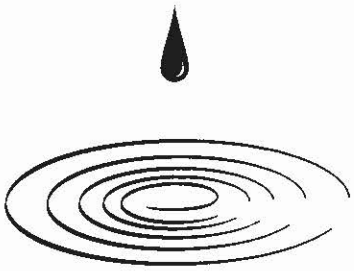

EDWARDS AQUIFER
AUTHORITY

Draft
30-Year Water Supply Plan

March 2001

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The Edwards Aquifer Authority (Authority) 30-Year Water Supply Plan was prepared under the guidance and direction of the Aquifer Management Planning Committee and the Comprehensive Water Management Plan Workgroup of the Authority's Board of Directors. The 30-Year Water Supply Plan was coordinated with the Brown-Lewis regional planning effort. Staff input to the 30-Year Water Supply Plan was provided under the direction of Mr. Gregory M. Ellis, General Manger, Mr. Rick Illgner, Program Manager for Planning and Conservation, and Mr. Ray Buck, AICP, Water Resources Coordinator. Mr. Mike Personett, Consultant, assisted throughout the development and writing of the plan.

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30-YEAR WATER SUPPLY PLAN FOR THE EDWARDS AQUIFER REGION

1.0 INTRODUCTION

Management of the Edwards Aquifer to maintain acceptable minimum flows at Comal and San Marcos Springs during drought conditions is central to the mission of the Edwards Aquifer Authority. The Authority, which was established in 1993 by Senate Bill 1477 (73rd Texas Legislature), is mandated to manage the southern portion of the Edwards Aquifer to protect important environmental resources while also protecting water supplies for municipal, industrial, irrigation and other water uses. The Authority's jurisdiction includes all of Bexar, Medina, and Uvalde counties and portions of Atascosa, Caldwell, Comal, Guadalupe, and Hays counties. Within this area, the Authority's enabling act requires that total permitted withdrawals from the aquifer be limited to no more than 450,000 acre-feet per year (ac-ft/yr) through 2007 and to 400,000 ac-ft/yr by 2008, unless the Authority's Board of Directors determines that additional supplies are available from the aquifer. Further, by the end of 2012, the Authority is required to ensure that spring flows are maintained at Comal and San Marcos Springs to protect threatened and endangered species to the extent required by federal law.

At present the Edwards Aquifer is the primary source of water supply for municipal, industrial, irrigation, and other uses within the Authority's jurisdictional area. The imposition of regulatory limits on withdrawals from the aquifer will therefore necessitate implementation of water management strategies, both to supplement available water supplies to satisfy current water demands and to provide additional water supplies to meet the growing water demands of the region.

1.1 Water Supply Planning in the Edwards Aquifer Region

Almost continuously since the mid-1980s, major water purveyors and water users in the Edwards Aquifer Region have been engaged in regional water resources planning with the goal of identifying cost-effective and environmentally acceptable water management strategies for meeting current and future water needs. The most recent effort, initiated and funded under Texas Senate Bill 1 (75th Texas Legislature), recently culminated with the adoption of a regional water supply plan for the South Central Texas Regional Water Planning Area (SCTRWPA), an area which includes all or portions of 21 Texas counties and which encompasses all of the Authority's jurisdictional area. Pursuant to S.B. 1 and rules of the Texas Water Development Board (TWDB), the regional water plans were required to include an assessment of current and projected water demands and current water supply availability, the identification of water supply needs, and an evaluation of strategies for meeting the identified water needs. Specific strategies were to

be recommended for individual "water user groups" with current or projected needs through 2030. Long-term strategies or alternative scenarios could also be included in the adopted regional water plans for the period from 2030 to 2050. However, strategy recommendations were not required if it was determined that there are no feasible strategies for meeting particular water needs.

The Authority's enabling act also requires the Authority to adopt a Comprehensive Water Management Plan (CWMP). The CWMP is to include conservation, future supply, and demand management plans; and, a 20-year plan for providing alternative supplies of water to the region, with five-year goals and objectives. In developing the CWMP, the Authority is to:

- Thoroughly investigate all alternative technologies;
- Investigate mechanisms for providing financial assistance for alternative supplies through the TWDB; and
- Perform a cost-benefit and environmental analysis.

The Authority initiated development of its CWMP in 1999. Early in this process it was determined that every effort would be made to coordinate the Authority's water supply planning with the development of the water plan for the South Central Texas Region, both to avoid unnecessary and costly duplication of effort and to ensure consistency. It should be noted that S.B. 1 includes provisions requiring the management plans of groundwater districts to be consistent with adopted regional water plans. Consequently, for the development of the CWMP, the Authority has generally adopted the planning methods and assumptions specified for the S.B. 1 regional planning program. This includes increasing the water supply planning horizon for the CWMP to 30 years and planning on 10-year increments. Although the Authority's statute prescribes five-year increments and goals, the Authority has determined there is minimal value in making the mid-decade interpolations. Particularly, the interpolations are of little value in light of the ten-year schedule for supply development by the SCTRWP. The Authority also agreed to adopt the SCTRWP water demand projections for the area within the Authority's regulatory jurisdiction. It was also agreed that the Authority would use consistent assumptions with regard to water availability from the Edwards Aquifer and consistent methods and assumptions for the evaluation of water management strategies.

In January 2000, a decision was made to delay the completion of the 30-year water supply plan component of the EAA CWMP until the final adoption of the SCTRWP. Specifically, once recommended strategies have been determined for meeting the water supply needs of the larger South

Central Texas Region, those strategies that apply to water users within the EAA's jurisdiction would be "extracted" from the regional plan and would form the basis for the EAA's 30-year water supply plan. Additionally, the cost/benefit analysis, the environmental analysis, and the TWDB funding sections for the 30-year water supply plan will be developed, finalized, and included in the CWMP when the SCTRWP is approved and adopted by the TWDB.

The Edwards Aquifer Authority (the Authority) has also initiated development of a combined Habitat Conservation Pan (HCP) and Environmental Impact Statement (EIS) for submittal to the U.S. Fish and Wildlife Service (USFWS). The focus of the HCP/EIS is to identify regulatory and management measures that, if implemented, will ensure the survival of nine Edwards Aquifer-dependent species, which have been listed, or are candidates for listing, as either threatened or endangered by the USFWS pursuant to the federal Endangered Species Act (ESA). The objective of the HCP/EIS is to satisfy the requirements of the both the ESA and the National Environmental Policy Act (NEPA). If approved by the USFWS, the HCP is expected to provide the basis for the issuance of an "incidental take" permit to the Authority that would allow the "lawful taking" of listed species should flows at Comal and San Marcos Springs fall below "take" levels established by the USFWS.

1.2 Purpose and Organization of Report

The Authority has adopted the recommendations presented in the South Central Texas Regional Water Plan as the 30-year water supply plan component of the Authority's Comprehensive Water Management Plan. Relevant information has been extracted from the regional water plan for the portion of the South Central Texas Regional Water Planning Area that is within the Authority's jurisdiction. This includes information pertaining to currently available water supply, projected water demands, projected water supply needs, and recommended strategies and their estimated costs. The Authority has adopted the recommendations presented in the SCTRWP with the understanding that regional water supply planning is a dynamic process and that SCTRWP is to be updated at a minimum every five-years. Accordingly, water management strategies recommended for implementation may be modified to reflect changing conditions or new information. Also, it is understood that other water management strategies that are of interest to the Authority will continue to be evaluated for possible inclusion in the SCTRWP and the Authority's water supply plan in the future.

In preparing this plan, the Authority relied on published information contained in the "initially prepared" draft and final draft of the SCTRWP and its appendices. In addition, extensive coordination occurred

with South Central Texas Regional Water Planning Group's engineering and planning contractor to ensure the accuracy of the information presented in the Authority's water supply plan.

The Authority's 30-year water supply plan is organized into three sections. Section 2.0 presents an overview of projected water demand and currently available water supply for the Authority's jurisdictional area. Also presented is a summary of water supply needs derived from the comparison of estimates of currently available water supply with projected water demands. This supply/demand analysis is presented for a "baseline scenario" of 340,000 acre-feet per year of withdrawals from the Edwards Aquifer, which is the water availability scenario adopted for planning purposes and used in the SCTRWP.

Section 3.0 of this plan provides a summary of water management strategies currently underway and the water management strategies recommended in the SCTRWP for implementation within the Authority's jurisdictional area. This includes information regarding the quantities and timing of water supplies to be provided by each strategy.

Section 4.0 presents a summary of the water supply plan for the Edwards Aquifer Region as presented in the adopted water plan for the South Central Texas Regional Water Planning Area.

2.0 SUPPLY/DEMAND ANALYSIS FOR THE EDWARDS AQUIFER AUTHORITY JURISDICITIONAL AREA

A key element of the S.B. 1 regional water planning process was to identify current and future water supply needs, or alternatively, potential water shortages. The "needs identification" was the result of comparing estimates of currently available water supplies under a "no new development scenario" to projections of future water demand. Water supply estimates under "no new development" refer to current conditions without new or expanded sources of supply. According to TWDB rules, this supply/demand analysis was to be performed for individual water user groups (WUGs). Within the municipal water use sector, all cities with a population of greater than 500 are designated WUGs. The rural areas of each county in the aggregate are also considered an individual WUG as are the aggregated water demands at the county-level for the manufacturing, steam electric power generation, irrigation, mining, and livestock water use categories.

For this analysis, projected water demands and estimates of currently available water supply were extracted from the SCTRWP for those WUGs and portions of WUGs that are located within the Authority's jurisdiction. The "template" for extracting this information was developed through the Trans-

Texas Water Program, West-Central Study Area and has been previously applied in the development of the Authority's CWMP (EAA 2000). It should be noted that the apportionment of projected water demand and currently available water supply for counties that are partially within the Authority's jurisdiction are approximations.

2.1 Water Demand Projections

The area within the Authority's jurisdiction has and is continuing to experience rapid population growth and corresponding increases in water demand. The estimated population of the area was 1.36 million in 1990. This has increased to an estimated population of 1.72 million at present; a 26 percent increase for the decade.

Estimated water use in 1990 and 1996 and water demand projections for the Authority's jurisdictional area are presented in Table 1. As indicated, total water demand within the Edwards Aquifer region is projected to increase by approximately 150,000 ac-ft/yr or by nearly 20 percent over the next 30 years. However, combined, the municipal, industrial, and steam electric water use sectors are projected to increase by more than 188,000 ac-ft/yr (44 percent increase), which at a regional level, is partially offset by a projected decrease in irrigation demand of nearly 39,000 acre-feet (12 percent decrease).

Table 1 – Historical and Projected Water Demand by Use Sector for the EAA Jurisdictional Area

Type of Use	1990	1996	2000	2010	2020	2030
Municipal	259,402	297,786	357,571	399,826	451,148	524,243
Industrial	19,028	34,519	22,192	25,287	28,163	31,117
Steam Electric	24,263	25,714	46,760	53,160	57,160	62,160
Irrigation	336,477	212,904	321,026	306,685	294,215	282,256
Mining	3,064	16,568	11,400	11,236	11,724	12,164
Livestock	5,238	7,276	6,178	6,178	6,178	6,178
Total	**647,472**	**594,767**	**765,127**	**802,372**	**848,588**	**918,118**

It should be noted that the demand projections presented above, which are taken from the initially prepared draft of the SCTRWP, are somewhat higher than recent historical use. The projections are based on forecasts developed by the TWDB in the early 1990's and which are used in the 1997 State Water Plan. For the municipal water use sector, demand projections are based on "dry-year" conditions, relatively high growth rates, and per capita water use rates from the early 1980s. Consequently, municipal water demand projections may not fully account for the significant reductions in per capita water use that have occurred over the past decade, particularly in Bexar County. For example, total reported municipal water use in the Edwards Aquifer area for 1990 and 1996 was 259,402 ac-ft and

297,786 ac-ft, respectively. As indicated in Table 1, current demand (i.e., year 2000) is estimated to be 357,571 ac-ft, which is 20 percent higher than estimated water use during 1996.It should be noted, however, that during 1996 municipal water demands throughout the region were affected by water use restrictions and that the "unconstrained" demand would likely have been appreciably higher that year. In any case, the adopted municipal water demand projections for the region can be considered "conservative" in that current levels of municipal water use are most likely lower than the projection of year 2000 water demand.

The irrigation demand projections presented in Table 1 should also be considered conservative. Unlike municipal water demand, which tend to be relatively consistent from year to year, irrigation demands can vary considerably. For example, in 1990, estimated irrigation water use in Bexar, Medina, and Uvalde counties was 335,061 ac-ft, while in 1996 estimated irrigation water use was only 212,416 ac-ft. The wide variation in estimates of irrigation water use are explained by local weather conditions, economic factors, which influence the amount of irrigated acreage and crop types, and water supply constraints. Also, historical estimates of irrigation water use are based largely on estimates of irrigated acreage and the estimated water use of different types of crops rather than actual measured use. The relatively high year 2000 projection should therefore be regarded as a demand scenario that combines very high acreage levels, high water use under dry conditions, and no water availability constraints or restrictions on use.

Water demand projections for each water use sector, by county, are presented in Tables 2 through 7 below.

Table 2 – Projected Municipal Water Demand within the EAA Jurisdictional Area

Municipal	2000	2010	2020	2030
Atascosa	559	600	635	701
Bexar	306,064	338,626	381,015	439,753
Caldwell	5,055	5,526	5,960	6,548
Comal	13,501	16,407	20,263	25,676
Guadalupe	6,028	9,027	10,174	12,547
Hays	12,542	15,254	18,317	23,167
Medina	7,112	7,312	7,467	7,832
Uvalde	6,710	7,074	7,317	8,019
Total	**357,571**	**399,826**	**451,148**	**524,243**

Table 3 – Projected Industrial Water Demand within the EAA Jurisdictional Area

Industrial	2000	2010	2020	2030
Atascosa	0	0	0	0
Bexar	16,805	19,682	22,359	24,935
Caldwell	0	0	0	0
Comal	3,450	3,487	3,548	3,799
Guadalupe	942	1,051	1,124	1,193
Hays	93	105	118	129
Medina	302	319	339	361
Uvalde	600	643	675	700
Total	**22,192**	**25,287**	**28,163**	**31,117**

Table 4 – Projected Steam Electric Power Generation Demand within the EAA Jurisdictional Area

Steam Electric	2000	2010	2020	2030
Atascosa	0	0	0	0
Bexar	36,000	36,000	40,000	45,000
Caldwell	0	0	0	0
Comal	0	0	0	0
Guadalupe	10,760	10,760	10,760	10,760
Hays	0	6,400	6,400	6,400
Medina	0	0	0	0
Uvalde	0	0	0	0
Total	**46,760**	**53,160**	**57,160**	**62,160**

Table 5 – Projected Irrigation Demand within the EAA Jurisdictional Area

Irrigation	2000	2010	2020	2030
Atascosa	1,442	1,341	1,287	1,235
Bexar	40,003	36,879	35,320	33,827
Caldwell	0	0	0	0
Comal	0	0	0	0
Guadalupe	0	0	0	0
Hays	0	0	0	0
Medina	144,413	138,582	132,804	127,270
Uvalde	135,168	129,883	124,804	119,924
Total	**321,026**	**306,685**	**294,215**	**282,256**

Note: The portion of total irrigation demand associated with conveyance and distribution losses from the Bexar-Medina-Atascosa Water District was inadvertently left out of the projections for Medina County. For the year 2000, the amount associated with such losses is approximately 22,000 ac-ft/yr.

Table 6 – Projected Mining Water Demand within the EAA Jurisdictional Area

Mining	2000	2010	2020	2030
Atascosa	0	0	0	0
Bexar	4,963	4,936	5,201	5,406
Caldwell	0	0	0	0
Comal	5,570	5,464	5,628	5,796
Guadalupe	196	198	200	202
Hays	84	82	68	55
Medina	143	128	128	129
Uvalde	444	428	499	576
Total	**11,400**	**11,236**	**11,724**	**12,164**

Table 7 –Projected Livestock Water Demand within the EAA Jurisdictional Area

Livestock	2000	2010	2020	2030
Atascosa	2	2	2	2
Bexar	1,487	1,487	1,487	1,487
Caldwell	416	416	416	416
Comal	178	178	178	178
Guadalupe	566	566	566	566
Hays	121	121	121	121
Medina	1,914	1,914	1,914	1,914
Uvalde	1,494	1,494	1,494	1,494
Total	**6,178**	**6,178**	**6,178**	**6,178**

2.2 Currently Available Water Supply under Alternative Edwards Aquifer Withdrawal Limits

Estimates of currently available water supply for the Authority's jurisdictional area were developed for an Edwards Aquifer pumping scenario of 340,000 ac-ft/yr, 450,000 ac-ft/yr, 400,000 ac-ft/year, 275,000 ac-ft/year, and 175,000 ac-ft/year. As indicated previously, the 340,000 ac-ft/year pumpage scenario was used as the baseline for water availability from the Edwards Aquifer for the SCTRWP. It should be noted and emphasized that the estimates of supply for the Edwards Aquifer pumpage scenario of 340,000 ac-ft/yr is for planning purposes only and does not reflect the Authority's current regulatory policies.

For this analysis, consultants to the SCTRWPG (HDR Engineering) developed estimates of currently available water supplies within the Authority's jurisdiction that are from non-Edwards Aquifer sources. These estimates are added to estimates of supply availability from the Edwards Aquifer for the 340,000 ac-ft/yr pumpage scenario. This information is presented in Tables 8 below.

2.3 Water Supply Needs

A comparison of water supply availability to projected water demands indicates that significant shortages exist within the Authority's jurisdictional area under the baseline Edwards Aquifer pumpage scenario. As indicated in Table 9, at present there is a shortage of approximately 240,000 ac-ft/yr, increasing to the

shortages range from nearly 127,000 ac-ft/yr to approximately 402,000 ac-ft/yr at present, increasing to approximately more than 400,000 ac-ft/yr by 2030.

Table 8 – Estimated Supply under 340,000 ac-ft/yr Edwards Aquifer Pumpage Scenario

Edwards Aquifer	2000	2010	2020	2030
Municipal	153,680	153,680	153,680	153,680
Irrigation	165,889	165,889	165,889	165,889
Industrial	20,431	20,431	20,431	20,431
Steam Electric	-	-	-	-
Mining	-	-	-	-
Livestock	-	-	-	-
Sub-Total	340,000	340,000	340,000	340,000
Non-Edwards				
Municipal	77,584	72,229	72,116	63,001
Industrial	10,726	10,726	10,726	10,726
Steam Electric	71,768	75,704	75,704	75,704
Irrigation	16,830	16,849	16,774	9,253
Mining	518	488	557	633
Livestock	6,178	6,178	6,178	6,178
Sub-Total	183,604	182,244	181,055	165,495
Total	**523,604**	**522,244**	**521,055**	**505,495**

Table 9 – Estimated Water Needs under 340,000 ac-ft/yr Edwards Aquifer Pumpage Scenario

	2000	2010	2020	2030
Demand	765,127	802,372	848,588	918,118
Supply	523,604	522,244	521,055	505,415
Need/Shortage	**-241,523**	**-280,128**	**-327,533**	**-412,623**

3.0 WATER MANAGEMENT STRATEGIES

As previously indicated, regional water supply plans developed pursuant to S.B. 1 and TWDB rules are required to recommend specific water management strategies, either singly or in combination, to meet identified water needs through 2030. Recommended strategies are to provide a "firm" or dependable water supply under drought-of-record hydrologic conditions. However, recommendations are not required if it is determined that there are no feasible strategies for meeting a particular need.

The SCTRWP includes recommended water management strategies that will meet all current and projected municipal, industrial, steam electric power generation, and mining needs within the South Central Texas Region and within the Authority's jurisdiction. However, the SCTRWP does not include recommendations for meeting all irrigation needs. Except for limited investments in irrigation water efficiency measures to reduce the magnitude of projected shortages, it was determined by the South Central Texas RWPG that there are no feasible strategies for meeting all projected irrigation demands.

This section provides a summary of the water management strategies included in the SCTRWP for water user groups within the Authority's jurisdiction. This includes water management strategies that are currently being implemented with existing funding, as well as strategies recommended for future implementation. Water supply "yield" estimates are provided for the strategies that are currently being implemented as well as for the recommended strategies. However, cost estimates are provided only for strategies recommended for implementation in the future as this information was not included in the SCTRWP for strategies that are already in progress. It should be noted that water supply yield and cost information is not shown for any of the recommended strategies for the year 2000. The SCTRWP recommends a number of strategies for immediate implementation but makes note that "candidate new supplies shown for the year 2000 are identified, but will not be available immediately." For this analysis, it is assumed that these strategies will be implemented during the current decade and that the supplies will become available by 2010.

In addition to information about the strategies in progress and the strategies recommended for implementation in the future, an overview of strategies recommended for further study is also provided.

3.1 Management Strategies Currently in Implementation

The SCTRWP recognizes seven water management strategies that are currently in some stage of implementation. These are projects for which there is a sponsoring entity and for which funding is already in place. Each of these strategies will provide additional water supply to users within the Authority's jurisdiction in the amounts shown in Table 10. As indicated, the estimated total amount of new supply to be provided by all of these strategies for users within the Authority's jurisdiction is approximately 38,000 ac-ft/yr by 2010, decreasing to 33,000 ac-ft/yr in 2020 and thereafter. A summary of each of these strategies is provided in the subsections that follow.

Table 10 – Water Management Strategies Underway with Existing Funds

Strategy (SCTRWP Identifier)	2000	2010	2020	2030
Schertz-Seguin WSP (SSWSP)	NA	12,470	12,470	12,470
Western Canyon Regional WSP (WCRWSP)	NA	4,500	4,500	4,500
Lake Dunlap WTP Expansion/Mid-Cities Project (CRWA)	NA	5,200	0	0
Carrizo Aquifer - Bexar/Guadalupe Counties (BMWD)	NA	4,000	4,000	4,000
Trinity Aquifer - Bexar County (BMWD)	NA	1,000	1,000	1,000
GBRA Canyon Reservoir Contract Renewal (GBRA)	NA	6,720	6,720	6,720
Hays/IH35 Water Supply Project	NA	4,500	4,500	4,500
Total	**NA**	**38,390**	**33,190**	**33,190**

3.1.1 Schertz-Seguin Water Supply Project (SSWSP)

The Schertz-Seguin water supply project consists of the development of a well field in the Carrizo Aquifer primarily in the southern portion of Gonzales County. The project is being developed by the Schertz-Seguin Local Government Corporation. Full implementation of this strategy will provide 20,000 ac-ft/yr of dependable water supply to users in Bexar, Comal, and Guadalupe counties. The estimated amount of water to be supplied by the project to users within the Authority's jurisdiction is shown in Table 11.

Table 11 – Water Supply from the Schertz-Seguin Water Supply Project for Users within the EAA Jurisdiction (ac-ft/yr)

	2000	2010	2020	2030
Bexar County				
Schertz (outside city)	NA	2,404	2,404	2,404
Guadalupe County				
Schertz	NA	7,596	7,596	7,596
Rural (60% of county total)	NA	1,020	1,020	1,020
Industrial (50% of county total)	NA	450	450	450
Steam Electric (100% of county total)	NA	1,000	1,000	1,000
Total	**NA**	**12,470**	**12,470**	**12,470**

3.1.2 Western Canyon Regional Water Supply Project (WCRWSP)

The Western Canyon Regional Water Supply Project (WCRWSP) is being implemented by the Guadalupe-Blanco River Authority (GBRA) and consists of the construction of a water treatment plant west of Canyon Reservoir and development of a water transmission system to deliver water to project participants. Full implementation of the project will provide a dependable water supply of 10,500 ac-ft/yr to users in Bexar, Comal, and Kendall counties. The estimated amount of water to be supplied by the project to users within the Authority's jurisdiction is presented in Table 12.

It should be noted that implementation of this strategy requires amendment of existing water rights held by GBRA for supply from Canyon Reservoir (Certificate of Adjudication No. 18-2074). The application for amendment of the water rights permit is currently pending before the Texas Natural Resource Conservation Commission (TNRCC).

Table 12 – Water Supply from the Western Canyon Regional Water Supply Project for Users within the EAA Jurisdiction (ac-ft/yr)

	2000	2010	2020	2030
Bexar County				
Fair Oaks	NA	500	500	500
San Antonio	NA	1,813	1,813	1,813
BMWD (other subdivisions)	NA	2,137	2,137	2,137
Rural	NA	50	50	50
Total	**NA**	**4,500**	**4,500**	**4,500**

3.1.3 Lake Dunlap Water Treatment Plant Expansion and Mid-Cities Project

The Lake Dunlap Water Treatment Plant Expansion and Mid-Cities Project is being implemented by the Canyon Regional Water Authority (CRWA). The project will divert water from Lake Dunlap north of the City of Seguin and will deliver water to CRWA participating entities via a water transmission and distribution system. The project will supply a total of 5,200 ac-ft/yr of municipal water supply delivered from Canyon Reservoir under a contract with GBRA. The estimated amount of water to be supplied by the project to users within the Authority's jurisdiction is shown in Table 13. This amount is shown as unavailable in 2020 and thereafter due to expiration of the water supply contract between CRWA and GBRA.

Table 13 – Water Supply from the Lake Dunlap WTP Expansion and Mid-Cities Project for Users within the EAA Jurisdiction (ac-ft/yr)

	2000	2010	2020	2030
Bexar County				
BMWD (other subdivisions)	NA	4,000	0	0
Rural	NA	1,200	0	0
Total	**NA**	**5,200**	**0**	**0**

3.1.4 BMWD Carrizo Aquifer

The Bexar Metropolitan Water District (BMWD) is currently implementing a project to supply a total of 4,000 ac-ft/yr from the Carrizo Aquifer in Bexar and Guadalupe counties to its customers (municipal users) in southern and northeastern Bexar County (i.e., Somerset and other BMWD subdivisions).

3.1.5 BMWD Trinity Aquifer

The BMWD is also implementing a project to supply approximately 1,000 ac-ft/yr from the Trinity Aquifer to its customers in northern Bexar County (i.e., Hill Country Village and Hollywood Park).

3.1.6 GBRA Canyon Reservoir Contract Renewal

The City of New Braunfels has an existing contract with GBRA for the supply of 6,720 ac-ft/yr from Canyon Reservoir with diversion from the Guadalupe River at New Braunfels. The contract has an expiration date of December 5, 2001. Under TWDB guidelines for S.B. 1 planning, the water supply associated with a contract is to be shown as unavailable in the decade following contract expiration. Consequently, a recommended water management strategy for the City of New Braunfels is to renew its existing contract with GBRA. It should be noted that other municipal water users within the Authority's jurisdiction also have water supply contracts with GBRA. However, these contracts do not expire during the 30-year planning period.

3.1.7 Hays/IH35 Water Supply Project

The Hays/IH35 Water Supply Project is currently being implemented to provide water supply to the cities of Kyle and Buda and to rural water users through the Creedmore-Maha Water Supply Corporation. The project involves the delivery of stored water from Canyon Reservoir through a diversion at Lake Dunlap and an existing regional water treatment plant at San Marcos. Full implementation of the project will include construction of a pipeline to deliver treated water from the San Marcos treatment plant to other users in Hays County.

Table 14 – Water Supply from the Hays/IH35 Water Supply Project for Users within the EAA Jurisdiction (ac-ft/yr)

	2000	2010	2020	2030
Hays County				
Rural	NA	4,400	4,400	4,400
Mining	NA	100	100	100
Total	**NA**	**4,500**	**4,500**	**4,500**

3.2 Management Strategies Recommended in the South-Central Texas Regional Water Plan

Sixty-one water management strategies were evaluated during the development of the SCTRWP. With variations of these options, the actual total number of strategies evaluated is 79. For the area included in the Authority's jurisdiction, 13 water management strategies are recommended by the SCTRWP for implementation during the next 30 years. An additional strategy, seawater desalination, is recommended for implementation after 2030. An overview of each recommended strategy, including its water supply yield and estimated annual cost, is presented in the subsections that follow.

It is important to note that for each of the strategies recommended in the SCTRWP there are additional steps, issues, and other considerations, which may influence actual implementation. These factors could result in major delays in project implementation or, potentially, a finding that a particular project is not feasible. Major considerations in project implementation include:

Identification of project sponsors. The sponsoring entity is not identified for many of the recommended water management strategies. For example, strategies recommended for supplying nearly 340,000 ac-ft/yr by 2030 to users in Bexar County are to be implemented by an unspecified "Regional Water Provider for Bexar County". According to the draft SCTRWP, this approach recognizes that implementation of some of the recommended strategies should occur on a regional basis, rather than through the independent actions of individual water suppliers/users. The designation of a Regional Water Provider for Bexar County also "...accounts for the fact that the water management strategies will be developed by individual sponsors or coalitions of sponsors" and that it is uncertain at this time who will actually sponsor particular projects. The bottom-line is that many of the institutional relationships required for the implementation of recommended water management strategies have not yet been fully defined.

Additional feasibility-level planning and engineering design. For the most part, the technical, economic, and environmental analyses conducted for the S.B. 1 planning process should be viewed as a "reconnaissance-level". Before potential project sponsors can or will commit to implementation of particular strategies, most will require much more detailed analyses to prove their feasibility. The water supply industry tends to be risk-averse and individual water suppliers are unlikely to fully commit to implementation of particular strategies until there is a greater degree of certainty of outcomes. Also, once the feasibility of a particular strategy has been demonstrated, there will generally be significant additional effort required for engineering design and site-specific environmental impact assessment.

Project permitting. Most of the major water management strategies recommended for implementation, particularly those involving new supply development, will require both state and federal regulatory approvals. For example, projects involving surface water supplies will generally require both a new or amended state water rights permits and federal approvals under Section 404 of the Clean Water Act. Such regulatory approvals will generally require a thorough evaluation of impacts analysis and may trigger a full environmental review under the National Environmental Policy Act (NEPA). Some of the recommended groundwater supply projects will likely require regulatory approvals by local underground water conservation districts. In addition to adding significant expense and time to project implementation, the regulatory process also provides opportunity for challenge by parties opposed to a particular project. This creates a degree of uncertainty with regard to the outcome of any regulatory process. Through the regulatory review process a project could be significantly modified or required regulatory approvals could be denied. Also, even if approved by regulatory agencies, a project could face legal challenge through state or federal courts.

Project financing. Financing for the construction of projects is another major consideration for most of the water management strategies recommended in the SCTRWP. For the South Central Texas Region as a whole, the estimated annual costs for implementation of recommended strategies ranges from approximately $120 million in the near term to approximately $425 million per year by 2040. This represents capital outlays in the billions of dollars, much of which will have to be financed through private markets, perhaps with state or federal assistance or participation. In any case, there will likely be significant demands on borrowing capacity of project sponsors and, importantly, substantial increases in wholesale and retail water rates.

Taken either individually or in combination, the implementation issues described above may render any particular water management strategy "infeasible". The risk and uncertainty is generally greater for those strategies that involve the development of new supply sources. Because of the many uncertainties surrounding implementation of the various water management strategies, as well as uncertainty with regard to the magnitude of projected water needs, the South Central Texas RWPG elected to include strategies which, in combination, will provide significantly more water than is apparently needed to meet projected needs under the 340,000 ac-ft/yr Edwards Aquifer pumpage scenario. This approach is intended to provide flexibility to respond to other changes in water supply or demand conditions or in response to project implementation delays. The approach also provides a cushion should particular strategies prove to be infeasible.

The water management strategies recommended to meet current and future needs within the Authority's jurisdiction are summarized in Table 15 and discussed further in the sections that follow:

Table 15 - Recommended Water Management Strategies

Strategy (SCTRWP Identifier)	2000	2010	2020	2030
Municipal Water Conservation (L-10 Municipal)	NA	44,669	43,660	38,291
Irrigation Conservation (L-10 Irrigation and L-15)	NA	27,314	27,314	27,314
Transfers of Edwards Irrigation Rights to Municipal Use (L-15)	NA	40,486	40,486	41,486
Edwards Aquifer Recharge Enhancement (L-18A)	NA	13,451	21,577	21,577
Canyon Reservoir – River Diversion (G-15C)	NA	10,500	15,700	15,700
Lower Guadalupe River Diversion (SCTN-16)	NA	94,500	94,500	94,500
Lower Colorado River Diversion (LCRA)	NA	0	66,000	138,000
Carrizo Aquifer – Wilson and Gonzales (CZ-10C)	NA	16,000	16,000	16,000
Carrizo Aquifer – Gonzales and Bastrop (CZ-10D)	NA	900	4,950	13,450
Simsboro Aquifer (SCTN-3C)	NA	55,000	55,000	55,000
SAWS Recycled Water Program (SAWS)	NA	19,826	26,737	35,824
Purchase Water from a Major Water Provider	NA	10,000	10,500	12,500
TOTAL	**NA**	**332,646**	**406,424**	**509,642**

3.2.1 Municipal Water Conservation (L-10 Municipal)

This strategy consists of the implementation of "aggressive" municipal water conservation policies and programs to reduce projected municipal water demands. According to the initially prepared draft of the SCTRWP, the projected water savings shown in Table 15 are based on public education, accelerated replacement of toilets, and more water-efficient landscape irrigation practices. However, it is not entirely clear how these water conservation measures differ from those associated with the TWDB's "advanced" water conservation scenario, the effects of which are already incorporated into municipal water demand projections. These "built-in" conservation effects are projected to reduce per capita municipal demand by about 12 to 25 percent over the next 30 years. The additional conservation described by this strategy would further reduce per capita municipal use within the Authority's jurisdiction, on average, by an additional seven percent over this period (17 to 32 percent overall).

A major issue relating to the implementation of municipal water conservation programs is the willingness of local water suppliers to commit the required funding on an on-going basis. Also, small communities within the region may not be able to implement some programs cost-effectively (e.g., toilet replacement,

public education). The Authority may consider developing a regional approach for the implementation of recommended municipal water conservation programs.

Table 16 – Supply and Estimated Cost for Additional Municipal Water Conservation (ac-ft/yr)

County – Use Sector	2000	2010	2020	2030
Atascosa – Municipal	NA	44	47	28
Bexar – Municipal	NA	42,509	41,210	36,533
Comal- Municipal	NA	718	848	718
Guadalupe – Municipal	NA	157	157	5
Hays – Municipal	NA	690	816	699
Medina – Municipal	NA	205	211	73
Uvalde – Municipal	NA	346	371	235
Total	**NA**	**44,669**	**43,660**	**38,291**
Estimated Annual Cost				
Atascosa	NA	$ 10,667	$ 10,645	$ 2,907
Bexar	NA	6,624,964	6,624,964	1,994,968
Comal	NA	192,220	192,220	74,650
Guadalupe	NA	91,753	91,781	44,599
Hays	NA	200,850	203,245	81,103
Medina	NA	72,348	72,348	19,383
Uvalde	NA	84,960	84,960	24,424
Total	**NA**	**$ 7,277,863**	**$ 7,280,169**	**$ 2,242,034**

3.2.2 Irrigation Conservation (L-10 Irrigation and L-15)

This strategy involves the widespread installation of Low Energy Precision Application (LEPA) irrigation systems and the use of furrow dikes to improve on-farm water use efficiency. For irrigated areas that rely on the Edwards Aquifer for supply, this strategy has two components – reductions in irrigation demand to reduce irrigation shortages; and, reductions in irrigation demand with the voluntary transfer of Edwards Aquifer pumpage rights to Bexar County for municipal water use. The SCTRWP recommends that approximately 13,000 ac-ft/yr of irrigation water savings would be used to reduce irrigation shortages, while approximately 32,000 ac-ft/yr would be transferred to the "Regional Provider for Bexar County" for municipal use. However, it was assumed that only 85 percent, or approximately 27,000 ac-ft/yr, would be available for municipal supply during drought due to curtailment of use per the Authority's Critical Period Management Plan. The projected water supply and costs associated with this strategy are summarized in Table 16. According to the SCTRWP, achievement of the estimated irrigation water savings will require the installation of LEPA systems and furrow diking on approximately 84,000 acres in the Edwards Aquifer irrigation area by 2010.

Key issues affecting the implementation of this strategy include the ability and willingness of irrigators to make the necessary investments and resolution of the adjudication of Edwards Aquifer water rights.

However, it is anticipated that much of the costs of irrigation efficiency improvements would be borne by municipal water users. Water rights transfers or leases will also require approval by the Authority.

Table 17 – Supply and Estimated Cost for Irrigation Conservation (ac-ft/yr)

County-Use Sector	2000	2010	2020	2030
Bexar – Municipal	NA	27,314	27,314	27,314
Atascosa – Irrigation	NA	163	109	57
Bexar – Irrigation	NA	1,905	1,905	1,905
Medina – Irrigation	NA	5,000	5,000	5,000
Uvalde – Irrigation	NA	5,958	5,958	5,958
Total	**NA**	**40,340**	**40,286**	**40,234**
Estimated Annual Cost				
Bexar – Municipal	NA	$ 992,318	$ 992,318	$ 0
Atascosa – Irrigation	NA	22,505	15,050	0
Bexar – Irrigation	NA	69,209	69,209	0
Medina – Irrigation	NA	181,650	181,650	0
Uvalde – Irrigation	NA	216,454	216,454	0
Total	**NA**	**$ 1,482,136**	**$ 1,474,681**	**$ 0**

3.2.3 Transfers of Edwards Irrigation Rights to Municipal Use (L-15)

The SCTRWP also recommends that municipal water users in Atascosa, Bexar, Medina, and Uvalde counties, and mining users in Medina County, purchase or lease approximately 50,000 ac-ft/yr of Edwards Aquifer irrigation rights. However, it was assumed that only 85 percent, or approximately, 40,000 ac-ft/yr, would be available for use during drought due to curtailment of use per the Authority's Critical Period Management Plan. Also the amount of municipal water supply provided by this strategy would be in addition to the 32,000 ac-ft/yr of transfers of conserved Edwards Aquifer supplies described above. The estimated supply to be provided by this strategy, and its annual costs, are shown in Table 17.

Implementation of this strategy will require resolution of permitting issues for users of water from the Edwards Aquifer and will depend on the willingness of irrigators to sell or lease their water rights. The transfers or leases will also require approval by the Authority. Under provisions of the Authority's enabling act, the holders of Edwards Aquifer irrigation rights can sell or lease up to 50 percent of their water right. As such, the total amount of irrigation water rights transfers could be approximately 120,000 or one-half of the total amount of irrigation water rights issued by the Authority.

Table 18 – Supply and Estimated Cost for Purchase/Lease of Edwards Aquifer Water Rights for Municipal Use (ac-ft/yr)

County - Use Sector	2000	2010	2020	2030
Atascosa – Municipal	NA	500	500	500
Bexar – Municipal	NA	32,986	32,986	32,986
Medina – Municipal	NA	2,900	2,900	2,900
Uvalde – Municipal	NA	4,000	4,000	5,000
Medina – Mining	NA	100	100	100
Total	**NA**	**40,486**	**40,486**	**41,486**
Estimated Annual Cost				
Atascosa – Municipal	NA	$ 47,059	$ 47,059	$ 47,059
Bexar – Municipal	NA	3,104,642	3,104,642	3,104,642
Medina – Municipal	NA	272,941	272,941	272,941
Uvalde – Municipal	NA	376,480	376,480	470,600
Medina – Mining	NA	9,412	9,412	9,412
Total	**NA**	**$ 3,810,534**	**$ 3,810,534**	**$ 3,904,654**

3.2.4 Edwards Aquifer Recharge Enhancement (L-18A)

This strategy consists of the construction of recharge enhancement structures on streams over the Edwards Aquifer recharge zone. These "Type 2" structures are designed to impound stream flows for a few days or weeks following a storm event. Recharge occurs through direct percolation of the impounded water into the aquifer through the streambed. As recommended in the SCTRWP, this strategy includes development of recharge enhancement projects at as many as 15 sites within Bexar, Comal, Hays, Medina, and Uvalde counties. Implementation of these projects would increase the "sustainable" municipal supply from the Edwards Aquifer for users in Bexar County by 21,577 ac-ft/yr (see Table 18). The total estimated project cost is approximately $287 million with an annualized unit cost of water is $1,087 per ac-ft. In addition to the water supply benefits of the project, recharge enhancement would also increase discharges at Comal and San Marcos Springs by approximately 80,000 ac-ft/yr.

It should be noted that these estimates are based on recharge enhancement projects sized to optimize recharge enhancement and minimize cost. The Authority has evaluated and is considering alternative projects at these sites that would be sized to maximize water storage and aquifer recharge. There are also other potential recharge enhancement sites that could be developed primarily to enhance aquifer levels and spring flows.

Actual development of the recommended recharge enhancement projects will require additional site-specific engineering and environmental analyses and both state and federal permitting. In addition, the Authority's policy with regard to "credits" for recharge enhancement is an unresolved issue, which may significantly affect the economic feasibility of particular recharge enhancement projects. Also, while the

SCTRWP indicates that the strategy is to be implemented by the "Regional Water Provider for Bexar County", it may be that the Authority is the logical sponsor for a recharge enhancement program.

Table 19 - Supply (ac-ft/yr) and Estimated Cost for Edwards Aquifer Recharge Enhancement

County-Use Sector	2000	2010	2020	2030
Bexar - Municipal	**NA**	**13,451**	**21,577**	**21,577**
Estimated Annual Cost				
Bexar - Municipal	**NA**	**$ 21,893,245**	**$ 23,455,062**	**$ 23,455,062**

3.2.5 Canyon Reservoir – River Diversion (G-15C)

This strategy consists of the sale of additional stored water from Canyon Reservoir to municipal and mining water users in Comal County. As indicated in Table 19, this strategy would provide 15,700 ac-ft/yr of additional water supply to municipal, industrial, and mining users in Comal County. Implementation of this strategy could involve diversion of the water supply from the Guadalupe River at or above Lake Nolte and the construction of water treatment and transmission facilities. It should be noted that implementation of this strategy is dependent upon TNRCC approval of GBRA's application to amend Certificate of Adjudication No. 18-2074 to increase the authorized water supply yield of Canyon Reservoir.

Table 20 – Supply (ac-ft/yr) and Estimated Cost for Canyon Reservoir Supply

County-Use Sector	2000	2010	2020	2030
Comal – Municipal	NA	5,030	12,700	15,700
Comal – Mining	NA	5,470	3,000	0
Total	**NA**	**10,500**	**15,700**	**15,700**
Estimated Annual Cost				
Comal – Municipal	NA	$ 3,910,610	$ 9,436,100	$ 9,875,300
Comal – Mining	NA	$ 4,252,641	$ 2,229,000	$ 0
Total	**NA**	**$ 8,163,251**	**$ 11,665,100**	**$ 9,875,300**

3.2.6 Lower Guadalupe River Diversion (SCTN-16)

This strategy consists of the diversion of water from the lower Guadalupe River at the GBRA saltwater barrier to off-channel reservoirs with transmission to a regional treatment facility and distribution to municipal water users in Bexar County. The water supply yield of the project, as shown in Table 20, would include presently underutilized surface water rights held by GBRA and Union Carbide Corporation, unappropriated stream flow, and undeveloped groundwater from the Gulf Coast Aquifer. The SCTRWP recommends that the "Regional Water Provider for Bexar County" sponsor this project. The total estimated cost to develop the project is approximately $429 million. The project will provide water supply at an annualized unit cost of approximately $870 per ac-ft.

A project of this magnitude will require extensive additional engineering, economic, and environmental analysis and will be subject to both state and federal regulatory requirements. Current state policy with regard to interbasin transfers of surface water could also affect project feasibility.

Table 21 – Supply (ac-ft/yr) and Estimated Cost for Lower Guadalupe River Diversion

County – Use Sector	2000	2010	2020	2030
Bexar – Municipal	NA	94,500	94,500	94,500
Estimated Annual Cost				
Bexar – Municipal	NA	$75,925,080	$77,059,080	$77,437,080

3.2.7 Lower Colorado River Diversion (LCRA)

This management strategy is based on a proposal by the Lower Colorado River Authority (LCRA), acting in concert with the Lower Colorado Regional Water Planning Group. The strategy consists of the diversion of water from the lower Colorado River near Bastrop and/or Bay City to off-channel reservoirs, transmission to regional water treatment facilities, and distribution to municipal water users in Bexar and Hays counties. The water supply yield of the project includes presently underutilized surface water rights, stored water from the LCRA Highland Lakes, and undeveloped groundwater from the Gulf Coast Aquifer. As indicated in Table 21, the project would initially provide water supply to users Bexar County by 2020 and to users in Hays County by 2030. In addition to the dependable supply to be provided to users within the Authority's jurisdiction, the project would also provide approximately 180,000 ac-ft/yr of additional supply to meet irrigation needs within the Lower Colorado Region.

A project of this magnitude will require significant additional engineering, economic, and environmental analysis and will be subject to both state and federal permitting requirements. A significant issue that has been raised is the potential adverse impacts on freshwater inflows to and the biological productivity of Matagorda Bay. Also, current state policy with regard to interbasin transfers of surface water could affect project feasibility.

Table 22 – Supply (ac-ft/yr) and Estimated Cost for Lower Colorado River Diversion

County-Use Sector	2000	2010	2020	2030
Bexar – Municipal	NA	0	66,000	132,000
Hays – Municipal	NA	0	0	6,000
Total	**NA**	**0**	**66,000**	**138,000**
Estimated Annual Cost				
Bexar – Municipal	NA	$ 0	$ 88,859,760	$134,163,480
Hays – Municipal	NA	0	0	8,804,390
Total	**NA**	**$ 0**	**$ 88,859,760**	**$142,967,870**

3.2.8 Carrizo Aquifer – Wilson and Gonzales (CZ-10C)

This water management strategy consists of the development of well fields in the Carrizo Aquifer in northern Wilson and southern Gonzales counties with transmission facilities to supply municipal water users in Bexar County. Implementation of this strategy would conform to the rules and policies of the Evergreen and Gonzales County underground water conservation districts. Accordingly, approximately 11,000 ac-ft/yr would be supplied from Wilson County and approximately 5,000 ac-ft/yr would be supplied from Gonzales County (see Table 22).

Significant issues that could affect project implementation include permitting from local underground water conservation districts and technical uncertainties with regard to the effects of long- term pumping of the aquifer.

Table 23 – Supply (ac-ft/yr) and Estimated Cost for Carrizo Aquifer in Wilson and Gonzales Counties

County – Use Sector	2000	2010	2020	2030
Bexar – Municipal	**NA**	**16,000**	**16,000**	**16,000**
Estimated Annual Cost				
Bexar – Municipal	**NA**	**$12,496,000**	**$12,496,000**	**$ 6,608,000**

3.2.9 Carrizo Aquifer – Gonzales and Bastrop (CZ-10D)

This strategy involves the development of well fields in the Carrizo Aquifer in northern Gonzales and southern Bastrop counties. However, during the 30-year planning period, only the supply from Gonzales County would be developed. Groundwater produced from Gonzales County would be conveyed to a regional water treatment facility and then distributed to municipal, industrial, and mining water users in Comal and Guadalupe counties. As shown in Table 23, the project would provide 14,000 ac-ft/yr of dependable water supply by 2030. Implementation of this strategy would conform to the rules and policies of the Gonzales County Underground Water Conservation District.

Significant issues that could affect project implementation include permitting from local underground water conservation districts and technical uncertainties with regard to the effects long- term pumping of the aquifer.

Table 24 – Supply (ac-ft/yr) and Estimated Cost for Carrizo Aquifer in Gonzales and Bastrop Counties

County-Use Sector	2000	2010	2020	2030
Comal – Municipal	NA	0	0	5,500
Guadalupe – Municipal	NA	50	600	600
Guadalupe – Industrial	NA	550	550	550
Comal – Mining	NA	0	3,500	6,500
Guadalupe – Mining	NA	300	300	300
Total	**NA**	**900**	**4,950**	**13,450**
Estimated Annual Cost				
Comal – Municipal	NA	$ 0	$ 7,758,600	$ 10,970,600
Guadalupe – Municipal	NA	636,200	1,687,400	490,800
Guadalupe – Industrial	NA	629,200	662,200	449,900
Comal – Mining	NA	0	4,317,100	6,305,000
Guadalupe - Mining	NA	343,200	361,200	245,400
Total	**NA**	**$ 1,608,600**	**$ 14,786,500**	**$ 18,461,700**

3.2.10 Simsboro Aquifer (SCTN-3C)

This strategy involves the development or expansion of well fields in the Simsboro Aquifer in Bastrop, Lee, and Milam counties with transmission to municipal water users in Bexar County. A key element of the project would be to beneficially use groundwater that is produced incidental to lignite mining operations. The strategy would provide 55,000 ac-ft/yr of dependable water supply (see Table 24). San Antonio Water Systems (SAWS) has agreements in place with the Aluminum Corporation of America (ALCOA) and with City Public Service of San Antonio to develop the project.

The Bastrop County portion of the supply from this strategy will be subject to permitting by the Lost Pines Underground Water Conservation District. Significant local opposition to the project has developed in the areas from which groundwater would be produced. There is also some debate with regard to the long-term effects of increased pumping of the aquifer.

Table 25 – Supply (ac-ft/yr) and Estimated Cost for Simsboro Aquifer

County – Use Sector	2000	2010	2020	2030
Bexar - Municipal	**NA**	**55,000**	**55,000**	**55,000**
Estimated Annual Cost				
Bexar – Municipal	**NA**	**$ 47,590,400**	**$ 47,590,400**	**$ 28,029,650**

3.2.11 SAWS Recycled Water Program (SAWS)

SAWS is currently implementing a Recycled Water Program capable of supplying approximately 35,000 ac-ft/yr for non-potable municipal and industrial use in Bexar County. Approximately 25,000 ac-ft/yr is included as currently available water supply. This strategy consists of the phased expansion of the SAWS Recycled Water Program to provide an additional 35,824 ac-ft/yr of dependable water supply for municipal use by 2030 (see Table 25).

The availability of additional customers with suitable non-potable demands that could be supplied with reclaimed water will affect implementation of this strategy. Expansion of the SAWS Recycled Water Program may eventually require development of extensive dual water distribution systems to serve smaller commercial and residential water users.

Table 26 – Supply (ac-ft/yr) and Estimated Cost for SAWS Recycled Water Program

County – Use Sector	2000	2010	2020	2030
Bexar - Municipal	**NA**	**19,826**	**26,737**	**35,824**
Estimated Annual Cost				
Bexar – Municipal	**NA**	**$ 17,264,566**	**$ 17,981,583**	**$ 18,924,359**

3.2.12 Purchase Water from a Major Water Provider

This water management strategy involves the purchase of water supplies from, or participation in the development of new water supplies with an unspecified "Regional Water Provider". Within the Authority's jurisdiction, six entities have been designated as Major Water Providers: SAWS, BMWD, GBRA, CRWA, and the cities of New Braunfels and San Marcos. This strategy may also involve the purchase of water supplies from, or participation in the development of new water supplies with the designated "Regional Water Provider for Bexar County".

Table 27 – Supply (ac-ft/yr) and Estimated Cost for Major Water Provider

County-Use Sector	2000	2010	2020	2030
Hays – Municipal	NA	5,000	5,000	5,000
Bexar – Industrial	NA	0	0	2,000
Bexar – Mining	NA	5,000	5,500	5,500
Total	**NA**	**10,000**	**10,500**	**12,500**
Estimated Annual Cost				
Hays – Municipal	NA	$ 2,995,000	$ 3,015,000	$ 3,015,000
Bexar – Industrial	NA	0	0	1,521,948
Bexar – Mining	NA	3,240,668	4,490,964	4,185,358
Total	**NA**	**$ 6,235,668**	**$ 7,505,964**	**$ 8,722,306**

3.2.13 Aquifer Storage and Recovery – Regional (SCTN-1A)

An aquifer storage and recovery (ASR) project is planned for development in southern Bexar County. The project, which is being developed by SAWS, will involve the temporary storage of water from the Edwards Aquifer in the Carrizo Aquifer in the winter months for subsequent recovery and use in the summer months. The strategy will not increase the overall water supply on an annual basis but will substantially reduce peak municipal water demands on the Edwards Aquifer during the summer and will improve the reliability of current water supplies for all users of the Edwards Aquifer.

3.2.14 Seawater Desalination (SCTN-17)

The draft SCTRWP recommends that a seawater desalination facility be developed on the north shore of San Antonio Bay with transmission of treated water to Bexar County for municipal use. The project would provide 56,000 ac-ft/yr of dependable water supply beginning in 2040, increasing to approximately 84,000 ac-ft/yr by 2050. While included as a recommended long-term strategy in the draft SCTRWP, there are significant concerns with regard to the economic feasibility and potential environmental impacts of seawater desalination.

3.3 Additional Water Management Strategies Recommended for Further Study

In addition to the strategies described above that are recommended for implementation to meet identified needs within the EAA's jurisdiction, the initially prepared draft SCTRWP also includes recommendations regarding strategies requiring further evaluation. These are:

Brush management (SCTN-4) - This strategy involves the selective clearing of certain invasive species of brush in rangeland areas of the Edwards Plateau. The objective is to reduce the consumption of water through evapo-transpiration and thereby increase surface water runoff and/or groundwater recharge. The practice is currently being studied in the Edwards Aquifer region by the USDA Natural Resource Conservation Service with funding support from a number of sources including the EAA. However, at this time it is not possible to accurately estimate the amount of water that widespread implementation of this strategy could contribute during severe drought. However, the strategy could increase stream flow and groundwater recharge during non-drought periods, which could contribute to water supplies available during drought. In addition to technical uncertainties with regard to the efficacy of brush management as a water management strategy, there are also significant issues associated with funding on-going brush removal and control activities on a large scale and there are significant environmental concerns associated with modification of habitat for threatened and endangered species native to the Edwards Plateau.

Weather Modification (SCTN-5) – Weather modification, or precipitation enhancement, involves the seeding of suitable rain producing clouds by aircraft equipped with silver iodide flares. This strategy is being practiced and evaluated at present in 15 counties of the South Central Texas Region. It is uncertain whether the strategy can increase the amount of water available during drought. However, increased precipitation could contribute directly to dryland crop, livestock, and wildlife production and could increase stream flows and groundwater recharge during non-drought periods. Depending on the timing, increased precipitation could also reduce demands on pumping from the Edwards Aquifer by decreasing crop irrigation requirements.

Rainwater Harvesting (SCTN-9) – This strategy involves the capture, storage, and use of rainwater, typically from the roofs of homes and businesses. Rainwater harvesting could also involve the collection and use of storm water from residential and commercial developments. Typically, rainwater harvesting is implemented on a small-scale basis and the water is used in close proximity to the point of capture. Most systems in use today provide non-potable water supply for irrigation of landscaped areas. However, technology is readily available for on-site treatment of the water to levels suitable for potable uses. Generally, given the cost of rainwater harvesting systems, applications are limited to sparsely settled rural areas where water supply from public water suppliers is cost-prohibitive or where the availability, quality, or cost is a limiting factor on groundwater use.

Additional Municipal Reuse – This strategy would involve development of new or expanded programs to reclaim municipal wastewater for beneficial reuse for non-potable purposes (e.g., landscaped areas, golf courses, cooling water, agricultural irrigation). To the extent that the use of reclaimed water is a substitute for other sources of water, either for current or future uses, the strategy can significantly increase available water supply. As described previously, SAWS is currently implementing a major Water Recycling Program in San Antonio and it is recommended in the draft SCTRWP that this program be expanded significantly in the future. There are undoubtedly other opportunities to develop reuse programs and projects in other communities in the region, particularly those communities with central wastewater collection and treatment facilities. Further study is required to identify and evaluate of such opportunities.

Small Aquifer Recharge Dams – This strategy would involve the construction of small recharge dams on ephemeral streams to retard or capture storm water runoff in order to increase recharge to local aquifers in the region. The strategy appears to be particularly suited to areas overlying the Trinity Group of aquifers, much of which is in the contributing zone of the Edwards Aquifer but generally located

outside of the EAA's jurisdiction. Small recharge dams may also reduce soil erosion and sedimentation and may qualify for technical and financial assistance from state and federal agencies.

Edwards Aquifer Recharge and Recirculation – Conceptually, this water management strategy would consist of artificial recharge of the Edwards Aquifer, diversion of resulting increased spring flow, and the return of this water to further recharge the aquifer. Artificial recharge could include enhancement of natural recharge as previously described, or water imported from another source, or a combination. The objective of this strategy would be to maintain minimum flows at Comal and San Marcos Springs and allow additional water to be withdrawn from the aquifer. One variation of this strategy (SCTN-6) was evaluated for the SCTRWP but is not included as a recommended strategy. Given the technical, economic, and legal uncertainties surrounding this strategy, additional research is required.

Cooperation with Corpus Christi for New Water Sources – This strategy involves establishment of a cooperative partnership with the City of Corpus Christi and the Coastal Bend Water Planning Region to further investigate and develop additional water sources for the benefit of both regions. Possibilities include desalination of seawater or brackish groundwater; development of groundwater supplies; and water exchanges, such as providing water from the Colorado River Basin to Corpus Christi in exchange for surface water to recharge the Edwards Aquifer that is committed to the Choke Canyon Reservoir.

Additional Water Storage – This water management strategy would involve construction of large-scale, regional aquifer storage and recovery and/or surface water storage facilities of a size to allow storage of surplus floodwaters for subsequent beneficial use. In addition to the potential for increasing water supplies, implementation of this strategy could buffer daily and seasonal variations in municipal water demand and improve the reliability of water supplies during drought or other emergencies.

4.0 WATER SUPPLY PLAN FOR THE EDWARDS AQUIFER REGION

As described in the previous section, for the Edwards Aquifer Region, the South-Central Texas Regional Water Plan (SCTRWP) includes seven water management strategies that are already in various stages of implementation and recommends implementation of an additional 13 strategies over the next 30 years. Other strategies are recommended for further study and could be included in future updates of the regional water plan. Assuming all of the recommended strategies are implemented in the timeframes indicated in the SCTRWP, total available water supply will increase by 556,832 ac-ft/yr by 2030. For all categories of water demand in the aggregate and assuming 340,000 ac-ft/yr of pumpage from the Edwards Aquifer, implementation of the SCTRWP would satisfy all projected water demands by 2010 and thereafter (Table 27). However, as previously noted, projected irrigation shortages would not be met as the recommended strategies are not considered feasible for meeting irrigation needs.

Table 28 – Water Supply and Demand Balance for the Edwards Aquifer Region with Strategies Recognized in the SCTRWP (ac-ft/yr)

	2000	2010	2020	2030
Projected Water Demand	765,127	802,372	848,588	918,118
Currently Available Water Supply	523,604	522,244	521,055	505,495
Supply from Strategies in Progress	NA	38,390	33,190	33,190
Supply from Recommended Strategies	NA	345,672	435,396	509,642
Shortage/Surplus	**-241,523**	**103,934**	**141,053**	**130,209**

Note: Excludes irrigation water conservation applied to irrigation shortages.

5.0 COST-BENEFIT AND ENVIRONMENTAL ANALYSIS

This section is intended to satisfy the requirements of Article 1, Section 1.25 of the Edwards Aquifer Authority Act, which requires the Authority to "...perform a cost-benefit analysis and an environmental analysis" as part of the development of a plan for providing alternative water supplies to the Edwards Aquifer region. As with other information presented in this plan, the information in this section is drawn entirely from the adopted SCTRWP or from supporting documentation. It was beyond the scope of the current effort to acquire additional data or to perform additional analyses of the costs, benefits, and environmental impacts of the various water management strategies recommended for implementation within the region. As previously noted, many of the recommended strategies will require additional feasibility-level planning and engineering design to refine current estimates of water supply yield and costs. Similarly, many of the strategies will be subject to extensive regulatory review, with particular attention given to full evaluation of potential environmental impacts and evaluation of measures to mitigate or avoid such impacts.

5.1 Cost-Benefit Analysis

A simplified cost-benefit analysis has been developed for the recommended 30-year water supply plan for the Edwards Aquifer region. As noted above, the analysis is based solely on information contained in or developed for the SCTRWP. A more sophisticated cost-benefit analysis, like that which might be performed for a large federally funded water supply project, is beyond the scope of the current effort.

For the purposes of this plan, "cost" and "benefit" are defined as follows:

> **Cost** is the estimated annual costs, in the aggregate, associated with implementation of the 13 "new" water management strategies recommended for implementation to meet projected water needs within the Edwards Aquifer region (see Table 29). Costs are not included for the seven water management strategies that are already in various stages of implementation as these costs were not reported in the SCTRWP.
>
> **Benefits** are the value of the additional water to be provided by the recommended plan in terms of the avoidance of social and economic impacts that would occur if the projected water needs of the Edwards Aquifer region are not fully satisfied. As stated in the SCTRWP, "the social and economic effects of not meeting a projected water need can be viewed as the potential benefit to be gained from implementing a strategy to meet the particular need".

TWDB rules for the regional water planning process required that the social and economic impacts of not meeting identified water needs were to be evaluated. At the request of the SCTRWPG, TWDB staff performed the analysis of impacts using a standard methodology employed for all 16 water planning regions in the state. TWDB used an input-output model to compute the estimated impacts for two measures of social impact of not meeting identified water needs – population and school enrollment - and for three measures of economic impact – gross economic output (sales and business gross income), personal income, and employment. Values for each of these variables were computed for each individual water user group with a projected water shortage and were reported by decade.

Table 29 - Estimated Annual Costs of Recommended Water Management Strategies (in millions of dollars 1999)

Recommended Strategy	2010	2020	2030
Municipal Water Conservation (L-10)	$ 7.28	$ 7.28	$ 2.24
Irrigation Conservation (L-10 and L-15)	1.48	1.47	0
Transfers of Edwards Aquifer Rights (L-15)	3.81	3.81	3.90
Recharge Enhancement (L-18A)	21.89	23.46	23.46
Canyon Reservoir – River Diversion (G-15C)	8.16	11.67	9.86
Lower Guadalupe River Diversion (SCTN-16)	75.93	77.06	77.44
Lower Colorado River Diversion (LCRA)	0	88.86	142.97
Carrizo Aquifer (CZ-10C)	12.50	12.50	6.60
Carrizo Aquifer (CZ-10D)	1.61	14.79	18.46
Simsboro Aquifer (SCTN-3C)	47.59	47.59	28.03
SAWS Recycled Water Program (SAWS)	17.26	17.98	18.92
Purchase Water from Regional Provider	6.24	7.50	8.72
Aquifer Storage and Recovery (SCTN-1A)	NA	NA	NA
Total	**$ 203.75**	**$ 313.97**	**$ 340.60**

For the purposes of this plan, relevant social and economic impact data for the Edwards Aquifer region was extracted from the larger data sets prepared by the TWDB for the South Central Texas region and then re-aggregated for the Edwards Aquifer Region. This was accomplished using the same procedures employed to extract population, water supply, and water demand data for the Edwards Aquifer Region from the SCTRWP. The results are shown in Table 30 below.

Table 30 - Social and Economic Impacts of Not Meeting Projected Water Needs in the Edwards Aquifer Region

Type of Impact	2010	2020	2030
Population	-727,451	-909,357	-1,182,355
School Enrollment	-186,124	-232,031	-299,982
Gross Business Activity	-$ 28.8	-$ 36.2	-$ 47.7
Personal Income	-$ 11.7	-$ 14.7	-$ 19.1
Employment	-422,675	-526,424	-689,956

Note: Values for gross business activity and personal income are expressed in billions of dollars per year in 1999 dollars.

As shown in Table 29, the estimated annual costs to implement the recommended water management strategies, by decade for the planning period, are approximately $204 million in 2010, $314 million in 2020, and $340 million in 2030. Using "avoided" negative impacts on gross business activity as the basis for comparison, the estimated "benefit" of meeting projected water needs in the Edwards Aquifer region is $28.8 billion in 2010, $36.2 billion in 2020, and $47.7 billion in 2030. Expressed as a ratio of benefit to cost, the benefit-cost ratios associated with implementation of the recommended water management strategies are 141, 115, and 140 for each decade, respectively.

5.2 Environmental Analysis

As indicated previously, the Edwards Aquifer Authority Act requires that an environmental analysis be conducted as part of the Authority's plan for providing alternative water supplies to the region. Presented below is a brief discussion of the environmental impact analysis requirements of the National Environmental Policy Act (NEPA) of 1969 and a discussion of the cumulative impacts of the recommended water supply plan on the Edwards Aquifer. Also included is a brief discussion of the potential environmental impacts associated with each of the water management strategies recommended in the methodology required by the TWDB/S.B. 1 and used by the SCTRWP.

5.2.1 National Environmental Policy Act

Again, it should be emphasized that detailed analyses of the potential environmental impacts of each recommended water management strategy was not conducted during the development of the SCTRWP. However, for most of the recommended strategies, thorough environmental review will be required as part of various state and federal regulatory processes. Most notably, any proposed strategy that will involve a "federal action" will be required to comply with NEPA requirements. NEPA, and associated regulations of the White House Council for Environmental Quality, requires federal agencies to evaluate the effects of their proposed actions on the natural and human environment and to consider alternative courses of action. A federal action can include federal funding participation in the implementation of a recommended water management strategy or federal regulatory approval(s) of a strategy (e.g., a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers).

The NEPA review process is often initiated with the preparation of an environmental assessment (EA). The purpose of an EA is to help the federal agency that is taking a proposed action decide whether a full environmental impact assessment (EIS) is warranted. Generally, an EA is focused only on those resources that have a likelihood of being significantly impacted. Key elements of an EA include:

- A description of the affected environment.
- A description of the proposed action (a.k.a., project), its purpose, and the needs that the action is intended to address (e.g., water supply).
- A discussion of "reasonable" alternatives to the proposed action, including the "preferred" alternative and the "no-action" alternative.

- For the each alternative, an evaluation of the potential environmental, social, and economic consequences or impacts. The EA is to include a discussion of both direct and indirect affects, as well as discussion of appropriate measures to avoid, minimize, or mitigate the potential impacts.
- A description of efforts to coordinate and obtain pertinent information and input from the public and governmental agencies. An EA should address all known and foreseeable concerns.

On the basis of the analysis and information presented in an EA, the sponsoring federal agency may propose and adopt, after public review, a "finding of no significant impact" (FONSI). Alternatively, the agency may determine, either at the outset of the NEPA review process or on the basis of the information in an EA, that there are significant impacts associated with the proposed action that warrant a more thorough evaluation through the preparation of an EIS. An EIS must address all of the key elements of an EA but does so in a more detailed manner and with a higher degree of analysis and supporting documentation. Specifically, in the portion of an EIS that addresses the consequences of a proposed action and the alternatives to the proposed action, a host of potential impacts are to be described and analyzed including:

- Land use impacts
- Impacts on farmland
- Social impacts
- Relocation impacts
- Economic impacts
- Impacts to historical and cultural resources
- Air quality impacts
- Noise impacts
- Visual impacts
- Water quality impacts
- Impacts on wetlands
- Impacts from modification of water bodies
- Impacts to wild and scenic rivers
- Floodplain impacts
- Wildlife impacts
- Impacts to threatened and endangered species
- Coastal zone impacts

- Impacts on energy use
- Construction impacts

5.2.2 Cumulative Impacts of the Recommended Water Supply Plan on the Edwards Aquifer

Based on the results of hydrologic simulations conducted as part of the development of the SCTRWP, implementation of the recommended water management strategies for the Edwards Aquifer Region would have the following cumulative impacts on the Edwards Aquifer:

- Relative to a baseline condition of 400,000 ac-ft/yr of pumpage from the Edwards Aquifer (subject to EAA Critical Period Management Rules), overall withdrawals from the Edwards Aquifer would increase with full implementation of the recommended plan. This is due to the additional yield that would be available as a result of the full development of recommended recharge enhancement projects (L-18a).

- For most of the 56-year historical period of simulation, flows from Comal Springs would increase relative to a baseline condition, particularly during the summer months. The increased spring discharge is attributed to Edwards Aquifer recharge enhancement (L-18A) and the San Antonio Water Systems aquifer storage and recovery project in southern Bexar County (SCTN-1A). It is noted however, that increases in flows from Comal Springs would be partially offset by increased pumpage from the Edwards Aquifer in closer proximity to the springs. This would occur as a result of transfers of irrigation water rights from the irrigated farming areas west of San Antonio to municipal water users in San Antonio and Bexar County.

- Simulations also indicate substantial increases in flows from San Marcos Springs due to the development of a recharge enhancement structure with pumped diversions of surface water in the upper portions of the San Marcos River watershed. Environmental Impacts of Recommended Water Management Strategies

Based on information developed for the SCTRWP, a brief discussion of potential environmental impacts associated with each recommended water management strategy is provided below.

Municipal Water Conservation (L-10 Municipal)

There are no known potential adverse environmental impacts associated with municipal water conservation programs. Rather, implementation of such programs will provide various environmental benefits including reduced demand on limited water supplies and reduced energy use associated with pumping, treatment, and distribution of water. Interior water conservation measures will also reduce wastewater flows, which has been shown to improve wastewater treatment processes. Interior water conservation measures, such as low-flow showerheads and high-efficiency clothes and dishwashers, will also reduce household energy consumption.

Irrigation Conservation (L-10 and L-15)

Improved irrigation efficiency is not expected to result in adverse environmental impacts. Rather, like municipal water conservation, improved irrigation efficiency will reduce demand on limited water supplies and reduce energy use for pumping and water distribution. Agricultural water conservation measures have also been shown to be effective in increasing crop yields and in reducing agricultural non-point sources of water pollution.

Transfers of Edwards Irrigation Rights to Municipal Use (L-15)

Transfers of Edwards Aquifer irrigation water rights to municipal use have some potential to result in changes in land use (e.g., fallowing of farmland) that could in turn affect wildlife habitat. However, such changes could be beneficial to the extent that land cover is returned to a more natural condition for livestock grazing or wildlife purposes. Concerns have been expressed that relocation of some existing Edwards Aquifer withdrawals from the farming areas west of San Antonio to pumping centers in Bexar County may reduce flows at Comal Springs. Hydrologic simulations indicate that moving withdrawals to locations in closer proximity to the springs will reduce aquifer levels in those areas and decrease spring flow. Importantly, implementation of this strategy would not require construction of additional well fields, treatment facilities, or pipelines, thereby avoiding land use and environmental impacts associated with such facilities. It should also be noted that transfers of Edwards Aquifer irrigation water rights to municipal use potentially spreads out the annual usage rather than concentrating it within a four-month growing season.

Edwards Aquifer Recharge Enhancement (L-18a)

Development of the recommended recharge enhancement program has the potential for adverse environmental impacts associated with changes in land use and hydrology. Impacts would include disturbance of aquatic and terrestrial habitat from construction activities, loss of habitat associated with the recharge structure sites, and potential loss of habitat associated with periodic inundation of the reservoir pool during recharge events. Habitat loss has the potential to affect threatened and endangered species, which are known to occur within the areas considered for recharge enhancement. Recharge enhancement will also reduce flows downstream of each site and will reduce the firm yield of the Choke Canyon Reservoir/Lake Corpus Christi system and reduce freshwater inflows to the Nueces Estuary. Finally, recharge enhancement sites on the Nueces, Frio, Sabinal, and Blanco Rivers are located within stream segments recommended by the Texas Parks and Wildlife Department for legislative designation as ecologically unique streams.

The recommended recharge enhancement program would increase average recharge to the Edwards Aquifer by an estimated 135,000 acre-feet per year. Under drought-of-record conditions, recharge enhancement would increase the dependable supply of water from the Edwards Aquifer by nearly 22,000 acre-feet per year. Importantly, a substantial amount of the increased recharge would not be recovered for municipal water supply and would therefore help maintain aquifer levels and would increase flows at Comal and San Marcos Springs by nearly 80,000 acre-feet per year. The increased springflow will contribute directly to the maintenance of critical habitat in and near the springs and will result in increased instream flows and freshwater inflows to the Guadalupe Estuary. Recharge enhancement will also help maintain aquifer levels, thereby reducing pumping costs and decreasing the amount of time users are subject to the Authority's Critical Period Management Rules.

Canyon Reservoir – River Diversion (G-15c)

Because this recommended strategy involves the use of surface water from an existing reservoir, there would be no significant environmental impacts associated with the development of the water supply. However, there would be changes in land use and potential impacts to habitat and cultural resources associated with the pipeline route and the sites for the water treatment plant and transmission pump stations. Generally such impacts can be avoided or minimized in the selection of pipeline routes and sites for major facilities.

Diversions from the Lower Guadalupe and Lower Colorado Rivers (SCTN-16 and LCRA)

Large-scale diversions of surface water flows from the lower Guadalupe River and from the lower Colorado River will reduce freshwater inflows to the Guadalupe Estuary and the Matagorda Bay and Estuary, respectively. Reduced freshwater inflows may adversely impact aquatic habitat and species. To minimize the potential impact much of the surface water diverted under this strategy would occur during high flow periods, when stream flows may exceed targets for freshwater inflows. Conversely, diversions would be restricted during low flow periods to protect senior water rights and environmental flows, during which time groundwater may be used to ensure a dependable water supply during drought. However, the extent and significance of reduced freshwater inflows and the impacts of such will require additional research and investigation.

Implementation of this strategy would also result in land use changes and the potential loss of habitat and cultural resources associated with diversion facilities, off-channel reservoirs, well fields, pipelines, pump stations, and water treatment facilities. However, such impacts can be largely avoided or minimized in the siting of major facilities and the routing of the pipeline.

Groundwater Supply from the Carrizo Aquifer (CZ-10c and CZ-10d)

The development of groundwater supplies from the Carrizo Aquifer in Wilson, Gonzales, and Bastrop counties represents a strategy that will avoid the significant adverse environmental impacts typically associated with the development of similar quantities of surface water. However, in addition to land use impacts associated with well fields, pipelines, and pumping stations, concerns have been expressed about the long-term effects of groundwater withdrawals on water levels and potential decreases in the base flow of streams due to reduced spring discharges. Hydrogeological investigations indicate that the additional groundwater withdrawals associated with the two Carrizo Aquifer strategies will draw down water levels in the aquifer over the planning period and that the lowering of water levels will result in projected decreases in the base flows of both the San Antonio and Guadalupe Rivers, and consequently, reduced freshwater inflows to the Guadalupe Estuary. The projected decreases in stream flow and freshwater inflows would be most pronounced during drought conditions. However, it is believed that these reductions will be largely offset by "enhanced springflow" associated with implementation of recommended recharge enhancement projects and by increasing discharges of treated wastewater effluent.

Simsboro Aquifer (SCTN-3c)

Large-scale development of groundwater supplies from the Simsboro Aquifer in Bastrop, Lee, and Milam counties has raised concerns about the impacts of declining aquifer levels on local groundwater users in the area and about potential decreases in springflow and the base flows of streams. Studies indicate that significant drawdowns of the aquifer will be limited to areas in proximity to well fields and that impacts on nearby wells can be mitigated by deepening wells or by providing connecting impacted users to public water supply systems. Available information also suggests that stream flows in the Brazos and Colorado Rivers would not be significantly impacted by this strategy.

As with other groundwater strategies, development of the Simsboro Aquifer strategy would require changes in land use associated with well field, pipelines, and pumping stations. However, most adverse impacts could be avoided in the siting of these facilities.

SAWS Recycled Water Program (SAWS)

Environmental impacts associated with expansion of the SAWS recycled water program are considered to be minimal. Additional reclaimed water transmission and distribution facilities would be largely located in areas already developed or areas likely to be developed in the future.

Purchase Water from a Regional Water Provider

The potential environmental impacts associated with implementation of this strategy are unknown, as the strategy involves purchases of water from or participation in the development of new water supplies with an unspecified regional water provider.

Aquifer Storage and Recovery – Regional (SCTN-1a)

Environmental impacts associated with the implementation of aquifer storage and recovery projects in proximity to the San Antonio metropolitan area and the City of Victoria are considered to be minimal. Impacts would be limited to changes in land use associated with well field and transmission pipelines. Adverse environmental impacts can generally be avoided or minimize in the siting of these facilities.

Seawater Desalination (SCTN-17)

As with other water management strategies, the development of a large-scale seawater desalination facility would result in potential land use changes, and associated environmental impacts, from the intake structures, treatment facilities, brine discharge, and transmission pipelines. Through proper siting, many of these impacts can be avoided or minimized. However, desalination technologies using membrane filtration have large energy requirements and produce brine with salinity levels that may be three to four times that of seawater. Consequently, disposal of the brine would likely require an outfall sited off-shore in the Gulf of Mexico rather than a discharge to sensitive estuarine ecosystems.

6.0 FINANCING MECHANISMS FOR DEVELOPMENT OF ALTERNATIVE WATER SUPPLY SOURCES

Implementation of the recommended water supply plan for the Edwards Aquifer region will require large capital investments by numerous water suppliers acting either individually or collectively. For the South Central Texas Region as a whole, the estimated capital cost to implement the recommended water management strategies is approximately $4.7 billion (in 1999 dollars). Consequently, the sources and availability of financing is a major concern.

This section provides an overview of potentially available mechanisms and sources for financing implementation of recommended water supply and water conservation strategies. This includes a brief discussion of options for self-financing by water purveyors, financing through commercial sources, financial assistance through the Texas Water Development Board (TWDB) and the Texas Department of Housing and Community Affairs (TDHCA), and federal funding. Importantly, this section is intended to satisfy Article 1, Section 1.25 of the Edwards Aquifer Authority Act, which requires that in developing a plan to provide alternative water supplies to the Edwards Aquifer region the Authority shall "...investigate mechanisms for providing financial assistance for alternative supplies through the Texas Water Development Board..."

6.1 Self-Financing

Some of the water management strategies recommended for implementation within the Edwards Aquifer Region could be financed directly by public agencies, individuals, and private entities. For example,

municipalities can (and do) use current tax or utility revenues to fund implementation of urban water conservation programs, to purchase irrigation water rights, and for capital improvements to water supply facilities. In fact, strategies with incremental costs that can be spread out over a long period of time, such as conservation programs, are well suited for funding on an on-going basis from tax or operating revenues. Similarly, small water-related capital improvement projects often can be funded from water utility operating revenues. Also, on-going operations and maintenance expenses associated with water supply facilities are typically funded with operating revenues (e.g., water sales).

Private individuals and businesses may also self-finance water supply and conservation strategies. For example, an irrigator might use operating revenues or the proceeds from the sale of irrigation water rights to purchase and install more efficient irrigation equipment. Similarly, private businesses could use operating revenues to fund water efficiency improvements to their facilities or manufacturing processes.

6.2 Commercial Financing

Most water supply projects that require large capital outlays are financed through commercial sources. Typically, market-rate commercial financing is obtained through the sale of long-term bonds to investors. Principal and interest is paid on the bonds from either tax or utility revenues or a combination. Public sector entities, such as municipalities and water districts, can issue tax-exempt bonds to finance water supply projects while water supply corporations and private businesses can issue taxable bonds. Water projects can also be financed through commercial banks. However, such loans tend to carry somewhat higher interest rates and are typically used only as "bridge" loans until long-term financing can be secured.

6.3 Texas Water Development Board Financing[1]

By law, the principal functions of the TWDB are to:

- Collect and disseminate water-related data;
- Assist with regional water planning and with the planning of regional water, wastewater, and flood protection projects;
- Prepare and periodically update the State Water Plan; and

[1] The information summarized in this section is based on fact sheets and other information provided by the Texas Water Development Board.

- Provide low-cost financial assistance for water-related projects.

The TWDB provides loans and some grants to "political subdivisions" of the state, such as cities, counties, water districts, and river authorities, and to certain not-for-profit water supply corporations. The TWDB issues general obligation and revenue bonds and uses the proceeds to purchase bonds from eligible political subdivisions and not-for-profit water supply corporations. Borrowers then use the funds provided by the TWDB to construct water-related projects. As borrowers repay the principal and interest on the bonds sold to the state, the TWDB uses these payments to service the debt on the state's bonds. As state bonds are paid off, additional state bonds can be sold to replenish the loan pool. Local and regional governmental entities may benefit from financing through the TWDB by obtaining lower interest rates than may be available through commercial sources. Also, small communities may have difficulty accessing commercial financing and often turn to TWDB for assistance with financing. Private individuals and for-profit corporations are not eligible for TWDB financial assistance.

Since its creation in 1957, the Legislature and voters have approved constitutional amendments authorizing the TWDB to issue up to $4.68 billion in bonds for the financing of water-related projects. This includes $2 billion in new bond issuance authority with the approval of Proposition 19 by the voters on November 6, 2001. With the additional authorization, the TWDB estimates that sufficient funds will be available to meet projected needs for at least the next 10 years.

TWDB administers several programs that could potentially be used to finance the further development and implementation of the recommended water management strategies for Edwards Aquifer region. The TWDB's principal financial assistance programs are:

- Texas Water Development Fund
- Water Infrastructure Fund
- Rural Water Assistance Fund
- Drinking Water State Revolving Fund
- Clean Water State Revolving Fund
- State Participation Program
- Economically Distressed Areas Program
- Agricultural Water Conservation Loan Program

A brief description of each program follows.

6.3.1 Texas Water Development Fund (TWDF)

The TWDB provides loans to political subdivisions and not-for-profit water supply corporations through the Texas Water Development Fund. The loans, which are offered at non-subsidized rates set 0.35 percent above the TWDB's borrowing costs, can be used for the planning, design, and construction of water-related facilities including:

- Water supply development (e.g., surface water reservoirs, wells, water rights purchases);
- Water supply infrastructure (e.g., pipelines, pumping facilities, storage reservoirs and tanks);
- Water treatment and distribution;
- Wastewater collection, treatment, and disposal; and
- Flood control.

As security for the loans, the TWDB accepts general obligation bonds, revenue bonds, and tax and revenue certificates of obligation. The term of repayment for loans from the TWDF is typically 20-25 years. State law requires that applicants for TWDF loans develop and adopt a water conservation plan and drought contingency plan.

On loans from the TWDF, the TWDB offers a pre-design funding option, which enables applicants to secure a loan commitment and lock-in interest rates based on preliminary engineering, cost, and environmental information. Funds to complete detailed facility planning and environmental studies are provided upon loan closing, while funds for detailed design and facility construction are escrowed until needed. If the pre-design funding option is not used, all project plans, specifications, and permits must be approved and construction bids opened prior to loan closing.

6.3.2 Water Infrastructure Fund (WIF)

Senate Bill 2, Article 4 (77th Texas Legislature) established WIF as a new funding source administered by the TWDB. The WIF can be used to provide loans to political subdivisions of the state for water supply projects and can be used for economic development related to water supply and conservation projects including provision of loans or grants to persons and private entities (e.g., rebates for water-conserving plumbing fixtures). The statute also provides that up to 10 percent of the funds to be allocated annually from the WIF can be in the form of grants, low-interest or zero-interest loans to political subdivisions located outside of Metropolitan Statistical Areas.

The TWDB has indicated its intent to earmark $50 million in state general obligation bond proceeds to the WIF.

6.3.3 Rural Water Assistance Fund (RWAF)

S.B. 2 also established the RWAF as a special account within the state's General Revenue Fund. Through the RWAF, the TWDB can provide low-interest loans to water supply corporations that have a service area population of less then 10,000 and which are located in counties in which no urban area exceeds 50,000 population. The fund can be used to buy-down interest rates on loans. Loans can be used for water supply projects including purchase of water from other water suppliers and consolidation of water systems. The funds can also be used to fund the TWDB's reservoir Storage Acquisition Fund, the Research and Planning Fund, and the Hydrographic Survey Account.

6.3.4 Drinking Water State Revolving Fund (DWSRF)

The DWSRF provides "subsidized" loans to finance projects to facilitate compliance with federal and state drinking water standards or to further the overall public health protection goals of the federal Safe Drinking Water Act. This includes the planning, design, and construction of projects to upgrade or replace water supply infrastructure, to correct violations of drinking water quality standards, to consolidate water systems, and to purchase capacity in water systems. The purchase of land or conservation easements for drinking water source protection is also eligible for funding through the DWSRF.

The DWSRF program is funded in part with capitalization grants provided annually through the U.S. Environmental Protection Agency. The TWDB also provides matching funds using the proceeds of sales of state general obligation or revenue bonds. The blending of federal and state funds results in a long-term interest rate set at 1.2 percent below market rates at the time of loan closing. Currently, the program has a loan capacity of approximately $70 million per year.

All "community" water systems are eligible for assistance including privately owned water systems. Prospective DWSRF applicants must submit information about existing and proposed drinking water facilities to the TWDB for inclusion in the Intended Use Plan developed each year. The Texas Natural Resource Conservation Commission (TNRCC) is responsible for prioritizing projects proposed in the

Intended Use Plan based on public health and safety considerations. Available loan funds are allocated based on a project's priority rating and readiness to proceed.

The pre-design funding option is also available on loans provided through the DWSRF. The maximum repayment period for DWSRF loans is 20 years from completion of project construction. State law requires that applicants for DWSRF loans develop and adopt a water conservation plan and drought contingency plan.

6.3.5 Clean Water State Revolving Fund (CWSRF)

The TWDB also administers the CWSRF, which provides below market rate loans to political subdivisions that have the authority to own and operate sewage systems. Not-for-profit water supply corporations and private entities are not eligible for CWSRF loans. Funds providing through the CWSRF can be used for the planning, design and construction of wastewater collection and treatment facilities, wastewater reclamation and reuse facilities, and for stormwater and nonpoint source pollution control projects.

Like the DWSRF, the CWSRF is funded partially with federal capitalization grants and partially with funds from the sale of TWDB bonds. The interest rate on CWSRF loans is 0.7 percent lower than the current market rate at the time of loan closing. The program has a current loan capacity of approximately $330 million per year.

The pre-design funding option is also available on loans provided through the CWSRF. The maximum repayment period for CWSRF loans is 20 years from completion of project construction. As with TWDF and DWSRF loans, State law requires that applicants for CWSRF loans develop and adopt a water conservation plan and drought contingency plan.

6.3.6 State Participation Program (SPP)

In addition to the TWDF and the two federally subsidized state revolving funds, the TWDB also has the authority to acquire a temporary ownership interest in regional water supply, wastewater, and flood control projects. This can include ownership interest in water rights, land, and facilities. Eligible entities include political subdivisions and not-for-profit water supply corporations that are sponsoring a regional

project. With the passage of Proposition 19, the TWDB is authorized to acquire up to a 100 percent interest in any single project. Previously, the maximum level of ownership was 50 percent.

The goal of the SPP is to capture "economies of scale" in optimally sized regional projects that are otherwise unaffordable without state participation. The program allows the graduated deferral of debt service payments on a regional project for a period of 13 years, which provides time for the customer base for a project to grow and augment the applicant's ability to repay deferred principal and interest. Ultimately, the TWDB recovers the full cash expenditure of funds. For example, on a regional project with a financing life of 34 years (the maximum) 100 percent of the interest and principal are deferred during the first two years. During years 13 through 19, the borrower then pays all accruing interest plus equal amounts of previously deferred interest. Then, during years 20 through 34, all of the annual accruing interest plus principal is repaid.

In effect, the SPP facilitates "right sizing" of regional facilities for future growth by allowing the state to "carry" a portion of the project's cost. This may eliminate the need to build parallel facilities or to otherwise replace undersized facilities in the future. The State's share is based on a determination of how much of a project is excess capacity that is currently unaffordable to the sponsor. Also, the remaining portions of a project's costs can be financed through other TWDB loan programs.

As with other TWDB financial assistance programs, applicants are required to adopt a water conservation plan and drought contingency plan.

6.3.7 Economically Distressed Areas Program

In 1989 the Texas Legislature established the EDAP to provide financial assistance through the TWDB in the form of grants, loans, or a combination grant/loan to bring water and wastewater utility services to "economically distressed areas" (e.g., colonias). An economically distressed area is defined as an area:

- In which the potable water supply or sanitary sewer services are inadequate to meet the minimal needs of residents;
- For which local financial resources are inadequate to address water and wastewater service needs; and
- With an established residential subdivision that was in existence on June 1, 1989.

Financing through the EDAP is limited to economically distressed areas within eligible counties, as defined by state law. Prior to application for financial assistance through the EDAP, the county must adopt model subdivision rules to prevent further development of substandard residential subdivisions. Within the Edwards Aquifer Region, only Uvalde County is eligible to receive EDAP funds for economically distressed areas.

6.3.8 Agricultural Water Conservation Loan Program (AWCLP)

The TWDB also administers the AWCLP, which was established by the Texas Legislature in 1985. Through the AWCLP, the TWDB can make loans to soil and water conservation districts, irrigation districts, and underground water conservation districts. "Borrower" districts can use the loans to fund improvements to irrigation district facilities (e.g., water measurement, canal lining, etc.). "Lender" districts can use the funds to make loans to private individuals or companies for the purchase and installation of on-farm irrigation efficiency improvements including upgrades of existing irrigation equipment, new irrigation equipment, preparation of irrigated land for conversion to dryland farming, preparation of dryland for more effective use of natural precipitation, brush control, and precipitation enhancement through weather modification.

6.4 Texas Department of Housing and Community Affairs[2]

The Texas Department of Housing and Community Affairs (TDHCA) administers the Community Development Fund (CDF). The CDF is largely funded from Community Development Block Grants awarded to the state through the U.S. Department of Housing and Urban Development. Through the CDF, the state provides grant funds on a competitive basis for public facility needs including water and wastewater utility improvements. During 1998, approximately $48 million was disbursed by the TDHCA through the CDF. The CDF program is targeted at providing assistance to low and moderate-income communities. It is likely that some communities within the Edwards Aquifer region could receive funding for water supply related projects through the CDF.

Each year, CDF funds are allocated among 24 state planning regions based on population, poverty rates, and unemployment rates. Applications for CDF funding are reviewed and scored by Regional Review Committees and TDHCA staff. Scoring criteria include community distress, the proposed project's benefit to low/moderate income persons, project impact, local matching funds, and other factors. One-

half of the scoring for each application is from the Regional Review Committee and one-half from TDHCA staff.

The TDHCA also administers several financial assistance programs targeted at improving living conditions in colonias located within 150 miles of the Texas-Mexico border. These are the Colonia Area Planning Fund, the Colonia Planning Fund, the Colonia Comprehensive Planning Fund, and the Colonia Construction Fund. The latter provides grant funds for plumbing improvements and for connections to water and/or wastewater systems funded through the TWDB Economically Distressed Areas Program.

6.5 Federal Funding

Federal funding of recommended water supply strategies is also a possibility. One mechanism is through the U.S. Department of Agriculture's Rural Utilities Service (RUS)[3], which provides direct and guaranteed loans and grants to develop water and wastewater systems. Funds are available to public entities and not-for-profit corporations serving rural areas and to cities and towns with a population of 10,000 or less. Applicants for direct loans must demonstrate that they are unable to obtain financing from other sources at reasonable rates and terms. Loans can be made for a term of up to 40 years. However, the term of a loan cannot exceed the useful life of the facility or terms established by state statute. Guaranteed loans are made and serviced by commercial lending institutions such as banks and savings and loan associations. The RUS typically will guarantee up to 80 percent of the interest and principal on such loans.

Preference for financial assistance through the RUS is given to public entities, in areas with a population of less than 5,500, for the purpose of restoring a deteriorating water supply or to improve, enlarge, or modify a water facility or inadequate waste facility. Priority is also given to funding request that involve consolidation of small systems and to applicants serving low-income populations.

Another potential avenue for federal funding of water supply strategies is through direct congressional appropriation of funds for a specific project. The congressional funding process occurs in two steps. First, a project must be authorized by statute. This can either be a bill drafted specifically to authorize a particular project or a provision incorporated into an omnibus bill, such as the biennial Water Resources Development Act. In addition to identifying and describing the project, authorizing legislation will

[2] Information summarized in this section was obtained from the Texas Department of Community Affairs' website.
[3] Information summarized in this section was obtained from the U.S. Department of Agriculture's website.

typically identify a federal agency through which federal funds are to be channeled, establish a maximum amount of federal funding to be appropriated, define non-federal cost-sharing requirements, and define any special conditions relating to project development.

The second step of the process is to secure congressional appropriation of the funds authorized for a project. Typically, an appropriation is made through congressional approval of the annual budget of the agency designated as the federal sponsor. For large projects with development schedules that span multiple years, appropriations of federal funds may need to be obtained each year until project completion.