream discharge requirements. In the future, local governments and economic development agencies could encourage water intensive industries to locate close to the "water factories" (discussed in the next chapter) to maximize reuse potential.

Agriculture

- Possible improved techniques of water application include drip and low volume irrigation, low energy precision irrigation, surge irrigation, and more scientific irrigation scheduling in response to actual crop needs. Furrow diking and laser leveling can improve efficiency by increasing the retention of water in the areas intended. Brush management can significantly reduce wasteful consumption by unproductive species.

Water conservation opportunities in agriculture are primarily a function of crop markets and energy costs. The water demand projections of the San Antonio Regional Water Resources Study through 2040 already take into account the likely conservation by irrigators in response to economic pressures.

Electric Energy Generation

- The major opportunities for conservation in steam electric generation involve in-system treatment, recirculation of cooling water, and reuse of treated wastewater. As with other industrial processes, these are expected as a natural result of economic pressures and stream discharge requirements.

PARAMETERS FOR ANALYSIS

The conservation opportunities listed in Table C-1 were used to construct an array of seven alternative program models. These were arranged in an increasing order of effort and cost required, and the amount of water which would be conserved. Table C-2 shows the program elements in each of these models. Table C-3 summarizes the estimated costs and savings.

These programs would achieve reductions ranging between 2% and 13.5% in the total projected regional water demand for the year 2000, and between 3% and 21% in municipal water use. The public sector cost per acre-foot of water conserved would range from $31 to $535.

Table C-2

ELEMENTS OF ALTERNATIVE WATER CONSERVATION PROGRAMS

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
	Education		Education, Resale Ordinances, Govt Audits			Education, Resale Ordinance Active Govt Replacement	
SUPPORTIVE PROGRAMS							
Public information/education	X	X	X	X	X	X	X
School education	X	X	X	X	X	X	X
Pricing:							
Increasing rate blocks		X	X	X	X	X	X
Seasonal rate blocks			X	X	X	X	X
Penalty charges				X	X	X	X
Leak detection		X	X	X	X	X	X

NOTE: Pricing alternatives may encourage voluntary retrofit device installation, low water use landscaping and installation of water conserving devices in new construction.

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
DEVICES FOR NEW CONSTRUCTION							
Low flush toilets	X	X	X	X	X	X	X
Low flow shower heads	X	X	X	X	X	X	X
Pipe insulation		X	X	X	X	X	X
Pressure regulation			X	X	X	X	X
Faucet aerator				X	X	X	X
Water efficient appliances							
Dishwashers	X	X	X	X	X	X	X
Washing machine					X	X	X
*Gray water systems					X		X

* Gray water systems or internal residential recycle systems may not be compatible with system wide reuse plan

Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
RETROFIT DEVICES FOR EXISTING HOUSING							
Displacement bottles	X	X					
Shower flow restrictors		X	X	X	X	X	X
Toilet dams			X	X	X	X	X
Pressure regulation				X	X	X	X
Faucet aerators					X	X	X
Pipe insulation					X	X	X
Replacement toilets					X		X
URBAN LANDSCAPE IRRIGATION							
Reduced watering	X	X	X	X	X	X	X
Irrigation scheduling		X	X	X	X	X	X
Low water use landscape			X	X	X	X	X
Low volume sprinkers				X	X	X	X
Moisture sensing valve-controller					X	X	X

Table C-2 (cont.)

Water Conservation Opportunity	ALTERNATIVE PROGRAMS 1A	1B	2A	2B	REVISED 2C	3A	3B
PUBLIC FACILITY RETROFIT							
Toilet dams	X	X	X	X	X	X	X
Faucet aerators		X	X	X	X	X	X
Automatic faucets			X	X	X	X	X
Shower flow restrictors				X			
Low flow showers					X	X	X
Public facility landscape maint					X		
MANUFACTURING							
Recirculation of cooling water	X	X	X	X	X	X	X
Reuse of cooling process water		X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
Efficient landscape irrigation			X	X	X	X	X
Low water using fixtures				X	X	X	X
Process modifications					X	X	X
AGRICULTURE							
Irrigation system evaluations	X	X	X	X	X	X	X
Irrigation scheduling	X	X	X	X	X	X	X
Laser leveling		X	X	X	X	X	X
Furrow diking			X	X	X	X	X
Low energy precision application				X	X	X	X
Surge flow irrigation					X	X	X
Drip & low volume irrigation						X	X
Brush management							X
ENERGY GENERATION							
Recirculation of cooling water	X	X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
In system treatment			X	X	X	X	X

* Energy Generation and Manufacturing reuse systems may not be compatible with system wide reuse plans.

Table C-3

COST AND SAVINGS FROM ALTERNATIVE WATER CONSERVATION PROGRAMS

ALTERNATIVE	1A	1B	2A	2B	REVISED 2C	3A	3B
Estimated Savings (acre feet/yr)	8,900	22,600	43,100	49,700	54,000	64,500	68,300
Estimated Cost per Acre Foot Saved	$31	$26	$365	$530	$515	$430	$412
Percent Savings of Municipal Water Use Projected Yr. 2000	3%	7%	13%	15%	16%	20%	21%
Percent Savings of Total Projected Demand Yr. 2000	2%	4.5%	8.5%	9.8%	10%	12.7%	13.5%

Notes: Projected muncipal water use year 2000 approximately 324,500 acre feet per year
Projected total demand year 2000 appproximately 506,000 acre feet per year

Data for unit savings, unit cost, and cost per acre-foot of water saved was taken from water conservation reports of the American Water Works Association and the U.S. Department of Housing and Urban Development. Target population data is from the San Antonio Regional Water Resources Study. In calculating water savings for educational programs and landscape irrigation programs, the estimated unit savings were set significantly lower than the sources suggested. This was done to avoid any double counting of water conservation measures.

The estimates of costs and impact levels in each alternative are consistent with recent plans developed by other communities. These include programs of the Resource Management Department, Austin, Texas; the East Bay Municipal Utility District, Oakland, California; and the Water and Wastewater Department, Phoenix, Arizona.

RECOMMENDATIONS

In two sessions, the Joint Committee rigorously analyzed the policy changes, target population/impact levels, costs and benefits of each of the potential program models. They discussed possible application rates and set goals for each program level based on what they believed would be realistically possible. They then evaluated each alternative in relation to long term water resource goals. (See Appendices G-I.)

After this analysis, the Joint Committee settled on a consensus goal of saving approximately 10% of total projected water demand (54,000 acre-feet) by the year 2000. The Committee felt that this was an ambitious but achievable goal. As experience with the program and results are observed, the Committee recommends that additional goals be considered.

The combination of policies, programs and impact levels which would achieve this goal was a modification of the original Alternative Program 2C (Table C-4). The following paragraphs summarize and comment on the Joint Committee recommendations.

Table C-4

COSTS AND SAVINGS OF RECOMMENDED CONSERVATION PROGRAMS

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
SUPPORTIVE PROGRAMS (all residents yr 2000)								
Public Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
School Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	$0	$0	Policy Change
Seas. Block	2.0 gpcd		1,636,373	100%	3,666	$0	$0	Policy Change
Penalty	.5 gpcd		1,636,373	10%	91	$0	$0	Policy Change
Leak Detection Programs		$3000/mile		100%	600	$150,000	$250	Maint Policy
NEW CONSTRUCTION (housing units constructed between 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3,106	$0	$0	Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2,081	$0	$0	Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621	$0	$0	Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621	$99,400	$1600	Ordinance
Pres Regulation	3.0 gpcd	$70.00	277,270	50%	465	$17,700	$380	Ordinance
Faucet Aerator	.5 gpcd	$2.00	277,270	100%	155	$7,300	$470	Ordinance
WE Washing Mach	5.0 gpcd	$70.00	277,270	75%	1,164	$66,000	$570	Ordinance
Gray Water Sys.	______	______	277,270	voluntary			______	Incentive
Landscape Measures for New Construction (housing units constructed between 1990 and 2000)								
LW Landscape	24.0 gpcd	$2000/home	277,270	75%	5,591	$10,903,000	$19,500	Ordinance
LV Irrig	13.0 gpcd	$1500/home	277,270	75%	3,028	$8,236,000	$27,200	Ordinance
M. Sensors	5.0 gpcd	$1200/home	277,270	75%	1,164	$6,600,000	$56,700	Ordinance
RETROFIT DEVICES (housing units built before 1990)								
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	50%	5,100	$6,000	$12	Retrofit Ord.
Toilet Dams	4.5 gpcd	$10.00	1,359,103	50%	3,430	$48,000	$140	Retrofit Ord.
Pressure Regul.	3.0 gpcd	$70.00	1,359,103	50%	2,280	$87,000	$380	Retrofit Ord.
Faucet Aerators	.5 gpcd	$2.00	1,359,103	50%	380	$18,000	$470	Retrofit Ord.
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	15%	115	$9,000	$820	Retrofit Ord.
Repl Toilets	10. gpcd	$300	1,359,103	25%	3,806	$339,000	$890	Retrofit Ord.
Landscape Irrigation (housing units constructed before 1990)								
Watering Prg	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
Irrig Sched	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
PUBLIC FACILITY RETROFIT (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%	700	$9,800	$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%	50	$2,000	$380	Govt Replace
Auto Faucet		$25.00		100%	50	$5,000	$900	Govt Replace
LF Showers	1.5 gpm	$15.00		100%	325	$2,000	$60	Govt Replace
Public Facility Landscapes (all public facilities)								
Irrig Sched	20% reduction in seasonal UAF water			100%	2,500	$25,000	$10	Maint Policy

The Joint Committee recommends that water conservation and demand management be integrated into water resource management and long range water resource planning. The focus of water conservation programs should change from a relatively independent activity, undertaken only in response to drought conditions, to a major component of the water resource management plan.

The comprehensive program includes public/school education components, pricing policies, building codes changes, retrofit device installation, landscape irrigation programs, leak detection, and public facility retrofit programs.

Education and Information

The supportive programs outlined above under this heading can be implemented easily and inexpensively. Awareness of water as a limited natural resource and the development of wise water use habits among the region's population must become normal features of our everyday life.

- Public education and information programs can save an average of one gallon per capita per day (gpcd), at a total regional cost of $200,000 per year. If they successfully reach 75% of the region's population, they would save 1375 acre-feet per year, for an effective cost of $145 per acre-foot saved.
- School programs could save similar amounts at similar costs.

Pricing Policies

Water pricing policies should reflect the full cost of developing water resources, providing water service, and implementing conservation programs. The Joint Committee recommends that this be accomplished through an increasing block rate structure with seasonal rate blocks and excess use penalties.

Translated into a possible rate structure, middle to high income residents would experience an 80-90% rate increase. As policy changes imposed by the water purveyors, these programs would reach 100% of their customers at essentially no cost to the public sector. The excess use penalty might affect 10% of the region's consumers.

- Increasing block rates of the magnitude suggested would reduce consumption by an average of 3.5 gpcd, or a total of 6416 acre-feet per year.
- Seasonal block rates would reduce consumption by a year-round average of 2 gpcd, or a total of 3666 acre-feet per year.
- An excess use penalty affecting 10% of the region's consumers might save an average 1/2 gallon per capita per day, or 91 acre-feet per year.

In this proposal, pricing policies thus account for an estimated 3% reduction in water use. Although the proportional decline in water use is often small initially, in comparison with the percentage increase in price, market incentives are an efficient means to reduce water demand.

The proposed pricing policies, in combination with education and retrofit programs, should actually provide greater benefits than Table 4 suggests. Since these benefits are a mixed result of the education and retrofit efforts, however, the associated water savings are estimated in those programs.

Leak Detection

All water purveyors should keep accurate records of internal water usage for accurate reporting of unaccounted-for water. They should undertake leak detection and prevention programs to reduce the unaccounted-for water losses associated with water main breaks.

- If this maintenance policy is adopted by all of the region's water purveyors, it could save 600 acre-feet per year at a total cost of $150,000, or $250 per acre-foot.

New Construction

Building code amendments should require the installation of low flush toilets, low flow showerheads, faucet aerators, and water efficient appliances, and the insulation of hot water pipes in all new construction throughout the region. These measures would affect the 277,270 people who are expected to live in new housing units built between 1990 and 2000. The costs would be borne by the private sector.

- Low flush toilets could save an average of 10 gpcd, or 3106 acre-feet per year. This saving is essentially costless.
- Low flow showers could save 6.7 gpcd or 2081 acre-feet/year. This saving is also essentially costless.
- Water efficient dishwashers could save 2 gpcd or 621 acre-feet/year. This is also essentially costless.
- Faucet aerators would save .5 gpcd or 155 acre-feet-/year. At a cost of $2 per unit, this would be $470 per acre-foot.
- Pipe insulation would save 2 gpcd or 621 acre-feet-/year. At $.62 per linear foot, this would cost $1600 per acre-foot.

- Water-efficient washing machines could be expected in 75% of the new homes built by 2000. They would save 5 gpcd or 1164 acre-feet/year. At an additional cost of $70 each, this translates into an effective cost of $570 per acre-foot.

Water pressure regulators should be required in appropriate areas.

- Lower inside pressure would save 3 gpcd at a cost of $70 per unit. Assuming that 50% of the new housing would be affected by this policy, this would be a total of 465 acre-feet/year at $380 per acre-foot.

Voluntary installation of gray water systems should be encouraged by an incentive such as a discount on water connection fees.

- Since it is unknown how many might respond to this incentive, no target is set for this program in Table C-4.

Ordinances should also require the use of low water using landscape design, low volume irrigation systems and moisture sensing valve controllers. These requirements would likely affect 75% of the new housing built. Their costs would be borne by the private sector.

- Xeriscape design could save 24 gpcd or 5591 acre-feet/year. At a cost of $2000 per home, this would be an initial one-time capital cost of $19,500 per acre-foot.

- Low volume irrigation systems could save 13 gpcd or 3028 acre-feet/year. At $1500 per home, this is a one-time cost of $27,200 per acre-foot.

- Moisture sensors could save 5 gpcd or 1164 acre-feet-/year. At $1200 per home, this is a one-time cost of $56,700 per acre-foot.

Residential Retrofit Programs

Simple retrofit devices, including toilet dams, shower flow restrictors, faucet aerators and pipe insulation, should be distributed to existing households. A total of over 1.3 million people are projected to be living in existing housing units (built before 1990) by the year 2000. First consideration should be to distribute these devices to lifeline customers, so that when the unit price of water increases they can easily reduce their use and thus keep their water bills roughly constant.

Ordinances should require retrofitting on resale of homes, or installation of water conserving devices upon structural remodelling. These programs would speed the process of retrofitting existing homes, but they would have a decreasing marginal impact over time as they eventually begin to saturate the region's housing stock. Data are not available to determine the full extent of noncompliance with the 1980 building code. As more is learned it may be necessary to decrease the retrofit program goal to adjust for fixtures already in compliance.

- Toilet dams would save 4.5 gpcd, or 3430 acre-feet/year if they are used in 50% of the households. At $10 per unit, this would be $140 per acre-foot.

- Shower flow restrictors would save 6.7 gpcd, or 5100 acre-feet/year with a 50% application rate. At $.50 per unit, this is $12 per acre-foot.

- Faucet aerators would save 1/2 gpcd, or 380 acre-feet/year at 50% application. At $2 per unit, this would be $470 per acre-foot.

- Insulation of the hot water pipes which are accessible in existing housing would save 1/2 gpcd. This might be accomplished in 15% of the housing units. At $.67 per linear foot, this would save 115 acre-feet per year at $820 per acre-foot.

Replacement toilet programs should focus on the replacement of 5-6 gallon per flush toilets with 1 to 1.5 gallon flush (ultra-low flow) toilets. The exclusive use of ultra-low flow toilets may affect system wide reuse plans by reducing wastewater plant inflows, but it should be pursued on its own merits.

° Replacement toilets would save 10 gpcd at a cost of $300 each. If 25% were replaced by 2000, this would be 3806 acre-feet at $890 per acre-foot.

A pressure reduction study should also be initiated to determine areas where excessive pressure can be reduced without affecting the public health, safety and welfare of users. Pressure reducing valves should be installed where excessive pressure can be reduced. For planning purposes, the Committee assumed this might be 50% of the region.

° Pressure reducing valves would save 3 gpcd or 2280 acre-feet/year. At $70 each, this is $380 per acre-foot.

Landscape irrigation programs for existing housing units should rely on education and voluntary compliance.

° A reduced watering program would save an average of 3 gpcd at a total cost of $100,000 per year. If 50% of the households participated, this would be 2284 acre-feet at an effective cost of $43 per acre-foot.

° An irrigation scheduling program could save similar amounts at the same costs.

Public Facilities

All public facilities should be retrofitted by the responsible agencies with toilet dams, faucet aerators, automatic closing faucets, and low flow showers.

- Toilet dams would save 1 gallon per flush. At a cost of $10 each, this would save 700 acre-feet/year at $140 per acre-foot.
- Faucet aerators would save 1/2 gallon per minute. At $2 each, this would be 50 acre-feet/year at $380 per acre-foot.
- Automatic closing faucets, at $25 each, would save 50 acre-feet/year at $900 per acre-foot.
- Low flow showers would save 1.5 gallons per minute, or 325 acre-feet/year. At $15 each, this would be $60 per acre-foot.

Irrigation scheduling should be established as standing maintenance policy for all government agencies.

- This program should aim to reduce seasonal water consumption by 20%. At this level it would save 2500 acre-feet/year. If it costs $25,000 to manage this program, this would be $10 per acre foot.

Manufacturing/industrial

Table C-4 does not show specific programs for water conservation by manufacturing and other industrial users, which was listed as a potential opportunity area in Table C-1. As previously noted, water conservation in this sector has already been the result of increasingly stringent discharge requirements. As new technologies develop for water reuse and recycling technologies, the Joint Committee strongly encourages the manufacturing and industrial water users to adopt them on a voluntary basis.

The Committee also recommends that future water intensive industries be located in close proximity to the "water factories" (discussed in the following chapter on Wastewater Reuse), to maximize reuse potential. Pricing policies may also have an effect on regional development patterns.

Agriculture

In agriculture, the water demand projections through 2040 have already taken into account maximum water conservation by irrigators. Again, this is an economic function of crop markets and energy costs.

The Edwards Underground Water District should continue and expand its present agricultural conservation efforts. The District should strongly encourage the following agricultural water conservation practices where they are applicable:

- Drip and low volume irrigation
- Low energy precision application irrigation
- Surge irrigation
- Canal lining or use of pipeline
- Irrigation scheduling
- Furrow diking
- Brush management

In addition, the District should incorporate incentives for irrigators to upgrade to more efficient irrigation equipment.

Electric Energy Generation

As with manufacturing industries, the Committee believes that water conservation practices have already been employed in this sector as a result of stream discharge requirements and economic necessity.

PROGRAM RESPONSIBILITIES

The Joint Committee recommends that the Edwards Underground Water District be the overall coordinator of all water conservation efforts. Implementation of water conservation program components is recommended as follows:

Table C-5
Conservation Program Activities, Responsibilities, and Annual Costs

Program Activities	Responsible Entity	Public Sector Cost	Private Sector Cost
Public Education	EUWD/Cities/Purveyors	$200,000	
School Education	EUWD/Cities/Purveyors	$200,000	
Pricing Policies	Cities/Purveyors, EUWD		
Leak Detection	Cities/Purveyors	$150,000	
New Construction Ordinance	Cities/Purveyors		
New Construction Devices	Developers		$191,000
Retrofit Programs	Cities/Purveyors	$507,000	
Landscape Watering and Scheduling	EUWD/Cities/Purveyors	$200,000	
Low Water Landscapes & Irrigation	Developers		$25,739,000
Public Facility Retrofit	Local, State & Federal Gov'ts	$18,800	
Public Facility Irrigation & Landscape	Local, State & Federal Gov'ts	$25,000	
Manufacturing	Industrial Firms		
Agricultural Irrigation	Agricultural Irrigators		
Energy Generation	Utility Companies		
	TOTALS:	$1,300,800	$25,930,000

CONCLUSIONS

Changing the region's water use practices through public policy is possible, but it will not be easy. The present and projected high water demands are a result of habitual behavior, ignorance of how to use less water, structural inefficiencies in existing fixtures and appliances, and the absence of real incentives to conserve.

The Joint Committee's recommendations address all of these major aspects of the problem. They include supportive educational programs to inform water users of how to use less water, and to encourage them to change their habits. They include new construction and retrofit programs to remove the structural inefficiencies. They also include economic incentives to help integrate beliefs and practices.

It is worth noting in conclusion that residents may easily believe that water conservation is important, but unless there are personal benefits in reducing individual water use, they will find it difficult to justify personal sacrifices. For this reason pricing, although unpopular, is an essential program element to provide the incentive for conservation.

WASTEWATER REUSE

REUSE OPTIONS

Treated wastewater is a valuable resource that must be factored into the region's water budget. Just as a gallon saved through conservation is equal to a gallon of new surface water, each gallon which is reused is a gallon less to be withdrawn from the aquifer.

As discussed in the plan component on groundwater management, current state law allows a landowner to withdraw groundwater virtually without restriction and to apply it in any beneficial use. The landowner may also reuse, without a water use permit, any wastewater produced in the process. This is what makes it a valuable resource.

Wastewater effluent may be reused ("reclaimed") either directly or indirectly, and for potable or non-potable purposes. Direct reuse is any reuse prior to discharge into a stream. Indirect reuse involves using a streambed to transport the water to another site where it is withdrawn and then used again. This is often less expensive because there is no need for a pipeline, and because natural processes in the stream may help purify the water along the way.

Direct reuse is common in industrial processing, to meet discharge requirements most economically. Direct reuse for drinking purposes is technically possible, but it is expensive and still experimental with respect to its health effects.

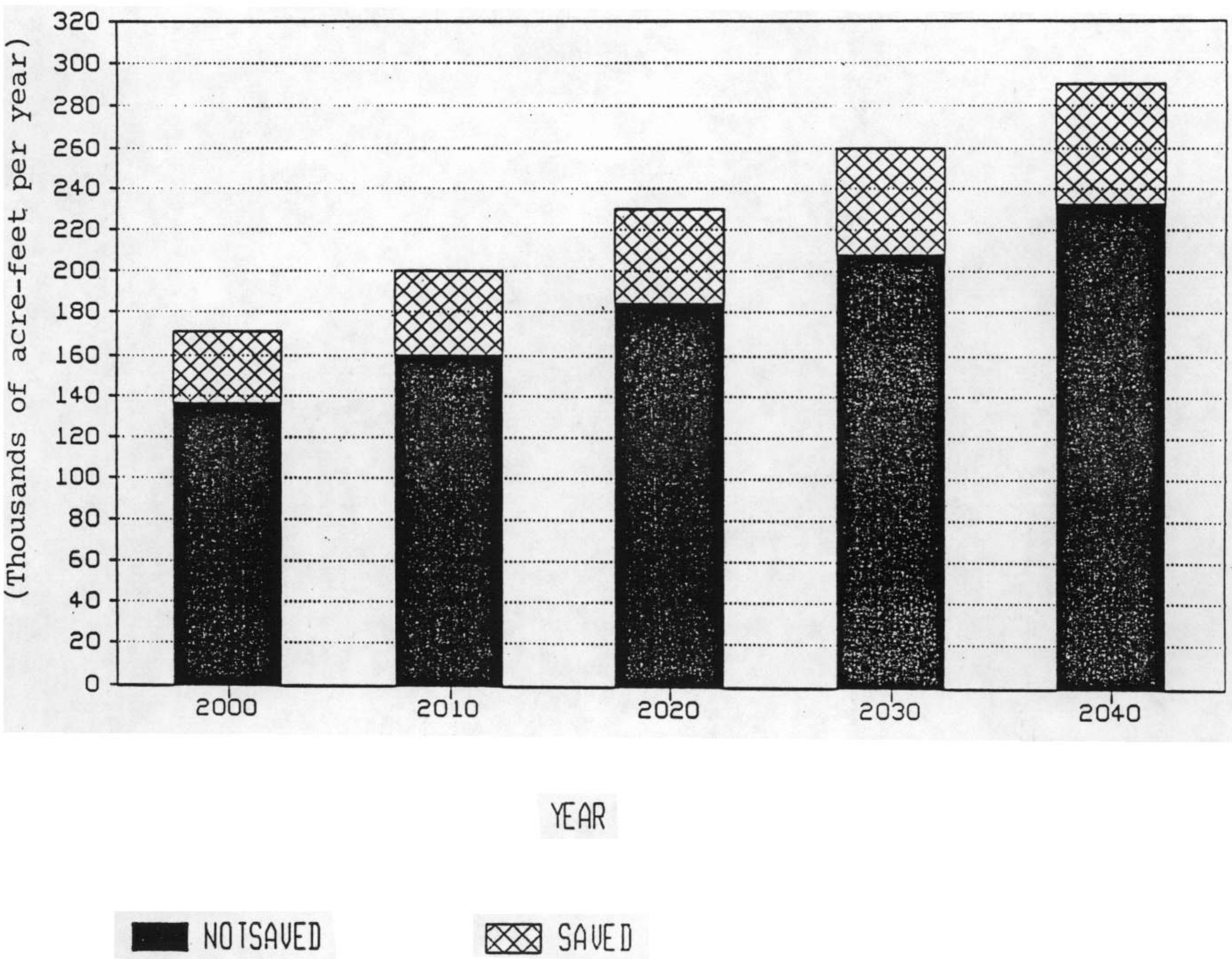
Indirect reuse for cooling and irrigation is practiced routinely throughout the world. Indirect reuse for drinking water purposes is also the practical effect of one user's withdrawing water from a stream below the point of another user's wastewater discharge.

The decision to reuse wastewater is a major step by any community. It involves a significant investment in facilities, education, and marketing. The community must ensure that the source is safe and that it will be used to offset demands from other water resources.

SAN ANTONIO REUSE PROPOSAL

The major opportunities for wastewater reuse are in the area served by the City of San Antonio's regional sewage treatment system. Figure R-1 shows the projected wastewater volume which the City expects to treat between 2000 and 2040, with and without this plan's conservation component. The goal of reducing total regional water demand by 10% translates into a likely 20% reduction in wastewater return flows.

Figure R-1
Forecast San Antonio Wastewater Volumes
With and Without Conservation, 2000-2040



The City is now completing an extensive capital improvements program which provides advanced secondary treatment at its existing sewage treatment plants. This approach has centralized all wastewater treatment at three regional facilities: Leon Creek, Salado Creek, and Dos Rios. Thus a large fraction of all the wastewater produced in the five county region is potentially available for reuse at these three sites south of the city.

Most of the wastewater which will be generated by future development, however, will be a considerable distance from these facilities. Some will be in watersheds which the City is only beginning to serve.

In 1987 the City adopted a new wastewater management strategy to serve these growth areas. The new strategy is to build subregional advanced secondary treatment facilities within the growth watersheds, instead of transferring all flows to one of the existing regional plants. Figure R-2 shows the area which can be most economically served by the existing facilities (the "Central Area") and the areas which would be served under the new strategy (the "Water Factory Area.")

Figure R-2
San Antonio Wastewater Treatment System Areas

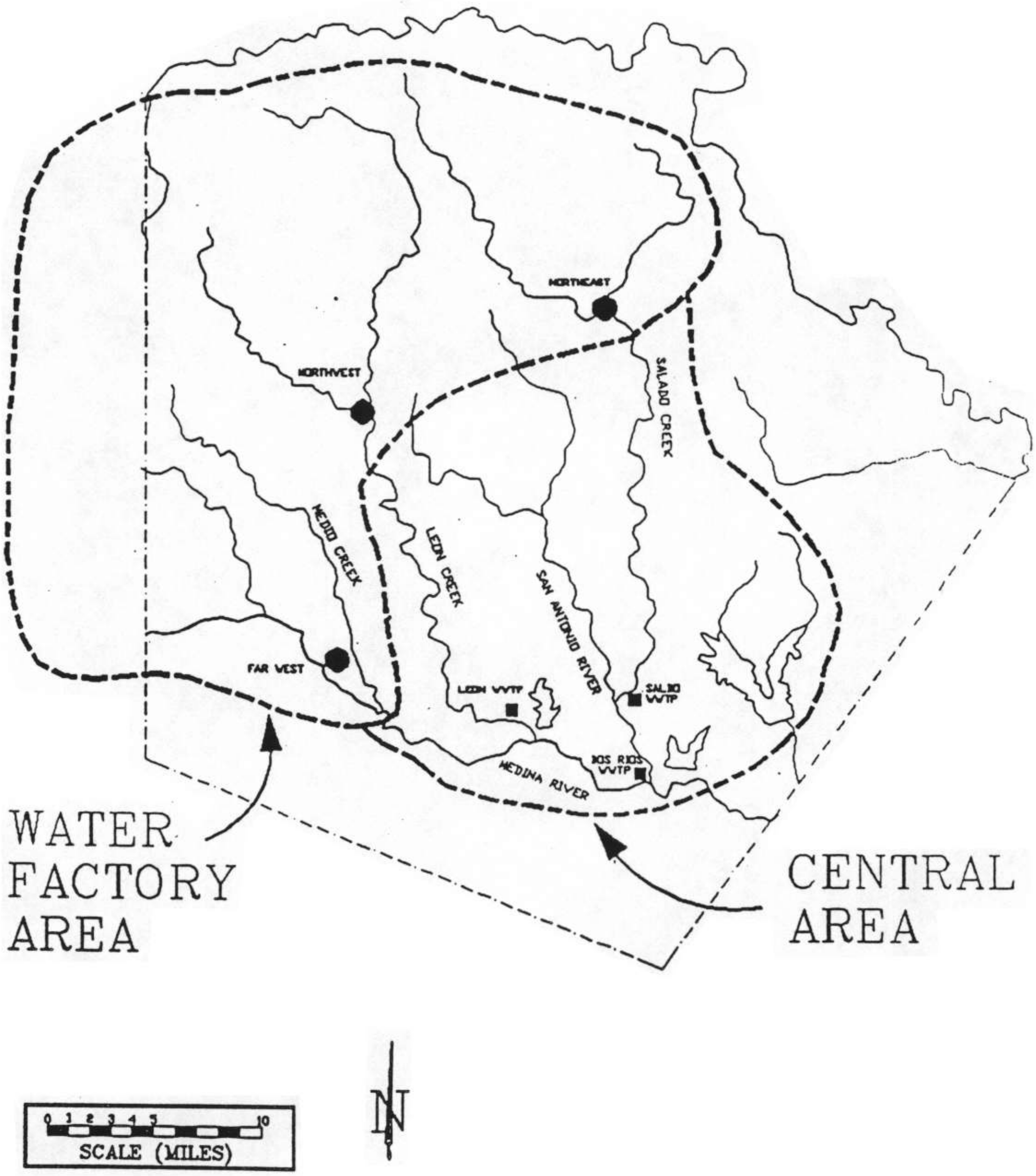
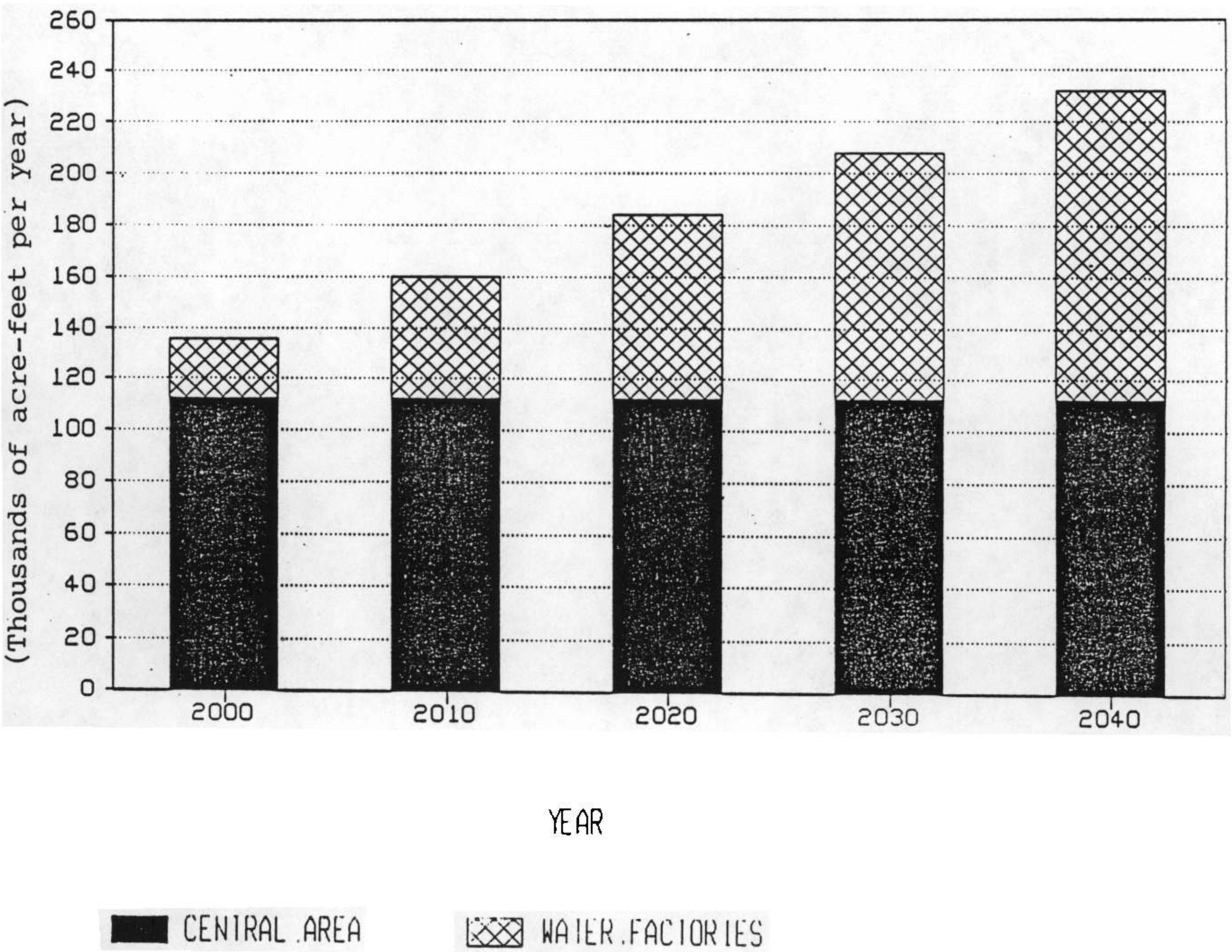


Figure R-3 shows the proportions of the total wastewater volume which would be handled in each way, after allowing for the reduction through conservation. The volume of wastewater generated within the Central Area is projected to remain stable at about 112,000 acre-feet per year from now through 2040. Wastewater from the growth areas is projected to increase by approximately 2400 acre feet per year over the same period. For planning purposes the City assumes that this growth will be equally distributed among the three growth area watersheds. Thus each growth area would increase by 8000 acre-feet each decade.

Figure R-3
Forecast San Antonio Wastewater Volumes,
Central Area and Water Factory Areas, 2000 - 2040



The effluent from the growth areas can be captured at three points within their watersheds (Figure R-2.) The City proposes to intercept the effluent at these points and to treat it beyond advanced secondary standards to a quality sufficient for reuse. The output of these plants could thus substitute for water which would otherwise be drawn from the aquifer. These new treatment plants are referred to as "water factories."

The "water factory" concept has two major advantages:

1. It avoids the need to build costly outfall lines to transfer wastewater from one side of the city to the other.
2. It makes additional water available to replace existing or possible new withdrawals from the aquifer.

The City proposes to construct these water factories and to convert the existing regional advanced secondary treatment facilities into water factories in two series of projects.

TARGET AREA "A"

The first series of projects includes the entire Salado Creek watershed and the San Antonio River above the Dos Rios plant. This is designated as "Target Area A" in Figure R-4.

Figure R-4
Wastewater Reuse Project Location Map,
Target Area "A" Watersheds

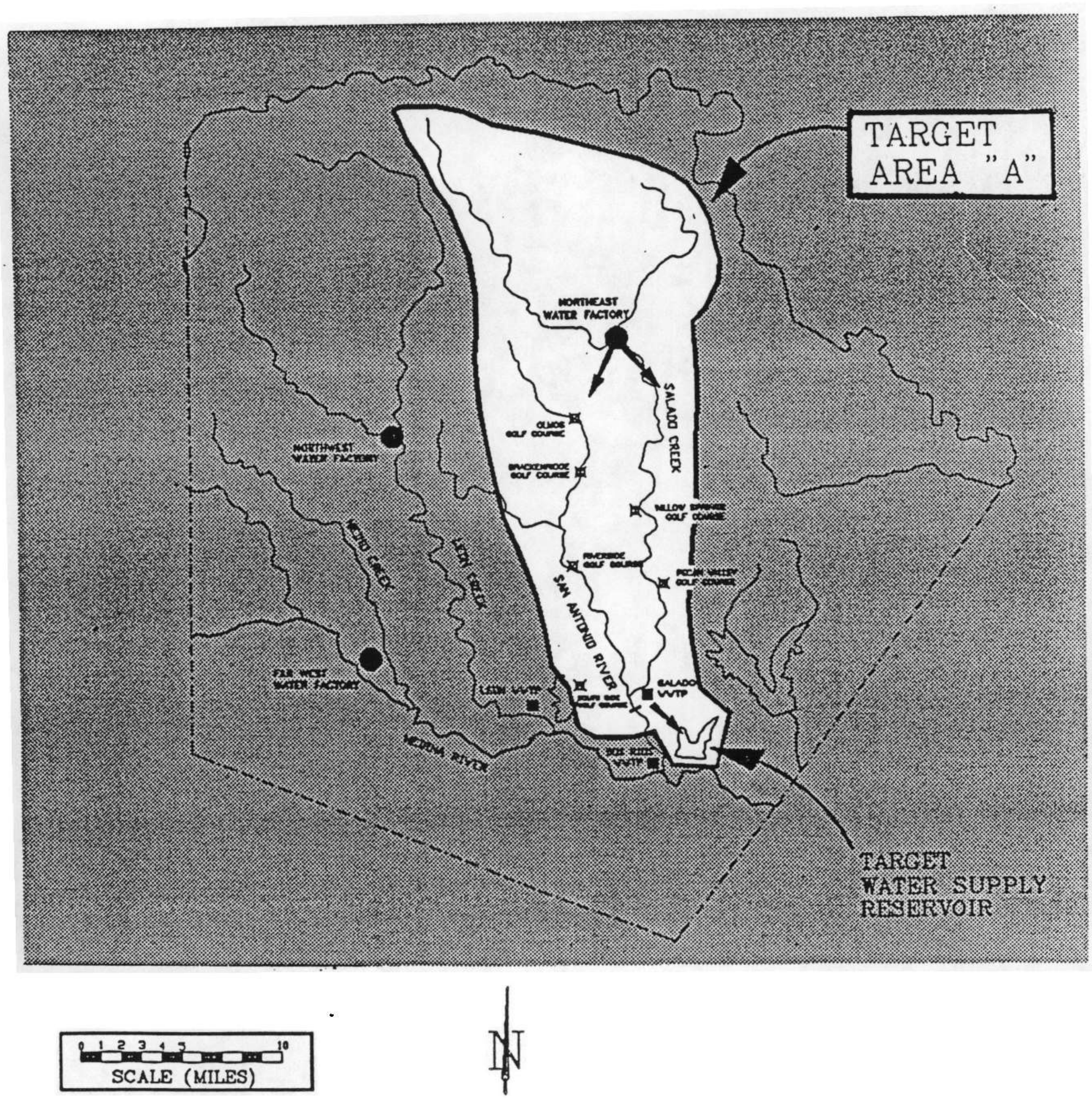
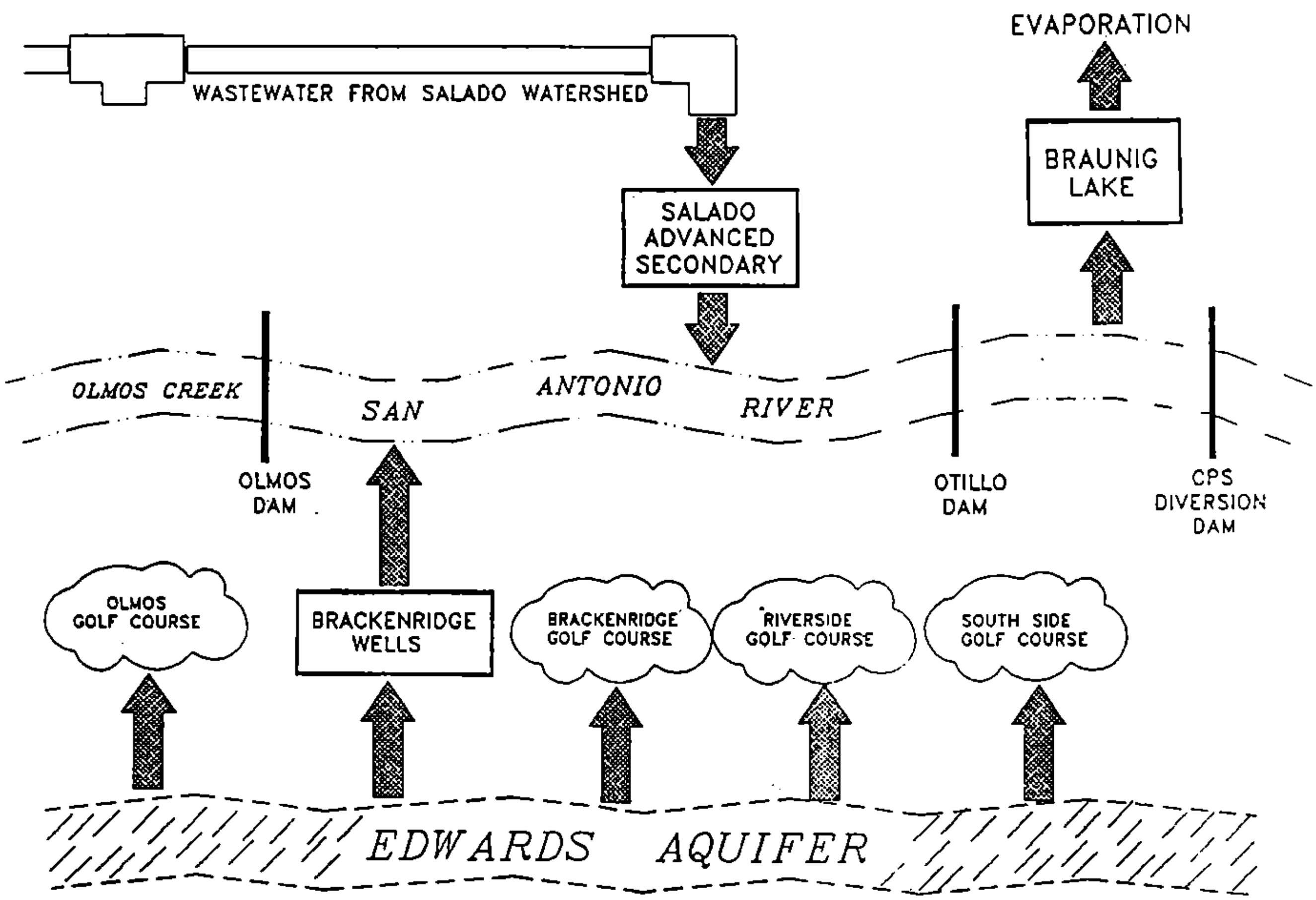


Figure R-5 shows schematically the existing wastewater management system in this area. All wastewater from the Salado Creek watershed is now treated at the Salado Creek WWTP, where advanced secondary effluent is discharged into the San Antonio River. River water is later withdrawn for use as cooling water in Braunig Lake. Meanwhile new water is drawn from the aquifer to provide flow in the river from Brackenridge Park through downtown and to irrigate four City-owned golf courses.

Figure R-5
Existing Water and Wastewater Management System,
Reuse Target Area "A"



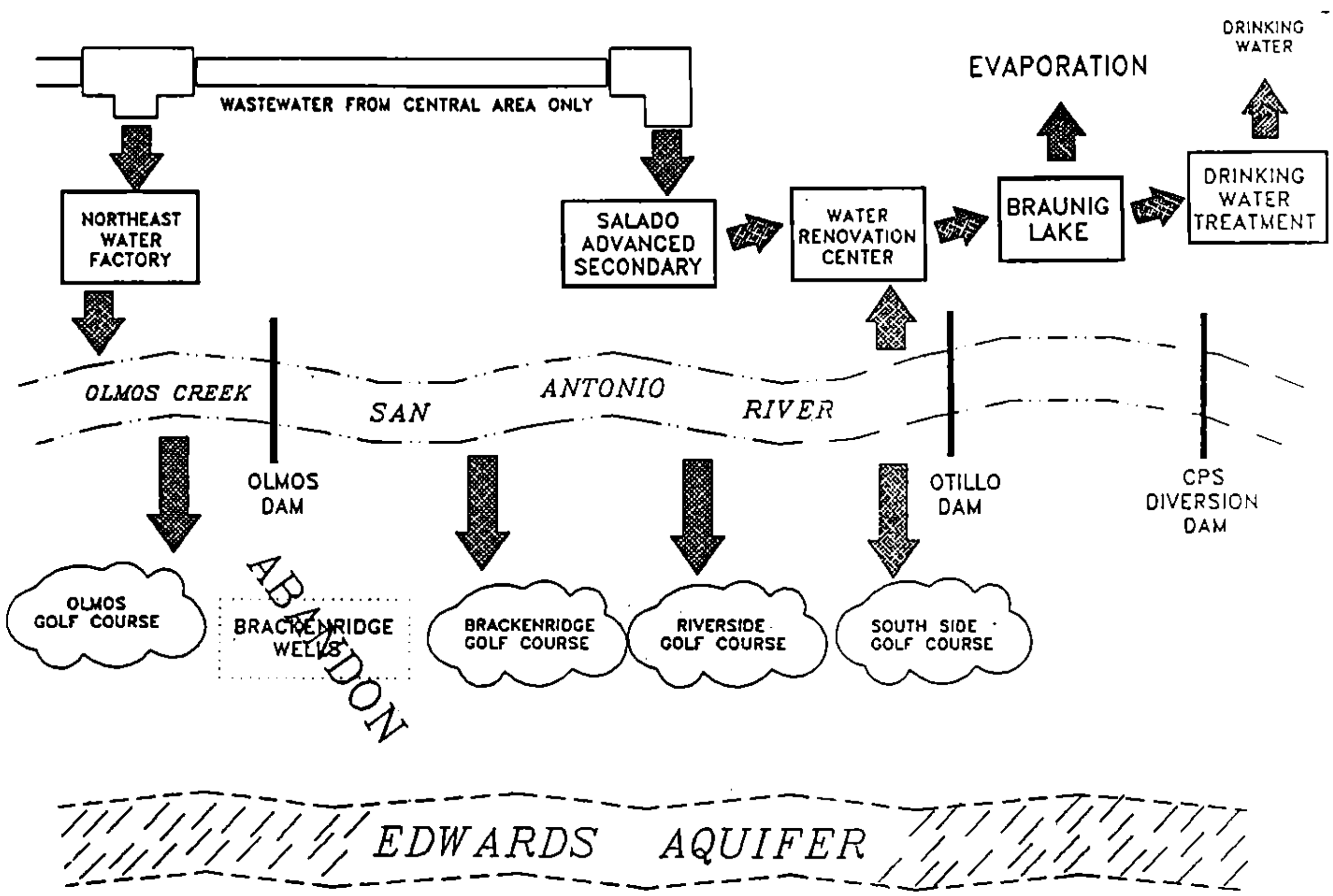
Northeast Water Factory Area

The proposed management system (Figure R-6) would intercept the wastewater flows from the upper Salado watershed at the first water factory, to be built in the "Northeast" area near San Antonio International Airport. This facility would provide advanced secondary treatment, nutrient removal, and any other treatment needed for reuse. The effluent could then serve reuse opportunities both along the San Antonio River and downstream along Salado Creek.

One outfall could discharge into a tributary of Olmos Creek, where it would become a source of the San Antonio River south of Olmos Dam. The transfer of this water in the river through the center of town would allow the City to close the wells which now pump aquifer water into the river. This water might also be able to substitute for well pumping in the zoo, if water temperature and quality issues can be resolved. The river would then also become the source of golf course irrigation water at four downstream City-owned golf courses. Pumping to supply the river now consumes 5000 acre-feet per year, and the four golf courses together consume another 4000 acre-feet.

A second outfall could discharge back into Salado Creek. This water might be used at Willow Springs and Pecan Valley golf courses, along the creek downstream.

Figure R-6
Proposed Water and Wastewater Management System,
Reuse Target Area "A"



If the wastewater generated in the upper Salado Creek watershed grows at the projected 8000 acre-feet per decade, then a total of 40,000 acre-feet could be available for reuse by 2040. The City government's uses in the San Antonio watershed would consume about half of this. The other half, which would become available after 2010, would have to be marketed to other potential users in the area.

Salado Creek Treatment Plant

With the opening of the Northeast Water Factory, the existing Salado Creek Wastewater Treatment Plant would then treat only the wastewater produced within the Central Area part of the watershed. This is projected to remain stable at 24,000 acre-feet per year through 2040.

The effluent from the Salado Creek WWTP would be transferred to a proposed "Water Renovation Center," where nutrients would be removed and the effluent given additional treatment for reuse. The amount of water from the Northeast Water Factory which is not reused by the golf courses or other consumers would also be recaptured from the streams and transferred to the Water Renovation Center.

The effluent from the Water Renovation Center would be discharged into Braunig Lake without being returned first to the San Antonio River. The lake consumes 7000 acre-feet per year in cooling water evaporation. Initially the additional inflow would be used to reduce the dissolved solids in the lake and stabilize its ecosystem. This would leave 17,000 acre-feet from the Salado Creek treatment plant, plus any unused water from the Northeast Water Factory, available for other reuse opportunities in the area.

A water treatment plant would then be built adjacent to Braunig Lake to convert surplus lake water into drinking water. The amount of water which could be reused as drinking water is thus the net remainder after all of the Target Area's non-potable reuse opportunities are developed. This water would be blended into the City Water Board's distribution network and delivered to its customers as needed.

Table R-1 summarizes the volumes of wastewater generated and available for reuse in this project target area.

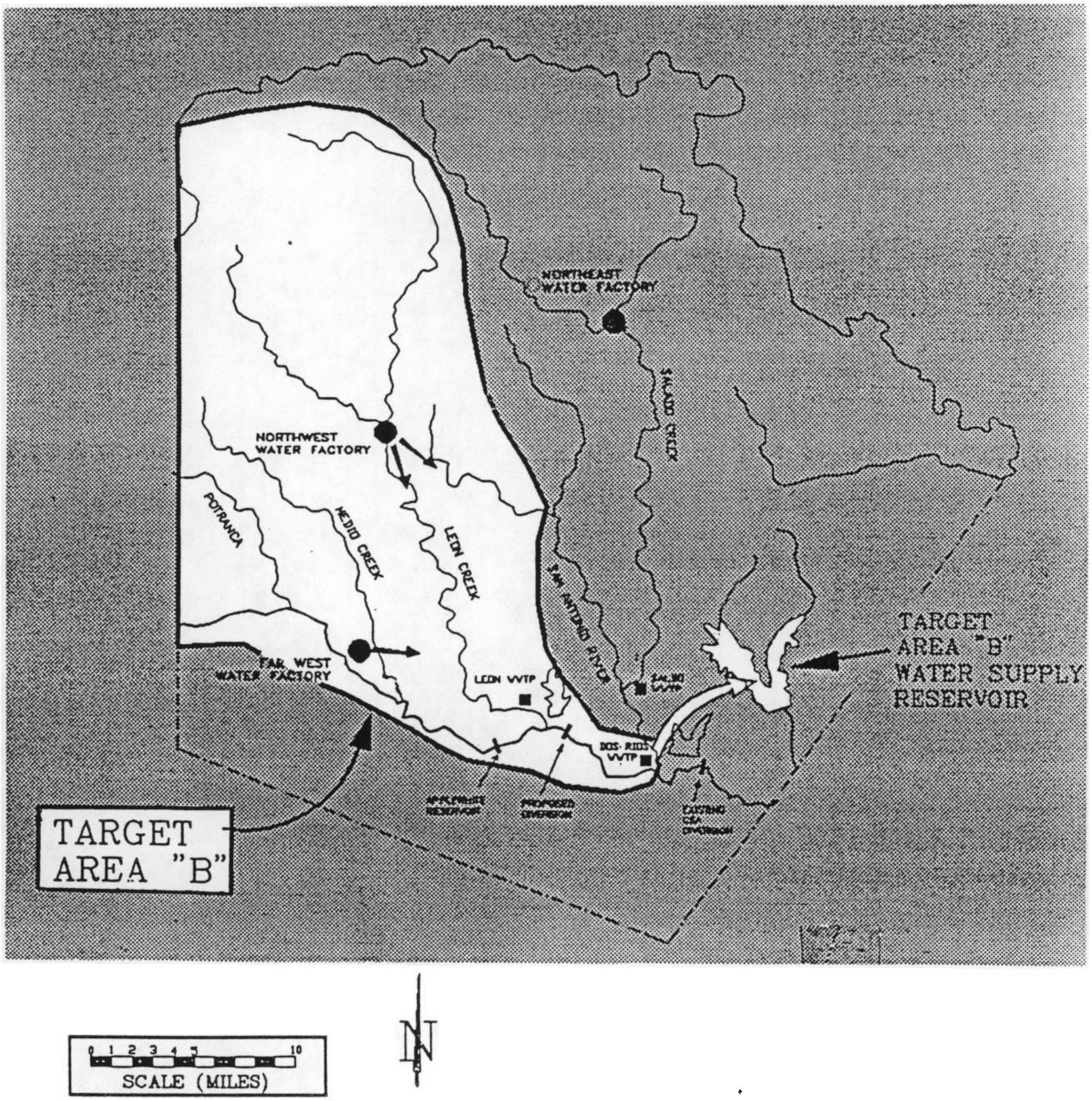
Table R-1
Wastewater Volumes Generated and Available for Reuse,
Target Area "A," 1995-2040
(Acre-feet per year)

	1995	2000	2010	2020	2030	2040
NORTHEAST WATER FACTORY						
Volume Generated and Available for Reuse	4,000	8,000	16,000	24,000	32,000	40,000
SALADO CREEK WWTP						
Volume Generated	24,000	24,000	24,000	24,000	24,000	24,000
Braunig Lake Evaporation	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000
Net Available for Reuse	17,000	17,000	17,000	17,000	17,000	17,000
TARGET AREA TOTAL						
Volume Generated	28,000	32,000	40,000	48,000	56,000	64,000
Braunig Lake Evaporation	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000
Net Available for Reuse	21,000	25,000	33,000	41,000	49,000	57,000

TARGET AREA "B"

The second series of projects in the City's reuse program ("Target Area B") would develop water factories in the Leon Creek and Medina River watersheds, and provide for reuse of the effluent from the existing Leon Creek and Dos Rios treatment plants. It would also meet the need for cooling water evaporation in Calaveras Lake. Figure R-7 shows the location of these projects.

Figure R-7
Wastewater Reuse Project Location Map,
Target Area "B" Watersheds



Northwest Water Factory Area

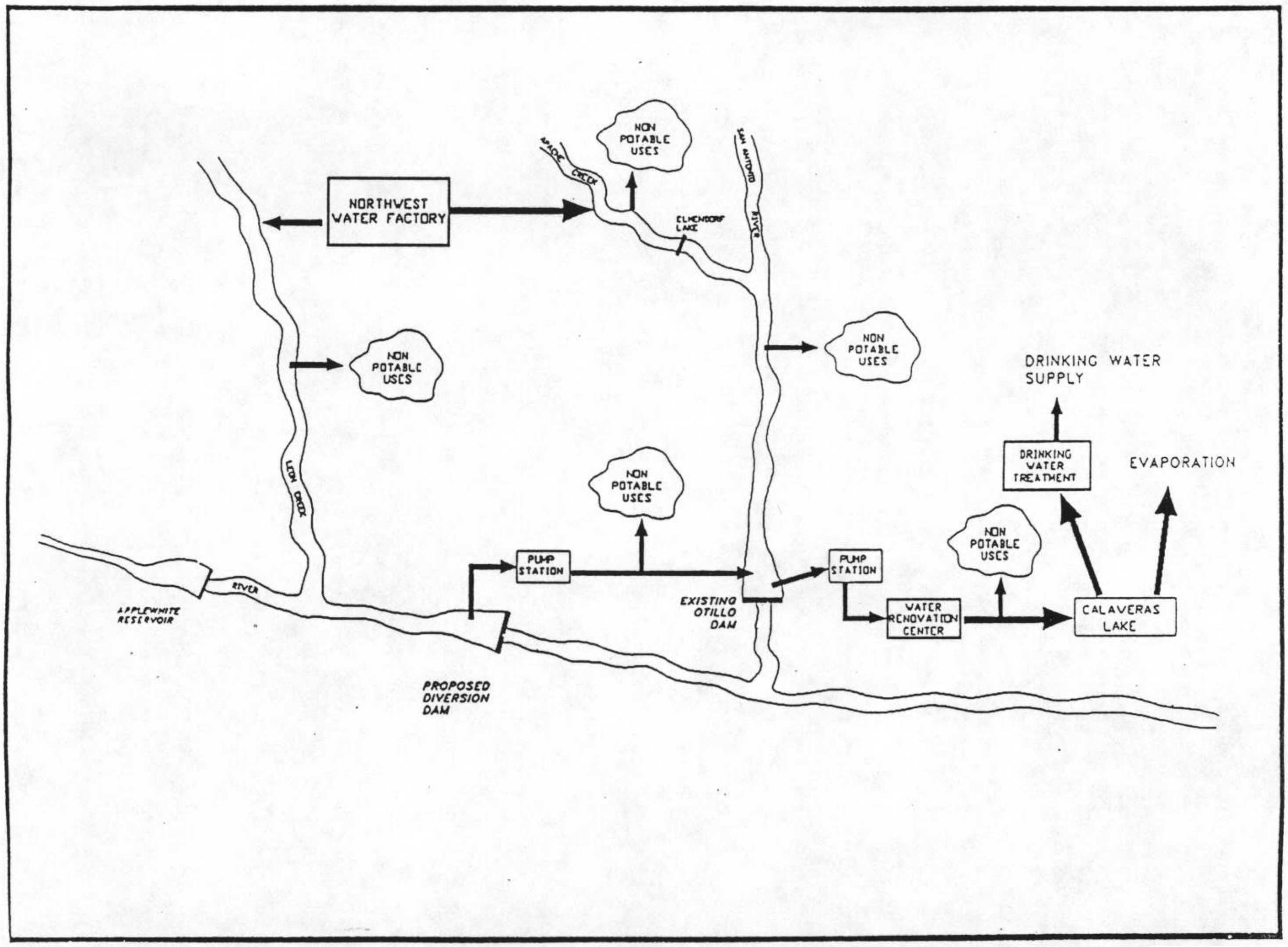
A water factory in the Northwest Service Area would intercept effluent from the upper Leon Creek watershed. The wastewater available in this watershed is projected to grow at the same steady rate as the volume in the Northeast: that is, from 8000 acre-feet per year in 2000 to 40,000 acre-feet by 2040. Figure R-8 shows schematically how the output of this facility would be used.

The City believes that the largest potential market for the Northwest Water Factory effluent would be in the Central Area. Therefore one outfall from this facility would transport the effluent by pipeline to Apache Creek. The water would then flow down Apache Creek, through Elmendorf Lake, and ultimately into the San Antonio River. This would serve potential reuse customers all along this route.

An added benefit of this project would be an improvement of the water quality in Elmendorf Lake, since water would then flow through the lake continually. Another benefit would be the potential to develop some kind of small lake or water feature where the present creek channel bisects Rosedale Park.

Any water which is not marketed along this route would be recovered from the San Antonio River at the existing Otillo Dam, just below the confluence of the river and Salado Creek. This water would be pumped to the Water Renovation Center, where more extensive treatment would be performed if necessary. From the Water Renovation Center, the water would then be piped to

Figure R-8
Schematic Reuse Plan for Northwest Water Factory Output



Calaveras Lake and be made available to more potential customers along the way.

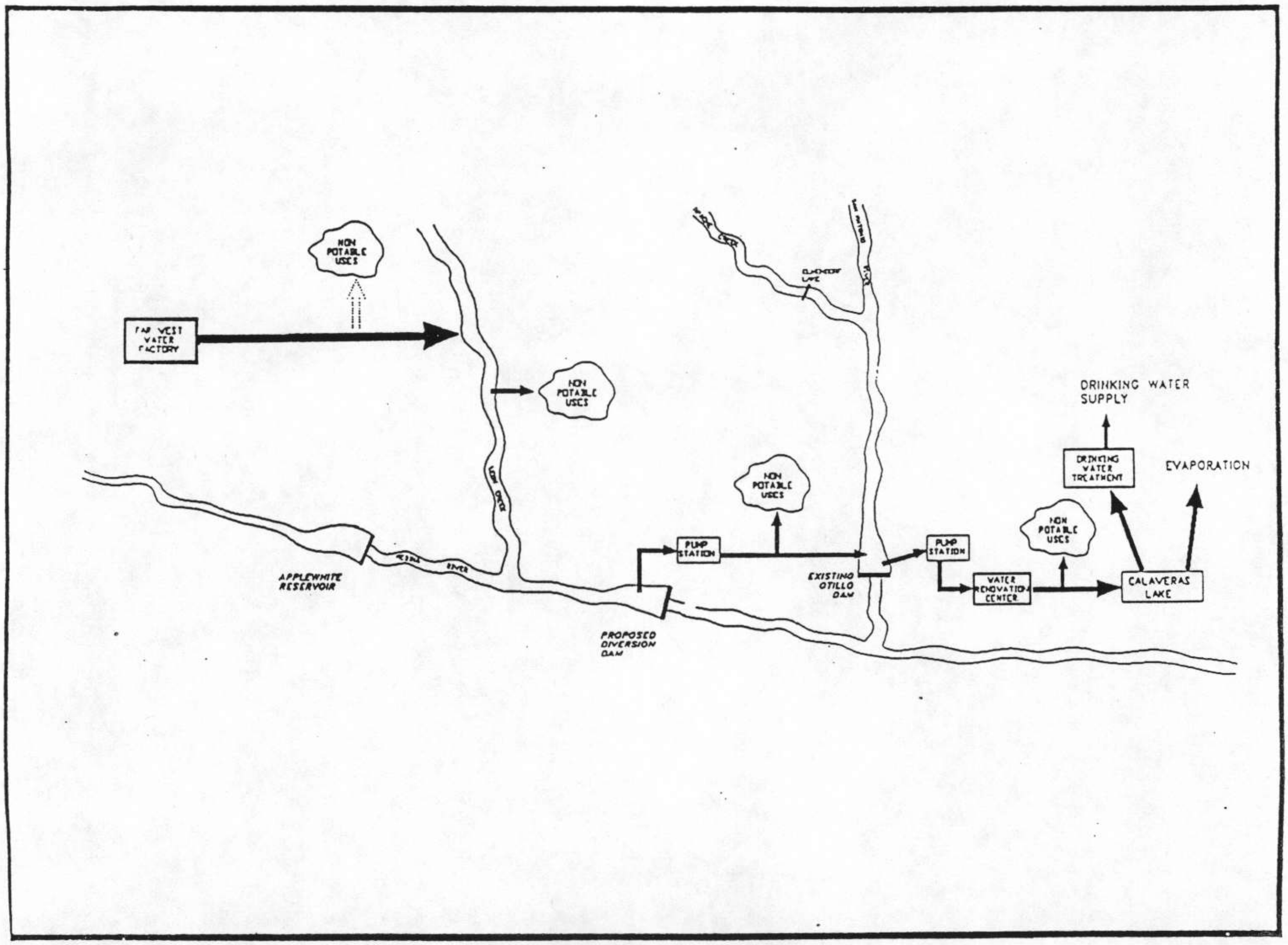
A second outfall from the Northwest Water Factory would discharge back into Leon Creek. This would provide for reuse opportunities along the creek downstream. Any water which is not used in this area would flow into the Medina River below Applewhite Reservoir. This water would be recaptured at a new diversion dam in the Medina River and transported by pipeline to the Water Renovation Center. After further treatment there, this water would also be piped to Calaveras Lake. The amount which reaches the lake from this source would thus depend on how much could be marketed to reuse customers along the routes of the various pipelines.

Far West Water Factory Area

Another water factory in the Far West Service Area would intercept effluent from the upper Medina River. Again, this amount is projected to grow from 8000 acre-feet per year in 2000 to 40,000 acre-feet by 2040. Figure R-9 shows the possible uses schematically.

The plan in this area would be to pipe the water to Leon Creek and market it to customers along the pipeline route. Any amount not consumed along the pipeline would then add to the volume available along Leon Creek from the Northwest water factory. Any remaining unused water would then enter the Medina River below Applewhite Reservoir. From this point it would be

Figure R-9
Schematic Reuse Plan for Far West Water Factory Output



treated in the same way as the remainder from the Northwest water factory. Thus it would increase the amount available for customers located anywhere between the Medina River diversion dam and Calaveras Lake.

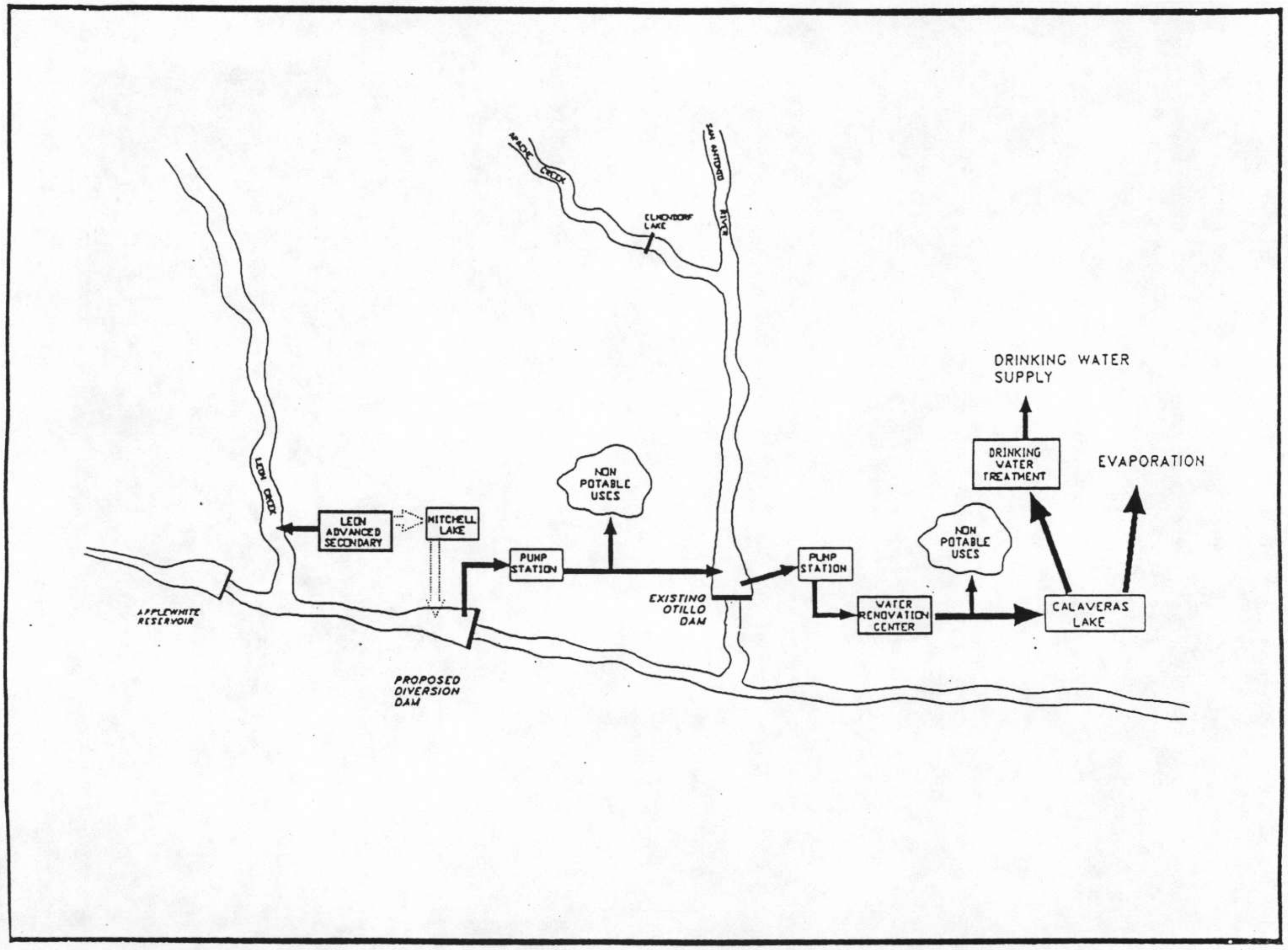
Leon Creek Treatment Plant

With the Northwest water factory in place, the effluent from the existing Leon Creek treatment plant is projected to remain steady at 24,000 acre-feet per year through 2040. This effluent is now discharged into Leon Creek, a short distance above the creek's confluence with the Medina River. The City proposes to convert this plant, like the Salado Creek treatment plant, into another water factory. Figure R-10 shows the plan schematically.

The effluent from the Leon Creek plant would continue to be discharged back into the creek above the Medina River. It would then be diverted from the river at the proposed diversion dam, pumped to the Water Renovation Center, and ultimately discharged into Calaveras Lake. This would further increase the amounts available for reuse customers along the pipeline routes from the diversion dam to the Water Renovation Center and from the Water Renovation Center to Calaveras Lake.

An alternative discharge route could divert the effluent through Mitchell Lake before it enters the Medina River. This would enhance Mitchell Lake's water quality, and it might make the Leon Creek effluent more marketable after it is withdrawn from the Medina River.

Figure R-10
Schematic Reuse Plan for Leon Creek Treatment Plant Effluent

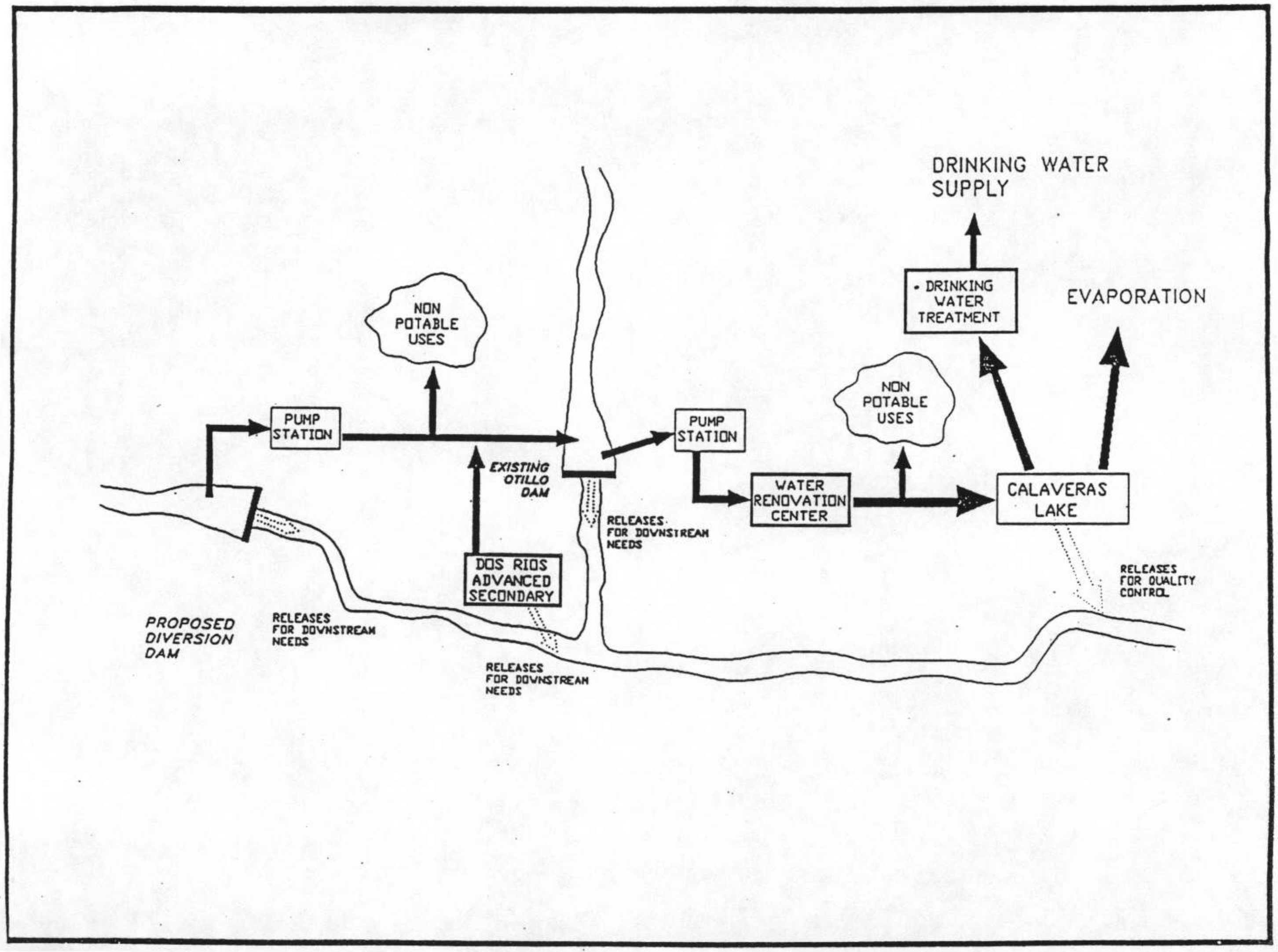


Dos Rios Treatment Plant

With the increases in City wastewater volumes being handled by other facilities, the effluent from the Dos Rios plant is projected to remain at 64,000 acre-feet per year through 2040. This effluent is now discharged into the Medina River immediately above the confluence with the San Antonio River. A portion is then withdrawn from the San Antonio River to meet evaporation requirements in Calaveras Lake. The remainder continues downstream, where the river serves other users and meets important environmental needs.

The City proposes to earmark the effluent from this plant to meet downstream release requirements. Any excess above these requirements could then be added to the volume being piped from the Medina River diversion dam to the Water Renovation Center and on to Calaveras Lake. Figure R-11 shows the elements of this plan.

Figure R-11
Schematic Reuse Plan for Dos Rios Treatment Plant Effluent



Summary of Target Area "B"

Table R-2 summarizes the projects in Target Area "B." With all of the options and alternatives in this area, it is impossible to specify how much effluent from each individual facility will wind up in each particular use. Wastewaters will be commingled at various points, both in streams and in pipelines. The City will also need to operate the system in the most cost-effective manner, which may vary depending on rainfall and other conditions.

Table R-3 presents combined data for the two target areas.

Table R-2
Wastewater Volumes Generated and Available for Reuse,
Target Area "B," 1995-2040
(Acre-feet per year)

	1995	2000	2010	2020	2030	2040
WASTEWATER GENERATED						
Northwest Water Factory	4,000	8,000	16,000	24,000	32,000	40,000
Far West Water Factory	4,000	8,000	16,000	24,000	32,000	40,000
Leon Creek WWTP	24,000	24,000	24,000	24,000	24,000	24,000
Dos Rios Treatment Plant	64,000	64,000	64,000	64,000	64,000	64,000
Gross Total Generated	96,000	104,000	120,000	136,000	152,000	168,000
OTHER USES						
Calaveras Lake Evaporation	37,000	37,000	39,000	39,000	39,000	39,000
Downstream River Releases	55,000	55,000	55,000	55,000	55,000	55,000
Total Committed to Other Uses	92,000	92,000	94,000	94,000	94,000	94,000
NET AVAILABLE FOR REUSE	4,000	12,000	26,000	42,000	58,000	74,000

Table R-3
Wastewater Volumes Generated and Available for Reuse,
Combined Target Areas, 1995-2040
(Acre-feet per year)

	1995	2000	2010	2020	2030	2040
WASTEWATER GENERATED						
Water Factories						
Northeast	4,000	8,000	16,000	24,000	32,000	40,000
Northwest	4,000	8,000	16,000	24,000	32,000	40,000
Far West	4,000	8,000	16,000	24,000	32,000	40,000
Subtotal	12,000	24,000	48,000	72,000	96,000	120,000
Existing Treatment Plants						
Salado Creek	24,000	24,000	24,000	24,000	24,000	24,000
Leon Creek	24,000	24,000	24,000	24,000	24,000	24,000
Dos Rios	64,000	64,000	64,000	64,000	64,000	64,000
Subtotal	112,000	112,000	112,000	112,000	112,000	112,000
Gross Total Generated	124,000	136,000	160,000	184,000	208,000	232,000
OTHER USES						
Braunig Lake Evaporation	7,000	7,000	7,000	7,000	7,000	7,000
Calaveras Lake Evaporation	37,000	37,000	39,000	39,000	39,000	39,000
Downstream River Releases	55,000	55,000	55,000	55,000	55,000	55,000
Total Committed to Other Uses	99,000	99,000	101,000	101,000	101,000	101,000
NET TOTAL AVAILABLE FOR REUSE	25,000	37,000	59,000	83,000	107,000	131,000

POTABLE AND NON-POTABLE REUSES

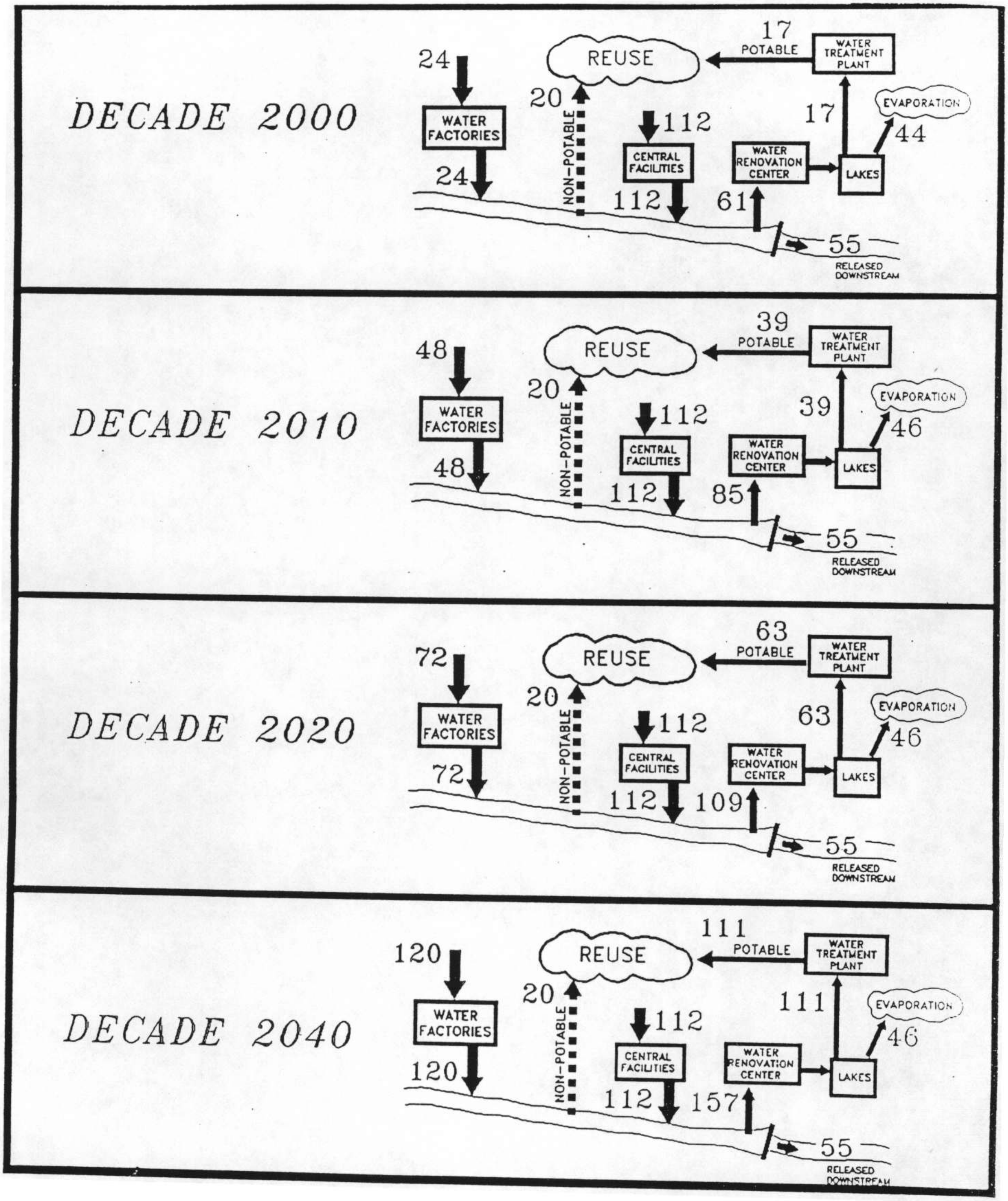
The amount of non-potable water which can be marketed for reuse in various watersheds cannot yet be confidently projected. The City will attempt to market this water aggressively to possible customers near each of the facilities, streams and pipelines. Nevertheless it is unrealistic to expect these users to absorb the entire net total which will be available.

Therefore the City also proposes to build a water treatment plant next to the Water Renovation Center, to convert unneeded lake water into drinking water. This water would then be blended into the City Water Board's distribution network for final delivery as needed throughout the city.

It is reasonable to assume that a minimum of 20,000 acre-feet will be absorbed in non-potable uses by the year 2000. Therefore the drinking water treatment plant would need an initial capacity to treat the remaining 17,000 acre-feet which would be surplus in the lakes. As more water becomes available from the Water Renovation Center, the capacity of the drinking water plant would be expanded in stages to 39,000 acre-feet in 2010 and 63,000 acre-feet in 2020.

Figure R-12 illustrates the entire program schematically by decade from 2000 to 2040.

Figure R-12
Schematic Summary of Proposed San Antonio
Wastewater Reuse Management Strategy, 2000 - 2040



The capital cost of this program to treat the water to non-potable standards is estimated to be $207 million. This is the additional cost above conventional advanced secondary treatment standards, including pipelines and associated facilities. It translates into a capital cost per acre-foot of capacity of $1170. The annual cost per acre-foot (that is, debt service plus operating and maintenance expenses) would be around $200.

The additional capital cost of the City Water Board's drinking water treatment plant is estimated at about $1000 per acre-foot of capacity. Under the pessimistic assumption that the City could sell no more than 20,000 acre-feet per year for non-potable uses, this plant would need to treat 63,000 acre-feet by 2020. The annual cost would be $10.1 million, or $160 per acre-foot for the additional treatment to potable standards. Thus the total cost of potable water from this source would be $360 per acre-foot. This is very competitive with the cost of other possible new water supplies.

The annual cost of the reuse program, not counting the additional cost of drinking water, and the possible associated sewer rate increases are detailed in Table R-4. This analysis suggests that, all other things equal, the average residential sewer bill of $14.04 per month in 1988 could increase to $16.00 in 1990 and then to $17.60 by 2010. It would continue at that level (in 1988 dollars) through 2040. Actual rate increases will depend on other capital requirements for the wastewater system during this period.

Table R-4
Wastewater Reuse Program Annual Costs and
Possible Sewer Rate Increases, 1990-2040

	1990	2000	2010	2020	2030	2040
PROJECT COSTS ($ millions - 1988)						
Water Factories						
Debt Service	2.8	5.6	8.4	8.4	8.4	0.0
Operating and Maintenance	2.5	5.0	7.5	10.0	12.5	15.0
Salado Creek Treatment Plant						
Debt Service	2.8	2.8	2.8	0.0	0.0	0.0
Operating and Maintenance	2.5	2.5	2.5	2.5	2.5	2.5
Leon Creek Treatment Plant						
Debt Service	0.0	2.8	2.8	2.8	0.0	0.0
Operating and Maintenance	1.0	2.5	2.5	2.5	2.5	2.5
Dos Rios Treatment Plant						
Debt Service	0.0	1.1	1.1	1.1	0.0	0.0
Operating and Maintenance	0.5	1.5	1.5	1.5	1.5	1.5
Total Debt Service	5.6	12.3	15.1	12.3	8.4	0.0
Total Operating and Maintenance	6.5	11.5	14.0	16.5	19.0	21.5
Total Annual Cost	12.1	23.8	29.1	28.8	27.4	21.5

SEWER RATE DATA*						
Incremental Rate Increase per 100 cubic feet (CCF)	$0.178	$0.126	$0.019	$0.00	$0.00	$0.00
Cumulative Rate Increase per CCF	$0.178	$0.304	$0.323	$0.323	$0.323	$0.323
Average Residential Bill	$16.00	$17.39	$17.60	$17.60	$17.60	$17.60
Dollar Increase over Current Bill	$1.96	$3.35	$3.56	$3.56	$3.56	$3.56
Percent Increase over Current Bill	14.0%	23.9%	25.4%	25.4%	25.4%	25.4%

CURRENT AND 1990 RESIDENTIAL SEWER BILL	
Current Minimum Bill (Includes 2 CCF Use)	$5.40
Average Volume Charge (9 CCF @ $.96/CCF)	$8.64
1988 Total	$14.04
Plus 1990 Increase of $.178 per CCF (11 CCF Use including 2 CCF in Minimum)	$1.96
1990 Total	$16.00

*Assumes 1988 revenue per $.01 of rate per CCF ($660,666) increases by 1.5% per year.

This program reflects a very substantial commitment of resources by the City of San Antonio. When implemented it would represent one of the most ambitious reuse programs in the nation.

RECOMMENDATIONS

The amount of water to be produced through reuse involved several policy issues for the Joint Committee. Conservation, evaporation, and minimum downstream flow requirements all affect the amount of water available for reuse.

To the extent that conservation reduces initial water consumption in the urban area, there is obviously less wastewater available for possible reuse. This effect is not detrimental to the City's proposal, because the City has already taken it into account. However, it does affect the calculations in the Joint Committee's Planning Model. The goal of conserving 10% of the total projected regional water demand translates into a likely 20% reduction in available wastewater flows.

The cooling water requirements of City Public Service, which owns Braunig and Calaveras Lakes, must also be met regardless of other considerations. Under existing CPS plans, 46,000 acre-feet per year will be required to improve water quality and provide for lake evaporation. The salinity of Braunig Lake needs to be reduced by an influx of fresh waters before it is acceptable for treatment as drinking water. Calaveras Lake would also benefit from a continual inflow of freshwater in place of the present periodic diversion of flood flows. A program to manage lake releases needs to be developed to accomplish these objectives.

The Joint Committee considered the minimum streamflow in the San Antonio River downstream from San Antonio as a major component of its reuse policy. During extreme drought conditions, there may be no natural flow at all in the San Antonio River downstream of the city. Data submitted by the San Antonio River Authority suggest that the minimum desirable streamflow in the San Antonio River as measured at the Falls City gauge is 55,000 acre-feet per year. Accordingly, releases of treated wastewater may need to equal this maximum amount annually.

The Joint Committee recognizes that treated effluent is an important water resource which must be reused in order for the region to effectively manage its water budget. The cost of developing this resource is competitive with the costs of alternative new supplies.

It is also clear that the major opportunities for wastewater reuse are in the area served by the City of San Antonio. Therefore the Committee recommends that the regional water resources plan include the following provisions for wastewater reuse by the City.

- The City of San Antonio should conduct its reuse program so that during drought conditions at least 55,000 acre-feet per year of streamflow is maintained in the San Antonio River as measured at the Falls City gauge.

° Any water reuse plan should ensure that all requirements are met for evaporation and water quality control in the CPS cooling lakes.

Targets for Year 2000

° New treatment facilities ("water factories") should meet at least 20,000 acre-feet per year of the regional water demand.

° The effluent from the existing Salado Creek advanced secondary treatment facility should be further treated and then discharged from a Water Renovation Center into Braunig Lake to improve the quality of the lake.

° A water treatment plant should be constructed adjacent to Braunig Lake to convert approximately 17,000 acre-feet per year of lake water into drinking water.

Targets After 2000

° The City should continue to develop the maximum potential market for reuse of the water factory effluents in non-potable purposes. The amount not absorbed in this market should be processed through the Water Renovation Center for release into Calaveras Lake.

° The effluent from the Dos Rios and Leon Creek advanced secondary treatment facilities should also be treated to a level allowing release into Calaveras Lake.

- The capacity of the water treatment plant designed to convert lake water to drinking water should be increased to the amounts not needed for evaporation and downstream releases. These are forecast to be 39,000 acre-feet per year by 2010 and 63,000 acre-feet per year by 2020.

The Joint Committee also recommends that future water using industries be encouraged to locate near these treatment facilities, and the streams and pipelines which will carry their outputs. Local economic development agencies can thus play a positive role in meeting the region's water needs.

Although San Antonio is by far the largest producer of wastewater in the region, it is not the only system with reuse potential. Accordingly the Committee recommends that all entities within the region, both private and public, explore the possibility of promoting reuse within their service areas.

SURFACE WATER

Any comprehensive water plan for the Edwards Region must consider the development of possible surface water supplies. As the Planning Model developed, it became apparent that even under average rainfall conditions, using an aggressive conservation program and ambitious wastewater reuse projects as additional resources, the region will face inevitable shortage as early as 2010. (See Table S-1.) A drought of any serious magnitude will accelerate the onset of a crisis. (Table S-2.) The likely recurrence of the "mild" drought situation of 1984-- let alone the historic drought of the 1950s -- impels the region to prepare for this situation before the end of this century.

Table S-1
Planning Model
Remainders After Groundwater Withdrawal,
Conservation and Reuse Programs

	2000	2010	2020	2040
1. Projected Demand	506,000	564,000	650,000	870,000
2. Groundwater Withdrawal	450,000	450,000	450,000	450,000
3. Conservation	50,600	56,400	65,000	87,000
4. Reuse	37,000	59,000	83,000	131,000
Total Available (2+3+4-1)	31,600	1,400	-52,000	-202,000

Table S-2
Planning Model Projections for Year 2000
Under Alternative Drought Conditions

	Average Condition	Mild Drought	Historic Drought
1. Recharge	608,000	350,000	180,000
2. Projected Demand	506,000	500,940	519,156
3. Groundwater Withdrawal	450,000	405,000	350,000
4. Conservation	50,600		
5. Drought Reduction		22,770	68,310
6. Reuse	37,000	34,000	32,500
Total (3+4+5+6-2)	31,600	-39,170	-68,346

SURFACE WATER OPTIONS

Development of new reservoirs and recharge dams in the Nueces River Basin is not feasible because of commitments to downstream surface water rights. Therefore any new reservoirs must be built within the San Antonio or Guadalupe River Basins. Possible sites in the San Antonio area include Applewhite and Cibolo in the San Antonio River Basin, and Cuero I and Cuero II in the Guadalupe Basin. (See Figure S-1.)

Both of these basins have been thoroughly studied.[1] Besides the information in these reports, the Committee also benefited from the expertise of several witnesses during the Committee process and the experience of the river authorities.

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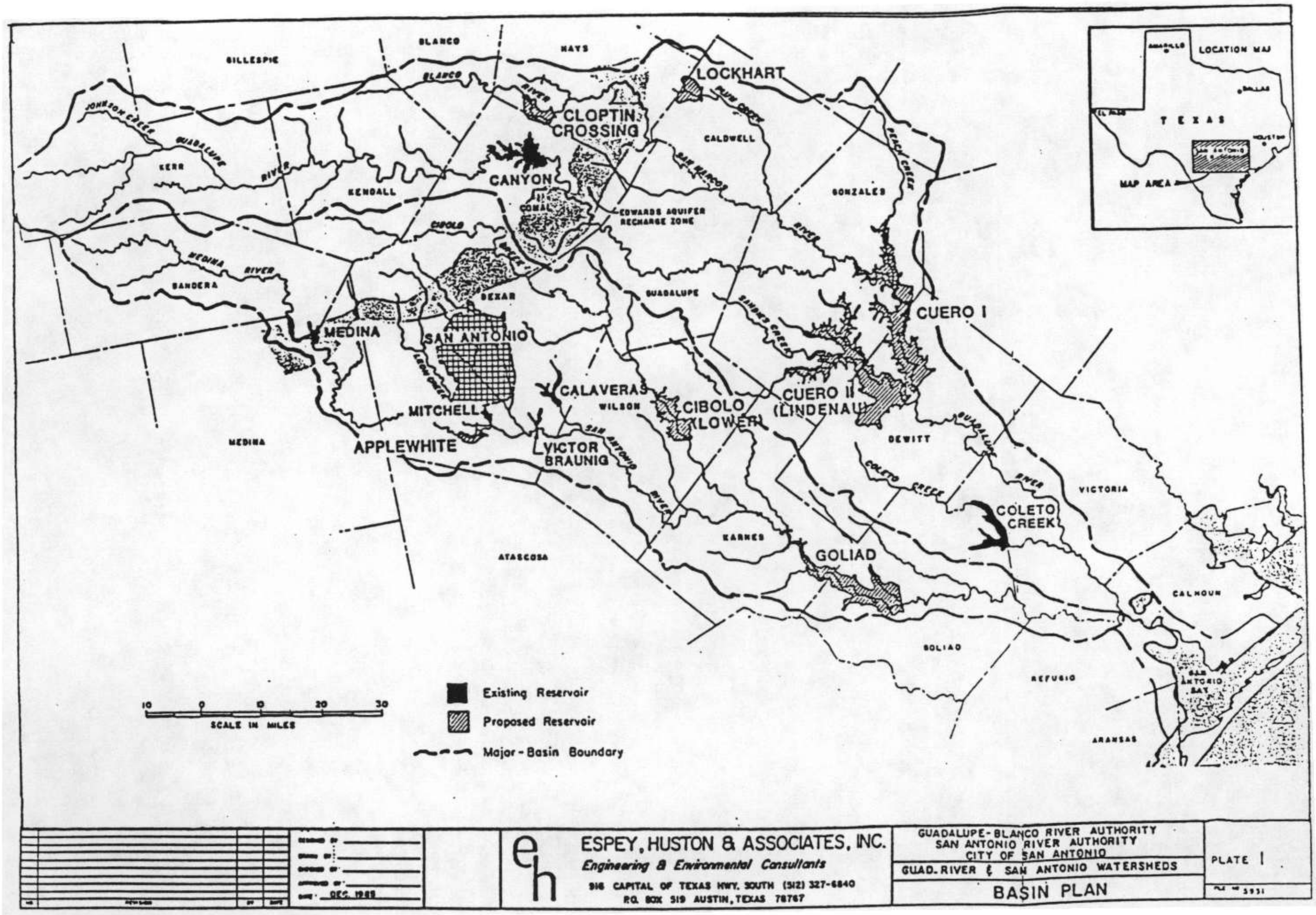
[1]U.S. Department of the Interior, Special Report on the San Antonio-Guadalupe River Basins Study, 1978; Espey Huston & Associates, Inc. for the San Antonio River Authority, Guadalupe-Blanco River Authority and City of San Antonio, Water Availability Study for the Guadalupe and San Antonio River Basins, 1986; CH2MHill, PRC Engineering, and Arthur Young, Inc. for the Edwards Underground Water District and City of San Antonio, San Antonio Regional Water Resources Study, 1986.

Figure S-1
Possible Surface Reservoir Locations,
San Antonio and Guadalupe River Basins



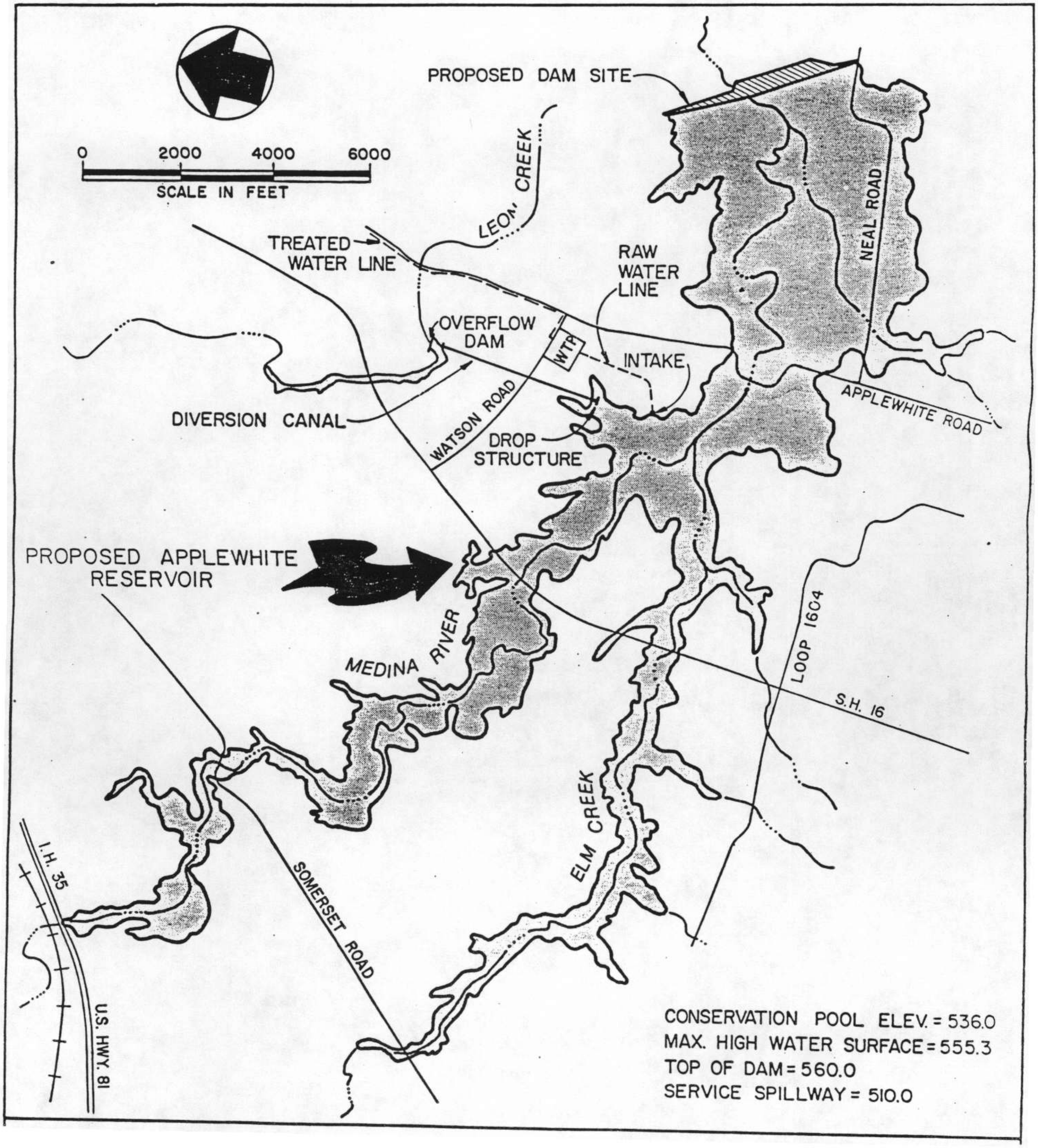
Applewhite

The San Antonio City Water Board proposes to build the Applewhite project to augment the city's dependable water supply. (See Figure S-2.) The project includes an earth-filled dam approximately 12,100 feet long across the Medina River, 2.4 miles upstream from its confluence with Leon Creek. The embankment would create an impoundment of 2,500 surface acres with a volume of 45,251 acre-feet at the conservation pool elevation of 536 feet above mean sea level. At the expected maximum high water level elevation of 555.3 feet amsl, the reservoir would inundate 7,295 acres.

Besides the Applewhite Dam itself, the original proposal by the City Water Board included a diversion dam on Leon Creek to divert flood flows from that creek into Applewhite Reservoir. Up to 544 acre-feet of water would be impounded with Leon Creek at elevation 536 feet amsl. A 6,300 foot long diversion canal would connect the Leon Creek impoundment with the reservoir. The Joint Committee's recommendation (below) does not include these features.

Of all the possible surface water projects in the region, Applewhite is the only project now under active consideration. The state water rights permit for the reservoir was issued in 1982, and the federal 404 permit is pending approval by the U.S. Army Corps of Engineers. The Corps prepared a draft Environmental Impact Statement in February, 1987, but it has not been finalized. Detailed design of the dam is 58% complete, and

Figure S-2
Plan Map of Proposed Applewhite Reservoir



it can be completed within a year once the 404 permit is granted. The Corps of Engineers is awaiting a formal statement from the City of San Antonio indicating the City's desire to proceed.

Because of its proximity to the ultimate users, Applewhite is the least expensive to build and operate of all the possible surface water projects considered. When used in conjunction with other surface water sources and the aquifer, it could be managed to produce an average yield of approximately 50,000 acre-feet per year. It could also provide terminal storage to optimize the pumping rate of surface water from Cibolo and Cuero, if those projects are also built.

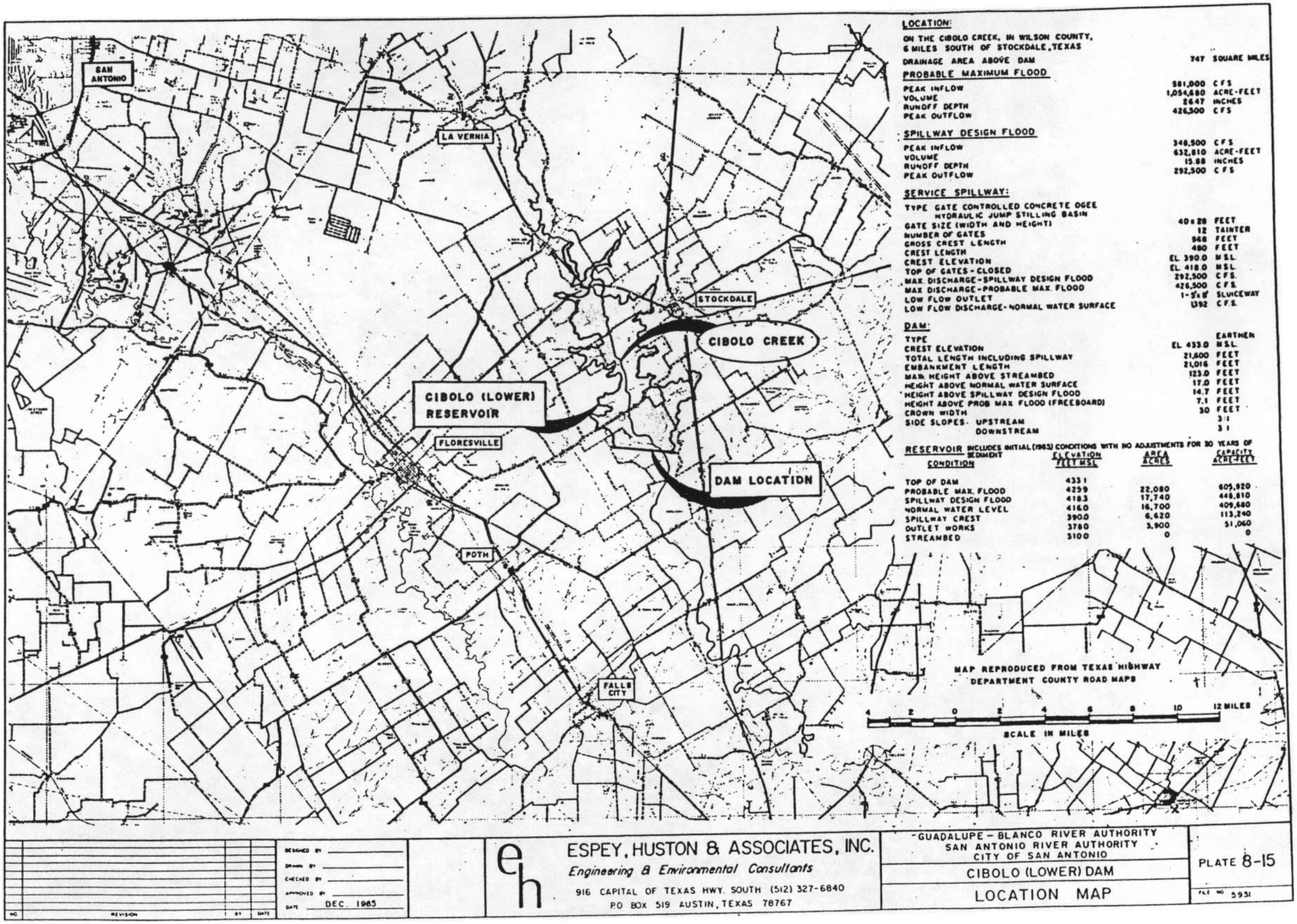
Since its inception, however, the Applewhite project has been the subject of debate. The Leon Creek Diversion may degrade the quality of the lake water with industrial effluent discharges. The wildlife mitigation plan developed by the Fish and Wildlife Service would take miles of valuable river bottom land from private ownership. These issues prompt concern about the project's viability. As a result, the Joint Committee recommends that the Leon Creek Diversion be deferred indefinitely and that a new mitigation plan be prepared.

Cibolo

The Cibolo dam site is located in Wilson County, six miles south of the city of Stockdale (Figure S-3.) The site was studied by Espey, Huston & Associates, Inc., for the San Antonio River Authority, Guadalupe-Blanco River Authority and City of San Antonio, in Water Availability Study for the Guadalupe and San Antonio River Basins, 1986. It would provide a firm yield of 30,000 acre-feet per year, after allowing for existing surface water rights and bay and estuary requirements. A pipeline would be needed to transport this water to the point of use, and a treatment facility where the water enters a distribution system.

FIGURE S-3

CIBOLO RESERVOIR LOCATION AND PLANNING DATA



Cuero I/Cuero II

Cuero I and Cuero II were also studied in the Espey Huston report. Cuero I dam would be approximately four miles upstream from the city of Cuero on the Guadalupe River (Figure S-4.) Cuero II would be located near the town of Lindenau on Sandies Creek (Figure S-5.) Cuero II could either be built as a single reservoir with water diverted from the Guadalupe River, or it could be developed as an addition to the Cuero I project.

If taken individually, the Cuero I reservoir would have a firm yield of 188,000 acre-feet per year, after allowing for existing water rights, bay and estuary requirements and San Antonio return flows. This is the largest firm yield which can be developed from any of the projects considered.

Cuero II would have a lower pool elevation than Cuero I, but "standing alone" it would still provide a firm yield of 107,000 acre-feet per year after allowing for other needs. For the combination of Cuero I and II reservoirs, the firm yield which can be developed is 219,000 acre-feet per year. Thus, assuming that Cuero I were constructed first, the incremental firm yield to be added by construction of Cuero II would only be 31,000 acre-feet per year.

The firm yields developed by the Cuero projects would allow for both in-basin needs of the Guadalupe-Blanco River Basin and contracts to supplement supplies in the area served by the aquifer. It has been estimated that the Cuero projects could deliver 75-80% of their firm yield to the aquifer region.

FIGURE S-4

CUERO I RESERVOIR LOCATION AND PLANNING DATA

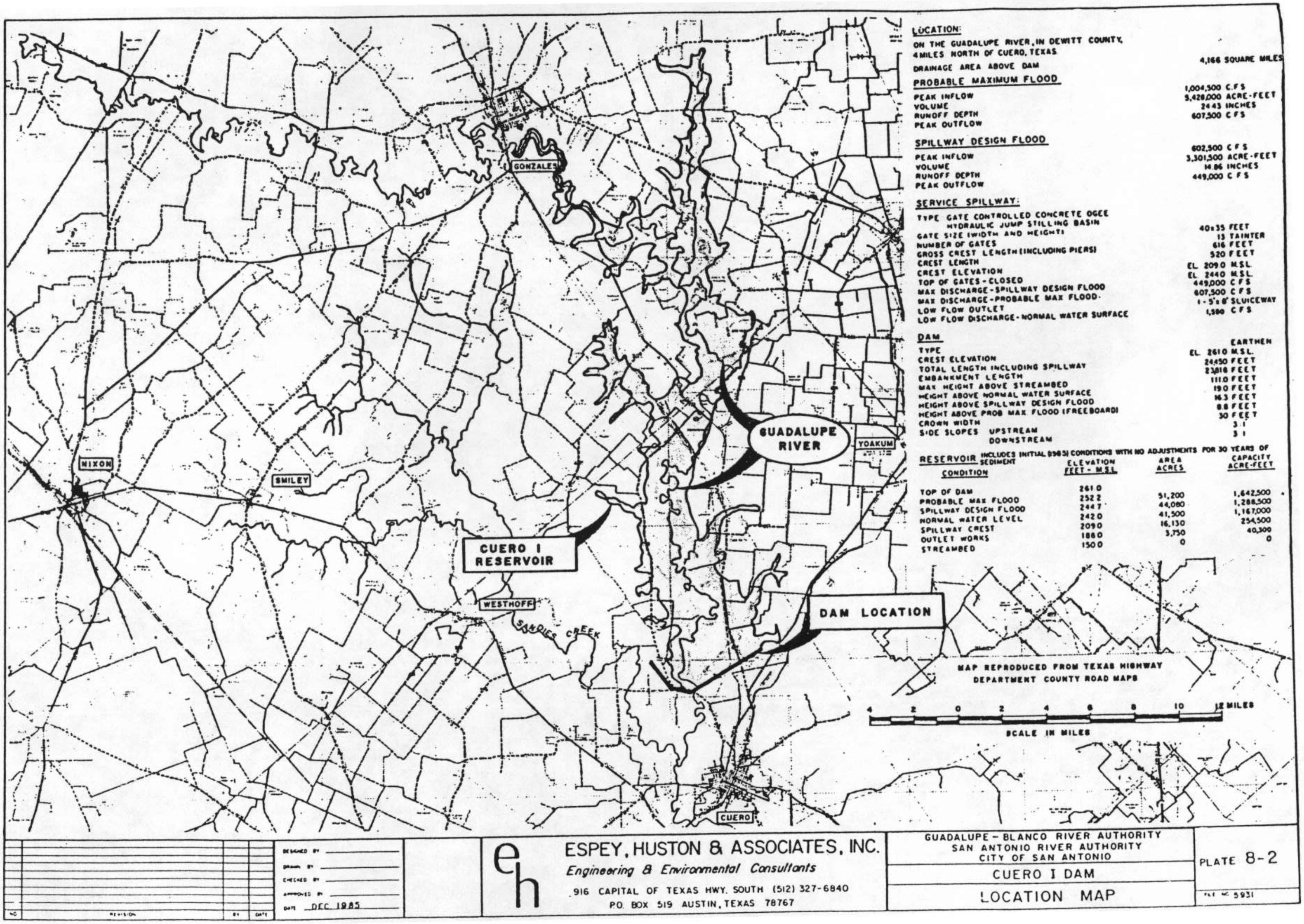
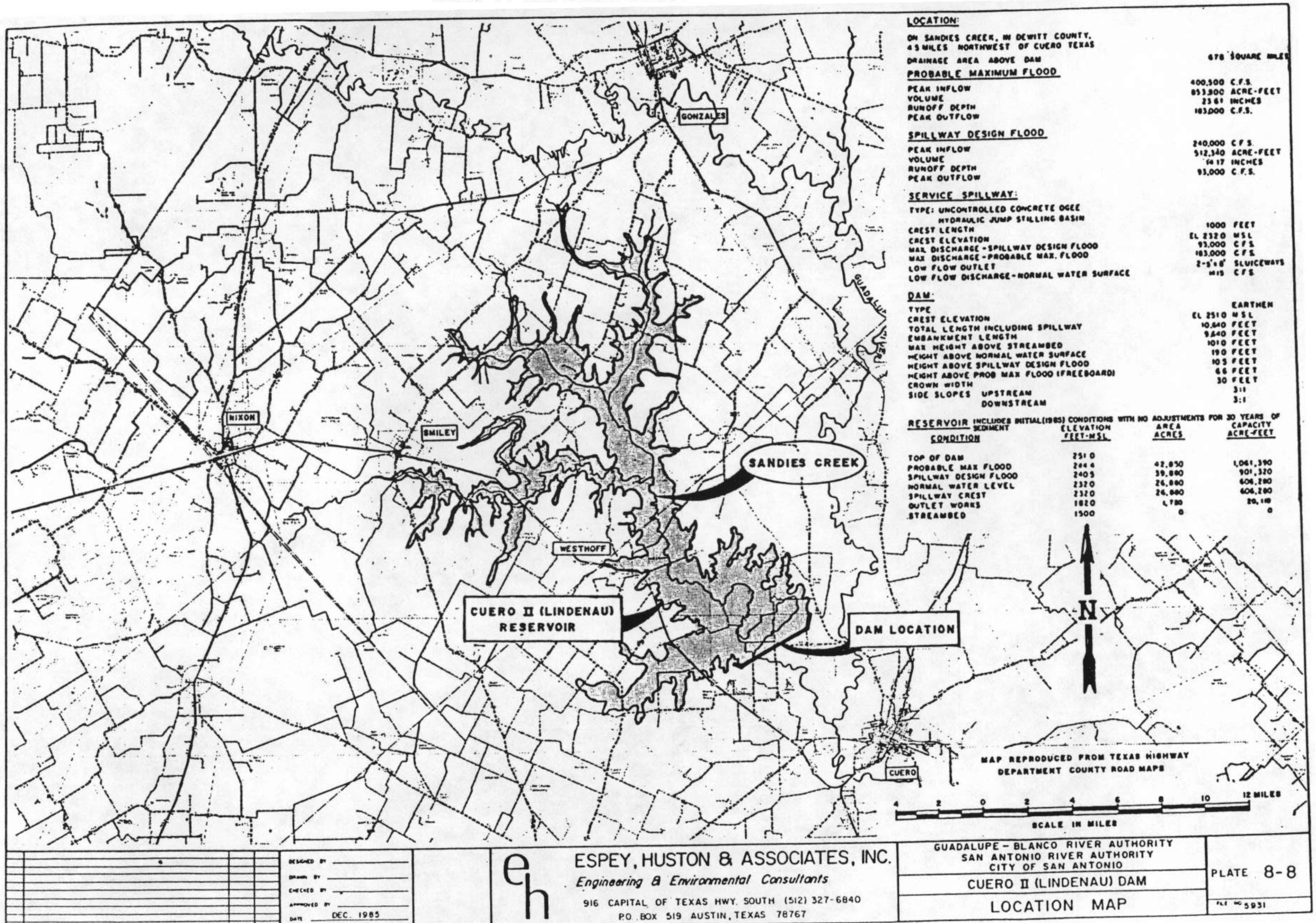


FIGURE S-5

CUERO II RESERVOIR LOCATION AND PLANNING DATA



Conveyance systems would also be needed to move the water to the point of use, and treatment facilities at the point where it enters distribution systems.

Canyon

The water from Canyon Reservoir is already fully committed to meet the needs of Guadalupe Basin users, particularly in Comal and Hays counties. However, the Committee added 14,000 acre-feet to its Planning Model to account for the use of this source to supplement the aquifer supply in Comal and Hays counties by the year 2000.

Medina

The existing Medina Lake is owned by the Bexar-Medina-Atascosa WC&ID which uses it to supply irrigation water within that district. Since this lake adds an annual average of 40,000 acre-feet to aquifer recharge, it is a factor in the area's water budget. The Edwards Board of Directors has authorized an analysis of the feasibility of purchasing lake water rights for use as additional recharge. There is no proposal to use this lake as a source of drinking water, because maximum recharge would require the lake to be kept at the highest possible level.

Table S-3 shows estimates of the time required to permit, construct and fill the possible new reservoirs under optimistic and pessimistic assumptions.

Table S-3
Development Time for Surface Water Projects
Under Optimistic and Pessimistic Assumptions

	Time in Years								Effective Yield
	Permit		Construction		Fill		Total		to Supplement
Reservoir	O*	P*	O	P	O	P	O	P	Aquifer**
Applewhite	1	2	3	4	2	2	6	8	50,000
Cibolo	5	7	4	5	4	15	13	27	30,000
Cuero I	5	8	4	5	3	10	12	23	141,000
Cuero II	2	4	4	5	2	8	8	17	80,250
Cuero I & II							8	14	165,000

*O = Optimistic; P = Pessimistic
** = 75% of Cuero Yields

Various combinations of these projects could be considered. Table S-4 shows the total yield which would be produced by these combinations. Table S-5 summarizes the costs, probable development time, and project yields for comparison. Table S-6 shows the Joint Committee's Planning Model with detail of the possible contributions from all of these projects.

Table S-4
Yields from Surface Water Project Combinations

Combination	Effective Yield to Supplement Aquifer (Acre-feet/year)
Applewhite + Cibolo	80,000
Cibolo + Cuero I	171,000
Cibolo + Cuero I & II	195,000
Applewhite + Cibolo + Cuero I & II	245,000
Applewhite + Cuero I	191,000

Table S-5

Comparative Summary of Potential Surface Water Projects

PROJECT	COSTS ($ Mil. 1988) Capital	O & M	DEVELOPMENT TIME (Years) Optimistic	Nominal	Pessimistic	PROJECT YIELD (KAF/YR) Average	Mild Drought	Severe Drought	Cost/ Ac-Ft
Applewhite	113.0	1.2	6	7	8	50	40	12	$2,260
Cibolo	258.0	2.5	13	20	27	30	30	30	$8,600
Cuero I	457.0	7.4	12	17	23	141	141	141	$3,241
Cuero II (Stand Alone)	398.0	8.2	8	12	17	80	80	80	$4,975
Cuero II (Incremental)	398.0	8.2	8	11	14	24	24	24	$16,583

Table S-6
Planning Model

Water Demands and Sources to Meet Demands
Based on Average Rainfall Conditions
(Acre-feet per year)

Plan Component	Year 2000	2010	2020	2040
(1) Average Recharge	608,000	608,000	608,000	608,000
(2) Projected Demand	506,000	564,000	650,000	870,000
(3) (a) Groundwater Withdrawal	450,000	450,000	450,000	450,000
(b) Allowance for Springflows	158,000	158,000	158,000	158,000
(4) Conservation (10% of Demand)	50,600	56,400	65,000	87,000
(5) Reuse (Net Available after River Release and Evaporation)	37,000	59,000	83,000	131,000
(6) Subtotal: Groundwater Withdrawal + Conservation + Reuse - Demand (3a+4+5-2)	31,600	1,400	-52,000	-202,000
(7) Surface Water				
(a) Canyon	14,000	14,000	14,000	14,000
(b) Applewhite	50,000	50,000	50,000	50,000
(c) Cibolo		30,000	30,000	30,000
(d) Cuero I		141,000	141,000	141,000
(e) Cuero II			24,000	24,000
(f) Surface Subtotal	64,000	235,000	259,000	259,000
(8) Net Balance: Groundwater Withdrawal + Conservation + Reuse + Surface Water - Demand (3a+4+5+7f-2)	95,600	236,400	207,000	57,000

COSTS

The estimated total capital cost of all of these reservoirs is $1.467 billion in 1988 dollars. This figure includes the associated costs of pipelines and water treatment plants.

Table S-7 displays the annual costs, including debt service and operation and maintenance. The financing periods are based on a financial program developed by each responsible agency. The lower half of the table illustrates a possible program to finance these amounts. For discussion purposes, this calculation includes the potential revenue from a "Water Availability Charge" (hook-up fee) which might be dedicated to surface water development, as well as increases in water rates. The Water Availability Charge would have the effect of making growth in the region pay a disproportionate share of the cost of meeting increased water demands.

Table S-8 shows the effect which this financing program would have on the water rates. In the case of the City Water Board, each $.01 increase per hundred cubic feet consumed would produce revenue of $645,000 in 1988. A $.01 increase for all water purveyors in the region would produce $970,000. The financing program in Table S-7 would therefore require a cumulative increase of $.85 per CCF by 2020. This would increase the average CWB residential water bill from $11.45 in 1988 to $18.32 in the year 2000 and $23.50 in 2020. These rates would stabilize and could decline slightly in the later decades of the planning period.

Table S-7
Surface Water Project Annual Costs and Financing Program, 1990-2040
($ millions - 1988)

	1990	2000	2010	2020	2030	2040
PROJECT COSTS						
Canyon						
Debt Service						
Operating and Maintenance	$0.6	$2.1	$2.1	$2.8	$2.8	$2.8
Total	$0.6	$2.1	$2.1	$2.8	$2.8	$2.8
Applewhite						
Debt Service	$1.0	$9.2	$9.2	$9.2	$8.4	$8.4
Operating and Maintenance	$0.0	$1.2	$1.2	$1.2	$1.2	$1.2
Total	$1.0	$10.4	$10.4	$10.4	$9.6	$9.6
Cibolo						
Debt Service			$23.0	$23.0	$23.0	$23.0
Operating and Maintenance	$1.0	$1.0	$2.5	$2.5	$2.5	$2.5
Total	$1.0	$1.0	$25.5	$25.5	$25.5	$25.5
Cuero I						
Debt Service		$31.9	$31.9	$31.9	$31.9	$31.9
Operating and Maintenance	$1.0	$7.4	$7.4	$7.4	$7.4	$7.4
Total	$1.0	$39.3	$39.3	$39.3	$39.3	$39.3
Cuero II						
Debt Service				$26.3	$26.3	$26.3
Operating and Maintenance			$1.0	$8.2	$8.2	$8.2
Total	$0.0	$0.0	$1.0	$34.5	$34.5	$34.5
Treatment Plants						
Debt Service	$0.1	$6.0	$10.4	$15.3	$12.2	$21.6
Operating and Maintenance	$0.0	$3.4	$6.5	$10.1	$10.1	$19.1
Total	$0.1	$9.4	$16.9	$25.4	$22.3	$40.7
Total Debt Service	$1.1	$47.1	$74.5	$105.7	$101.8	$111.2
Total Operating & Maintenance	$2.6	$15.1	$20.7	$32.2	$32.2	$41.2
Total Regional Annual Cost	$3.7	$62.2	$95.2	$137.9	$134.0	$152.4
PROJECT FINANCING						
WATER AVAILABILITY CHARGE						
# of New Equiv. Dwelling Units	5,711	6,627	7,691	8,926	10,359	12,022
Funds Generated by WAC*	$5.7	$6.6	$7.7	$8.9	$10.4	$12.0
WATER RATES						
City Water Board	$0.0	$36.1	$56.9	$83.8	$80.4	$91.2
Other Purveyors	$0.0	$19.5	$30.6	$45.1	$43.3	$49.1
Funds Generated by Rates	$0.0	$55.6	$87.5	$129.0	$123.6	$140.4
TOTAL FUNDS GENERATED						
Water Availability Charge	$5.7	$6.6	$7.7	$8.9	$10.4	$12.0
Water Rate Increases	$0.0	$55.6	$87.5	$129.0	$123.6	$140.4
Total Regional Funds Generated	$5.7	$62.2	$95.2	$137.9	$134.0	$152.4

* At $1000 per equivalent dwelling unit. Based on limited customer data; understates regional total.

Table S-8
Possible Water Rate Increases Due to Surface Water Projects, 1990-2040

	1990	2000	2010	2020	2030	2040
Amount to be Raised by Water Rates ($ mil.)	$0.0	$55.6	$87.5	$129.0	$123.6	$140.4
Incremental Rate Increase per 100 cubic feet (CCF)*	$0.00	$0.484	$0.178	$0.187	($0.142)	($0.009)
Cumulative Rate Increase per CCF*	$0.00	$0.484	$0.662	$0.849	$0.707	$0.699
Average CWB Residential Bill	$11.45	$18.32	$20.85	$23.50	$21.49	$21.37
Dollar Increase over Current Bill	$ 0.00	$ 6.87	$ 9.40	$12.06	$10.04	$ 9.92
Percent Increase over Current Bill	0%	60.0%	82.2%	105.3%	87.7%	86.7%

CURRENT AND 2000 CWB AVERAGE RESIDENTIAL BILL

Current Minimum Bill (Includes 2 CCF Use)	$ 5.09
Average Volume Charge (12.2 CCF @ $.521/CCF)	$ 6.36
1988 Total	$11.45
Plus 2000 Increase of $.484 per CCF (14.2 CCF including 2 CCF in Minimum)	$ 6.87
2000 Total	$18.32

*Assumes 1988 revenue per $.01 of rate per CCF ($970,000) increases by 15% per decade.

RECOMMENDATIONS

The Planning Model shows that all four of the possible new reservoirs will be needed by 2040. The Committee therefore recommends their construction, beginning with a modified Applewhite Reservoir as the first phase.

Applewhite is the logical first step in a regional surface water development program. To bring another project as far along in the permitting process would take at least five years under optimistic assumptions, and most probably more than that.

The Committee recommends that San Antonio City Council act as soon as possible to allow the Water Board to proceed with the Applewhite project. After hearing both from CWB and from various intervenors, however, the Committee concluded that the project should be reconfigured to defer the Leon Creek Diversion dam. An improved mitigation plan which does not include the Medina River to the northwest should also be developed.

The Committee also carefully studied the Cibolo and Cuero I and II reservoirs. It urges the San Antonio River Authority and the Guadalupe-Blanco River Authority to proceed actively with design and permitting for these projects. One possibility would be to transport water successively from Cuero to Cibolo to Applewhite, and then to incorporate it into the distribution systems of San Antonio and other communities which may participate in these projects' development.

This chapter in the Committee's report must end on a note of urgency. Immediate action to develop surface water supplies is essential. It is as essential to this plan as the overall plan is essential to the future of the region. Without this action it will be impossible to obtain approval of the Plan Component on Groundwater Withdrawal Policy. Without control of increased pumping, it will be impossible to preserve the flow of the springs when the next serious dry spell hits. And without this action it may also be impossible to convince anyone that the region is serious about solving its water supply problems.

PART III

FINANCIAL AND INSTITUTIONAL CONSIDERATIONS

FINANCIAL CONSIDERATIONS

COSTS OF THE PLAN COMPONENTS

Who will pay for all of these additional water resources, and how much?

The first step in the Committee process was to determine the cost of each component in the Planning Model. Table F-1 details the capital cost and the annual cost (debt service, operating and maintenance expenses) to implement the total program year by year from 1990 through 2040. Only public sector costs were calculated and assigned to the appropriate implementing agencies. The financing period for each project was based on a financing program developed by each responsible agency. All costs are expressed in 1988 dollars, to facilitate comparisons.

Table F-1
Plan Component Project Costs by Year, 1990-2040
($ millions - 1988)

PROJECT	CAPITAL COST	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
GROUNDWATER WITHDRAWAL	3.0																	
Debt Service		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	3.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION	0.0																	
Debt Service																		
Operation & Maint.		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	0.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE																		
WATER FACTORIES	140.0																	
Debt Service		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Operation & Maint.		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total	140.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	10.6	10.6	10.6	10.6	10.6	10.6	10.6
SALADO CREEK WWTP	28.0																	
Debt Service		2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	28.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
LEON CREEK WWTP	28.0																	
Debt Service												2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	28.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.3	5.3	5.3	5.3	5.3	5.3	5.3
DOS RIOS WWTP	11.0																	
Debt Service												1.1	1.1	1.1	1.1	1.1	1.1	1.1
Operation & Maint.		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	11.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.6	2.6	2.6	2.6	2.6	2.6	2.6
REUSE SUBTOTAL	207.0	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	23.8	23.8	23.8	23.8	23.8	23.8	23.8
SURFACE WATER																		
CANYON	0.0																	
Debt Service																		
Operation & Maint.																		
Total	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	2.1	2.1	2.1	2.1	2.1	2.1	2.1
APPLEWHITE	113.0																	
Debt Service		1.0	3.2	5.9	7.8	9.1	9.3	9.3	9.3	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Operation & Maint.		0.0	0.0	0.0	0.5	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	113.0	1.0	3.2	5.9	8.3	10.3	10.5	10.5	10.5	10.5	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
CIBOLO	258.0																	
Debt Service													23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	2.5	2.5	2.5	2.5
Total	258.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I	457.0																	
Debt Service												31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	457.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II	398.0																	
Debt Service																		
Operation & Maint.																		
Total	398.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TREATMENT PLANTS	241.3																	
Debt Service		0.1	0.3	0.8	1.8	2.6	5.3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	9.5	9.5
Operation & Maint.						1.1	1.1	1.1	1.1	1.1	1.1	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Total	241.3	0.1	0.3	0.8	1.8	3.7	6.4	7.1	7.1	7.1	7.1	9.4	9.4	9.4	9.4	9.4	12.9	12.9
SURFACE SUBTOTAL	1,467.3	3.7	6.1	9.3	12.7	16.6	19.5	20.2	20.2	20.2	20.1	62.2	86.7	86.7	86.7	86.7	90.2	90.2
TOTAL REGIONAL COST	1,677.3	18.4	20.8	24.0	27.4	31.3	34.2	34.9	34.9	34.9	34.8	88.6	113.1	113.1	113.1	113.1	116.6	116.6

Table F-1 (cont.)
Plan Component Project Costs by Year, 1990-2040
($ millions - 1988)

PROJECT	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GROUNDWATER WITHDRAWAL																			
Debt Service	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION																			
Debt Service																			
Operation & Maint.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE																			
WATER FACTORIES																			
Debt Service	5.6	5.6	5.6	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Operation & Maint.	5.0	5.0	5.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	10.0	10.0	10.0	10.0	10.0	10.0
Total	10.6	10.6	10.6	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	18.4	18.4	18.4	18.4	18.4	18.4
SALADO CREEK WWTP																			
Debt Service	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8						
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	2.5	2.5	2.5	2.5	2.5	2.5
LEON CREEK WWTP																			
Debt Service	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
DOS RIOS WWTP																			
Debt Service	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Operation & Maint.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
REUSE SUBTOTAL	23.8	23.8	23.8	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	28.8	28.8	28.8	28.8	28.8	28.8
SURFACE WATER																			
CANYON																			
Debt Service																			
Operation & Maint.																			
Total	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.8	2.8	2.8	2.8	2.8	2.8
APPLEWHITE																			
Debt Service	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	8.4	8.4
Operation & Maint.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	9.6	9.6
CIBOLO																			
Debt Service	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I																			
Debt Service	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II																			
Debt Service														26.3	26.3	26.3	26.3	26.3	26.3
Operation & Maint.				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.2	8.2	8.2	8.2	8.2	8.2
Total	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	34.5	34.5	34.5	34.5	34.5	34.5
TREATMENT PLANTS																			
Debt Service	9.5	9.5	9.5	10.4	10.4	10.4	10.4	10.4	14.3	14.3	14.3	14.3	14.3	15.3	15.3	15.3	15.3	15.3	15.0
Operation & Maint.	3.4	3.4	3.4	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	10.1	10.1	10.1	10.1	10.1	10.1
Total	12.9	12.9	12.9	16.9	16.9	16.9	16.9	16.9	20.8	20.8	20.8	20.8	20.8	25.4	25.4	25.4	25.4	25.4	25.1
SURFACE SUBTOTAL	90.2	90.2	90.2	95.2	95.2	95.2	95.2	95.2	99.1	99.1	99.1	99.1	99.1	137.9	137.9	137.9	137.9	137.1	136.8
TOTAL REGIONAL COST	116.6	116.6	116.6	126.9	126.9	126.9	126.9	126.9	130.8	130.8	130.8	130.8	130.8	169.3	169.3	169.3	169.3	168.5	168.2

Table F-1 (cont.)
Plan Component Project Costs by Year, 1990-2040
($ millions - 1988)

PROJECT	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
GROUNDWATER WITHDRAWAL															
Debt Service	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Operation & Maint.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CONSERVATION															
Debt Service															
Operation & Maint.	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
REUSE															
WATER FACTORIES															
Debt Service	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	0.0
Operation & Maint.	10.0	10.0	10.0	10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	15.0
Total	18.4	18.4	18.4	18.4	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	15.0
SALADO CREEK WWTP															
Debt Service															
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
LEON CREEK WWTP															
Debt Service	2.8	2.8	2.8	2.8											
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	5.3	5.3	5.3	5.3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
DOS RIOS WWTP															
Debt Service	1.1	1.1	1.1	1.1											
Operation & Maint.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	2.6	2.6	2.6	2.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
REUSE SUBTOTAL	28.8	28.8	28.8	28.8	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	21.5
SURFACE WATER															
CANYON															
Debt Service															
Operation & Maint.															
Total	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
APPLEWHITE															
Debt Service	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Operation & Maint.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Total	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
CIBOLO															
Debt Service	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Operation & Maint.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
CUERO I															
Debt Service	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
Operation & Maint.	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3	39.3
CUERO II															
Debt Service	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Operation & Maint.	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Total	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
TREATMENT PLANTS															
Debt Service	15.0	15.0	15.0	15.0	12.2	12.2	12.2	12.2	12.2	19.1	19.1	19.1	19.1	19.1	21.6
Operation & Maint.	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	19.1
Total	25.1	25.1	25.1	25.1	22.3	22.3	22.3	22.3	22.3	29.2	29.2	29.2	29.2	29.2	40.7
SURFACE SUBTOTAL	136.8	136.8	136.8	136.8	134.0	134.0	134.0	134.0	134.0	140.9	140.9	140.9	140.9	140.9	152.4
TOTAL REGIONAL COST	168.2	168.2	168.2	168.2	164.0	164.0	164.0	164.0	164.0	170.9	170.9	170.9	170.9	170.9	176.5

Administration of the Groundwater Withdrawal Policy is estimated to cost $1.3 million per year. Roughly $1 million of this is the cost of additional staff for the Edwards Underground Water District to administer the certification of historic rights, the conditional permit system, and the water rights market proposed in the chapter which explains this policy. The remainder is for amortization of the capital equipment which will be needed to monitor groundwater withdrawals effectively.

The public sector costs of the conservation programs are also estimated at $1.3 million per year. This is the cost of the recommended education programs, leak detection programs by the water purveyors, administration of building retrofit and landscape watering programs, and a continuing program of public facility retrofitting and landscape conservation (Table C-5, page 144.)

The capital cost of San Antonio's wastewater reuse program is estimated to be $207 million. Since this is a phased program, expanding as the available wastewater flows increase, the annual costs would peak at around $29.1 million between 2010 and 2019.

Inevitably, the largest cost component is the cost of surface reservoirs. These will begin with Applewhite ($113 million) being constructed in the 1990s, then Cibolo ($258 million) and Cuero I ($457 million) beginning around 2000, and Cuero II ($398 million) in 2020. The costs of water treatment plants ($241.3 million) will increase in stages as these reservoir projects are completed. The total annual cost of debt service and operation and maintenance will rise throughout the planning period to $152.4 million in 2040.

POSSIBLE REVENUE SOURCES

Once these costs were established, the Committee faced a number of basic policy issues. Foremost among these were how to apportion these costs across the region, and how to evaluate their impact on various population segments. For example, should costs be apportioned to each county based on population, or acreage, or water use, or some other measure? Should existing consumers be required to pay for new regional water resources, or should the entire burden be placed on new growth? How should the costs be divided among municipalities, agricultural users, manufacturers, and tourists? How can we mitigate the potential impacts on existing local industries, and on new businesses which might locate within the region? How will these costs affect other plan components such as conservation, so as to be consistent with the program goals? (See Appendix J.)

In the course of wrestling with these issues, the Committee considered an array of financing alternatives. (See Table F-2.)

Table F-2
Comparative Analysis of Possible Revenue Sources

Revenue Source	Potential Revenue	Administering Entity	Method of Cost Recovery	Sector Affected	All Users or New Growth	Approval Required	Impact on Conservation	Applicable Program	Able to Meet Full Costs?
EUWD Property Tax	$.01 increase = $3,822,701	E.U.W.D.	Land Value	Entire Region	All	Referendum	None	Groundwater Mgmt Conservation	Yes Yes
Well Permit Fees	$1000/well/year	E.U.W.D.	Growth	Irrigators, Municipal & Industrial	Growth	State Legislation	None	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Well Pumpage Fees	@$.01/1000 gal. (= $3.26/AF) 100,000 AF = $325,850	E.U.W.D.	Water Consumption	Irrigators, Municipal & Industrial	All	State Legislation	Positive	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Water Rates	$.01/100 cu ft = $970,000	Water Purveyors	Water Consumption	Municipal & Industrial	All	City Ordinances TWC Approval State Legislation	Positive	Conservation Surface Water	Yes Yes
Sewer Rates	$.01/100 cu ft = $660,666 (San Antonio)	City of San Antonio	Water Consumption	Municipal & Industrial	All (San Antonio)	City Ordinance	Positive	Reuse	Yes
Recreation Fees	Not determined	River Authorities and Cities	User Fee	Facility Users	All	None	None	Surface Water	No
Water Availability Hook-up Charge	$1000/dwelling unit equivalent	Water Purveyors	Growth	Municipal & Industrial	Growth	City Ordinances State Legislation	None	Groundwater Mgmt Conservation Surface Water	Yes Yes No
Sales Tax	Not determined	State	Economic Activity	Entire Region	All	State Legislation Referendum	None	Surface Water	No
State/Federal Aid	Not determined	Cities Water Purveyors River Authorities E.U.W.D	N/A	N/A	N/A	None	None	Reuse Surface Water	No No

Possible revenue sources that were considered include the property tax levied by the Edwards Underground Water District, well permit fees, well pumpage fees, a water availability fee, the water consumption rates charged by water purveyors, the sewage fees charged by the City of San Antonio, the recreation fees charged for public use of area lakes, a regional sales tax, and state and federal aid. These are described in the following paragraphs.

Edwards District Property Tax

The Edwards tax is the ad valorem property tax authorized by the state and levied in the counties which form the Edwards District. The District's 1988 tax rate of $.0097 per $100 of assessed value generates $3,350,000 from a regional tax base of $38.227 billion. An increase in this tax could most logically be used for administration of the groundwater withdrawal policy and/or for conservation programs.

The potential revenues from higher tax rates are illustrated in Table F-3 below. A tax rate of over $.02 per $100 would require a county by county referendum.

Table F-3
Potential Revenue Generated at Alternative EUWD Tax Rates

County	Tax Base	$.01/$100	$.02/$100	$.05/$100*	$.25/$100*
Hays	$1,041,100,000	$104,110	$208,220	$520,550	$2,602,750
Comal	$1,256,000,000	$125,600	$251,200	$628,000	$3,140,000
Bexar	$35,092,212,945	$3,509,221	$7,018,443	$17,546,106	$87,730,532
Medina	$396,600,000	$39,660	$79,320	$198,300	$991,500
Uvalde	$441,100,000	$44,110	$88,220	$220,550	$1,102,750
TOTAL	$38,227,012,945	$3,822,701	$7,645,403	$19,113,506	$95,567,532

*Would require county by county referendum.

Well Permit and Pumpage Fees

Well permit fees could be levied against new well owners and operators, if authorized by new state legislation. The potential revenue would depend on the number of wells drilled per year and the amount of the fee per well.

Similarly, a well pumpage fee could be levied against well owners and operators, charging them for the amounts they pump. The revenue generated would depend on the proportion of total pumpage which is subject to the fee, as well as on the rate per 1000 gallons. This fee would also require new state legislation.

Both of these types of fees could be used for the groundwater withdrawal or conservation programs, or they could be applied to offset the cost of surface water projects.

Water Availability Charge

A water availability charge (hook-up charge) was considered, possibly as a means of financing new water supply projects. This would be a one-time fee assessed against new water utility customers, calculated on an "equivalent-dwelling-unit" basis. It would make new growth in the region pay directly for the additional water resources needed to serve that growth. A fee of $1000 per equivalent-dwelling-unit would generate approximately $5.7 million in 1990, rising to $12 million by 2040 (Table F-4.) This charge would require a policy change for the water purveyor assessing it.

Table F-4
Potential Revenue from a Water Availability Charge

	1990	2000	2010	2020	2030	2040
Annual New Equivalent-Dwelling-Units*	5,711	6,627	7,691	8,926	10,359	12,022
Water Availability Charge	$1000	$1000	$1000	$1000	$1000	$1000
Revenue Generated ($ millions)	$5.7	$6.6	$7.7	$8.9	$10.4	$12.0

*Based on limited customer data; understates regional total.

Water Rates

Increases in the rates charged by water purveyors could serve two separate purposes. First, they are a potential means of financing surface water projects, water treatment and distribution facilities, and conservation programs. Second, the rate structures could be redesigned to encourage conservation. Increasing block water rates (that is, charging more per unit as larger quantities are consumed), seasonal peak water rates (charging more per unit during peak demand seasons), and excess use penalties could all be powerful conservation incentives.

Under existing rate structures, each \$.01 increase per hundred cubic feet (CCF) consumed would produce \$645,000 in revenue for the City Water Board or \$970,000 total for all water purveyors in the region. The water purveyors would need the approval of their regulatory agencies (the Texas Water Commission, or the San Antonio City Council in the case of CWB) to increase their rates and redesign their rate structures to encourage conservation.

The San Antonio City Water Board proposes to finance construction of the Applewhite water supply project. Under existing financing practice, the Water Board estimates that 80% of the construction cost could be financed by revenue bonds and the remainder from operating revenues. Needed rate increases would be phased in over a period of years, to minimize the impact on existing consumers.

Sewer Charges

The wastewater reuse program could be financed by the sewer rates charged to the users of San Antonio's area wastewater treatment system (Table R-4, page 177.) Possible rate increases would depend upon the system's needs for maintenance and expansion, federal and state mandates for pretreatment and treatment of effluent, changes in technology, and other decisions such as sewer extension policies. These rates are set by San Antonio City Council, under federal EPA requirements to recover the actual cost of service to each class of user.

Recreation Fees

Recreation users at Braunig and Calaveras Lakes are charged fees to defray the lakes' operation and maintenance expenses. Increases might be applied to surface water projects. The revenue potential has not been estimated, but it would be minor. These fees are set by the San Antonio River Authority, which operates the lakes.

Sales Tax

The sales tax is administered by the state and applied to retail sales of goods and services as determined by state law. This could be a major source of revenue applied to surface water development. However, the Committee ruled out this option because the Legislature is not likely to make it available for this purpose.

State and Federal Aid

Finally, state and federal aid, in the form of loans, grants, or deferred payment programs, could be another possible revenue source. In principle, it could offset a large share of the cost of either surface water or wastewater reuse projects. The amount which may be available, however, depends on state or national policies, and appropriations by the Legislature or Congress.

RECOMMENDATIONS

The Joint Committee reviewed each potential revenue source in several dimensions. One was the impact on various segments of the population, including whether the burden would fall on existing users or only on new growth. Another was the need for new legislation or other institutional change to implement it. A third was whether it would contribute to the goal of conservation. Finally, each revenue source was studied as to whether it could meet the full costs of an appropriate planning component.

For each potential revenue source, the Committee had to decide: (1) whether or not to use it at all; (2) if so, which plan component(s) it should finance; and (3) the estimated revenue to be assumed. Table F-2 above (page 210) outlines the Committee's analysis.

By Plan Component, the Committee's recommendations are as follows.

Groundwater Withdrawal Management

This program should be administered by the Edwards District. Because of its regional impact, it should be funded by the District's property tax. The $1.3 million annual expenditure translates into a tax increase of $.0034 per $100.

Conservation

This program is intended to operate regionwide, although municipalities and local water purveyors must implement it at the local level. Therefore the cost should be shared throughout the region by funding the program through the Edwards District's property tax. The institutional structure to accomplish this is discussed in the next chapter. The annual cost of $1.3 million would require an increase in the Edwards tax of $.0034 per $100.

Wastewater Reuse

The City of San Antonio should operate the wastewater reuse program with funds generated by its sewer rates. The impact of this program on the sewer rates was discussed above, in the Plan Component chapter on reuse (Table R-4, page 177.) State and federal loans and grants should be pursued for this program. However, the Committee recognizes that aid may not be readily available for this purpose.

Surface Water

The Joint Committee agrees that the San Antonio City Water Board should finance the Applewhite Reservoir through its bond program as the first phase of surface water development. As discussed in the preceding chapter, this project should not include the Leon Creek Diversion and it should include a revised mitigation plan. CWB has been responsible for permitting, design and construction of this project on behalf of the City of San Antonio, and it will operate the reservoir upon completion.

The San Antonio River Authority and the Guadalupe-Blanco River Authority should undertake the permitting and design of the Cibolo and Cuero I and II reservoirs. These projects should be financed by the river authorities through their bond programs. The river authorities could recover these costs either directly through contracts with regional water purveyors, or indirectly through the Edwards District acting as regional water broker. Either way, the costs ultimately would be borne by water rate-payers.

IMPLEMENTATION

INSTITUTIONAL CONSIDERATIONS

At this point, two issues still remain to be addressed before the plan can be implemented. These are (1) the responsibilities of various agencies in carrying out the plan, and (2) the development of a work program and implementation action schedule.

Agency Roles and Relationships

First and foremost, it is crucial that this plan be implemented as a regionwide program. There is only one agency in the region which can assume overall responsibility for this effort: the Edwards Underground Water District. The District is the only logical candidate to implement the Groundwater Withdrawal Policy. It is the only agency below the state level which could effectively coordinate other entities throughout the region in implementing the other plan components. To do this, the District must have adequate funding, staffing, and capital equipment, as well as appropriate legislative authority.

Two other plan components suggest obvious choices as implementing agencies. In wastewater reuse, the City of San Antonio will remain responsible for its reuse program, under the policies recommended above for river releases and enhancement of the lakes. In surface water development, the City Water Board will develop the plan's first surface water supply project, the

Applewhite Reservoir. The San Antonio River Authority and the Guadalupe-Blanco River Authority are also obvious choices as contracting agencies for the Cibolo and Cuero reservoirs. A choice which does not need to be made yet is whether the river authorities should pay for these projects through direct contracts with regional water purveyors, or whether the Edwards District should assume a role as the region's overall water broker.

The most complex problem of interagency relationships will arise in implementing the conservation program. To be both equitable and effective, this must be a regionwide program. But to be manageable, it must be implemented by each municipality, school district, and local water purveyor. Municipalities must adopt the ordinances amending their building codes and they must retrofit their public facilities. School districts must carry out the recommended school education programs and retrofit their own facilities. Water purveyors must institute leak detection programs and restructure their rates, with appropriate regulatory approval. Some agency must also address the requirements of conservation in irrigated agriculture and among other underground water users.

It must be stressed that less than the maximum effort by every participating agency will compromise both effectiveness and equity. The restructuring of water rates in particular may require state legislation to ensure uniform compliance by over 200 water purveyors in the region.

These considerations suggest a role for the Edwards District as overall coordinator of the conservation program. The District could coordinate the development and implementation of local conservation plans by municipalities and water purveyors throughout the region, and offer technical assistance to these agencies as needed. It could also assist farmers and other groundwater users to apply the most advanced water conservation technologies.

Action Schedule

Implementation of this plan will be as complex as the plan itself. The first requirement will be to secure passage of new state legislation authorizing the Groundwater Withdrawal Policy. This law must address the historic rights of the parties affected as well as the procedures to achieve the long-run management goal.

Other legislative initiatives such as new fees are for consideration and possible implementation in the future. These fees would be innovations today, but they could become a matter of course tomorrow in order to implement the plan and to ensure equity in regional water resources.

A major consideration is to ensure that all elements of the plan go forward in a coordinated and timely fashion. This will involve working with the Legislature and the Texas Water Commission. A specific action agenda and work program needs to be developed, to lay out the steps required to secure the new legislation and to establish the implementation mechanisms. The

City of San Antonio must expect to play a role as the model for other municipalities in the region.

The City of San Antonio and the Edwards District will continue to be the primary parties responsible for bringing the plan to fruition. Their financial resources, staff expertise, management capacity and political leadership are crucial to attaining the plan's goals. They are also the agencies best suited to evaluate the plan's progress. This requires some form of continuing relationship between them as Joint Sponsors of the effort.

RECOMMENDATIONS

Based on the success of the Joint Sponsor relationship since 1983, and of the expanded Joint Committee since late 1987, a variation on the existing arrangement is proposed. Upon approval of this plan by the San Antonio City Council and the Edwards District Board of Directors, these two agencies should enter into a new Memorandum of Understanding. This document should provide for the appointment of an Oversight Committee to continue the work of the present Joint Committee. The new Committee should be composed of six Edwards Board members or their appointed representatives, five City Council members or their appointed representatives, and a representative of each of the three river authorities. Its chief responsibility should be to monitor, evaluate, and report to the two parent agency policy bodies on progress in implementing each plan component. The Committee should recommend to its parent agencies any changes which may become necessary in the implementation process.

The San Antonio City Council and the Edwards District Board of Directors should hold public hearings on this plan during July and August 1988. Following these hearings, both policy bodies should approve the plan in formal session. They should then direct their staffs to develop a draft of the follow-up Memorandum of Understanding, to be presented and approved by both agencies before the end of summer. Funds for the implementation work program should be programmed in their fiscal year 1988-89 budgets.

The following paragraphs describe some of the work needed, and possible time frames for completion. These actions are summarized in an "Action Program" beginning on page 227.

Legislation/Groundwater

As soon as the City Council and the Edwards Board approve the plan, they should instruct staff to begin translating the proposed Groundwater Withdrawal Policy into a draft Act of the Legislature. This staff work should begin even before the new Memorandum of Understanding is finalized. The Joint Committee, or the proposed Oversight Committee, should approve the draft by early September. The Committee should then present it to the full City Council and Edwards Board for their approval before the end of September.

Legislators from the region should be briefed on the proposal as it is being developed in final form. Their suggestions for refinement should be considered and incorporated into a revised draft during the early fall. Sponsors in the Texas House and Senate should be identified as part of this process. They should be ready to introduce the bill upon the opening of the 1989 session of the Legislature in January.

<u>Groundwater Withdrawal Policy</u>

Preparations to implement the Groundwater Withdrawal Policy should begin as soon as the Act is approved by the Legislature. The Edwards District will need to develop the mechanics of this program, including designing administrative systems, recruiting staff, and purchasing needed equipment. A public education program will be needed to inform groundwater users throughout the region about the new regulatory process. Funding for these activities should be in place by July, 1989.

<u>Conservation</u>

The City Water Board should establish San Antonio's ongoing program of public awareness on responsible water use as a permanent operational program. It should complete its study of a new conservation-oriented rate structure during the fall of 1988. The new rates should be submitted to a public hearing and approved by City Council before the end of the year. They should become effective January 1, 1989.

The City should develop a specific action plan to implement its part of the conservation program. This should include the adoption of building code amendments and the development of a plan to retrofit City facilities. The action plan should assign responsibilities to specific City agencies, with a detailed checklist of the actions needed and a schedule for completion. Funding for these initiatives should be included in the City's 1988-89 budget.

Meanwhile the Edwards District should develop a program to reach the overall goal of conserving 10% of the total regional water demand. It should sponsor the development of educational programs and materials, both for community education and for use in the schools. It should provide technical assistance to municipalities throughout the region in developing conservation ordinances and facility retrofit programs. All municipalities should adopt these ordinances and institute these programs within the next year. The District should also assist local water purveyors in developing leak detection programs, restructuring their water rates, and securing regulatory approval of the new rate structures. A specific work program to accomplish these tasks should be developed during the summer of 1988.

Wastewater Reuse

The San Antonio City Council should approve the Wastewater Reuse Action Plan in July 1988, immediately following approval of this overall Regional Water Resources Plan. Council should authorize development of a funding program and a construction schedule for the new water factories, the improvements to existing facilities, and upgrading of area lakes. The City should pursue state permitting requirements with all due speed.

Surface Water

The San Antonio City Council should act to develop the Applewhite Reservoir, with the modifications recommended in this plan, during July 1988. Council should forward a resolution of intent to the Corps of Engineers in order to secure the 404 permit, and request a permit deadline extension from the Texas Water Commission. The City Water Board should then complete the design of the project within the next year and proceed to construction as soon as possible.

The San Antonio River Authority and the Guadalupe-Blanco River Authority should begin the development of plans for permitting and design of the Cibolo and Cuero projects. These plans should aim to start construction around the year 2000. All of the region's major water agencies (that is, the river authorities, the Edwards District, and the City Water Board) should begin discussions of possible funding mechanisms and contractual arrangements to distribute the water from these additional supplies.

AGENCY CITY OF S.A./EDWARDS DISTRICT

RECOMMENDATION: Approval by Joint Committee policy bodies of Groundwater Withdrawal Policy.

RESPONSIBILITY:
- San Antonio City Council
- Edwards Underground Water District Board of Directors

ACTION(S) NECESSARY: Public hearings by both policy bodies, followed by consideration and approval in formal session.

SCHEDULE:
July - Public hearing and approval by City Council
August - Public hearing and approval by Edwards District

RECOMMENDATION: Develop draft bill to authorize Groundwater Withdrawal Policy.

RESPONSIBILITY: Joint Committee

ACTION(S) NECESSARY:

1) Approval of draft bill by Joint Committee.

2) Approval by Joint Sponsors policy bodies.

3) Briefings for area legislators.

SCHEDULE: September, 1988

ACTION PROGRAM **SUBJECT** LEGISLATION/GROUNDWATER

ACTION PAGE 3 **OF** 3

AGENCY CITY OF S.A./EDWARDS DISTRICT

RECOMMENDATION: Secure passage of bill to authorize Groundwater Withdrawal Policy in Texas House and Senate.

RESPONSIBILITY: City of San Antonio/Edwards District

ACTION(S) NECESSARY:

1) Revise draft of bill based on recommendations of local legislators.

2) Obtain sponsors in both Houses.

SCHEDULE: October, 1988 - January, 1989

ACTION PROGRAM

SUBJECT: GROUNDWATER WITHDRAWAL POLICY
ACTION PAGE 1 OF 1
AGENCY: EDWARDS DISTRICT

RECOMMENDATION: Upon adoption of the Groundwater Withdrawal Policy by the State Legislature, begin implementation measures.

RESPONSIBILITY: Edwards Underground Water District

ACTION(S) NECESSARY:

1) Develop administrative systems for implementation, recruit staff and purchase needed equipment.

2) Develop public education program to inform groundwater users about new requirements.

3) Provide program funding.

SCHEDULE: Early summer, 1989

ACTION PROGRAM

SUBJECT CONSERVATION

ACTION PAGE 1 **OF** 4

AGENCY CITY WATER BOARD

RECOMMENDATION: Establish continuing program to foster public awareness of responsible water use.

RESPONSIBILITY: City Water Board

ACTION(S) NECESSARY:

1) Develop educational strategy and materials.

2) Provide funding in 1989 budget.

SCHEDULE: Implement permanent program in 1989.

RECOMMENDATION: Implement a new rate structure to encourage conservation.

RESPONSIBILITY: City Water Board/City Council

ACTION(S) NECESSARY:

1) Develop specific proposal to implement the Pricing Policies recommended in this plan.

2) Schedule public hearing and secure approval of new rate structure by City Council.

SCHEDULE: Complete rate study by October, 1988.

Schedule hearing and approve new rates before the end of 1988, to become effective 1/1/89.

AGENCY CITY OF SAN ANTONIO

RECOMMENDATION: Implement municipal water conservation program for City of San Antonio.

RESPONSIBILITY: City of San Antonio

ACTION(S) NECESSARY: Develop work program and schedule of specific actions including:

a) Adopt building code conservation requirements for new construction and remodeling;
b) Develop public facilities retrofit program;
c) Coordinate implementation programs with other local water purveyors.

SCHEDULE: Develop action program during summer, 1988.

Provide funding in FY 1988-89 budget.

ACTION PROGRAM

SUBJECT CONSERVATION

ACTION PAGE 4 **OF** 4

AGENCY EDWARDS DISTRICT

RECOMMENDATION: Develop implementation program to attain regionwide goal of conserving 10% of projected water demand.

RESPONSIBILITY: Edwards Underground Water District

ACTION(S) NECESSARY:

1) Develop and distribute community and school educational materials.
2) Develop technical assistance programs for municipalities.
3) Develop technical assistance programs for water purveyors.
4) Establish funding mechanism.

SCHEDULE: Develop specific action program during summer, 1988.

AGENCY CITY OF SAN ANTONIO

RECOMMENDATION:	Develop funding program and construction schedule to implement the Wastewater Reuse Action Plan.
RESPONSIBILITY:	City of San Antonio
ACTION(S) NECESSARY:	Approval by City Council of Wastewater Reuse Action Plan including: a) Development of new water factories in growth area watersheds; b) Enhancement of existing facilities; c) Upgrading of area lakes; d) Development of educational and marketing programs; e) Approval of state permits; f) Funding mechanism and implementation schedule.
SCHEDULE:	City Council approval of overall Plan in July, 1988. Develop implementation action schedule by September, 1988.

AGENCY CITY OF SAN ANTONIO/CITY WATER BOARD

RECOMMENDATION: Begin development of Applewhite Reservoir Project.

RESPONSIBILITY: City of San Antonio/City Water Board

ACTION(S) NECESSARY: City Council approval of Applewhite project:

1) Request permit deadline extension from Texas Water Commission;

2) Forward resolution of intent to Corps of Engineers regarding 404 permit;

3) Establish funding mechanism.

SCHEDULE: City Council action in July, 1988.

Complete design of project by summer, 1989.

Begin construction in early 1990s.

ACTION PROGRAM

SUBJECT SURFACE WATER

ACTION PAGE 2 **OF** 2

AGENCY RIVER AUTHORITIES

RECOMMENDATION: Begin planning for Cibolo and Cuero reservoir projects.

RESPONSIBILITY: Cibolo: San Antonio River Authority
Cuero: Guadalupe-Blanco River Authority

ACTION(S) NECESSARY:

1) Develop program for planning, permitting and design.

2) Initiate discussions of contractual arrangements with water purveyors.

SCHEDULE: Submit permit applications to the Texas Water Commission by 1995.

Begin construction by 2000.

AFTERWORD

Ultimately, everyone in the region has a major stake in the success of this plan. Each agency, and each individual consumer, must recognize that we all depend on the same Edwards Aquifer. It is a common resource with a finite capacity. If the region is to continue to grow and prosper, we must act upon this knowledge now.

APPENDICES

APPENDIX A
REGIONAL WATER PLANNING CHRONOLOGY, 1952-1987

1952	San Antonio City Master Plan recommends that San Antonio join with the Corps of Engineers and Guadalupe-Blanco River Authority to construct Canyon Lake.
1953	City Water Board seeks to participate in the Canyon Lake project. The request is denied, and the City appeals to the Texas Board of Water Engineers. The matter is not resolved until the Texas Supreme Court hands down a decision in favor of the City in 1966.
1955	Texas Basins Project study begun.
1959	56th Texas Legislature creates the Edwards Underground Water District in wake of historic drought.
Sept., 1964	Bureau of Reclamation releases study on Cuero dam project.
1964	Governor John Connally directs the Texas Water Commission to develop a comprehensive state water plan.
1965	Texas Basins Project study completed. Results serve as a base for development of the state water plan.
Oct. 26, 1966	Texas Supreme Court, in case #A-10989 (City of San Antonio et al. vs. Texas Water Commission et al.) finds that San Antonio is authorized to purchase water from Canyon Lake.
1967	State Legislature passes Texas Water Quality Act of 1967, establishing the Texas Water Quality Board. TWQB is charged with maintaining state water quality.
1968	State publishes first statewide Water Plan, begins to make water a prominent issue.
1970	TWQB issues first Edwards "Board Order" to protect water quality in the Edwards Aquifer.
Aug., 1970	Bureau of Reclamation begins San Antonio-Guadalupe River Basins Study.
1971-1974	San Antonio Ranch New Town is proposed over the aquifer recharge zone. Resulting controversy over possible pollution of the aquifer by development makes aquifer protection a popular issue.
1974	TWQB issues strengthened Board Order to protect the aquifer from contamination.
1974	Local environmental groups form the Aquifer Protection Association to raise funds for purchase of land on the recharge zone.

1974	Court of Appeals hands down decision allowing San Antonio Ranch to proceed; actual development is slow.
Oct. 27, 1974	Congress passes Public Law 93-943, authorizing construction of Cibolo Reservoir.
Dec., 1974	City executes sewer service contract with Denton Utility Co. for Encino Park Municipal Utility District, decides not to oversize outfall line.
1975	GBRA and CWB begin negotiations for purchase of water from Canyon Lake.
August, 1975	Representative of Barshop Enterprises file Zoning Case #6207, asking for a change of zoning to allow single family and multi-family housing and a regional "Supermall" on a 117.107 acre tract at the southeast corner of US 281 N and FM 1604.
Oct. 2, 1975	City Council passes Ordinance #45792, establishing the Edwards Recharge Overlay zoning district as part of the City's Zoning Ordinance.
Oct. 16, 1975	Council approves rezoning of the Supermall site.
Oct., 1975	City establishes an Aquifer Protection Office within the Public Works Department to review developments proposed over the recharge zone.
Nov. 1, 1975	Aquifer Protection Association begins petition drive to ask Council to reverse the mall zoning, or submit the issue to a referendum.
Jan. 19, 1976	APA secures enough signatures to force referendum on the mall zoning.
April, 1976	After bitter controversy, citizens vote overwhelmingly to reverse the mall zoning. San Pedro North Ltd. files suit to have the referendum declared invalid.
April, 1976	City Water Board finalizes proposed contract with GBRA for Canyon Lake water and transmits it to City Council for approval.
May, 1976	City Council retains firm of Metcalf & Eddy to determine if the mall zoning would endanger the aquifer.
May, 1976	Council votes down GBRA contract.
Nov., 1976	Metcalf & Eddy issues Phase I report. Council approves expansion of the study to consider how much development over the recharge zone is safe.
April, 1977	First City Council election under 10-1 districting plan.
June, 1977	Council passes Ordinance #48106 imposing a moratorium on all

further development over the recharge zone pending completion of the Metcalf & Eddy study. Encino Park Venture et al. sue the City and several individual Council members for $750,000,000 in damages.

July, 1977	Council retains the firm of Ross, Hardies, O'Keefe, Babcock & Parsons to defend the City against the Encino Park Venture lawsuit.
Sept. 8, 1977	Council passes Ordinance #48484, an Interim Development Ordinance drafted by Ross-Hardies. The new ordinance repeals Ordinance #48106 and recognizes vested rights to development over the recharge zone.
1977	Texas Water Quality Board is replaced by new Texas Department of Water Resources, with responsibility for protecting the aquifer's water quality.
Jan., 1978	Fourth Court of Civil Appeals rules in San Pedro North Ltd. vs. City of San Antonio that a zoning change is not subject to being reversed by a referendum. The decision is subsequently upheld by Texas and U.S. Supreme Courts.
Nov., 1978	Bureau of Reclamation's San Antonio-Guadalupe River Basins Study is completed, providing data on the yields of various possible reservoirs.
Feb., 1979	Planning Commission's Water Resources Task Force issues its report.
1979	Metcalf & Eddy study is released; Interim Development Ordinance repealed.
July, 1979	Council passes Resolution #79-35-74 requesting the City Water Board to proceed with Applewhite Reservoir.
1980	City executes a second sewer service contract with Encino Park MUD, reaffirms intention not to oversize Encino Park outfall line.
Feb., 1981	City authorizes a joint venture of local engineers to perform a sewer service study of the Upper Salado Creek Watershed (SAWPAC.)
June, 1981	Council passes Resolution #81-34-64 reaffirming support for Applewhite.
Nov., 1981	City receives SAWPAC study and implements many of its recommendations. However, the study is never formally adopted by City Council.
1982	Planning Commission forms ad hoc Committee on Water Planning. Its final report recommends a detailed study of regional water resources, guided by a Technical Advisory Committee.

1983 State Legislature passes Act requiring approval by the Edwards District Board of Directors for any transport of aquifer water outside the region.

Nov., 1983 City and Edwards District sign a Memorandum of Understanding to undertake jointly a San Antonio Regional Water Resources Study. They appoint a Technical Advisory Committee to define scope of work and recommend consultants.

Dec., 1983 Council instructs CWB to refrain from entering the Walsh property to conduct geotechnical surveys for Applewhite.

1984 Technical Advisory Committee begins work, recommends CH2M-Hill to undertake regional water resources study.

April, 1986 CH2M-Hill final report is accepted by the City and Edwards District.

June, 1986 Council and Edwards District form and Implementation Advisory Task Force including a Citizens Advisory Group to help reach consensus on regional water resources recommendations.

Dec., 1986 CAG submits recommendations to Council and Edwards District.

Jan., 1987 Council and Edwards District establish Joint Sponsors Committee to review water issues and recommend legislation which both bodies can support in the 1987 session of the Texas Legislature.

Feb., 1987 Army Corps of Engineeers issues Draft Environmental Impact Statement on Applewhite project.

March, 1987 Joint Committee approves Joint Resolution describing the principles and policies accepted to date and forming the basis for action in the 1987 Legislature.

March, 1987 Council and Edwards District approve the Joint Resolution and endorse legislation subsequently enacted as House Bill 1942.

Apr. 16, 1987 Council hears Zoning Case #87026 filed by representatives of Barshop Enterprises for a shopping mall over the recharge zone near the intersection of FM 1604 and NW Military Drive. Council approves the rezoning, but agrees to consider a moratorium on construction over the recharge zone.

Apr. 23, 1987 Council does not act on the moratorium, as developers agree to hold up zoning cases voluntarily until a public information meeting scheduled for May 18.

May 18, 1987 1200 citizens pack San Antonio College McAllister Auditorium to hear presentations on aquifer protection issues. Mayor Cisneros forms City Council Committee on the Aquifer.

June, 1987 Council Committee on the Aquifer begins meeting each week to discuss policy to protect the aquifer.

Oct., 1987 Aquifer Committee report is adopted by unanimous City Council; implementation begins on recommendations.

Oct., 1987 City and Edwards District re-establish Joint Committee on Water Resources with additional representatives from Nueces, San Antonio, and Guadalupe-Blanco River Authorities.

APPENDIX B

MEMORANDUM OF UNDERSTANDING
EDWARDS UNDERGROUND WATER DISTRICT
AND
CITY OF SAN ANTONIO
November 1983

A study of water resource issues and alternatives has been proposed by the City of San Antonio, The Edwards Underground Water District and the City of San Antonio have determined that it is in their mutual interests to jointly undertake the development and preparation of the design of a study of regional water resource issues and alternatives.

The objective of the proposed study is to provide sufficient nformation and make recommendations about regional water resource issues and alternatives:

1) to enable reasonable people to make responsible decisions concerning public and private investments in the water resources of the region,
2) to insure that those decisions are consistent with regional economic development and environmental integrity and
3) to inspire long-term confidence in these decisions.

Therefore the City of San Antonio and the Edwards Underground Water District agree to the following:

1. A technical advisory committee (TAC) is to be created by the respective entities to prepare the study design, solicit proposals, review the proposals, recommend a

contractor, monitor the study and report progress to the City of San Antonio and the Edwards Underground Water District at regular intervals.

2. The study design will be reviewed with the District, City and other interested and affected parties for their actual consideration of participation in the actual study.
3. The TAC will consist of nine members with a broad range of expertise. The District and City will jointly appoint the Chairman and each entity will appoint four (4) members. At least seven of the members shall be from the affected region.
4. The members of the TAC will have expertise and capabilities in water resource management, resource economics, agricultural economics, investment analysis, environmental analysis, water law, public policy, and project management.
5. The expenses of the TAC including per diem, travel, document preparation and staff support will be split evenly by the District and the City.
6. The study should begin at the earliest date possible consistent with accomplishing the task of preparing the study design and selecting the prime contractor. The initial meeting of the TAC will be held within 90 days of the date of this agreement. The study elements could include:
   a. Preparation of demand forecasts which consider demographic and economic variables;

b. Examination of future water and wastewater conservation and reuse programs that could be initiated and that impact on water demand;

c. Determination of the capacity and availability of water in the Aquifer;

d. Review of long-range water management plans;

e. Analysis of institutional, economic, financial, investment and legal aspects of these water management plans;

f. Formulation of alternative water supply plans;

g. Evaluation, comparison and presentation of these alternatives.

Henry Cisneros
Mayor
City of San Antonio

Robert C. Hasslocher
Chairman of the Board
Edwards Underground Water District

1-12-84
Date

APPENDIX C

CITIZEN ADVISORY GROUP
RESOLUTION

The following resolutions were approved by the Citizens Advisory Group (CAG) on November 24, 1986.

1. "Allocation of ground water should be accomplished as a part of a comprehensive water plan that must include conservation, reuse and surface water development.

   Further, an average pumping limit of 450,000 acre feet/year or subsequent adopted amount be established based upon a procedure for allocation either by assigning a 2 acre feet/acre amount to irrigated agriculture based upon prior years irrigated land and historic pumpage for previous three years of other water users; or by historic use as established be previous three years pumping for all users. This initial allocation of water rights is not subject a use fee."

   Further, any pumping in excess of the 450,000 acre feet/year target or a subsequent adopted amount should be charged a fee for purposes of developing additional water resources.

2. "Operations of a regional water resource plan should include a drought contingency plan. This drought contingency plan should be established through a conjunctive effort of appropriate authorities in the region to provide for water resources in the San Antonio, Guadalupe-Blanco and Nueces River Basins."

3. "Pending development and implementation of the conjunctive regional drought contingency plan, those water using entities within the region should develop interim drought contingency plans for implementation in the event of a severe drought based on their projected needs."

4. "Flows in the primary and secondary region in excess of the amount needed to maintain bay and estuary productivity and downstream water rights should be captured for utilization in the primary and secondary region."

5. "It is recommended that a water conservation plan be implemented that incorporates techniques to reduce water demand and thereby increase water availability."

6. "Any water plan demand forecast should involve close coordination with economic and industrial development agencies to determine future demand in the region on a periodic basis."

7. "Action should be taken to secure participation of the regional military bases in the Water for the Future program.

   With legislative authority, all water purveyors in the region would be required to institute effective and when necessary, mandatory, water Conservation programs.

Priorities for revenue generating mechanisms for financing Water for the future programs mean implementing the following cost recovery mechanisms, in order of priority and consistent with the adopted Allocation Policy (#1).

1. Ground water withdrawal fees
2. Water rate increases
3. Special sales taxes
4. Other fees and taxes

B. "To adequately provide for optimal use and water management in the Region (primary and secondary area) there must be new laws to allow conjunctive management of surface and ground water.

It is recommended to establish a Regional Water Council Consisting of Edwards Underground Water District, Guadalupe-Blanco River Authority, San Antonio River Authority, Nueces River Authority, a member from each of the major cities in the five county EUWD area: San Antonio, San Marcos, New Braunfels, Hondo and Uvalde and other appropriate entities to establish a conjunctive use policy for the region (primary and secondary areas) which would include a drought contingency plan and guidelines for resolving conflicts between ground water and surface water users. The Regional Water Council would convene on a regular basis to discuss and resolve, by consensus, conflicts pertaining to water use issues affecting the members of the Council.

In the event that it shall become necessary to regulate ground water withdrawals within the Edwards Aquifer, it is recommended that the Edwards Underground Water District be given the regulatory and enforcement powers necessary to regulate such withdrawals.

APPENDIX D

JOINT RESOLUTION

Proposing concurrence in the initiatives taken by the City of San Antonio and the Edwards Underground Water District, which includes all or parts of the counties of Comal, Hays, Bexar, Medina and Uvalde, to seek and implement solutions for the regional problems the people of that region face both now and in the future as the result of their dependence on the water resources of the Edwards and associated limestone aquifers for water supply and economic stability.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. The Edwards and associated limestone aquifers underlie in whole or in part the five county area of Comal, Hays, Bexar, Medina and Uvalde. The importance and unique hydrologic characteristics of the Edwards Underground Water District. In Texas, no other underground water resource shares the geologic, hydrologic and physical characteristics of the Edwards Aquifer. Further, this water-bearing formation is the sole source of water supply for the City of San San Antonio, other towns and communities in the region, a strong and productive agricultural economy in Uvalde and Medina Counties and sensitive environmental areas and developing tourist centers in Hays and Comal Counties.

SECTION 2. In addition to the unique physical properties of this water resource, the five-county region is served by a site-specific institutional structure which has evolved in response to and been shaped by the regional dependence on its water and related land resources. Three of Texas' major river systems traverse and are hydrologically connected to the Edwards Aquifer: the Nueces, San Antonio and Guadalupe-Blanco. All three serve downstream interests as well and all three ultimately drain into and provide fresh water inflows to the coastal bays and estuaries. The Edwards Underground Water District, which reaches to all five counties, has broad water resource planning authority and responsibility and limited management authority and responsibility. The City of San Antonio, Texas' third largest city, is the largest user of water from the Edwards and the largest city nationally relying solely on ground water for municipal water supply. The three river systems are managed by the Nueces, San Antonio and Guadalupe-Blanco River Authorities; each was created legislatively with authorities and responsibility defined by the legislature.

SECTION 3. Recognizing the regional dependence on water supply from the Edwards Aquifer, the Edwards Underground Water District and the City of San Antonio began in 1983 a comprehensive regional study. This study had as its purpose the formulation of a plan for the region through the year 2040 and program of plan implementation that would:

1. Protect the quality of water in the Edwards and associated aquifers and river systems and the environmental values provided by the unusual geology and topography of the area that the aquifers and stream systems serve.

2. Protect, maintain and enhance the economic stability of the diverse interests in the region by assuring an adequate supply of high quality water.

3. Make the most effective and efficient use of the water resources available from the Edwards and associated limestone aquifers and of the three surface water systems that are interdependent with those aquifers by implementing water conservation and reuse measures.

4. Provide an equitable way of sharing costs and management authority and responsibility among water users and beneficiaries.

SECTION 4. The joint study of long-range regional water needs in the five-county area was completed and its report released in April 1986. The Edwards Underground Water District and the City of San Antonio have disseminated study results throughout the region and are diligently pursuing a program of reaching public consensus through meetings and information distribution.

SECTION 5. The Edwards Underground Water District and the City of San Antonio have now undertaken an orderly program of implementing necessary actions to assure that regional study purposes are achieved. Some of these actions can and are being undertaken under existing legislative authorities. Additional legislative authorities may be sought to make it possible for this region to meet its future responsibilities. Particularly, this will be the case to implement the innovative arrangements that will be needed to accomplish the most efficient and equitable system for managing these unique ground and surface water resources conjunctively on behalf of the region.

SECTION 6. Among other concepts that may be a part of implementing a regional water resources planning and management program for the five-county region, the legislature recognizes and concurs in the following general definition of a regional comprehensive water plan and the policy statements that serve as a guide to the region as it proceeds:

* REGIONAL COMPREHENSIVE WATER RESOURCES PLAN

Planning and plan implementation must include consideration of factors involving water supply; water demand; cost of services and facilities; water and environmental resource protection and conservation; equity in sharing costs and resources; and an orderly legal and institutional structure for planning and implementation to assure that all these factors are properly weighted in a management process.

Water supply objectives are the maintenance, increase, or protection of sources of water.

- o Ground water supply considerations are those which contribute to the proper development and protection of aquifer resources. These include protection of recharge areas; protection and maintenance of recharge sources; prevention of waste by brush control where appropriate; proper management of well withdrawals to optimize hydrologic and hydraulic characteristics and to protect storage capacity; prevention of quality deterioration from vertical and/or lateral movement of poor quality water; reservation of water in storage to provide a cushion of supply in periods of drought.

- o Surface water must be considered in terms of those developments or activities that make surface water resources effectively and feasibly available for use. These may include construction of dams and reservoirs; integrated operation of existing facilities; salvage, reclamation, and reuse of water; elimination of wasteful practices; conjunctive use with ground water; and artificial recharge.

Water demand objectives are to provide water of good quality, for all regional beneficial purposes; assure water supplies at reasonable costs for beneficial purposes; and to assure that the costs of provision of the water supply for all purposes are shared equitably. In allocating water to meet regional water demands, the objectives for the region would include a balanced consideration of regional economic, environmental, and social needs.

Environmental and water resource objectives include maintenance of streamflow, and surface and ground water quality, protection and enhancement of fish and wildlife; protection of habitat; protection of historic, cultural, archeological, and social values; preservation of water-oriented recreational and aesthetic amenities

* POLICY STATEMENTS

1. One of the ultimate goals of the Edwards aquifer region is to maintain the aquifer's current high water quality. With technical assistance from the Edwards Underground Water District, cities in the region will adopt ordinances in 1987 for water quality protection to prevent degradation by contamination of sensitive areas of the aquifer. The ordinances will cover matters including but not limited to: using, producing, transporting or storing hazardous materials by commercial activities; assuring the integrity of sewer lines; protecting caves and sinkholes.

2. There must be new laws to allow conjunctive management of surface and ground water to provide for optimal use of water in the primary and secondary areas of the Region.

3. Allocation of ground water should be accomplished as a part of a comprehensive regional water plan that must include programs of conservation, reuse and surface water development.

o Allocation policy will require the establishment of maximum amounts that may be pumped from wells. The allocations systems must be carefully designed and carried out to achieve the following:

- protection of water quality
- protection of the economic stability of the region by an assurance of the water supply
- protection of the environmental values of the region
- protection of spring flow and downstream water availability
- prevention of overdraft of the Edwards Aquifer
- recognition of historic uses and users
- provision for markets for the purchase, lease or trade of ground water rights

Management of the Edwards Aquifer would be based upon recharge rates and annual withdrawal limits sufficient to insure natural flow at comal and San Marcos Springs during periods of average rainfall. The annual withdrawal limits would acknowledge the needs of present users of water from the Edwards Aquifer.

The formula for ground water allocation would be based upon fair and equitable principles which consider historic use, current needs, conservation practices and reuse. Specifically, the formula for allocations for irrigated agriculture would provide for two acre feet per acre based upon the historic number of acres irrigated during the years preceding the initiation of allocations.

Development, administration enforcement of the comprehensive regional water plan should be the responsibility of the Edwards Underground Water District.

Administration and enforcement powers inherent in the comprehensive regional water plan are based on the equitable protection of the region's economic, social and geographic interests.

During the 1987 Legislative session the City of San Antonio and the Edwards Underground Water District will sponsor only legislation authorizing the Edwards Underground Water District to be assigned the responsibility for development, administration and enforcement of a drought contingency plan.

o The level of pumpage allocated to users on initiation of the allocations system would not be subject to a withdrawal use fee. Any increase of pumpage withdrawals above initially allocated amounts may be subject to a withdrawal fee as defined in the comprehensive regional water plan and its program for financing needed requirements for future development and resource protection. Revenue generating mechanisms will be established in the following priority:

1. Ground water withdrawal fees
2. Water rate increases
3. Special sales taxes
4. Other fees and taxes and other in-kind contributions

o The establishment of the operational system for allocations with the resultant definition and establishment of ground water rights will allow for the development of a market in ground water rights.

4. First priority shall be given to the development of a drought contingency plan. Any necessary authority will be limited to such drought management plans. This drought contingency plan should be established through a conjunctive effort of appropriate authorities in the region to provide for water resources in the San Antonio, Guadalupe-Blanco and Nueces River Basins. Such plans should be developed in consultation with representatives of the cities and river authorities in the district, and appropriate regulatory and enforcement power necessary should be granted to the district by the Legislature during the 1987 session.

Development of the drought contingency plan should be based upon a regional policy of no overdraft over an extended period.

The EUWD and the City of San Antonio will maintain the institutional relationship of the Joint Sponsors Committee on Water Resources for the development of water resource and management policies and the mechanisms and authorities necessary to implement those policies. The recommendations of the Joint Committee are subject to approval by the Board of Directors and City Council.

5. Operation of a regional water resource plan should include a drought contingency plan. This drought contingency plan should be established through a conjunctive effort of appropriate authorities in the region to provide for water resources in the San Antonio, Guadalupe-Blanco and Nueces River Basins.

6. As an interim action, pending development and implementation of the conjunctive regional drought contingency plan, the Edwards Underground Water District will convene work sessions in 1987 with water using entities within the region to develop interim drought contingency plans for implementation.

7. Legislative authority should be obtained to require all water purveyors in the region to institute effective and when necessary, mandatory water conservation programs.

8. As an interim action in recognition of the critical importance of water within the Region, and of the need to make water conservation a way of life in the future, the Edwards Underground Water District will convene work sessions in 1987 with water using entities to prepare integrated water conservation programs for implementation. These programs will be part of ongoing activities that will incorporate techniques to reduce water demand and thereby increase water availability.

9. Any water plan demand forecast should involve close coordination with economic and industrial development agencies to determine future demand in the region on a periodic basis.

10. The key role played by the federal government in the region, particularly its military presence, requires their full participation in water resources planning and development.

11. Flows in the primary and secondary region in excess of the amount needed to maintain bay and estuary productivity and downstream water rights should be captured for utilization in the primary and secondary region.

12. In recognition of common interests and the spirit of cooperation, planning for the primary and secondary areas should include the Edwards Underground Water District, Guadalupe-Blanco River Authority, San Antonio River Authority, Nueces River Authority and major cities from the five county EUWD area (San Antonio, San Marcos, New Braunfels, Hondo and (Uvalde).

TEXAS LEGISLATIVE SERVICE

HB 1942
AS FINALLY PASSED AND SENT TO THE GOVERNOR

4--230

AN ACT

relating to the powers, duties, and compensation of the directors of the Edwards Underground Water District and to the authority of the district to exclude counties from the district.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Sections 3, 5, 6, 7, 9, 11, and 12, Chapter 99, Acts of the 56th Legislature, Regular Session, 1959, are amended to read as follows:

Sec. 3. POWERS OF THE DISTRICT. (a) The District shall have and is hereby authorized to exercise the following powers, right and privileges and functions:

(1) to conserve, preserve, protect and increase the recharge of and prevent the waste and pollution of the underground water;

(2) to acquire lands and easements by purchase or by exercise of the power of eminent domain for the erection of dams and for the purpose of drilling and equipping in-put wells, and to drill, equip and operate in-put wells, construct dams, and to install pumps and other equipment necessary to recharge the underground water-bearing formations; to acquire by contract or purchase, waters and water rights deemed necessary or appropriate by the Directors of the District for conserving and recharging underground water-bearing formations; and to appropriate water for such recharge under the provisions of Art. 7470, Revised Civil Statutes, as amended; provided, however, the power of eminent

domain as herein provided for, shall be limited to the Counties of Bexar, Comal, Hays, Medina, Uvalde;

(3) to cause surveys to be made of the underground water reservoirs or subdivisions thereof and of underground water-bearing formations; to cause investigations to be made to determine the movement of underground water and the quantity thereof available for production and use and the improvements and developments needed in recharging underground water reservoirs or Subdivisions thereof and underground water-bearing strata;

(4) to develop comprehensive plans for the most efficient use of underground water and for the prevention of waste and pollution of underground water; to collect and preserve information regarding the prevention of waste and pollution of underground water and to publish such plans and information, and otherwise bring them to the notice and attention of the users of underground water within the District;

(5) to institute and defend suits and proceedings before any court or any administrative body or agency, State or Federal, in carrying out the purposes, powers and functions of the District;

(6) to enter into contracts with and to participate in joint efforts and projects with water districts, conservation districts, cities and towns, counties and municipal and governmental agencies of every kind, both State and Federal, and with individuals and private corporations, for the purpose of conserving, protecting, recharging, or benefiting underground water-bearing formations within the District and waters therein, and the Board of Directors of the District shall be empowered to use, dedicate and pledge

taxes and revenues of the District and to use the proceeds from District bonds for said purposes whether the District or some other municipal or governmental agency or department is in charge of such work or development;

(7) to require that copies of water well drillers' logs required to be kept and furnished to the Texas Department of Water Resources or its successor by The Water Well Drillers Act, as amended (Article 7621e, Vernon's Texas Civil Statutes), be furnished to the District. The well log required herein shall at the request in writing to the district, by certified mail, by the owner or the person having such well drilled, be held as confidential matter and not made of public record;

(8) to report to the Texas Department of Water Resources violations of The Water Well Drillers Act, as amended (Article 7621e, Vernon's Texas Civil Statutes), and rules and regulations of the department pertaining to the Act;

(9) to require the owner or lessee of land on which an open or uncovered well is located to keep the well permanently closed or capped with a covering capable of withstanding weight or pressure of at least 400 pounds per square inch, except when the well is in actual use. As used in this subsection, "open or uncovered well" means an artificial excavation at least 10 feet deep that is dug or drilled for the purpose of producing water from the underground water reservoir and is not capped or covered as required by this subsection. If the owner or lessee fails or refuses to close or cap the well in compliance with this subsection within 30 days after being directed to do so in writing by certified mail by an

officer, agent, or employee of the District, any person, firm, or corporation employed by the District may go on the land and close, plug, or cap the well. Expenses incurred by the District in closing, plugging, or capping a well, not to exceed $100, shall constitute a lien on the land on which the well is located. The lien is perfected by filing in the County Court of the county where the well is located a sworn petition executed by the Chairman of the Board of Directors of the District, stating the following:

(A) the existence of the well;

(B) the legal description of the property on which the well is located;

(C) the approximate location of the well on the property;

(D) the failure or refusal of the owner or lessee, after notification, to close, plug, or cap the well as required by this section within 30 days after notification;

(E) the closing, plugging, or capping of the well by the District or its authorized agent, representative, or employee; [and].

(F) the expense incurred by the District in closing, plugging, or capping the well.

If after notice and hearing the County Court finds the facts required by this section, he shall enter a judgment which shall constitute a lien on the land when recorded in the deed records. The judgment of the County Court is appealable as are other civil cases in which the County Court has original jurisdiction;[.]

(10) to develop, implement, and enforce one or more drought management plans in order to minimize, as far as practicable, the

drawdown of the water table or the reduction of artesian pressure and spring flow; to prevent waste; and to protect the groundwater resource from serious harm. The District shall develop one or more drought management plans in consultation with representatives of cities, counties, river authorities, water purveyors, and other interested parties within the District, and the District shall implement and enforce a drought management plan pursuant to rules of the Board of Directors adopted in accordance with Subsection (b) of this section. A drought management plan must be:

(A) consistent with water policies adopted and approved by the Board of Directors and must provide for those matters determined to be necessary and appropriate by the Board of Directors, including:

(i) objective standards for determining that drought conditions exist, continue, and cease and for determining stages of drought;

(ii) description of specific drought management activities for the stages of drought; and

(iii) requirements for reducing water use in accordance with established priorities, which must include uses for essential human needs, agricultural, industrial, power, recreational, commercial, and other categories of use;

(B) developed and approved by September 1, 1988, by a two-thirds vote of the Directors present at a meeting at which a quorum is present;

(C) provided to the Texas Water Commission and made available for additional public review. The Board may not initiate enforcement of the drought management plan until June 1, 1989, or the effective date of rules adopted by the Board of Directors as provided by Subsection (b) of this section, whichever date is later;

(D) developed and enforced by the Texas Water Commission if a drought management plan is not approved in accordance with Paragraph (B) of this subdivision, and the enforcement provisions of Subsection (b) of this section do not take effect;

(11) in a drought management plan, to set priorities of water use, to prorate the available water supply among the uses and users, to require compliance among all users, and to include other measures as are necessary and advisable to conserve, preserve, protect, recharge, and prevent waste and pollution of the underground water;

(12) to plan through a drought management plan for the uses of water throughout the District during periods in which there is a drought or a shortage of precipitation of seasonal or longer duration relative to the expectation of the users;

(13) to adopt a rule declaring that a drought exists within the District when insufficient water is available to meet the needs of the users or when conditions require temporary reduction in total use within the area to protect water resources from serious harm;

(14) to impose restrictions on users of the water resources as may be necessary to protect the water resources of the area from serious harm and to assure equitable distribution of available water resources among all water users;

(15) to rescind a declaration of drought and to rescind any restrictions adopted pursuant to that declaration;

(16) to require the registration of water wells within the District in accordance with rules of the Board of Directors and to require that records be kept and reports be made of the drilling, equipping, and completing of water wells and of the production and use of underground water.

(b) The Board of Directors may adopt and enforce reasonable rules for the purposes of carrying out the powers described in Subdivisions (10) through (16) of Subsection (a) of this section relating to the development, implementation, and enforcement of one or more drought management plans and the registration of water wells within the District. If the District adopts rules under this subsection, the District shall conduct a public hearing within each county in the District to permit members of the public to comment on the rules as they may be proposed from time to time. Notice of each hearing, along with a brief resume of the proposed rules, shall be published once each week for two consecutive weeks in one or more newspapers with general circulation in the District and the county. The first notice shall be published not later than the 14th day before the date the hearing is to be held. The hearing shall be conducted by one or more officers of the Board of Directors. A rule takes effect not earlier than the 14th day after the date of its adoption. The District may enforce this section and its rules by injunction, mandatory injunction, or other appropriate remedy in a court of competent jurisdiction as authorized by Section 3(a)(5) of this Act.

(c) A person may appeal the reasonableness and validity of a rule adopted by the District under this section as provided by Subsection (d) of this section after first appealing to the Texas Water Commission under rules adopted by the commission. If the commission determines a rule is unreasonable or otherwise invalid, it shall, at its discretion, either declare that the rule is null and void and direct the Board of Directors of the District to adopt a substitute rule or reform the rule so that it is reasonable and valid.

(d) A person affected by and dissatisfied with any rule made by the District under this section may file suit against the District or its Directors to challenge the validity of the rule. The suit shall be filed in a court of competent jurisdiction in Bexar County.

(e) A person affected by and dissatisfied with any act of the Texas Water Commission pursuant to this section is entitled to file suit against the Texas Water Commission to challenge the validity of the act of the commission. The suit shall be filed in a court of competent jurisdiction in Travis County. The term "person" as used in this section shall have the meaning as stated in Section 3A(a) of this Act.

(f) The Texas Water Commission shall begin registration of wells located within the Edwards Underground Water District pursuant to rules adopted by the Texas Water Commission in accordance with Sections 11.201 through 11.207 and Section 28.011, Water Code. The registrations shall be completed in a timely manner and the information shall be provided to the Edwards

Underground Water District by March 1, 1988. On the adoption of rules for registration of wells by the Board of Directors in accordance with Subsection (b) of this section, the District shall assume the responsibility for well registration in the District.

Sec. 5. BOARD OF DIRECTORS OF DISTRICT. The government and control of the District shall be vested in a Board of Directors consisting of eighteen (18) [~~fifteen (15)~~] Directors. Six (6) of the Directors shall be elected by the qualified voters residing in the area of Bexar County included within the boundaries of the District and[~~,~~] three (3) of the [~~which~~] Directors shall be elected by [~~the majority vote of~~] the qualified voters residing in the area of each of the four (4) [~~five (5)~~] counties of Hays, Comal, Medina, and Uvalde included within the boundaries of the District. The area of the District lying in each of the five (5) Counties of Bexar, Comal, Hays, Medina, and Uvalde is hereinafter referred to as a "county area." [~~The three (3) Directors elected to serve as the first Directors from each county area included within the District shall at the first meeting of the Board of Directors determine by lot which shall serve for a term of two (2) years and which shall serve for a term of four (4) and six (6) years respectively, and the terms so determined shall be and constitute the first term of office of each of said Directors. Thereafter there shall be elected at large in each county area one director each two (2) years to serve for a term of six (6) years. All~~] Directors shall hold office for staggered six-year terms and until their successors have been elected and have qualified by taking the oath of office. Before entering upon the duties of his office each member of the Board of Directors shall take the Constitutional oath of office and the same shall be filed in written form with the Secretary of the Board. Vacancies occurring in the Board of Directors from any county area shall be filled by the remaining member or members of the Board from such county area and the person so appointed shall serve for the unexpired term of the person in whose place he is appointed. All members of the Board of Directors shall be qualified [property-tax-paying] voters [over--the--age--of twenty-one-(21)-years,] residing within the District and within the county area or county commissioner precinct for Bexar County from which he is elected or appointed.

Sec. 6. ELECTION OF DIRECTORS. (a) All elections within the District shall be conducted in accordance with procedures provided by resolutions adopted by the Board of Directors or as set forth in the bylaws and the Election Code, and the results of all elections shall be canvassed by the Board of Directors of the District at the regular or special meeting following each election. All elections shall be held on the third Saturday in January of each odd-numbered year and at the polling places designated by the Board of Directors of the District. The terms of office of Directors elected at each election shall begin on March 1 following their election.

(b) Persons seeking to have their names placed on the ballot shall make application to the Board of Directors or its authorized representative in accordance with procedures prescribed by the Board of Directors and as provided in the order calling the election.

(c) The authorized representative of the Board of Directors shall prepare the ballot for each county from the names of candidates who have filed applications, and the placing of the names of the candidates on the ballots shall be determined by lot. The drawing of lots for the placing of the names of the candidates on the ballots shall be by an officer of the Board of Directors, and all candidates, or their designated representative, may be present at the drawing.

(d) The Directors from the Bexar County area shall be elected from four (4) single member districts and two (2) at large. The four (4) single member districts shall be coterminous with and bear the same numbers as the Bexar County commissioner precincts within the Bexar County area of the District. Candidates for the single member district positions must live within the district they seek to represent.

(e) The candidates receiving a plurality shall be declared elected. If there is a tie in the votes received, the winner of the election shall be determined by the majority of the Board of Directors. The at-large Directors of Bexar County shall be elected simultaneously by plurality, with the two (2) candidates receiving the greatest number of votes being declared elected.

(f) Any Director of the District may serve the full term to which he is elected or appointed regardless of redistricting or reapportionment.

(g) The Directors from Hays, Comal, Medina, and Uvalde County areas shall be elected at large from each county area. [~~Within sixty (60) days after this Act becomes effective the County~~

~~Judge of each of the five (5) Counties embracing areas included in the District shall call an election to be held at such polling place or places within the county area in said County as he may deem proper for the election of three (3) Directors from such area. The election so called shall be held on the first Tuesday following thirty (30) days after publication of notice of said election, and notice of said election in each county area shall be given by publication in a newspaper of general circulation in the County, said notice to be published at least once not less than thirty (30) days prior to the date set for the election. The order of the County Judge providing for said election and for the notice thereof shall name the officers of the election and direct that the same be held in accordance with the General Election laws of the State. All matters relating to such election shall be filed with the County Judge of the County in which each election is held, and the results of the election in each county area shall be canvassed and certified by the County Judge of each County. The order calling the election and all actions pertaining to the election shall be entered in the minutes of the Commissioners Court. In the first election conducted by the County Judge of each County, candidates' names shall be placed upon the ballot upon application made not less than twenty-five (25) days before the election accompanied by an endorsement in writing signed by not less than twenty (20) qualified voters of the county area in which they are candidates. In elections after the first election the placing of names of candidates upon the ballots shall be governed by rules adopted by resolution of the Board of Directors or set forth in the By-Laws of~~

the-District.--After-the-election-of-said-first-Board-of--Directors all---elections--within--the--District--shall--be--carried--out--in accordance-with-appropriate-resolutions-and-actions-of-the-Board-of Directors-of-the-District-and-the-result-of-all-elections-shall--be canvassed--by--the--Board-of-Directors-of-the-District-at-a-meeting following-each-biennial-election.--All-elections--after--the--first election--shall--be--held-on-a-date-in-the-month-of-November-and-at the-polling-places-designated-by-the--Board--of--Directors--of--the District.--The-term-of-office-of-Directors-elected-at-each-election after-the-first-election-shall-commence-on-the-first-day-of-January following--their--election.---In-all-elections,-including-the-first election,-the-person-or-persons-receiving-the--greatest--number--of votes,--that--is--a--plurality,--shall-be-declared-elected.--Should there-be-a-tie-in-the-votes-received-the--winner--of--the--election shall--be-determined-by-lot-in-a-manner-approved-by-the-majority-of the-Board-of-Directors-of-the-District.]

Sec. 7. COMPENSATION OF DIRECTORS. Directors of the District shall be entitled to One Hundred [Fifty] Dollars ($100) [($50)] per day for each day of official service, whether sitting as a Board or serving on a committee of the Board, and in addition thereto shall be entitled to reimbursement for all actual expenses necessarily incurred by reason of [such] service to the district. [No-Director-shall-receive-a-total-amount-of-more-than-Nine-Hundred Dollars-($900)-in-any-twelve-(12)-month-period--for--service--as--a Director--and--as--a--member--of-a-committee;-provided,-however,-no Director-shall-be-disqualified-to-render-service-to-the-District-as an--employee--or---representative---and---to---receive---reasonable

~~compensation therefor, provided such Director shall be disqualified from voting on any resolution providing for such employment or fixing the compensation therefor. All fees for services as a Director or as a member of a committee of Directors and all necessary expenses in connection with such service shall be paid out of funds raised in the county area from which the Director is elected or appointed.~~]

Sec. 9. COUNTY CHAIRMAN--EXECUTIVE COMMITTEE. The [~~three (3)~~] Directors elected or appointed from each county area within the District shall appoint one of their number County Chairman and the five (5) County Chairmen so appointed shall constitute the Executive Committee of the District, which Executive Committee, acting by a majority vote at any meeting at which a quorum is present, shall be authorized to take all action relating to routine affairs of the District which they may consider necessary between regular meetings of the Board of Directors, and the Board of Directors may confer upon the Executive Committee all such powers and authority with regard to affairs of and the exercise of the powers of the District as the Board of Directors may from time to time deem proper.

Sec. 11. VOTING OF ADDITIONAL TAX. Upon the approval of the majority of the [~~three (3)~~] Directors from any county area, and upon the vote of the majority of the Board of Directors of the District, an election may be held within such county area for the purpose of voting upon and authorizing the levy of taxes in addition to the two cents (2¢) per One Hundred Dollars ($100) as hereinabove provided, but not to exceed an additional annual tax of twenty-three cents (23¢) on the One Hundred Dollars ($100) of the County valuations of property subject to District taxation within a county area included in the District. Said additional taxes may be voted and thereafter collected in one or more county areas, whether or not other county areas in the District vote additional taxes. Said election shall be held in accordance with the State election laws applicable to the voting of taxes for the support of County bonds and such laws applicable to the voting of taxes for the support of County bonds and such additional taxes shall be levied only if authorized by a majority vote of the resident, qualified property tax-paying voters of the District who own taxable property therein which has been duly rendered for taxation voting at said election. In the event of the voting of such tax the same shall go into effect and be collected for the year commencing on the January 1st following the election and shall be levied, assessed and collected in the manner specified in Section 10 hereof.

Sec. 12. DEPOSITORIES--HANDLING OF FUNDS. All funds collected through the levy of a tax on property located in each county area of the District shall be kept in a separate fund in a depository within such County and such funds shall be subject to disbursement only in a manner and for purposes approved by a majority of the Directors elected from such county area and by the majority vote of the Board of Directors of the District as a whole; to the end that the disbursement and use of all funds collected by taxation within each county area shall be subject to the control of the [~~three--(3)~~] Directors from such County. Each Director who is authorized to withdraw funds, either on his sole signature or with the joinder of others, shall give an official bond in the amount of Five Thousand Dollars ($5,000) in the form required to be given by Directors of Water Control and Improvement Districts. Any funds of the District not arising from the collection of taxes on property within a county area shall be deposited in an appropriate central fund of the District in a depository selected by a majority vote of the Board of Directors of the District and shall be used and disbursed for purposes and in the manner directed by a majority vote of the Board of Directors of the District. With the approval by a majority vote of the [~~three (3)~~] Directors from any county area, funds raised by taxation within such county area may be transferred to an appropriate central fund of the District and used and disbursed by action of the Board of Directors as a whole as above provided.

SECTION 2. Chapter 99, Acts of the 56th Legislature, Regular Session, 1959, is amended by adding Section 17A to read as follows:

Sec. 17A. EXCLUSION OF A COUNTY AREA. The residents of any county area of the District may, on petition of ten (10) percent of the registered voters within the county area of the District, request that the Board of Directors hold a referendum, in conjunction with the next regularly scheduled Directors election, to determine whether or not that county area will remain within the District. The petition must be submitted to the Board of Directors not later than November 1 before the date of the election. On approval by unanimous vote of all Directors from the county area from which the petition is received, the referendum shall be called and added to the ballot of the January Directors election in the county area. Approval of the withdrawal must be by the affirmative vote of a majority of the voters voting on the proposition: "The __________ county area of the Edwards Underground Water District shall be withdrawn from the Edwards Underground Water District." The withdrawal of any county area voting to withdraw from the District is effective on March 1 following the referendum. On and after that date, the boundaries of the District shall be redefined to exclude the county area; the levy and collection of the District's taxes within the county area shall cease; the offices held by the Directors elected or appointed from the county area shall terminate; and the other matters provided by law or by agreement with any person affecting the authority and operations of the District shall be automatically redesignated and redefined to be consistent with the withdrawal of the county area.

SECTION 3. (a) This Act does not affect the terms of the directors representing Bexar County on the effective date of this Act.

(b) The residency requirements of Section 6(d), Chapter 99, Acts of the 56th Legislature, Regular Session, 1959, as amended by this Act, do not apply to persons serving as directors on the effective date of this Act or to candidates for districts 1, 2, and 4 at the 1989 election or to candidates for districts 3 and 4 at the 1991 election. Candidates for director at those elections must reside within the Bexar County area of the district.

(c) In 1989, the directors for Bexar County shall be elected as follows:

(1) one director-at-large for a four-year term;

(2) director for district 4 for a two-year term; and

(3) directors for districts 1 and 2 for six-year terms.

(d) On the expiration of the term of office in 1991 of the director currently representing Bexar County, a director for district 3 shall be elected for a six-year term. A successor director for district 4 shall also be elected at the 1991 election for a six-year term.

(e) On the expiration of the term of office in 1993 of the director currently representing Bexar County, a director-at-large shall be elected for a six-year term. A successor director for the other at-large position shall also be elected at the 1993 election for a six-year term.

(f) After the expiration of terms prescribed by Subsections (c), (d), and (e) of this section, all terms are six-year terms.

SECTION 4. (a) Except as provided by this section, this Act takes effect immediately.

(b) Section 5, Chapter 99, Acts of the 56th Legislature, Regular Session, 1959, as amended by this Act, takes effect January 1, 1989.

SECTION 5. The importance of this legislation and the crowded condition of the calendars in both houses create an emergency and an imperative public necessity that the constitutional rule requiring bills to be read on three several days in each house be suspended, and this rule is hereby suspended, and that this Act take effect and be in force according to its terms, and it is so enacted.

President of the Senate

Speaker of the House

I certify that H.B. No. 1942 was passed by the House on May 8, 1987, by the following vote: Yeas 134, Nays 0, 1 present, not voting; and that the House concurred in Senate amendments to H.B. No. 1942 on May 26, 1987, by the following vote: Yeas 143, Nays 0, 1 present, not voting; and, pursuant to the provisions of Article XVI, Section 59(d) of the Constitution of Texas, a copy of H.B. No. 1942 was transmitted to the Governor on May 27, 1987, and the recommendation of the Texas Water Commission was filed with the Speaker of the House on June 1, 1987.

Chief Clerk of the House

I certify that H.B. No. 1942 was passed by the Senate, with amendments, on May 21, 1987, by the following vote: Yeas 30, Nays 0.

Secretary of the Senate

APPROVED: ______________________

Date

____

Governor

Version 11/9/87

APPENDIX F

A Regional Water Resource Perspective

PREFACE

The title of the paper promises more than the capacity of the writer to deliver. Like the subject, the title has a range of meanings. To some, it represents a cliche, a shorthand for trying to describe "solutions" to as yet undefined problems; to others, perhaps the more critical of us, the title raises the expectation that a detailed examination will be provided of all of the interrelationships of how water in south-central Texas in its various forms and classifications is used, will be used in the future and how and by whom that water will be required and how any associated costs will be distributed among the users and non-users.

PURPOSE

The purpose of this paper is to try to describe the relationship of the various Edwards Aquifer water users within the context of at least two conditions, the present policies - laws and physical constraints and the future conditions that would exist if the policies outlined in the Joint Resolution are cooperatively, regionally adopted and transformed into law. It should be obvious that any attempt at a full and detailed description of the water resource interrelationships now and in the future must be vastly over-simplified. Some relationships or "linkages" may be left out and/or not accurately described. Hopefully, the expected and anticipated (lengthy) review process will sort those out.

DISCUSSION

It is commonly stated that the Edwards Aquifer is unique among groundwater systems. Among the several reasons that this is true, is that the Edwards Aquifer is a conduit for moving large quantities of water from one river basin, across another and discharging into yet another. The physical characteristics of the Edwards Aquifer allow for and create an interrelationship among various categories of users- irrigators, cities, springflow, upstream and downstream. Within these categories there are subcategories of user or interest groups. It should not be automatically assumed that within categories of user groups that all view the issues in the same way. For example, an owner of a water right in the lower Nueces Basin will view enhanced recharge to the Edwards Aquifer in a totally different manner than the owner of a water right in the lower Guadalupe Basin. A listing of some of the categories and subcategories of water users is presented in Table 1.

TABLE 1

CATEGORIES OF USERS

- o Irrigators
- o Cities
  - * Metro
    - San Antonio
    - Cities/Communities with separate water systems
  - * Other cities/communities in Edwards Aquifer area (Uvalde, Hondo, New Braunfels, San Marcos, to name some)
- o Springflow
  - * Recreation/tourist economic
  - * Natural habitat/environment
- o Downstream
  - * Nueces Basin
    - Water rights
  - * San Antonio Basin
    - Water quality
    - Water rights/availability
    - Land owners in affected reservoir sites
  - * Guadalupe Basin
    - Water quality
    - Water rights/availability to cities
    - Bays and estuaries
    - Land owners in affected reservoir sites
- o Upstream
  - Water rights/availability

Relationships Under Present Physical and Institutional Conditions

- At present, all pumpers have the right to pump unlimited quantities of water from the Edwards Aquifer.

- The Cities share with Irrigators the ability to exercise the right to pump to the extent of using all of the available water in the Edwards Aquifer.

- Metro-cities have the capacity to pump significantly larger volumes of water than Irrigators and thus have a greater influence on water levels in the Edwards Aquifer.

- The Springflow and the Downstream-Guadalupe Basin water users are dependent upon whatever Edwards Aquifer water is left over after pumping by Cities and Irrigators.

- The Downstream-San Antonio Basin user is dependent upon the Metro-cities for water discharged into the San Antonio River as treated wastewater, the amount increasing or decreasing depending upon a decision to discharge this water.

- The Downstream-Nueces user is dependent upon the natural process of rainfall for water availability.

o The Upstream, Downstream-Guadalupe and San Antonio Basins, Irrigators and Cities are limited in their ability to divert significantly larger quantities of this natural rainfall to recharge by the water rights of the Downstream-Nueces Basin users.

Potential Consequences of Continuation of Present Policie

Physical

o The flow from the Comal and San Marcos Springs will cease, impacting the Springflow-recreation/tourist/ economic activities of New Braunfels and San Marcos and the natural habitat/environment of the river systems in the surrounding area.

o Water quality in the Downstream Guadalupe Basin will be seriously degraded as less water is available for dilution of return flows entering the river from towns and farming areas in its drainage area.

o Aquatic life, including federally listed endangered species, in the springs and rivers will suffer damage or be wiped out. The impacts will extend to the bays and estuaries.

- Lowered water levels in the Edwards Aquifer will increase the risks of progressive degradation of water quality, either as a result of intrusion of water of poor, saline quality or contamination from pre-existing surface land uses.

- Cities and Irrigators will have higher energy costs as a result of pumping from lowered water levels, with Irrigators being less able than Cities to pay the increased costs.

- More water may be available in the Downstream-San Antonio Basin as more treated wastewater is discharged from the Metro-cities due to increased population, unless this water is diverted to other consumptive uses.

Institutional

- Lawsuits and/or federal or state intervention will be likely if conditions allowed by the present policies are allowed, by local and regional inaction, to continue into the future.

- An outside perception of the region as being "water-short" will develop, thus hampering further economic development.

Summary of Relationships Based Upon a Continuation of Present Trends

- o Many Irrigators will not be able to continue competing for water at the lowered levels and will cease farming or revert to dryland farming.

- o Some Cities, especially those along Northern and Southern boundaries of the Edwards Aquifer system, will have limited water availability because of water quality impacts or water level declines.

- o Springflow and Downstream-Guadalupe Basin users may cease to have water available for all uses, including recreation, water quality protection, water supply, instream environmental requirements and bay and estuary needs.

- o Downstream-San Antonio River Basin user may have additional water if treated wastewater is not diverted for other consumptive uses.

- o The Downstream-Nueces Basin user does not appear to be significantly affected by present policies unless these users were to have a serious interest in attempting to divert increased water from the Edwards Aquifer Recharge or Artesian Aquifer to the lower Nueces Basin.

o The Upstream water user may be impacted indirectly, because any institutional change involving full-scale state adjudication of water rights could extend to these users.

Relationships Among Users as a Result of Cooperative Adoption of Policies Outlined In Joint Resolution

Summary Restatement of Policies

o Laws will need to be changed. (section 5)

o A Regional Comprehensive Water Resources Plan must be developed and adopted that includes:

* Groundwater quality protection.
* Drought management plans.
* Demand management, including conservation and reuse.
* Groundwater management through allocations/pumping limits.
* Surface water development.
* Balanced environmental protection (section 6).

o Groundwater quality non-degradation. (section 6)

o Laws that go beyond groundwater regulation/allocation will be necessary in order to allow conjuntive management of ground and surface water in the entire region. (section 6, policy 2) o Regulation of groundwater pumping is necessary along with demand management and supply augmentation. (section 6, policy 3)

* Pumping limits to maintain quality, economic stability, environment, downstream quality and availability, to prevent overdraft, to recognize historic uses and to allow for markets.
* Pumping limits may vary from year to year considering rainfall, recharge, withdrawal rates and springflow discharge rates.
* Management of the Edwards Aquifer would be based upon recharge rates and annual withdrawal limits sufficient to insure natural flow at Comal and San Marcos Springs during periods of average rainfall.
* Pumping limits would provide for historic use by grandfathering historic pumping, specifically irrigated agriculture, at two acre feet per acre.
* The EUWD would be responsible for administration of the comprehensive regional water plan based upon equitable protection of the region's economic, social and geographic interests.
* Historic or grandfathered pumping rights would not be subject to a withdrawal use fee. Amounts in excess of these amounts may be subject to such fees.

* Revenues for the development of a regional water system, to include surface water, reuse, and water conservation will be generated from one or more of the following mechanisms:
    1. Groundwater withdrawal fees
    2. Water rate increases
    3. Special sales tax
    4. Other fees, taxes, and in-kind contributions.

  The entire Edwards Aquifer region has an interest in developing additional water resources and will participate through one or more of the revenue-generating mechanisms in supporting a regional water system.
* Markets in water rights would be allowed to develop.

Relationships that Result from These Policies

o Current Irrigators and City pumpers will have quantified rights and will be limited to pumping historic amounts, but will have greater assurance of water level maintenance under average conditions and extended availability under drought conditions. The ability to buy, sell or trade in groundwater rights among users will be established.

- o Springflow and Downstream-Guadalupe users will have greater assurance of water availability under average conditions and extended availability under drought conditions.
- o Future pumping demand (new) increases for Cities and Irrigators will have to be met from conservation, reuse, surface water and water rights markets at higher costs.
- o Downstream-San Antonio Basin users will be dependent upon the amount of treated wastewater released by Metro-Cities, with the amount varying depending upon reuse, growth and diversion to other consumptive uses.
- o "New" Irrigators and Cities or current Irrigators and Cities with assigned allocations that exceed those allocations will be subject to revenue-generating mechanisms designed to recover costs of supply development, along with other possible sources of revenue.

Table 2 is an attempt to summarize some of these relationships.

TABLE 2

USER CATEGORY	PRESENT POLICIES NOW			PRESENT POLICIES FUTURE			JOINT RESOLUTION POLICIES		
	WATER AVAILABILITY	SOURCE; QUALITY	PRICE/ COST	WATER AVAILABILITY	SOURCE; QUALITY	PRICE/ COST	WATER AVAILABILITY	SOURCE; QUALITY	PRICE/ COST
IRRIGATOR CURRENT	UNLIMITED	E.A.; HIGH	LOW	LIMITED, DECLINING LEVELS, POSSIBLE RESTRICTIONS	E.A.; SOME CHANGE	HIGHER	LIMITED, BUT ASSURED	E.A.; HIGH	ESSENTIALLY SAME AS NOW
IRRIGATOR NEW	UNLIMITED	E.A.; HIGH	LOW	LIMITED, DECLINING LEVELS, POSSIBLE RESTRICTIONS	E.A.; SOME LOWER	HIGHER	LIMITED TO AVAILABILITY	E.A., WATER MKTS., OTHER SOURCES; HIGH	MUCH HIGHER
CITIES -METRO CURRENT	UNLIMITED	E.A.; HIGH	LOW	LIMITED, SOME MORE THAN OTHERS; RESTRICTIONS	E.A.; SOME LOWER THAN OTHERS	HIGHER	LIMITED, BUT ASSURED	E.A., SURFACE MKTS., CONSERVATION; HIGH	SOME MORE THAN OTHERS
CITIES -METRO NEW	UNLIMITED	E.A.; HIGH	LOW	LIMITED, SOME MORE THAN OTHERS; RESTRICTIONS	E.A.; SOME LOWER THAN OTHERS	HIGHER	LIMITED TO AVAILABILITY	E.A., SURFACE MKTS., CONSERVATION; HIGH	MUCH HIGHER
CITIES -OTHER CURRENT	UNLIMITED	E.A.; HIGH	LOW	LIMITED, SOME MORE THAN OTHERS; RESTRICTIONS	E.A.; SOME MUCH LOWER THAN OTHERS	HIGHER, SOME MUCH HIGHER	LIMITED, BUT ASSURED	E.A., SURFACE MKTS., CONSERVATION; HIGH	HIGHER, NOT AS MUCH AS METRO
CITIES -OTHER NEW	UNLIMITED	E.A.; HIGH	LOW	LIMITED, SOME MUCH MORE THAN OTHERS; RESTRICTIONS	E.A.; SOME MUCH LOWER THAN OTHERS	HIGHER, SOME MUCH HIGHER	LIMITED TO AVAILABILITY	E.A., SURFACE MKTS., CONSERVATION; HIGH	MUCH HIGHER
SPRING-FLOW	LIMITED	E.A.; HIGH	NO COST	ELIMINATED	----- MUCH LOWER QUALITY	-----	LIMITED, BUT ASSURED	E.A.; HIGH	NO ADDITIONAL COST
DOWN-STREAM -GUADA-LUPE	LIMITED	E.A.; HIGH	NO COST	VERY LIMITED	----- MUCH LOWER QUALITY	-----	LIMITED, BUT ASSURED	E.A.; HIGH	NO ADDITIONAL COST
DOWN-STREAM -SAN ANTONIO RIVER	LIMITED	WASTEWATER; LOW	NO COST	INCREASED FLOW	WASTEWATER; LOW	-----	VARIABLE	WASTEWATER; LOW	NO ADDITIONAL COST
DOWN-STREAM -NUECES	LIMITED	FLOW PAST R.Z., E.A. SURFACE WATER	HIGH	NO CHANGE	COULD INCREASE BY PUMPING E.A.	HIGH	NO CHANGE	WATER EXCHANGES	HIGHER
UPSTREAM	UNLIMITED, EXCEPT FOR WATER RIGHTS	FLOW ABOVE R.Z., E.A.	LOW	MAY BE RESTRICTED DUE TO CHANGING LAWS	FLOW ABOVE R.Z.	LOW	PROBABLY SOME ADDED WATER RIGHTS LIMITS	FLOW ABOVE R.Z., TO A LIMITED EXTENT	SAME

Figure D
Impact of Policy Alternatives

VERSION	ALLOCATION	CONSERVATION	RELEASE TO RIVER	IMPACTS OF CONSERVATION	IRRIGATORS			METRO CITIES			OTHER CITIES			SPRINGFLOW			GUADALUPE			S. A. RIVER		
					ALLO	CONS	REUSE	ALLO	CONS	REUSE	ALLO	CONS	REUSE	ALLO	CONS	REUSE	ALLO	CONS	REUSE	ALLO	CONS	REUSE
1	425	17	90	Reuse	-	-	0	=	=	=	=	=	0	+	+	0	+	+	0	0	0	0
2	425	10	90	Reuse	-	0	0	=	-	=	=	-	0	+	+	0	+	+	0	0	0	0
3	500	10	30	River	+	0	0	+	-	+	+	-	0	=	+	0	=	+	0	0	-	=
4	500	5	30	River	+	0	0	+	0	+	+	0	0	=	-	0	=	-	0	0	0	-
5	475	10	90	River	0	0	0	0	-	0	0	-	0	-	+	0	-	+	0	0	-	0
6	475	10	90	Reuse	0	0	0	0	-	=	0	-	0	-	+	0	-	+	0	0	0	0
7	450	10	90	River	0	0	0	-	-	0	-	-	0	0	+	0	0	+	0	0	-	0
8	450	17	90	River	0	-	0	-	=	-	-	=	0	0	++	0	0	++	0	0	=	-
9	475	10	30	River	0	0	0	0	-	++	0	-	0	-	+	0	-	+	0	0	-	=
10	475	10	30	Reuse	0	0	0	0	-	+	0	-	0	-	+	0	-	+	0	0	0	-

Impact Key

++ very positive

\+ positive

0 neutral

\- negative

= very negative

Table C

"PLANNING MODEL"

Allocation Amount	450000	Water Demand and Alternatives
Conservation Goal	10%	to Meet Demands
Amount to River	55000	Based upon Average Conditions
-get Reuse Met	Yes	

	YEAR			
	2000	2010	2020	2040
(1) RECHARGE	608000	608000	608000	608000
(2) PROJECTED DEMAND	506000	564000	650000	870000
(3) ALLOCATION AMOUNT	450000	450000	450000	450000
(4) Deficit(allocation-demand)	-56000	-114000	-200000	-420000
(5) CONSERVATION 10% Goal	50600	56400	65000	87000
(6) MAXIMUM POTENTIAL EFFLUENT				
(a) Water Factories	30000	60000	90000	150000
(b) Existing Plants				
Salado	30000	30000	30000	30000
Leon	30000	30000	30000	30000
Dos Rios	80000	80000	80000	80000
(c) Total	170000	200000	230000	290000
(7) EFFLUENT MINUS CONSERVATION (20% Reduction)				
(a) Water Factories	24000	48000	72000	120000
(b) Existing Plants				
Salado	24000	24000	24000	24000
Leon	24000	24000	24000	24000
Dos Rios	64000	64000	64000	64000
(c) Corrected Total	136000	160000	184000	232000
(8) DEVELOPED WATER AFTER EVAPORATION				
a) Water Factories	24000	48000	72000	120000
b) Existing Plants				
Salado(7000)	17000	17000	17000	17000
Leon(2000)	24000	22000	22000	22000
Dos Rios(37000)	64000	27000	27000	27000
c) Total	129000	114000	138000	186000
(9) RIVER RELEASE	55000	55000	55000	55000
(10) AMOUNT AVAILABLE FOR REUSE (8c)-(9)	74000	59000	83000	131000
(11) TARGET REUSE				
(a) Water Factories	20000	20000	20000	20000
(b) Existing Plants				
Salado	17000	17000	17000	17000
Leon	0	22000	22000	22000
Dos Rios	0	27000	27000	27000
(c) Total	37000	86000	86000	86000
(12) ACTUAL REUSE AMOUNT	37000	59000	83000	86000
(13) Allocation + Conservation + Reuse - Demand (3+5+12-2)	31600	1400	-52000	-247000

2/c

January 14, 1988
Joint Committee
Water Conservation Report

PURPOSE:

To present several alternatives for water conservation programs that demonstrate the increasing percent reduction associated with increasing effort, regulation, and water cost.

POLICY GOAL:

To fully integrate the concepts and methods of water conservation and water demand management into water resources management and long range water resources planning.

OBJECTIVES:

- reduce the longterm demand of water users in order to extend or expand the available supply
- ensure that all water consumers in the region have adequate water resources to maintain public health, safety, and welfare
- provide all water users the opportunity to reduce their water demand voluntarily
- implement the plan fairly and in a manner that preserves, to the greatest extent possible, the aesthetic qualities and economic development opportunities for the region

POLICY GOAL DECISIONS REQUIRED:

- Require a long term sustained reduction in water usage based on 1985 water use statistics. Current proposals are for a 10% reduction in projected water use.
- Establish deadline for achievement of 10% long term reduction goal.

YEAR	PROJECTED WATER DEMAND	CONSERVATION GOAL
1990	450,000	?
1995	475,000	?
2000	506,000	?
2020	650,000	?
2040	870,000	?

- Establish program for acheivement of long term reduction goal from water conservation opportunities.

SUMMARY OF WATER CONSERVATION ALTERNATIVES
PROGRAM ALTERNATIVES

ALTERNATIVE	1A	1B	2A	2B	2C	3A	3B
Estimated Savings (acre feet/yr)	8,900	22,600	43,100	49,700	51,600	64,500	68,300
Estimated Cost per Acre Foot Saved	$31	$26	$365	$530	$535	$430	$412
Percent Savings of Municipal Water Use Projected Yr. 2000	3%	7%	13%	15%	16%	20%	21%
Percent Savings of Total Projected Demand Yr. 2000	2%	4.5%	8.5%	9.8%	10%	12.7%	13.5%

Notes: Projected muncipal water use year 2000 approximately 324,500 acre feet per year
Projected total demand year 2000 appproximately 506,000 acre feet per year

WATER CONSERVATION OPPORTUNITIES
Potential Long Range Water Conservation Practices

General Application

Public Education
School Education

Pricing:
- Uniform rate blocks
- Increasing rate blocks
- Seasonal rate blocks
- Penalty charges
- Demand charges

Leak Detection
Plumbing & Landscaping Ordinances

MANUFACTURING

- Recirulation of cooling water
- Reuse of cooling process water
- Reuse of treated wastewater
- Efficient landscape irrigation
- Low water using fixtures
- Process modifications

STEAM ELECTRIC

Recirculation of cooling water
Reuse of treated wastewater
In-system treatment

Interior Residential Use

Retrofit Devices:
- Displacement Bottles
- Shower Flow Restrictors
- Toilet Dams
- Replacement Toilets
- Low-flow shower head
- Pipe insulation
- Pressure regulators
- Faucet aerators
- Water efficient appliances

Devices For New Construction
- Low-flush toilets
- Low-flow shower heads
- Pipe insulation
- Pressure regulator
- Air-assisted showers
- Air-water toilet
- Faucet aerator
- Water efficient appliances
- Dual-water systems

URBAN LANDSCAPE IRRIGATION

Reduced watering
Low water-use planting (Xeriscape)
Low volume sprinklers
Irrigation scheduling
Moisture sensing valve controllers

EVALUATION OF WATER CONSERVATION OPPORTUNITIES

Water Conservation Opportunity	Alternative Program 1A	1B	2A	2B	2C	3A	3B
	Education		Education, Resale Ordinances, Govt Audits			Education, Resale Ordina Active Govt Replacement	
RETROFIT DEVICES FOR EXISTING HOUSING							
Displacement Bottles	X	X					
Shower flow restrictors		X	X	X	X	X	X
Toilet Dams			X	X	X	X	X
Pressure regulation				X	X	X	X
Faucet aerators					X	X	X
Pipe Insulation						X	X
Replacement toilets							X
SUPPORTIVE PROGRAMS							
Public Education	X	X	X	X	X	X	X
School Education	X	X	X	X	X	X	X
Pricing:							
Increasing Rate Blocks		X	X	X	X	X	X
Seasonal Rate Blocks			X	X	X	X	X
Penalty Charges				X	X	X	X
Leak Detection		X	X	X	X	X	X

NOTE: Pricing alternatives may encourage voluntary retrofit device installation, low water use landscaping and installation of water conserving devices in new construction.

	1A	1B	2A	2B	2C	3A	3B
URBAN LANDSCAPE IRRIGATION							
Reduced Watering	X	X	X	X	X	X	X
Irrigation scheduling		X	X	X	X	X	X
Low water use Landscape			X	X	X	X	X
Low volume sprinklers				X	X	X	X
Moisture sensing valve-controller					X	X	X

January 14, 1988
Joint Committee
Water Conservation Report

THE FOLLOWING WATER CONSERVATION OPPORTUNITIES ARE DIRECTED TO SPECIFIC ELEMENTS OF THE REGIONAL POPULATION

	Alternative Programs						
Water Conservation Opportunity	1A	1B	2A	2B	2C	3A	3B
DEVICES FOR NEW CONSTRUCTION							
Low flush toilets	X	X	X	X	X	X	X
Low flow shower heads	X	X	X	X	X	X	X
Pipe insulation		X	X	X	X	X	X
Pressure regulation			X	X	X	X	X
Faucet aerator				X	X	X	X
Water efficient Appliances							
Dishwashers	X	X	X	X	X	X	X
Washing machine						X	X
*Gray Water Systems							X

* Gray water systems or internal residential recycle systems may not be compatible with system wide reuse plan

ENERGY GENERATION							
Recirculation of cooling water	X	X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
In system treatment			X	X	X	X	X
MANUFACTURING							
Recirculation of cooling water	X	X	X	X	X	X	X
Reuse of cooling process water		X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
Efficeint landscape irrigation			X	X	X	X	X
Low water using fixtures				X	X	X	X
Process modifications					X	X	X
PUBLIC FACILITY RETROFIT							
Toilet Dams	X	X	X	X	X	X	X
Faucet aerators		X	X	X	X	X	X
Automatic faucets			X	X	X	X	X
Shower flow restrictors				X			
Low flow showers					X	X	X

* Energy Generation and Manufacturing reuse systems may not be compatible with system wide reuse plans.

Alternatives 1A & 1B

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
Retrofit Devices (housing units built before 1990 only)								
D. Bottles	2.3 gpcd	$0.20	1,359,103	25%	875		$14.00	Retrofit Ord.
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	25%	2,550		$12.00	Retrofit Ord.
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	25%	190		$820.00	Retrofit Ord.
Supportive Programs (all residents yr 2000)								
Public Ed.	1.0 gpcd	$100,000	1,636,373	25%	458	$100,000	$218.20	Education
School Ed.	1.0 gpcd	$100,000	1,636,373	25%	458	$100,000	$218.20	Education
Leak Detect	1.0 gpcd	$3000/mile	1,636,373	100%	1,833			Policy Change
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	$0	$0	Policy Change
New Construction Ordinance (housing units constructed between 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3106	$0	$0	Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2081	$0	$0	Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621	$0	$0	Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621	$0	$1600	Ordinance
Landscape Irrigation (all residents yr 2000)								
Watering Prog	3.0 gpcd	$75,000	1,636,373	25%	1375	$75,000	$54.50	Education
Irrig Sched	5.0 gpcd	$75,000	1,636,373	25%	2291	$75,000	$32.73	Education
Public Facility Retrofit (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%			$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%			$380	Govt Replace

Alternative Programs 2A, 2B, & 2C

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
Retrofit Devices (housing units built before 1990)								
D. Bottles								
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	50%	5,100		$12.00	Retrofit Ord.
Toilet Dams	4.5 gpcd	$10.00	1,359,103	50%	3,430		$140.00	Retrofit Ord.
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	50%	380		$820.00	Retrofit Ord.
Pressure Regul.	3.0 gpcd	$70.00	1,359,103	50%	2,280		$380.00	Retrofit Ord.
Faucet Aerators	.5 gpcd	$2.00	1,359,103	50%	380		$470.00	Retrofit Ord.
Supportive Programs (all residents yr 2000)								
Public Ed.	1.0 gpcd	$150,000	1,636,373	50%	917	$150,000	$164.00	Education
School Ed.	1.0 gpcd	$150,000	1,636,373	50%	917	$150,000	$164.00	Education
Leak Detect	1.0 gpcd	$3000/mile	1,636,373	100%	1,833			Policy Change
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	0	0	Policy Change
Seas. Block	2.0 gpcd		1,636,373	100%	3,666	0	0	Policy Change
Penalty	.5 gpcd		1,636,373	10%	91	0	0	Policy Change
New Construction (housing units constructed between 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3106			Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2081			Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621			Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621		$1600	Ordinance
Pres Regulation	3.0 gpcd	$70.00	277,270	100%	932		$380	Ordinance
Faucet Aerator	.5 gpcd	$2.00	277,270	100%	155		$470	Ordinance
WE Wash Machine	5.0 gpcd	$70.00	277,270	100%	1553		$570	Ordinance
Landscape Irrigation (housing units constructed before 1990)								
Watering Prog	3.0 gpcd	$100,000	1,359,103	50%	2284	$100,000	$43	Education
Irrig Sched	5.0 gpcd	$100,000	1,359,103	50%	3806	$100,000	$26	Education
Landscape Measures for New Construction (housing units constructed between 1990 and 2000)								
LW Landscape	24.0 gpcd	$2000/home	277,270	100%	7455			Ordinance
LV Irrig	13.0 gpcd	$1500/home	277,270	100%	4038			Ordinance
M. Sensors	5.0 gpcd	$1200/home	277,270	100%	1553			Ordinance
Public Facility Retrofit (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%			$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%			$380	Govt Replace
Auto Faucet		$25.00		100%				Govt Replace
LF Showers	1.5 gpm	$15.00		100%			$60	Govt Replace

Alternative Programs 3A & 3B

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
Retrofit Devices (housing units built before 1990 only)								
D. Bottles								
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	75%	7,651		$12.00	Retrofit Ord.
Toilet Dams	4.5 gpcd	$10.00	1,359,103	75%	5,140		$140.00	Retrofit Ord.
Pressure Reg	3.0 gpcd	$70.00	1,359,103	75%	3,426		$470.00	Retrofit Ord.
Faucet Aerators	0.5 gpcd	$2.00	1,359,103	75%	1,147		$380.00	Retrofit Ord.
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	75%	571		$820.00	Retrofit Ord.
Repl Toilets	10 gpcd	$300	1,359,103	25%	3806		$890.00	Retrofit Ord.
Supportive Programs (all residents yr 2000)								
Public Ed.	1.0 gpcd	$200,000	1,636,373	75%	1375	$200,000	$145	Education
School Ed.	1.0 gpcd	$200,000	1,636,373	75%	1375	$200,000	$145	Education
Leak Detect	1.0 gpcd	$3000/mile	1,636,373	100%	1833			Policy Change
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	$0	$0	Policy Change
Seas. Block	2.0 gpcd		1,636,373	100%	3,666	$0	$0	Policy Change
Penalty	.5 gpcd		1,636,373	10%	92	$0	$0	Policy Change
New Construction (housing units constructed betweeen 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3,106		$0	Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2,081		$0	Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621		$0	Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621		$1600	Ordinance
Pres Regulation	3.0 gpcd	$70.00	277,270	100%	932		$380	Ordinance
Faucet Aerator	.5 gpcd	$2.00	277,270	100%	155		$470	Ordinance
WE Wash Machine	5.0 gpcd	$70.00	277,270	100%	1553		$570	Ordinance
Gray Water			277,270	-----	------		-----	Ordinance
Landscape Irrigation (all housing units before 1990)								
Watering Prog	3.0 gpcd	$125,000	1,359,103	75%	3426	$125,000	$36	Education
Irrig Sched	5.0 gpcd	$125,000	1,359,103	75%	5710	$125,000	$22	Education
Landscape Measures for New Construction (housing units constructed between 1990 and 2000)								
LW Landscape	24.0 gpcd	$2000/home	277,270	100%	7455			Ordinance
LW Irrig	13.0 gpcd	$1500/home	277,270	100%	4038			Ordinance
M. Sensors	5.0 gpcd	$1200/home	277,270	100%	1553			Ordinance
Public Facility Retrofit (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%			$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%			$380	Govt Replace
Auto Faucet		$25.00		100%				Govt Replace
LF Showers	1.5 gpm	$15.00		100%			$60	Govt Replace

WATER CONSERVATION OPPORTUNITY PROGRAM DESCRIPTIONS

Alternative Program 1A

Alternative Program 1A has minimal new ordinances and policy changes. Public and school education programs and retrofit programs are targeted to impact 25% of the population that is most likely to change water use habits. Ordinances for new construction account for a majority of the water savings in this alternative. Water Conserving devices required for new construction are limited to those which which do not require additional costs. Public facilities such as offices, parks, schools, airports are required to retrofit toilets with water dams or the equivalent.

With this alternative water savings could be expected from policy and ordinances changes is projected to be 8,900 AF/YR. Since much of this alternative relies on public education it could be expected that savings would fluctuate depending on how the water supply situation is perceived.

Actions Required	Responsible Entity
Retrofit Policy	EUWD/Cities/purveyors
New Construction Ordinance	Cities/purveyors
Public Education Activity	EUWD/Cities/purveyor
School Education Activity	EUWD/Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	individual manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy Adoption	Cities/purveyors	$2,000/yr
New construction Devices	Developers	$0
Public Education Activity	EUWD/Cities/purveyors	$100,000/yr
School Education Activity	EUWD/Cities/purveyors	$100,000/yr
Landscape watering and scheduling	EUWD/Cities/purveyors	$150,000/yr
Energy Generation Policy Adopt	Utility companies	$
Manufacturing Policy Adoption	Manufacturers	$

Alternative Program 1B

Alternative Program 1B proposes reduce per capita water use by approximately 7% (22,600 acre feet per year). Public Education and school education programs are carried over from Alternative 1A. Alternative 1B proposes an increasing block water rate structures to change water use habits. It is intended that the change in water rates will encourage water users to voluntarily adopt conservation practices. Other features include:

- o Retrofit devices to be distributed for existing housing include displacement bottles and shower flow restrictors.
- o Utilities would be required to initiate leak detection programs to minimize distribution systems losses.
- o New construction would be required to include water conserving devices that do not increase construction costs and to insulate hot water pipes.
- o Public facilities such as offices, parks, schools, airports are required to retrofit toilets with water dams or the equivalent and to install faucet aerators on indoor lavatories.

Actions Required	Responsible Entity
Retrofit Policy Adoption	Cities/purveyors
New Construction Ordinance	Cities/purveyors
Public Education Activity	EUWD/Cities/purveyor
School Education Activity	EUWD/Cities/purveyors
Leak Detection Program	Cities, Purveyors
Pricing Policy	Cities, Purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	individual manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$5000/yr
New construction devices	Developers	$100,000/yr
Leak Detection	Cities/purveyors	$150,000,yr
Public Education Activity	EUWD/Cities/purveyors	$100,000/yr
School Education Activity	EUWD/Cities/purveyors	$100,000/yr
Landscape Watering and Scheduling	EUWD/Cities/purveyors	$150,000/yr
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$

Alternative Program 2A

Alternative Program 2A proposes to reduce per capita water use between 10% and 13% (approximately 43,000 acre ft per year). Public and school education programs and retrofit programs in alternative 2A are increased to target 50% of the population which are most likely to change water use habits. This alternative features increasing block and seasonal water rate structures to change annual and seasonal water use habits. It is predicted that the installation rate for retrofit devices should increase and that landscape water use will be reduced through irrigation scheduling and conversion to water efficient landscapes (xeriscape).

- Retrofit devices to be distributed for existing housing include toilet dams and shower flow restrictors.

- Utilities would be required to make changes in rate structures and initiate leak detection programs to minimize distribution systems losses to assure that all customers are being fairly charged for water use.

- New construction would be required to include water conserving devices that do not increase construction costs and to insulate hot water pipes and install pressure reducing valves at meters to maintain constant pressure.

- Public facilities such as offices, parks, schools, airports are required to retrofit toilets with water dams or the equivalent, install faucet aerators and automatic closing faucets on indoor lavatories.

Alternative 2A

Actions Required	Responsible Entity
Retrofit Policy	EUWD/Cities/purveyors
New Construction Ordinance	Cities/purveyors
Landscape Ordinance	Cities/purveyors
Leak Detection Policy	Cities/purveyors
Pricing Policy	Cities/ purveyors
Public Education Activity	EUWD/Cities/purveyor
School Education Activity	EUWD/Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	Manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$54,000/yr
New construction Devices	Developers	$135.400/yr
Leak Detection Program	Cities/purveyors	$150,000/yr
Public Education Activity	EUWD/Cities/purveyors	$150,000/yr
School Education Activity	EUWD/Cities/purveyors	$150,000/yr
Landscape Watering and Schedule	EUWD/Cities/purveyors	$200,000/yr
Low Water Landscapes	Developers	$14,670,000/yr
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$

Alternative Program 2B

Alternative Program 2B proposes increasing block, seasonal, and excessive use penalty charges as well as a substantial retrofit program to achieve a water use reduction of 13% to 15% in per capita use (approximately 50,000 acre feet per year). Public and school education programs are the same as alternative 2A.

This alternative features a pressure reduction study, excessive use penalty charges, and new construction ordinances for faucet aerators and low volume irrigation systems. It is predicted that these rate structures will increase the installation rate for retrofit devices and that landscape irrigation use will become more efficient due to seasonal rate increases and excessive use penalties. Other features include:

- Retrofit devices to be distributed for existing housing include toilet dams and shower flow restrictors.
- A pressure reduction study would be initiated to determine areas in which excessive pressure can be reduce without altering the public health safety and welfare of users.
- Utilities would be required to make changes additional changes in their rate structures to discourage excessive use with penalty charges. Overall rates would be designed to reduce water use by approximately 4%. Revenues derived from seasonal rates and excess use penalties could be set aside for water resource development projects.
- Public education, school education, and landscape irrigation watering and scheduling programs would be similar to previous alternatives. Rate structures should improve program effectiveness.
- ALL landscaping for new contruction would be required to make use of Xeriscape principles in developing low water requiring landscapes with low volume irrigation systems (sprinkler irrigation allowed only for turf areas).
- New Construction would be required include water conserving devieces that do not increase construction costs and install hot water pipe insulation, pressure reducing valves, and faucet aerators.
- Public facilities such as offices, parks, schools, airports, are required to retrofit toilets with water dams or the equivalent, install faucet aerators, automatic closing faucets, and shower flow restrictors.

Alternative 2B

Actions Required	Responsible Entity
Retrofit Policy	Cities/purveyors
Leak Detection Policy	Cities/purveyors
Pricing Policies	Cities/purveyors/EUWD
New Construction Ordinance	Cities/purveyors
Landscape Ordinance	EUWD/cities/purveyor
Public Education Activity	EUWD/Cities/purveyor
School Education Activity	EUWD/Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	Manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$140,800/yr
Leak Detection Program	Cities/purveyors	$150,000/yr
New Construction Devices	Developers	$142,700/yr
Public Education Activity	EUWD/Cities/purveyors	$150,000/yr
School Education Activity	EUWD/Cities/purveyors	$150,000/yr
Landscape Watering and Scheduling	EUWD/Cities/purveyors	$150,000/yr
Low Water Landscapes and Irrigation	Developers	$25,665,000/yr
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$

Alternative Program 2C

Alternative Program 2C proposes increasing block, seasonal, and excessive use penalty charges as well as a substantial retrofit program to achieve a water use reduction of 14% to 16% in per capita use (51,600 acre feet per year).

It is predicted that these rate structures will increase the installation rate for retrofit devices and that landscape irrigation use will become more efficient due to seasonal rate increases and excessive use penalties. Features include:

- Retrofit devices to be distributed for existing housing include toilet dams, shower flow restrictors, and faucet aerators.

- A pressure reduction study would be initiated to determine areas in which excessive pressure can be reduced without altering the public health safety and welfare of users.

- Utilities would be required to make changes additional changes in their rate structures to discourage excessive use with penalty charges. Penalty charges are targeted for those who have excessive use. Overall rates would be designed to reduce water use by approximately 4%. Revenues derived from seasonal rates and excess use penalties could be set aside for water resource development projects.

- Public education, school education, and landscape irrigation watering and scheduling programs would be similar to previous alternative 2A and 2B.

- All landscaping for new contruction would be required to make use of Xeriscape principles in developing low water requiring landscapes, in addition low volume irrigation systems with moisture sensing valves would be required.

- New Construction would be required include water conserving devices that do not increase construction costs and install hot water pipe insulation, pressure reducing valves, and faucet aerators.

- A program would be developed to encourge the purchase of low water use clothes washing machines.

- Public facilities such as offices, parks, schools, airports, are required to retrofit toilets with water dams or the equivalent, install faucet aerators, automatic closing faucets, and shower flow restrictors.

Alternative 2C

Actions Required	Responsible Entity
Retrofit Policy	Cities/purveyors
Leak Detection Policy	Cities/purveyors
Pricing Policies	Cities/purveyors/EUWD
New Construction Ordinance	Cities/purveyors
Public Education Activity	EUWD/Cities/purveyor
Landscape Incentive Policy	EUWD/Cities/purveyors
School Education Activity	EUWD/Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	Manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$163,000/yr
Leak Detection Program	Cities/purveyors	$150,000/yr
New construction Devices	Developers	$220,300/yr
Public Education Activity	EUWD/Cities/purveyors	$150,000/yr
School Education Activity	EUWD/Cities/purveyors	$150,000/yr
Landscape watering and scheduling	EUWD/Cities/purveyors	$200,000/yr
Low Water Landscapes and Irrigation	Developers	$26,541,000/yr
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$

Alternative Program 3A

Alternative Program 3A relies on increasing block, seasonal, and excessive use penalty charges as well as a substantial retrofit program to achieve a water use reduction of 16% to 19% in per capita use (approximately 64,500 acre feet per year).

Public and school education and retrofit programs are expanded to target 75% of the population which are most likely to change water use habits. It is predicted that these rate structures will increase the installation rate for retrofit devices and that landscape irrigation use will become more efficient due to seasonal rate increases and excessive use penalties. Proposed features include:

- o Retrofit devices to be distributed for existing housing include toilet dams, shower flow restrictors, and faucet aerators. In addition distribution system pressure would be studied and an effort would be made install pressure regulation devices to maintain pressure at 80 psi. Retrofit devices can potentially reduce per capita water use by 6.0%.
- o Utilities would be required to make changes additional changes in their rate structures to discourage excessive use with penalty charges. Overall rates would be designed to reduce water use by approximately 4%. Revenues derived from seasonal rates and excess use penalties could be set aside for water resource development projects.
- o Public education, school education, and landscape irrigation watering and scheduling programs would be similar to previous alternatives with target population increased to 75%.
- o Economic incentives would be designed for low water use landscape retrofit and low volume irrigation use. Due to large capital cost of landscaping and strict requirements for rebate small percent of population may apply for program.
- o New landscapes would and irrigation systems would be required to install moisture sensing valve controllers. A rebate or other incentive would be given for existing irrigation systems.
- o New Construction would be required include water conserving devices that do not increase construction costs and install hot water pipe insulation, pressure reducing valves, and faucet aerators.
- o A program would be developed to encourge the purchase of low water use clothes washing machines.
- o Public facilities such as offices, parks, schools, airports, are required to retrofit toilets with water dams or the equivalent, install faucet aerators, automatic closing faucets, and shower flow restrictors.

Alternative 3A

Actions Required	Responsible Entity
Retrofit Policy	Cities/purveyors
Leak Detection Policy	Cities/purveyors
Pricing Policies	Cities/purveyors/EUWD
New Construction Ordinance	Cities/purveyors
Public Education Activity	EUWD/Cities/purveyor
Landscape Incentive Policy	EUWD/Cities/purveyors
School Education Activity	EUWD/Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	Manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$280,000/yr
Leak Detection Program	Cities/purveyors	$150,000/yr
New construction Devices	Developers	$220,300/yr
Low Water Landscapes and Irrigation	Developers	$26,541,000/yr
Public Education Activity	EUWD/Cities/purveyors	$200,000/yr
School Education Activity	EUWD/Cities/purveyors	$200,000/yr
Landscape Watering and Scheduling	EUWD/Cities/purveyors	$150,000/yr
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$

Alternative Program 3B

Alternative Program 3B is similar to 3A to achieve a water use reduction of 17% to 20% in per capita use (approximately 68,300 acre feet per year). In addition this alternative proposes gray water reuse systems for at single and multifamily new construction and a toilet replacement program for existing housing.

- Retrofit devices to be distributed for existing housing include toilet dams, shower flow restrictors, and faucet aerators. In addition distribution system pressure would be studied and an effort would be made install pressure regulation devices to maintain pressure at 80 psi. Retrofit devices can potentially reduce per capita water use by 8.0%. In addition, incentives would be made to for homeowners to install low water and ultra low water using toilets.

- Utilities would be required to make changes additional changes in their rate structures to discourage excessive use with penalty charges. Overall rates would be designed to reduce water use by approximately 4%. Revenues derived from seasonal rates and excess use penalties could be set aside for water resource development projects.

- Public education, school education, and landscape irrigation watering and scheduling programs would be similar to previous alternatives with target population increased to 75%.

- New landscapes would and irrigation systems would be required to install moisture sensing valve controllers. A rebate or other incentive would be given for existing irrigation systems.

- New Construction would be required include water conserving devices that do not increase construction costs and install hot water pipe insulation, pressure reducing valves, and faucet aerators.

- Incentive programs would be developed to promote the use of gray water reuse systems at single and multifamily residences. Gray water reuse has a potential to reduce per capita consumption by a large margin, however systems are expensive and incentive program may not be compatible with region wide reuse plans.

- A program would be developed to encourge the purchase of low water use clothes washing machines.

- Public facilities such as offices, parks, schools, airports, are required to retrofit toilets with water dams or the equivalent, install faucet aerators, automatic closing faucets, and shower flow restrictors.

Alternative 3B

Actions Required	Responsible Entity
Retrofit Policy	Cities/purveyors
Metering & Leak Detection Policy	Cities/purveyors
Pricing Policies	Cities/purveyors/EUWD
New Construction Ordinance	Cities/purveyors
Plumbing & Landscape Ord	EUWD/Cities/purveyors
Graywater system policy	
Public Education Activity	EUWD/Cities/purveyor
Landscape Ordinances	Cities/purveyors
School Education Activity	EUWD/Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	Manufacturer
Public Facility Retrofit	City, County, State, & Federal entities

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$622,000/yr
Leak Detection Program	Cities/purveyors	$150,000/yr
New construction Devices	Developers	$220,300/yr
Low Water Landscapes and Irrigation	Developers	$26,541,000/yr
Landscape Watering and Scheduling	EUWD/Cities/purveyors	$250,000/yr
Public Education Activity	EUWD/Cities/purveyors	$200,000/yr
School Education Activity	EUWD/Cities/purveyors	$200,000/yr
Graywater system incentives	EUWD/Cities/purveyors	$
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$

APPENDIX H
QUESTIONS AND ISSUES REGARDING THE PRESENTATION
ON WATER CONSERVATION BY EUWD STAFF
& JOINT COMMITTEE DECISIONS 1/14/88

The analysis presented by the EUWD staff on a water conservation program exhibits a comprehensive overview of selected conservation options. The report provides an extensive analysis of program alternatives and opportunities pertaining to a municipal water conservation program. The Committee's review and revision of target goals for the year 2000 can be considered ambitious, attainable or both. Nonetheless, as a municipality that will be affected by this program, several concerns arise as to the analysis presented as well as actual implementation of the conservation program proposed. In regarding the goal of conserving 10% of the water usage in the Edwards region, it is not understood why agriculture is not listed in the steps necessary to achieve this 10% goal. What are the incentives (disincentives) for the agriculture community? At two acre feet the agricultural community is to be allocated 180,000 acre feet (a guesstimate) which is over 1/3 of the total current usage. How will the 10% goal of 18,000 acre feet be met? We are concerned about the statements made on 1/14/88 that existing irrigation practices, existing acres planted, or existing electrical costs will do anything but maintain the status quo.

Please elaborate. Without every aspect of the region achieving a 10% conservation level it will be impossible to achieve that goal. Without a detailed agricultural conservation plan in place (similar to the one being considered for municipalities) we believe we should reduce the regional goal to the 6% level mentioned in the Regional Water Study.

I. The following are concerns regarding assumptions made in the EUWD staff analysis.
   - Determine the validity of the market penetration assumptions presented. What market or end-use studies have been done? How were the results translated in this analysis?
   - Test of reasonableness is necessary of values given for leak detection assumptions due to physical characteristics of individual utilities.
   - Test of reasonableness of value is necessary for unit savings (per capita and acre feet/year) of all proposed measures.
   - Staff suggests that values are not additive. Need to determine what the resultant savings will be in preparing various combinations of the conservation measures presented.
   - An assessment of the derivation of actual water savings through education is necessary in order to avoid double counting with actual implementation measures. What is the rationale for those savings? How, when and where has

the education principle for savings been tested? Can it be applied here?
- Once these goals are reached by the year 2000 what will the projected savings be? At what point do we reach the plateau of savings? Would an increase in conservation have to occur to maintain the ultimate goal? If so, at what point in time?

II. Issues involved with the conservation oriented rate structures presented include:
- The need to further evaluate other rate structures alternatives and their potential applicability to the region. (CWB currently has inverted block rate structure).
- The dollar impact on the rate payer.
- The impact on investor-owned water utilities and issues associated with the over-recovery of revenues due to conservation pricing.
- The experience of other cities that have adopted similar and other rate structures.
- The impact of the water utilities' revenues and expenses based on the pricing structure.
- Examination of water usage savings from changes in rate structures.

III. A. Thirdly, a citywide conservation program can impact the recruitment of water-intensive industries to the City. Can other incentives be given to promote their location in the region if their water use is diminished? An analysis of potential savings through industrial and manufacturing conservation should also be considered. Or is this a separate program to be later reviewed? If so, it must be factored in just as the irrigation/agricultural component to be seen later.

B. Another critical concern is the confidence in the new construction water savings for the year 2000 which constitute approximately 40% of total projections. Costs for these devices and landscaping is dependent on current rates; also the costs will be borne by the ratepayer at the time of purchase who may opt for a home without all the water saving devices in order to save money. Costs for installation and procurement of these items can also change which can affect the projected savings. What mechanism will insure that these measures will be implemented since most development is in the Country? If the goal for 2000 is not reached then the burden of conservation measures shifts to other sections.

IV. Lastly, there are questions that must be addressed regarding the implementation of a water conservation program. The following are some of these questions:
- What new ordinances are necessary for each locality?
- What governmental entity will have regulatory authority over the conservation program, and in what capacity? How

will that entity insure that all municipalities will prepare program that represents best effort?

- What other municipalities are involved?
- How will unincorporated areas be included?
- What incentives will be provided to existing homeowners to retrofit? Who will pay for the incentives? What is the ultimate cost to the ratepayer?
- What are the costs associated with the retrofitting of public facilities? Who will fund the retrofitting?
- What are the impacts on revenues and expenses of San Antonio's water utility implementing conservation measures?
- What will be the process for inclusion of other water purveyors in the conservation program?
- Will San Antonio have to stop pumping the Edwards to maintain the streamflow that assures our tourist industry in the downtown area?
- With the recent revisions to the plumbing code, what percentage of housing stock has been either built or replaced with water efficient devices? How much water has been saved to date? Does this affect the program projections?
- Several concerns have been raised regarding residential and commercial water efficiency usage. Measures must be taken to assure that property owners are responsible for maintenance to prevent waste.
- Pressure regulation by utility is best applied in level terrains. There are some points in the City where pressure cannot be made any lower. Will this affect projections? Pressure regulators in the homes, once installed, will have minimal effect if not used properly.

This initial query is not meant to be all-inclusive but as a starting point that should engender more legitimate concerns by all municipalities involved.

Addressing these issues and others that may arise is a crucial component of the overall development of a water resource plan for the Edwards Aquifer region.

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District 9

January 21, 1988
Joint Committee
Water Conservation Report

POLICY GOAL:

To fully integrate the concepts and methods of water conservation and water demand management into water resources management and long range water resources planning.

OBJECTIVES:

- o reduce the longterm demand of water users in order to extend or expand the available supply
- o ensure that all water consumers in the region have adequate water resources to maintain public health, safety, and welfare
- o provide all water users the opportunity to reduce their water demand voluntarily
- o implement the plan fairly and in a manner that preserves, to the greatest extent possible, the aesthetic qualities and economic development opportunities for the region

POLICY GOAL DECISIONS REQUIRED:

- o Require a long term sustained reduction in water usage based on 1985 water use statistics. Current proposals are for a 10% reduction in projected water use.
- o Establish deadline for achievement of 10% long term reduction goal.

YEAR	PROJECTED WATER DEMAND	CONSERVATION GOAL
1990	450,000	?
1995	475,000	?
2000	506,000	10%
2020	650,000	10%
2040	870,000	10%

- o Establish program for achievement of long term reduction goal from water conservation opportunities.

January 21, 1988
Joint Committee
Water Conservation Report

SUMMARY OF WATER CONSERVATION ALTERNATIVES
PROGRAM ALTERNATIVES

ALTERNATIVE	1A	1B	2A	2B	REVISED 2C	3A	3B
Estimated Savings (acre feet/yr)	8,900	22,600	43,100	49,700	54,000	64,500	68,300
Estimated Cost per Acre Foot Saved	$31	$26	$365	$530	$515	$430	$412
Percent Savings of Municipal Water Use Projected Yr. 2000	3%	7%	13%	15%	16%	20%	21%
Percent Savings of Total Projected Demand Yr. 2000	2%	4.5%	8.5%	9.8%	10%	12.7%	13.5%

Notes: Projected muncipal water use year 2000 approximately 324,500 acre feet per year
Projected total demand year 2000 appproximately 506,000 acre feet per year

January 21, 1988
Joint Committee
Water Conservation Report

WATER CONSERVATION OPPORTUNITIES
Potential Long Range Water Conservation Practices

General Application

Public Education
School Education

Pricing:
- Uniform rate blocks
- Increasing rate blocks
- Seasonal rate blocks
- Penalty charges
- Demand charges

Leak Detection
Plumbing & Landscaping Ordinances

MANUFACTURING

- Recirulation of cooling water
- Reuse of cooling process water
- Reuse of treated wastewater
- Efficient landscape irrigation
- Low water using fixtures
- Process modifications

AGRICULTURE

Low Energy Percision Application
Surge Irrigation
Irrigation scheduling
Laser Leveling
Forrrow Diking
Drip & Low volume irrigation
Brush Management

Interior Residential Use

Retrofit Devices:
- Displacement Bottles
- Shower Flow Restrictors
- Toilet Dams
- Replacement Toilets
- Low-flow shower head
- Pipe insulation
- Pressure regulators
- Faucet aerators
- Water efficient appliances

Devices For New Construction
- Low-flush toilets
- Low-flow shower heads
- Pipe insulation
- Pressure regulator
- Air-assisted showers
- Air-water toilet
- Faucet aerator
- Water efficient appliances
- Dual-water systems

URBAN LANDSCAPE IRRIGATION

Reduced watering
Low water-use planting (Xeriscape)
Low volume sprinklers
Irrigation scheduling
Moisture sensing valve controllers

STEAM ELECTRIC

Recirulaton of cooling water
Reuse of treated wastewater
In-system treatment

January 21, 1988
Joint Committee
Water Conservation Report

EVALUATION OF WATER CONSERVATION OPPORTUNITIES

	ALTERNATIVE PROGRAMS				REVISED		
Water Conservation Opportunity	1A	1B	2A	2B	2C	3A	3B
	Education		Education, Resale Ordinances, Govt Audits			Education, Resale Ordina Active Govt Replacement	
RETROFIT DEVICES FOR EXISTING HOUSING							
Displacement Bottles	X	X					
Shower flow restrictors		X	X	X	X	X	X
Toilet Dams			X	X	X	X	X
Pressure regulation				X	X	X	X
Faucet aerators					X	X	X
Pipe Insulation					X	X	X
Replacement toilets					X		X
SUPPORTIVE PROGRAMS							
Public Information/Education	X	X	X	X	X	X	X
School Education	X	X	X	X	X	X	X
Pricing:							
Increasing Rate Blocks		X	X	X	X	X	X
Seasonal Rate Blocks			X	X	X	X	X
Penalty Charges				X	X	X	X
Leak Detection		X	X	X	X	X	X

NOTE: Pricing alternatives may encourage voluntary retrofit device installation, low water use landscaping and installatio of water conserving devices in new construction.

URBAN LANDSCAPE IRRIGATION							
Reduced Watering	X	X	X	X	X	X	X
Irrigation scheduling		X	X	X	X	X	X
Low water use Landscape			X	X	X	X	X
Low volume sprinkers				X	X	X	X
Moisture sensing valve-controller					X	X	X

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Water Conservation Report

THE FOLLOWING WATER CONSERVATION OPPORTUNITIES ARE DIRECTED TO SPECIFIC ELEMENTS OF THE REGIONAL POPULATION

	ALTERNATIVE PROGRAMS						
Water Conservation Opportunity	1A	1B	2A	2B	REVISED 2C	3A	3B
DEVICES FOR NEW CONSTRUCTION							
Low flush toilets	X	X	X	X	X	X	X
Low flow shower heads	X	X	X	X	X	X	X
Pipe insulation		X	X	X	X	X	X
Pressure regulation			X	X	X	X	X
Faucet aerator				X	X	X	X
Water efficient Appliances							
Dishwashers	X	X	X	X	X	X	X
Washing machine					X	X	X
*Gray Water Systems					X		X

* Gray water systems or internal residential recycle systems may not be compatible with system wide reuse plan

	1A	1B	2A	2B	2C	3A	3B
PUBLIC FACILITY RETROFIT							
Toilet Dams	X	X	X	X	X	X	X
Faucet aerators		X	X	X	X	X	X
Automatic faucets			X	X	X	X	X
Shower flow restrictors				X			
Low flow showers					X	X	X
Public Facility Landscape Maint					X		
ENERGY GENERATION							
Recirculation of cooling water	X	X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
In system treatment			X	X	X	X	X
MANUFACTURING							
Recirculation of cooling water	X	X	X	X	X	X	X
Reuse of cooling process water		X	X	X	X	X	X
* Reuse of treated wastewater		X	X	X	X	X	X
Efficient landscape irrigation			X	X	X	X	X
Low water using fixtures				X	X	X	X
Process modifications					X	X	X

* Energy Generation and Manufacturing reuse systems may not be compatible with system wide reuse plans.

	1A	1B	2A	2B	2C	3A	3B
AGRICULTURE							
Irrigation system evaluations	X	X	X	X	X	X	X
Irrigation Scheduling	X	X	X	X	X	X	X
Laser Leveling		X	X	X	X	X	X
Furrow Diking			X	X	X	X	X
Low Energy Precision Application				X	X	X	X
Surge Flow Irrigation					X	X	X
Drip & Low Volume Irrigation						X	X
Brush Management							X

REVISED ALTERNATIVE PROGRAM 2C

Action	Est. Unit Savings	Unit Cost or Total Cost	Target Population (EUWD)	Application Rate (EUWD)	Total Savings AF/YR	Total Cost $/YR	Cost Per AF Saved	Accomplished by
RETROFIT DEVICES (housing units built before 1990)								
S. Flow Rest	6.7 gpcd	$0.50	1,359,103	50%	5,100		$12	Retrofit Ord.
Toilet Dams	4.5 gpcd	$10.00	1,359,103	50%	3,430		$140	Retrofit Ord.
Pressure Regul.	3.0 gpcd	$70.00	1,359,103	50%	2,280		$380	Retrofit Ord.
Faucet Aerators	.5 gpcd	$2.00	1,359,103	50%	380		$470	Retrofit Ord
Pipe Insulation	0.5 gpcd	$0.67/ft	1,359,103	15%	115		$820	Retrofit Ord
Repl Toilets	10. gpcd	$300	1,359,103	25%	3,806		$890	Retrofit Ord
SUPPORTIVE PROGRAMS (all residents yr 2000)								
Public Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
School Ed.	1.0 gpcd	$200,000	1,636,373	75%	1,375	$200,000	$145	Education
Landscape Irrigation (housing units constructed before 1990)								
Watering Prg	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
Irrig Sched	3.0 gpcd	$100,000	1,359,103	50%	2,284	$100,000	$43	Education
Pricing								
Incr. Block	3.5 gpcd		1,636,373	100%	6,416	0	0	Policy Chang
Seas. Block	2.0 gpcd		1,636,373	100%	3,666	0	0	Policy Chanc
Penalty	.5 gpcd		1,636,373	10%	91	0	0	Policy Chanc
NEW CONSTRUCTION (housing units constructed between 1990 and 2000)								
LF Toilets	10 gpcd	$0	277,270	100%	3,106			Ordinance
LF Shower	6.7 gpcd	$0	277,270	100%	2,081			Ordinance
WE Dishwasher	2.0 gpcd	$0	277,270	100%	621			Ordinance
Pipe Insulation	2.0 gpcd	$0.62/ft	277,270	100%	621		$1600	Ordinance
Pres Regulation	3.0 gpcd	$70.00	277,270	50%	465		$380	Ordinance
Faucet Aerator	.5 gpcd	$2.00	277,270	100%	155		$470	Ordinance
WE Washing Mach	5.0 gpcd	$70.00	277,270	75%	1,164		$570	Ordinance
Gray Water Sys.	______	______	277,270	voluntary			______	Incentive
Landscape Measures for New Construction (housing units constructed between 1990 and 2000)								
LW Landscape	24.0 gpcd	$2000/home	277,270	75%	5,591			Ordinance
LV Irrig	13.0 gpcd	$1500/home	277,270	75%	3,028			Ordinance
M. Sensors	5.0 gpcd	$1200/home	277,270	75%	1,164			Ordinance
PUBLIC FACILITY RETROFIT (all public facilities)								
Toilet Dams	1 g/flush	$10.00		100%	700		$140	Govt Replace
Faucet Aerators	.5 gpm	$2.00		100%	50		$380	Govt Replace
Auto Faucet		$25.00		100%	50		$900	Govt Replace
LF Showers	1.5 gpm	$15.00		100%	325		$60	Govt Replace
Public Facility Landscapes (all public facilities)								
Irrig Sched	20% reduction in seasonal UAF water			100%	2,500	$25,000		Maint Polic
Leak Detection Programs		$3000/mile		100%	600	$150,000		Maint Polic

PROGRAM DESCRIPTIONS

RETROFIT PROGRAMS

- Retrofit devices to be distributed for existing housing include toilet dams, shower flow restrictors, pipe insulation, and faucet aerators. First consideration would be to distribute devices to lifeline customers, so that as the price per unit water increases, they would be able to reduce use keeping their water bills at about the same price. Ordinances could also be required to retrofit on resale or install the water conserving devices on remodels. These programs would speed the process of retrofitting homes, but would have a limited economic life due to the eventual saturation of the residential communities within the District.

- Replacement toilet programs would focus on the replacement of 5-6 gallon per flush toilets with 1 to 1.5 gallon flush (ultra-low-flow) toilets. Possible measures to encourage the use of low flow toilets include replacement of existing toilets with the ultra-low-flow models, ordinances requiring the installation of ultra-low-flow toilets in new construction or remodels, rebates on purchase of new toilets, or discounts on new water connection fees.

  The widespread use of ultra-low-flow toilets may not be compatible with system wide reuse plans, due to resultant reductions in plant inflows.

- A pressure reduction study would be initiated to determine areas in which excessive pressure can be reduced without altering the public health safety and welfare of users, pressure reducing valves would be installed where excessive pressure can be reduced.

SUPPORTIVE PROGRAMS

- Public Information programs would promote the wise water use habits and water awareness throughout the regional population. Programs would feature brochures, bill inserts, exhibits, films, speakers bureau, public service announcements and advertising to educate residents about their water supply and encourage conservation.

- School Education programs would promote the wise water use habits at the elementary school level and follow students thru high school level with a change of focus to water awareness and appreciation for water as a limited natural resource. Activities include teacher training, films, development of Edwards Aquifer education materials, aquifer exhibits such as at the San Antonio Zoo, speakers bureau, and annual contests.

- Landscape Watering programs would promote the efficient irrigation of existing landscapes and encourage the use of low water using plants through education. Educational Programs may include Xeriscape demonstration gardens, brochures, efficient lawn watering education programs, daily irrigation information "ET PROGRAM", and landscape seminars and conferences.

- Pricing Policies would be changed to reflect the cost of providing water service and to encourage conservation. Although the relative decline in water use is often small in comparison to the relative increase in the water price, the response of demand to price provides an opportunity using pricing as a conservation measure.

  In this proposal pricing policies account for approximately a 3% reduction in water use. However the proposed pricing policies combined with education and retrofit programs provide a greater benefit. Since this benefit is a result of education and retrofit efforts, resultant water savings are being estimated in the respective program.

SUPPORTIVE PROGRAMS (cont.)

Pricing Policies:
INCREASING BLOCK RATE: In an increasing block rate structure, the unit cost of water increases as use increases. The "blocks" of the rate structure are designed so that for most customers, the last unit of consumption is at the highest block rate. This increases the customer's incentive to conserve. The upper block rates may be the marginal cost of water conservation programs, reuse programs or surface water development cost. The overall rate structure may be designed so that long term revenue is equal to costs.

From a financial standpoint, increasing block rates shift a higher percentage of revenue to the last units of water being sold, which are particularly sensitive to annual weather fluctuations. This could complicate revenue forecasting by creating greater seasonal and annual fluctuations in revenue. Large volume users consider this rate inequitable.

SEASONAL BLOCK RATE: Seasonal pricing involves charging more for water in summer months, when demand is high, and less in winter months when demand is low. Seasonal pricing is based on the assumption that water systems are sized to meet peak summer demands, and that the incremental cost of extra system capacity required for peak summer demands should be recovered through higher summer water rates.

Seasonal pricing can be implemented in conjuntion with increasing block rates. In this combination the increasing block rate would be based on the market cost of the water resources using the cost associated with production, conservation and reuse programs, and surface water development. The seasonal rate would be an adjustment to the summer months based on cost of extra system capacity.

EXCESS USE PENALTY: Excess use penalty would be a penalty imposed on the water user when their water use increases by more than a set percentage of an allocated amount, average monthly use, or previous monthly use.

NEW CONSTRUCTION

- o New Construction would be required to include water conserving devices that do not increase construction costs and install low flow and utlra-low-flow toilets, low flow shower heads, hot water pipe insulation, pressure reducing valves at the water meters, faucet aerators, and water efficient dishwashers.

- o Landscapes for new contruction would be required to make use of Xeriscape principles in developing low water use landscapes. New developments would be required to restrict the amount of lawn area as a percent of total landscaped area, and incorporate low water use plant materials, low volume irrigation systems such as drip or low flow irrigation technologies with moisture sensors such as tensiometers for valve controllers.

- o Gray water systems for residential development would be encouraged through an incentive programs. Gray water reuse for a very great reduction in residential water use, by using filtered waste water for toilet flushing and landscape irrigation. Through the use grey water reuse techniques, residential water requirements may be reduced by 25%.

PUBLIC FACILITES

- o Leak detection and prevention programs would be implemented to reduce the unaccounted for water losses associated with water main breaks. A preliminary review of San Antonio City Water Board's unaccounted for water loss data suggests that approximately 600 acre feet per year could be saved in avoidable unaccounted for water losses. Data also suggest that the City Water Board has been reducing unaccounted for water losses since 1980.

  It is important to point out that distribution systems have unavoidable and undiscoverable leakage. A fair measure of undiscoverable losses in a well constructed distribution system is described as the following: one drop per second from each joint, five drops per second from each hydrant and stop valve, and three drops per second from each service pipe, including tap and unit cock. Given the typical distribution network, unavoidable and undiscoverable leakage is estimated to be between 2500 and 3000 gallons per mile per day.

- o Public facilities such as offices, parks, schools, and airports would be required to retrofit toilets with water dams or the equivalent, install faucet aerators, automatic closing faucets, and shower flow restrictors. The purpose of this program would be to insure the efficient water use at public facilities.

  Assuming that water used at City of San Antonio municipal administration buildings and other facilities is reported as free metered water by the City Water Board, preliminary data suggest that 7,500 acre feet of water per year is used for purposes such as drinking, toilet flushing, swimming pools, and the San Antonio river. For the purposes of this report a goal of 15% reduction or 1125 AF per year has been set.

- o Public facility landscape irrigation programs would consist of educational programs and adoption of landscape management practices that conserve water. In this proposal a goal of 20% reduction in public facility irrigation has been used.

  A preliminary review of San Antonio City Water Board unaccounted for water data suggests that for the period 1983 to 1986 seasonal unaccounted for water averaged 12,400 acre feet per year. Assuming that this water is used for landscape irrigation at public facilities, improvements in the application of this water may result in an additional 20% or 2,500 acre feet per year reduction in unaccounted for water.

Alternative 2C

Actions Required	Responsible Entity
Retrofit Policy	Cities/purveyors
Public Education Activity	EUWD/Cities/purveyor
School Education Activity	EUWD/Cities/purveyors
Landscape Education Activity	EUWD/Cities/purveyors
Pricing Policies	Cities/purveyors/EUWD
New Construction Ordinance	Cities/purveyors
Landscape Incentive Policy	EUWD/Cities/purveyors
Public Facility Retrofit	City, County, State, & Federal entities
Public Facility Landscape	City, County, State, & Federal entities
Leak Detection Policy	Cities/purveyors
Energy Generation Policy	Utility companies
Manufacturing Policy	Manufacturer
Agricultural Irrig Policy	Irrigators

FISCAL CONSIDERATIONS:

Retrofit Policy	Cities/purveyors	$506,000/yr
Public Education Activity	EUWD/Cities/purveyors	$200,000/yr
School Education Activity	EUWD/Cities/purveyors	$200,000/yr
Landscape watering and scheduling	EUWD/Cities/purveyors	$200,000/yr
New construction Devices	Developers	$180,000/yr
Low Water Landscapes and Irrigation	Developers	$26,273,000/yr
Public Facility Retrofit	Govt Entities	$10,000/yr
Public Facility Irrigation & Landscape	Govt Entities	$25,000/yr
Leak Detection Program	Cities/purveyors	$150,000/yr
Energy Generation Policy	Utility companies	$
Manufacturing Policy	Manufacturers	$
Agricultural Conservation Policy	Agricultural Irrigators	$

APPENDIX J
ISSUES TO CONSIDER IN DISCUSSION OF FINANCIAL ALTERNATIVES

I. Institutional Issues

A. Legislative changes required to implement financing mechanisms.

1. Is the proposed legislation constitutionally permissible?

2. Is it politically viable?

B. Selection of administering agency.

1. Should an existing agency assume this function (e.g., CWB, EUWD, SARA, GBRA), or should a new regional agency be established?

2. What financing options are available to that agency? (For example, can it tax? issue bonds?)

3. Will this decision require legislative change?

C. Water rights market.

1. Should this include a system of "credits" for water rights in return for financial contributions?

2. Should it include credits for substitution of other non-potable water?

D. Future decision making process.

1. How will major policy issues be decided?

2. How will routine matters be determined?

II. Cost Allocation Issues

A. Basis of "allocating" cost to each county.

1. Should costs be allocated based on population, acreage, water use, or some other measure?

2. How does an area "buy into" the allocation program based on need?

III. Impact Issues

A. Geographic and sectoral impact.

1. How would the financing mechanism affect the population in each of the counties within the Edwards District?

2. How would it affect significant sectors of the population?
   - Municipal and industrial users
   - Irrigators
   - Tourists
   - Existing users vs. new development.

B. Regional economic impact.

1. How would the financing mechanism affect industries located in the region now?

2. How would it affect new industry considering locating here?

3. Would it create a special hardship on agricultural businesses?

C. Impacts on utilities/agencies.

1. How would the financing mechanism affect their revenues and expenses?

2. Would it increase the scope of their responsibilities?

D. Region-wide equity.

1. Would financing burdens be distributed equitably?

IV. <u>Financial Policy Issues</u>.

A. Selection of financing agency.

1. What agency(s) should have the responsibility for administering the financing mechanism?

2. Will this decision require legislative change?

B. Types of costs involved and appropriate financing for each.

1. Should operation and maintenance costs be financed from taxes or operating revenues?

2. Who should bear the cost? (For example, the cost of checking wells, or permitting wells.)

3. Should capital costs be financed through debt? Debt alternatives must consider:

a. Proportion of construction cost to be financed through debt <u>vs</u>. revenue;
b. Advantages/disadvantages of General Obligation bonds (lower interest rate <u>vs</u>. limit on amount an entity can issue and requirement of voter approval);
c. Advantages/disadvantages of Revenue bonds (fewer limitations <u>vs</u>. higher interest rate);
d. Whether entire amount should be issued at one time or spread over annual issues to cover requirements for each year;
e. Whether entire amount will be tax-exempt;
f. Required reserve fund amount;
g. Impact on debt coverage ratio for the issuing entity;
h. Optimum maturities to minimize interest rate;
i. Cost of issuing the bonds.

C. Limitations on potential financing mechanism increases.

1. What limits are imposed on taxes by law? (For example, the Edwards District can only collect $.02 maximum per $100 under current law.)

2. What is the practical ceiling on fees (e.g., a well pumping fee)?

D. Ability to enforce fees.

1. Is the cost of enforcement prohibitive? (For example, the cost of checking every well.)

2. Is the required fee structure politically feasible?

E. Over- or Under-Recovery.

1. What if the mechanism over- or under-recovers the needed revenue?

F. Potential State and Federal Grants.

1. What is their realistic availability?

2. What conditions and limitations would come with them?

G. Privatization options.

1. How should potential tax advantages/disadvantages be handled?

H. Financial Flexibility.

1. Can the financing mechanism be easily updated?

V. <u>Utility Rate Issues</u>.

A. Impacts on Ratepayers.

1. How would rate changes affect existing <u>vs</u>. future customers--"old water" <u>vs</u>. "new water"?

2. How would they affect residential <u>vs</u>. commercial <u>vs</u>. industrial customers?

3. Should lifeline rates be instituted?

4. How can we avoid "rate shock"?

B. Impacts on Utilities.

1. How can we assure stability of the revenue source supporting the financing mechanism?

   a. What happens in extremely dry or wet years?
   b. What is the impact on revenues of the price-elasticity of demand on revenues?
   c. What would be the impact on extension charges of slower than expected growth?

2. What is the potential for over/under recovery of revenue with steeply inverted block rates?

3. What is the proper balance between system development charges and rate-generated revenues to recover capital costs?

4. How would this affect the principle of setting rates based on actual costs?

VI. <u>Conservation Issues</u>

A. Consistency with conservation objective.

1. Does the proposed financing mechanism tend to encourage conservation?