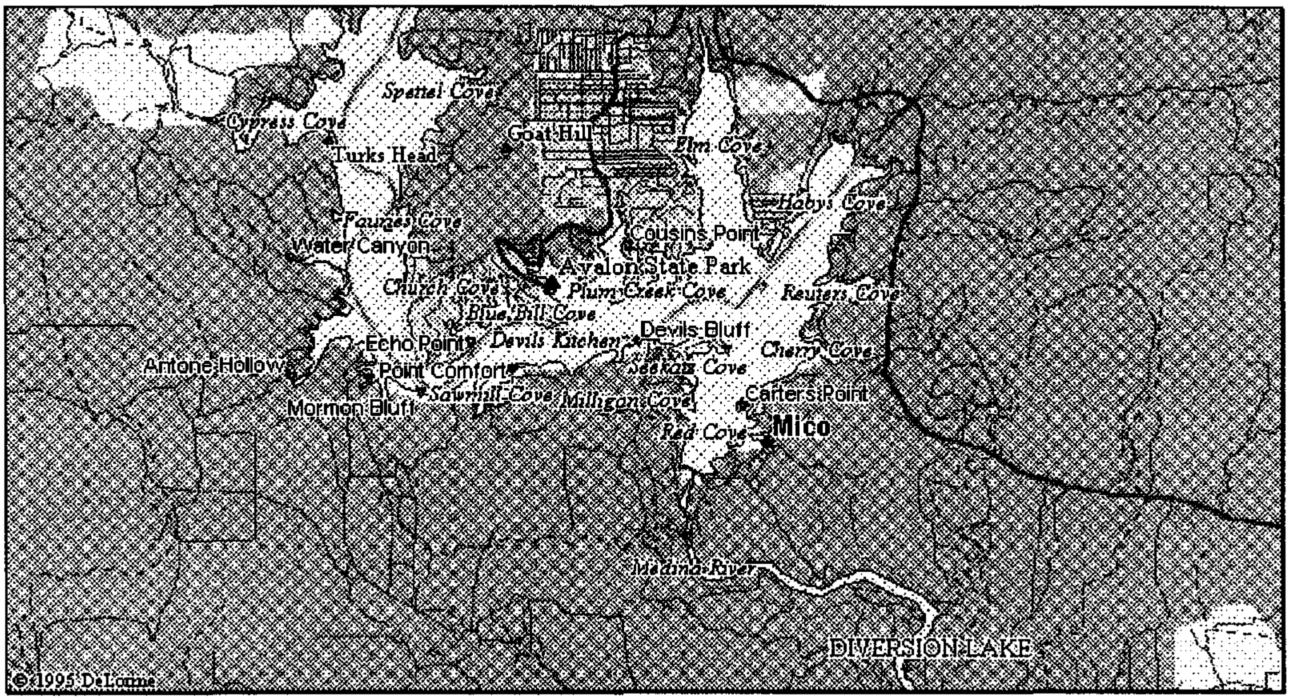
MEDINA COUNTY

REGIONAL WATER MANAGEMENT PLAN



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EXECUTIVE SUMMARY

The Medina County Regional Water Plan was developed in order to evaluate the long-term alternatives to the use of groundwater and perform a cost analysis on the effectiveness of such alternatives. Due to the regulations set forth in Senate Bill 1477, pumpage from the Edwards Aquifer will be limited to a maximum of 450,000 acre-feet per year until 2008 and 400,000 acre-feet per year beginning in the year 2008. Currently Medina County relies heavily on the Edwards Aquifer, drawing an average 91,811 acre-feet of groundwater per year, based on a twelve (12) year average. Therefore, alternative water sources will be required in order to meet future demands. The specific objectives of the plan include the following:

- Establish county wide population and water demand projections for Medina County;
- Describe the quantity and quality of water resources that are available to meet the future demands within the study area and to quantify any limits to development of these resources;
- Evaluate conjunctive management and use of groundwater and surface water resources within Medina County and provide a basis for management strategies that may be used to fulfill the regional water demands;
- Formulate the basic elements of alternative plans that may be used to reconcile water demands with the resources available.

Each of these objectives are outlined and discussed in the remaining sections of the summary.

Based on the 1996 Consensus Texas Water Plan, the current population of Medina County is 29,223 people. As shown in Table 2-2, the population projections for Medina County in the year 2050 show an approximate increase of 50%, or a per capita increase of about 17,965 people. All population groups experience the greatest growth between the years 2000 and 2020. Using these projections, a water demand forecast was established utilizing the following water use categories: municipal, manufacturing, irrigation, mining, livestock and steam electric. The total water demand projected for Medina County, in the year 2050, is a 137,700 acre-feet. This is a projected increase of 28% for the municipal demand.

The Edwards Aquifer is the main source of groundwater in Medina County. On average, approximately 96% of the current groundwater usage is taken from this aquifer. Based on current groundwater usage, 88,322 acre-feet is pumped from the Edwards Aquifer yearly in Medina County. With regards to surface water sources, only one perennial stream flows through Medina County, which is the Medina River. The Medina Lake System, composed of Medina Lake and Diversion Lake, has a total maximum capacity at surface level of 257,413 acre-feet. The Bexar-Medina-Atascosa Water Control and Improvement District No. 1 (BMA) uses a system of man-made canals to distribute the water from this system for irrigation purposes. A smaller reservoir, Pearson Lake, is located off of the main BMA canal and is used to store any remaining water in the canal after irrigation season or when the water is not in use.

Given the population projections and available water sources, additional water management strategies must be pursued in order to fulfill the regional needs of the County. During the 1980's BMA explored three options to help alleviate water losses in the Medina Lake System. Of those options the only viable option was to sell excess water to neighboring water purveyors and use the revenues generated to repair the system. Through a series of agreements and plans this option is being accomplished. BMA's recent amended adjudication will allow BMA to use their 66,0000 acre-feet of water for either irrigation or manufacturing and industrial (M&I) uses. In order to better evaluate the potential of the Medina Lake System, the SIMYLD-II computer program was used to simulate four different scenarios using the following components: Medina Lake, Diversion Lake, Pearson Lake, ground water resources and aquifer storage recovery (ASR). Formulas, maps, figures and graphs detail the results of each of these cases within this report. In addition, a supply versus demand comparison of the water resources of Medina County was used to determine future water availability and formulate the Water Resource Management Plan.

Finally, using the information mentioned above, three alternatives were developed and are as follows:

1. "No action;"
2. Utilizing ASR and provisions of Senate Bill 1477 as management tools for a regional water system;

3. Utilizing the BMA canal system for delivery of raw water to a central location for treatment and development off-channel storage of treated water.

Of these options, alternative three (3) is the most feasible and can be implemented in a series of five phases, which are:

1. Irrigation Canal Improvements are made to deliver the raw water from Medina Diversion Dam to the proposed treatment facility at Pearson Lake;
2. Pearson Lake is constructed to store 3,400 acre-feet of Raw Water to be used for Municipal and Irrigation uses;
3. A 4 million gallon per day water treatment plant should be constructed at Pearson Lake;
4. Booster pump and ground storage facilities should also be constructed; and
5. Treated Water Delivery System developed to supply water to the County.

The total capital costs for the completed project is estimated to be $26,440,764 and the total operational costs is estimated at $1.61 per 1,000 gallons. The final total capital and operational costs to deliver water is estimated to be $3.38 per 1000 gallons.

SECTION 1
INTRODUCTION

The Medina County Regional Water Plan is an extensive planning effort led by the Bexar-Medina-Atascosa Water Control and Improvement District No. 1 (BMA). The project is jointly funded by BMA and the Texas Water Development Board (TWDB).

OBJECTIVES

The Medina County Regional Water Plan will evaluate the water system currently being used throughout Medina County and will develop long range alternatives to the use of groundwater. The study will also analyze the region to determine cost effectiveness of the alternative water supplies. The benefits of this study are as follows:

- Provide an alternative water plan to help alleviate the depletion of the Edwards Aquifer;
- Provide an alternative water supply to protect endangered species from aquifer depletion and reduced spring flows;
- Provide an economical method of storing and treating potable water;
- Provide an economical method of transporting these treated waters to the user.

The Edwards Aquifer is rapidly being depleted and an alternative water source in this critical basin is desperately needed. Based on the provisions of Senate Bill 1477, the pumpage from Edwards Aquifer will be limited to a maximum of 450,000 acre-feet per year until 2008 and 400,000 acre-feet per year beginning in the year 2008. Therefore, an alternative water supply will be required to meet future demands. The specific objectives of the plan include the following:

- Establish county wide population and water demand projections for Medina County;
- Describe the quantity and quality of water resources that are available to meet the future demands within the study area and to quantify any limits to development of these resources;
- Evaluate conjunctive management and use of groundwater and surface water resources within Medina County and provide a basis for management strategies that may be used to fulfill the regional water demands;

- Formulate the basic elements of alternative plans that may be used to reconcile water demands with the resources available.

PHYSICAL DESCRIPTION OF THE STUDY AREA

The geographical area for the planning study is Medina County (Figure 1-1). Medina County is located in south-central Texas and is bounded by Bandera County on the north, by Bexar and Atascosa Counties on the east, by Frio County on the south and by Uvalde County on the west. The County has a surface area of 1,331 square miles.

Agriculture is the leading enterprise in Medina County. The main crops in the area are peanuts, pecans, corn and grain sorghum. Cattle raising and the production of eggs and milk also are prevalent in Medina County.

Many agriculture related industries are located in or near the larger cities. Devine has a peanut processing plant, a cotton gin, a grain storage facility and a plant nursery. A pecan processing plant is located in Yancey. In Hondo, there is a grain storage facility and a soil conditioner manufacturing plant. Hothouse tomatoes are also grown in Hondo. There are three cattle feedlots that have a total capacity of about 10,000 head of cattle. The largest of these is located near Devine and another is near D'Hanis. The smallest one is found near Hondo. A state fish hatchery is located near Natalia.

The natural resources of Medina County are used by a variety of industries. D'Hanis has a brick manufacturing plant. Hondo, Devine and LaCoste each have a concrete mixing plant. Building sand, gravel, clay and caliche are mined in many areas. Six (6) oil and gas fields are located within the County. Large amounts of coal have been mined and large quantities remain, however none is currently being mined.

The county seat, Hondo, is also the home of many other industries. An aircraft repair plant, a bathroom fixture plant, a carpet padding plant and a National Weather Service radar observatory are all located there. Gary Air Force Base, a U.S. Air Force flight training school, is located just outside of town. In addition, there are two car-testing tracks and a tire-testing fleet.

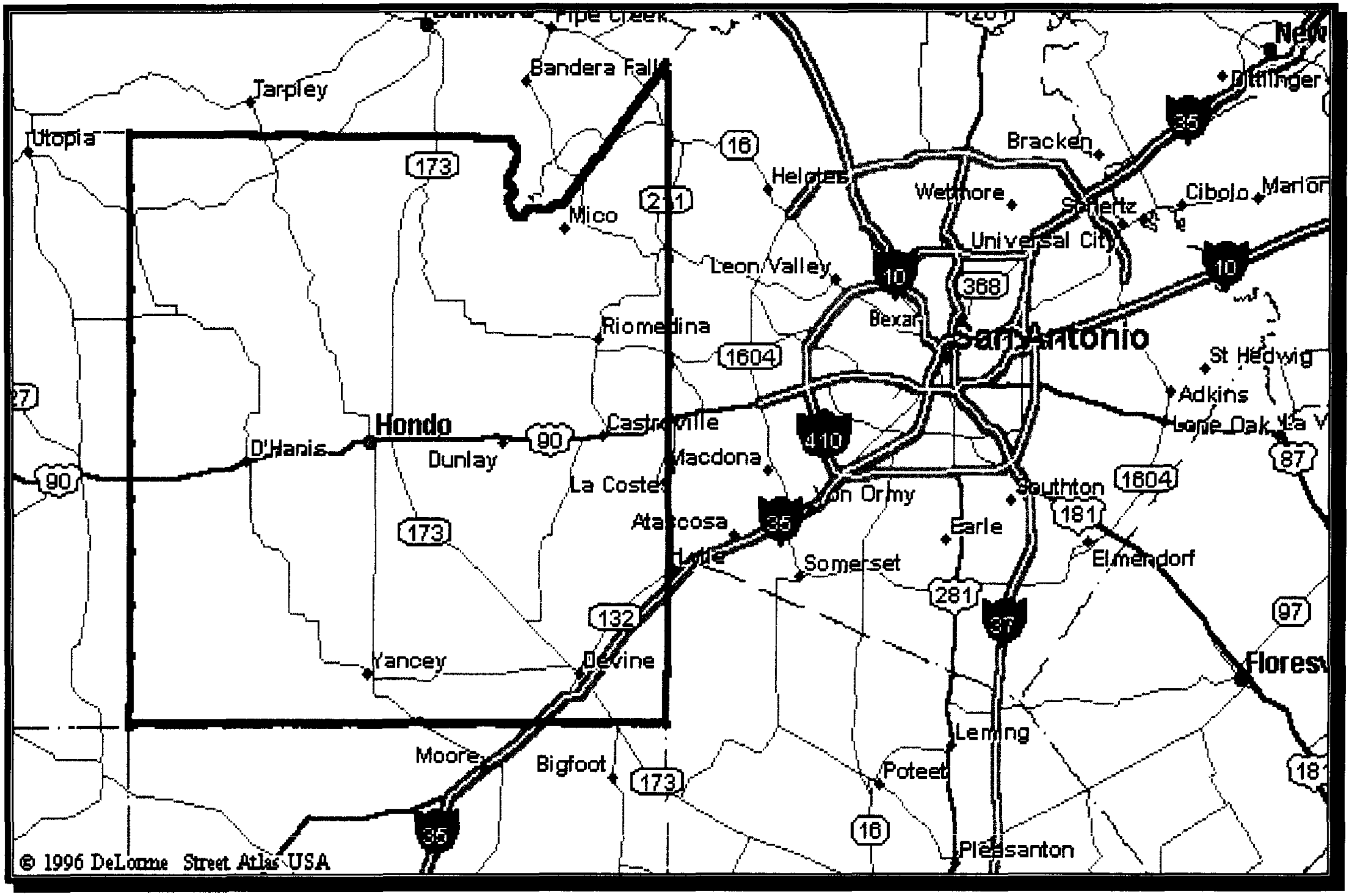


Figure 1-1. Location Map of Medina County

U.S. Highway 90 crosses the County from east to west through Castroville, Hondo and D'Hanis. The Southern Pacific Railroad crosses the County from the east to west through LaCoste, Hondo and D'Hanis.

The major streams of the County include the Medina River, the Chacon, Hondo, Francisco Perez, Quihi, San Geronimo, Seco and Verde Creeks. The Frio River flows just inside the southwestern part of the County for a short distance. All of the streams flow in a south to southeast direction.

Climate

The climate of the region is classified as subtropical, subhumid with temperatures varying between 32 and 96 degrees Fahrenheit. The region typically has hot summers and dry winters. Average annual temperature is between 66 and 69 degrees Fahrenheit. Average annual precipitation was between 26 and 32 inches between the years 1951 and 1980. Occasional droughts cause damage to crops and decrease the quantity of available water. The average gross lake surface evaporation rate for the area is 65 to 67 inches, which is more than twice the average annual precipitation rate of 28 inches. Prevailing winds are out of the south southeast.

Wildlife and Natural Areas

Medina County is home to protected endangered or threatened bird species including the Bald Eagle, Black-Capped Vireo, Golden-Checked Warbler, Gray Hawk, Interior Least Tern, Peregrine Falcon-American, Peregrine Falcon-Arctic, Swallow-Tailed Kite-American, White-Faced Ibis, White-Tailed Hawk, Wood Stork and Zone-Tailed Hawk. Other endangered or threatened species include the Black Bear, Coati, Texas Tortoise, Texas Horned Lizard, Indigo Snake, Texas Salamander, Comal Blind Salamander, Rio Grande Lesser Siren, Bracted Twistflower and Texas Mock Orange (Trans-Texas Interim Report, Volume 2).

Medina Lake is surrounded by the Live Oak-Mesquite-Ash-Juniper Parks and Woods. The wetlands in the area are classified as lacustrine. Lacustrine wetlands consist of both deep and shallow open water habitats not dominated by typical wetland vegetation. Medina River, Medina Irrigation Canal, Diversion Lake and the tributary streams also contain wetlands. The wetlands in these areas are classified as riverine and palustrine. These areas are generally small and are typically associated with a water body. In addition to open water and streambed wetland areas, small areas of forested wetlands dominated by either-broad leafed deciduous or needle-leafed deciduous species exist downstream of the Medina Lake Dam.

One Category 2 Federal Candidate Species, the Bracted Twistflower, has been documented near the Medina Lake. Category 2 indicates that the species is under review by the U.S. Fish and Wildlife Service for possible listing as endangered or threatened but more information is needed. Increased use of Medina Lake as a water source will not affect the Bracted Twistflower since no water will be added outside of the existing reservoir. The Widemouth Blindcat and the Toothless Blindcat, both candidates for federal listing and listed as threatened by the Texas Parks and Wildlife Department, are troglobitic species found only in deep wells in the Edwards Aquifer beneath the City of San Antonio. Because the alternatives are expected to increase recharge and not affect recharge water quality, no adverse impact on these species is anticipated (Trans-Texas Water Program Volume 2, 1995).

Surface and Groundwater

The surface drainage of Medina County is generally to the south and southeast which coincides with the slope of the area. The northern and western parts of the County are drained by the Squirrel, Seco, Hondo, Verde and Quihi Creeks, which are intermittent streams draining into the Frio River. The northern and eastern parts of the County are drained by the Medina River, which eventually drains into the San Antonio River. The Medina River is the only perennial stream and is the main source of surface water flowing through the County. The southeastern part of the County is drained by the Black, Francisco Perez and Chacon Creeks which join the Frio River in McMullen County. The entire area is subject to heavy rains and floods which can fill the usually dry stream channels and occasionally overflow.

The Carrizo, Wilcox and Edwards Groups cover areas within Medina County. Soil types in the vicinity of Medina Lake are characterized by the undulating Brackett Association and undulating Tarrant Rock Outcrop Association on uplands with slopes from 1 to 8 percent. The steep Tarrant-Brackett Association is found on uplands with steep slopes between 20 to 40 percent. These areas are low in available water capacity and are used for rangeland and wildlife habitat.

Groundwater is generally available from five strata:

- Glen Rose Limestone;
- Leona Formation;
- Carrizo Sand;
- Wilcox Group;
- Edwards Limestone.

The Glen Rose Limestone supplies small to moderate amounts of fresh to slightly saline water from the lower Glen Rose Limestone and potable but highly mineralized water from the upper Glen Rose Limestone. The water from the upper Glen Rose Limestone is generally only used for domestic and stock purposes. Some of the water in the Glen Rose Limestone travels through faults into the Edwards Aquifer.

The silts, sands and gravels of the Leona Formation contains small amounts of water under water table conditions. However, in some areas the water is under artesian conditions due to the impermeable layers of silt and clay. In a large area near Devine, the Leona Formation overlies the Carrizo sand and increases recharge to the Carrizo Aquifer.

The Carrizo sands contains hard water that is otherwise low in dissolved solids. Most of the water is used for irrigation purposes but it is acceptable for most public supply and industrial purposes. The Wilcox Group underlies the Carrizo sands. Some of the sands in the Wilcox Group may become hydraulically connected with the Carrizo sand. However, the Wilcox Group sands tend to be less permeable and contain water of lower quality.

The Edwards Limestone is extensively faulted and contains the most usable water in Medina County. The water contained in the Edwards Limestone is generally of uniform quality as long as the movement of water remains unrestricted. A large area in southern Medina County contains highly mineralized water.

Portions of the Edwards, Trinity and Carrizo-Wilcox Aquifers lie within Medina County. The Edwards Aquifer supplies nearly all of the County's water demand. This Aquifer provides water of increasing salinity as the water enters discharge areas.

Topography

Two major physical provinces, which are separated by the Balcones fault zone, occupy Medina County. The northern part of the County is formed by the Edwards Plateau, which is a division of the Great Plains. The remaining two-thirds of the County is part of the Rio Grande Plain, a division of the Gulf Coastal Plain.

The altitude ranges between 560 feet at the southeast corner to 2,030 feet at the northwest corner of the County. The relief is about 1,470 feet, however the altitude difference does not exceed 500 feet at any location.

The Balcones Escarpment, the boundary between Edwards Plateau and Gulf Coastal Plain, was formed by movement along the fault zone. The area north of the major faults is known as the "Hill Country." The hills are circled by steplike terraces formed by massive limestone beds with softer marls and shales. Streams have formed deep valleys throughout the Edwards Plateau area.

South of the Balcones Escarpment is the minor relief of the low plains, where, with local exceptions, the alternating strata of different formations dip more rapidly to the south than does the land surface. Erosion of the alternating hard and soft layers has formed cuestas with northward facing escarpments. An exception to this topography is the areas covered with chert and caliche of the Uvalde Gravel where the Uvalde Gravel protects the underlying less resistant formations from erosion.

Geology and Soils

The rocks exposed in Medina County are of sedimentary origin, with the exception of several igneous intrusions north and west of Hondo. The sedimentary rocks range in age from Cretaceous to recent and consist of limestone, chalk, caliche, conglomerate, gravel, sand, silt, shale and clay (Holt, 1959).

The water bearing formations in Medina County from oldest to youngest are: Glen Rose Limestone, Edwards Limestone and associated limestone, Austin Chalk, Anacacho Limestone, silts and sands of the Escondido Formation, sands of the Indio Formation, Carrizo Sand and sands and gravels of the Leona Formation. Each formation forms a belt extending east to west across Medina County. The formation continuity has been disrupted by faulting. The beds dip in a south southeast direction. The slope of the beds is generally steeper than the slope of the land.

The Edwards Limestone is the principal water bearing formation in Medina. Another formation which yields moderate amounts of water is the Glen Rose Limestone. This formation supplies water to the northern parts of the County. Both the Edwards Limestone and the Glen Rose Limestone are of Cretaceous age. The other Cretaceous formations are the Austin Chalk, the Anacacho Limestone and Escondido Formation. The Austin Chalk and Escondido Formations contain small amounts of water, generally of poor quality. The water for the south part of the County is supplied by the Carrizo Sand and the Indio formation of Tertiary age. Also, the Leona formation of Quaternary age yields water for irrigation and other farm use.

The Edwards Limestone has been lowered by a series of faults which are a part of the Balcones fault system. The Culebra anticline in eastern Medina County and western Bexar County is related to the Balcones fault system. Water in the Edwards Limestone usually moves in either southward or eastward direction while locally controlled by faults.

The Ouachita Mountains (Paleozoic) of Oklahoma extends southwestward into Texas, where it is concealed under a Cretaceous covering. It takes the name "Ouachitasynclinorium" for the entire basin in Texas. This belt also passes through southern Medina County. The part of the geosyncline west of Medina County is less well known. A geosyncline is a low trough like area in bedrock in which rocks incline together from opposite sides. It is probable that the sediments in that part of the trough find their closest relationship with those of the Marathon and Solitario regions. The source of the sediment is the Llanoria landmass lying to the east and south of the geosyncline. Stratigraphic data from wells for Medina County are given in Table 1-1. The soil types and their extents in Medina County are given in Table 1-2.

Table 1-1. Stratigraphic Data From Wells In Medina County

Name And Location Of The Well	Total Depth (Ft.)	Depth To Paleozoic (Ft.)	Type Of Rock
Rothe 1, California-Medina Assoc.; Medina Co. School Lands, Sec 1012; 8 mi. NW of D'Hanis.	3705	2616±	Black Shale*
Zerr 1, Switzer et al.; I.I. Casenova Surv. 459; 5 mi. W-NW of Hondo	3635	---	Black Shale**

* Exact depth to Paleozoic not determined. Core examined at 3556-58 feet.

** Exact depth to Paleozoic not determined. Sample examined at 3635 feet.

Source: Sellards, E.H., W.S. Adkins and F.B. Plummer, Ninth Printing 1990, The Geology of Texas, Volume 1 Stratigraphy: University of Texas, Bureau of Economic Geology.

Table 1-2. Approximate Acreage and Proportionate Extent of the Soils in Medina County

Soil Type	Area (Acres)	Extent (%)
Amphion Clay Loam, 0 to 1% Slopes	14,700	1.7
Amphion Clay Loam, 1 to 3% Slopes	2,600	0.3
Atco Loam, 0 to 1% Slopes	16,300	1.9
Atco Loam, 1 to 3% Slopes	9,900	1.1
Austin Silty Clay, 1 to 5% Slopes	1,900	0.2
Brackett Association, Undulating	10,600	1.2
Brackett-Rock Outcrop Association, Hilly	8,900	1.0
Caid Sandy Clay Loam, 0 to 1% Slopes	3,800	0.4
Caid Sandy Clay Loam,1 to 3% Slopes	5,400	0.6
Caid Sandy Clay Loam, 3 to 5% Slopes	1,100	0.1
Castroville Clay Loam, 0 to 1% Slopes	37,200	4.3
Castroville Clay Loam, 1 to 3% Slopes	19,100	2.2
Devine Association, Undulating	4,700	0.5
Dina Association, Gently Undulating	6,800	0.8
Divot Clay Loam	21,800	2.5
Divot Clay Loam, Frequently Flooded	3,000	0.4
Doss Association, Gently Undulating	2,500	0.3
Duval Fine Sandy Loam, 0 to 1% Slopes	3,200	0.4
Duval Fine Sandy Loam, 1 to 3% Slopes	18,000	2.1
Duval Loamy Fine Sand, 0 to 5% Slopes	13,000	1.5
Hanis Sandy Clay Loam, 0 to 1% Slopes	7,500	0.9
Hanis Sandy Clay Loam, 1 to 3% Slopes	9,300	1.1
Hindes Association, Gently Undulating	8,600	1.0
Kavett-Tarrant Association, Undulating	3,000	0.3
Kincheloe Soils, 10 to 30% Slopes	4,600	0.5
Knippa Clay, 0 to 1% Slopes	47,500	5.5
Knippa Clay, 1 to 3% Slopes	12,500	1.4
Lacoste Soils, 1 to 5% Slopes	5,400	0.6
Mercedes Clay, 0 to 1% Slopes	40,600	4.7

Table 1-2 (Continued). Approximate Acreage and Proportionate Extent of the Soils in Medina County

Soil Type	Area (Acres)	Extent (%)
Mercedes Clay, 1 to 3% Slopes	9,900	1.1
Mereta Clay, 1 to 3% Slopes	12,000	1.4
Miguel Fine Sandy Loam, 0 to 1% Slopes	12,500	1.4
Miguel Fine Sandy Loam, 1 to 3% Slopes	3,300	0.4
Miguel Soils, 0 to 1% Slopes	1,900	0.2
Monteola Clay, 1 to 5% Slopes	15,200	1.8
Monteola Gravelly Clay, 1 to 5% Slopes	21,800	2.5
Nueces Solis, 0 to 5% Slopes	15,000	1.7
Olmos Association, Undulating	37,500	4.3
Olmos Complex, 1 to 8% Slopes	4,200	0.5
Orif Complex	3,000	0.4
Patilo-Eufaula Association, Gently Undulating	15,300	1.8
Poth Loamy Fine Sand, 0 to 3% Slopes	6,800	0.8
Pratley Clay, 0 to 3% Slopes	17,600	2.0
Quihi Association, Gently Undulating	21,000	2.4
Quihi And Devine Soils, 1 to 8% Slopes	800	0.1
Real Association, Undulating	30,400	3.5
Real And Brackett Soils, 1 to 8% Slopes	1,000	0.1
Rehm Complex, 1 to 8% Slopes	10,500	1.2
Sabenyo Clay Loam, 1 to 5% Slopes	5,800	0.7
Speck Association, Undulating	46,300	5.3
Tarrant-Rock Outcrop Association, Undulating	55,700	6.4
Tarrant-Rock Outcrop Association, Hilly	47,000	5.4
Tarrant-Rock Outcrop-Brackett Association, Steep	18,000	2.1
Tarrant And Speck Solis, 1 to 8% Slopes	1,700	0.2
Tiocano Clay	1,800	0.2
Topia Clay, 0 to 2% Slopes	3,000	0.4
Valco Clay Loam, 0 to 2% Slopes	10,100	1.2

Table 1-2 (Continued). Approximate Acreage and Proportionate Extent of the Soils in Medina County

Soil Type	Area (Acres)	Extent (%)
Victoria Clay, 0 to 1 Percent Slopes	31,500	3.6
Webb Fine Sandy Loam, 0 to 1 % Slopes	4,400	0.5
Webb Fine Sandy Loam, 1 to 3 % Slopes	11,600	1.3
Webb Fine Sandy Loam, 3 to 5 % Slopes	800	0.1
Wilco Loamy Fine Sand, 0 to 3 % Slopes	8,700	1.0
Yologo Association, Undulating	29,300	3.4
Yologo And Hindes Soils, 1 to 8 % Slopes	1,700	0.2
Total Land Area	**860,600**	**99.1**
Stream Beds and Water Areas	**7,880**	**0.9**
Total County Area	**868,480**	**100**

Source: Dittmar Glenn W., Michael L. Deike and Davie L. Richmond, 1977, Soil Survey of Medina County, Texas: U.S. Department of Agriculture Soil Conservation Service.

DEMOGRAPHIC DESCRIPTION

The County had a population of 27,312 people in 1990. The average per capita income in 1994 was $15,170. Agriculture, tourism, manufacturing and mining form the core of the economy. Hunting has become a major industry as well as oil and gas production, light manufacturing and aircraft related industry. Table 1-3 shows the general demographic data for Medina County.

Table 1-3. General Demographic Data For Medina County

1990 Population	Area (sq. mi.)	Population Density (cap./sq. mile)	Per Capita Income, 1994 ($)
27,312	1,331	21	15,170

Source: Medina County and Hondo, Texas Community Profile, Medina Economic Development Foundation and the TWDB.

Medina County's population has increased by 18% since 1980. Average annual population increase is 2% for the County (State Comptroller's Office).

ECONOMIC DESCRIPTION

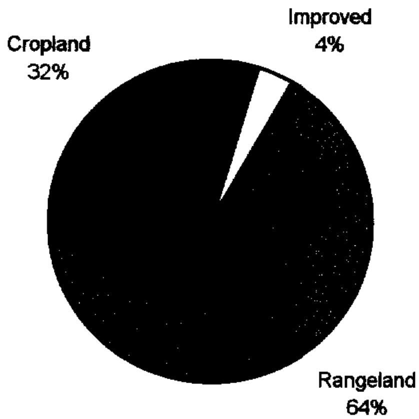
Average per capita income in 1994 was $15,170, which ranks the County as 206th in the state. Personal income grew by over 10% between 1992 and 1994, above the statewide average of about 7% over the same period. Medina County has an employment growth rate of 46% since 1991. Average employment for 1996 was 15,165, while average unemployment was 493 (3.1%) for the same year. Potential labor within 5 minutes to 1 hour is 1,328,034 based on 1990 census.

Agriculture, manufacturing, mining and tourism provide the basis for Medina County's economy. The largest and strongest of these is agriculture. Production of corn, grain sorghum and truck crops and cattle ranching provide a strong agricultural economy. Retail sales totaled over $160 million in Medina County, while deposits in eight banks and two savings & loans totaled over $200 million in 1992.

The cities of Castroville, Devine and Hondo all have municipal airports. Hondo Municipal Airport / Industrial Park is home to several major industries such as Gary Aerospace, Universal Rundle Corporation, Northrop Worldwide Aviation and Doss Aviation.

Agriculture

Eighty-three percent (83%) of the land in Medina County is used for agricultural production. Raising livestock, mainly cattle, sheep and goats, is common in the rugged upland areas. Sorghum, Corn, Hay and Wheat are the main crops. The value of all of the agricultural production was $64 million in 1991. Table 1-4 and 1-5 summarize the agricultural products and the acreage they cover:



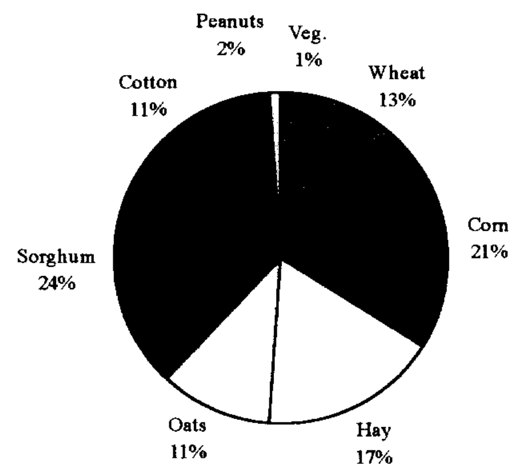
Source: Medina County and Hondo, Texas Community Profile, Medina Economic Development Foundation.

Table 1-4. Agricultural Land Use, Acres

Land Type	Area
Rangeland	460,000
Cropland	225,000
Improved	25,000

Table 1-5. Major Crops, Acres

Product	Area
Wheat	15,000
Corn	24,000
Hay	20,000
Oats	13,000
Sorghum	28,000
Cotton	12,500
Peanuts	2,300
Vegetables	1,000



Source: Medina County and Hondo, Texas Community Profile, Medina Economic Development Foundation.

Manufacturing

Light manufacturing and aircraft related industry are also sources of income for the County. Manufacturing includes newsprint production, fertilizer manufacturing and brick manufacturing. Aircraft and aircraft components are also made within the County. Other aircraft related industry involves flight screening and aircraft repair. The value of the goods which were produced and shipped from Medina County was $23.3 million in 1987.

Mining

Oil and gas production takes place to some extent in Medina County. Sand, gravel, clay and caliche are mined in areas of the County. Coal mining used to take place and large amounts of coal remain unmined.

Tourism

Hunting and fishing attract many tourists to the County. White-tailed deer, dove and quail are favorites for hunting. Approximately 9,000 deer are killed each year in the County. Feral hogs, javelina, wild turkey and exotics are also among popular hunting animals. The County also has many historical sites, antique shops and bed and breakfasts.

CURRENT WATER PLANNING AND REGULATORY STATUS

Bexar-Medina-Atascosa Water Control and Improvement District No. 1 is a water conservation and improvement district created pursuant to the "conservation amendment" to the Texas Constitution. BMA is a political subdivision of the State of Texas and it holds certificates of Adjudication Nos. 19-2130 and 19-2131 which are based upon certified filings No. 18 and 19. These certificates authorize the impoundment of state water in and diversion of water from Medina, Diversion and Chacon Lakes. This includes the transfer of water from the Medina River Basin, a sub-basin of the San Antonio River Basin, into the Nueces River Basin. BMA holds a water right that allows storage of approximately 260,000 acre-feet of water in two lakes, with annual diversion of 66,000 acre-feet for irrigation, municipal and industrial purposes. BMA's irrigation right allows for the irrigation of 34,000 acres within the district.

BMA's Certificates have a priority date of November 1910, through the initiation of construction of the dams, diversion works and the irrigation canals presently in place and utilized by BMA. Certificate of Adjudication No. 19-230 authorizes BMA to impound up to 4,500 acre-feet of water per year in Medina Lake and to impound, divert and use up to 66,000 acre-feet of water per year from the reservoirs for irrigation, municipal and industrial purposes. BMA is authorized to divert water from its reservoir system at a point located on the Diversion Dam at a rate not to exceed 450 cubic feet per second. BMA's Certificate of Adjudication has no minimum stream flow requirement restricting its diversion rights. The contractual obligations of BMA are:

- 5,000 acre-feet reserved for Bandera County;
- Contracts with Bexar Metropolitan Water District;
- Commitments made to the Edwards Aquifer Authority, San Antonio Water System and Texas Parks and Wildlife Department during the course of the hearing on BMA's amendment to its Certificate of Adjudication.

Calculations of water supply from the Edwards Aquifer will be based on the provisions of Senate Bill 1477, which set pumpage at 450,000 acre-feet per year until 2008 and 400,000 acre-feet per year beginning in 2008. The total requested pumpage from the Edwards Aquifer was 792,864 acre-feet. Each entity will have a prorated share of the 400,000 acre-feet or their historical average yearly pumpage, which ever is larger. If the total pumpage value is still higher than the 400,000 acre-feet limit then each entity's total yearly pumpage will be lowered by an equal percentage.

SECTION 2

POPULATION PROJECTIONS AND WATER DEMANDS

POPULATION PROJECTIONS

The most recent population estimates by the U.S. Bureau of Census found that Texas was the second most populated state in the United States. The large population will continue to place additional pressure on the state's water resources to meet its water needs.

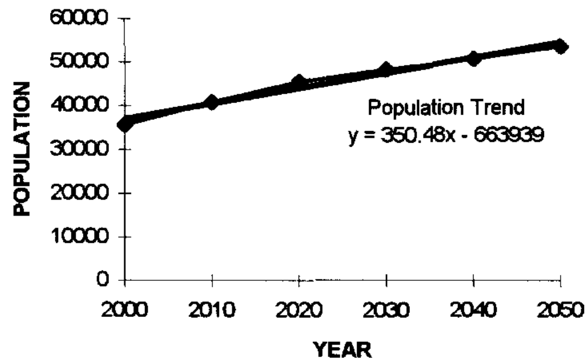
According to the Trans-Texas Water Program, the 1990 population of the Edwards Aquifer area was 1.4 million. Projections for the years 2020 and 2050 expect populations of 2.4 million and 3.7 million people respectively. This is a projected total increase of 164%.

The population projections for Medina County used in this study are from the 1996 Consensus Texas Water Plan estimates prepared by the Texas Water Development Board (TWDB). The technique used by TWDB for population projections was a "cohort component" procedure. Cohort refers to age, sex, race and ethnic groups. The components of cohort which can change are fertility rates, survival rates and migration rates. Projections of each cohort are summed to obtain the expected total population. The limitations of the projections depend on the limitations of the 1990 census count and other factors such as the results of implementation of the North American Free Trade Agreement (NAFTA).

Table 2-1 gives the population projections for Medina County through the year 2050. The cities with populations greater than 1,000 are listed in Table 2-2. The County Other category in Table 2-2 includes the smaller communities (less than 1,000 population) as well as the rural population of the County. The city of Lytle occupies land in Medina, Bexar and Atascosa Counties. All of the city of Lytle's municipal water supply comes from wells located in Medina County, therefore the entire population of Lytle was included in Table 2-2.

Table 2-1. Medina County Population Projections

Year	Population
2000	35,665
2010	40,791
2020	45,416
2030	48,426
2040	50,735
2050	53,630



Source: TWDB Planning Division - 1996 Consensus Texas Water Plan, Population and Consumptive Water Demand Forecasts.

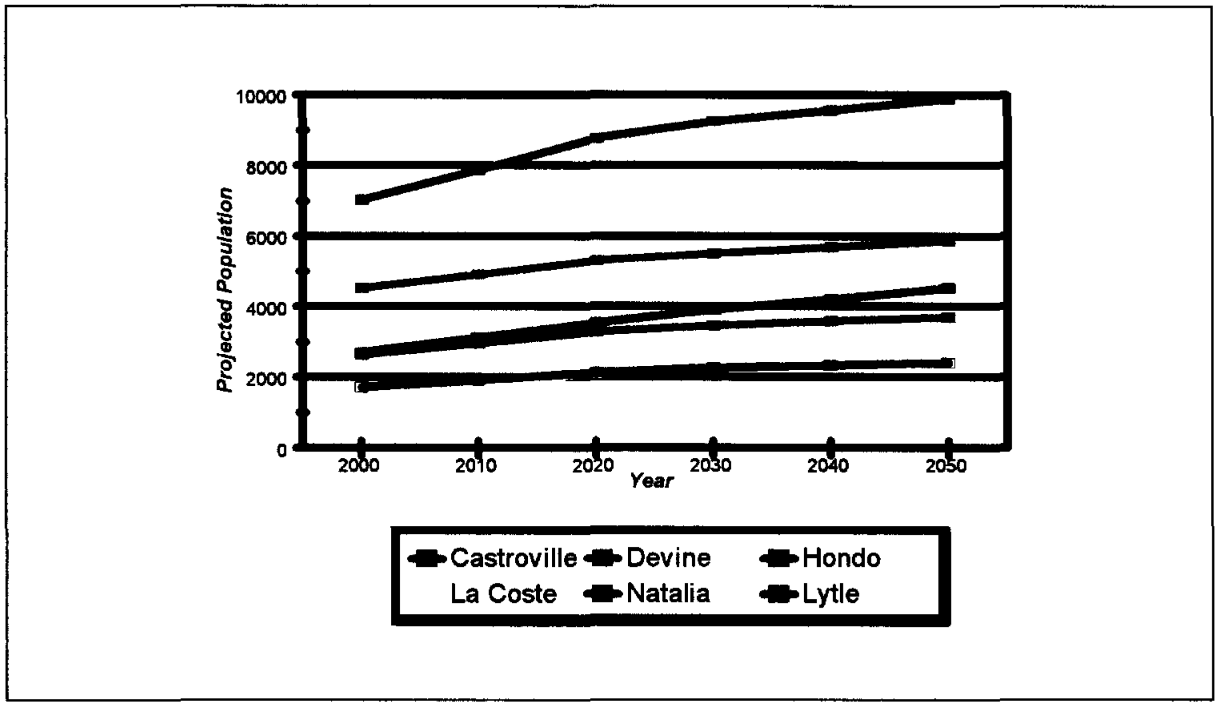
Table 2-2. Population Projections Of Major Cities In Medina County

Year	Castroville	Devine	Hondo	LaCoste	Natalia	Lytle	County Other	Total
1990	2,159	3,928	6,018	1,021	1,216	2,251	12,630	29,223
2000	2,632	4,524	7,032	1,426	1,703	2,698	15,650	35,665
2010	2,950	4,921	7,880	1,789	1,909	3,124	18,218	40,791
2020	3,289	5,310	8,782	2,092	2,126	3,542	20,275	45,416
2030	3,469	5,515	9,268	2,307	2,244	3,916	21,707	48,426
2040	3,583	5,686	9,574	2,463	2,318	4,214	22,897	50,735
2050	3,701	5,862	9,890	2,630	2,394	4,535	24,618	53,630

Source: TWDB Planning Division - 1996 Consensus Texas Water Plan, Population and Consumptive Water Demand Forecasts.

Figure 2-1 graphically shows the population projections for Medina County.

Figure 2-1. Population Projections For Medina County



The following trends were observed in the population projections over the period between 2000 and 2050. The percentage increase in the projected population for all of Medina County is approximately 50%, or a per capita increase of about 17,965 people.

- The population of Lytle and LaCoste are expected to increase by 68% and 85% respectively. This is attributed to an expected westward migration of people who work in the San Antonio area and will choose to live in these smaller urban areas.

- The population in Castroville, Hondo and Natalia are all expected to increase by about 41%. Devine is projected to increase its population by about 30%.

- The population in the County Other Category, which includes the smaller communities and the rural areas of Medina County, are projected to grow by approximately 57%.

The projected increase in population for each decade and for the planning period is shown in Table 2-3.

Table 2-3. Population Increase By Decade And Planning Period

City	2000-2010	2010-2020	2020-2030	2030-2040	2040-2050	Total 2000-2050
Castroville	318	339	180	114	118	1,069
Devine	397	389	205	171	176	1,338
Hondo	848	902	486	306	316	2,858
LaCoste	363	303	215	156	167	1,204
Natalia	206	217	118	74	76	691
Lytle	426	418	374	298	321	1,837
County Other	2,568	2,057	1,432	1,190	1,721	8,968
Total	**5,126**	**4,625**	**3,010**	**2,309**	**2,895**	**17,965**

Source: TWDB Planning Division - 1996 Consensus Texas Water Plan, Population and Consumptive Water Demand Forecasts.

As reflected in the decade by decade growth projections, all population groups will experience the greatest growth between the years 2000 and 2020. The population in the smaller communities and the rural areas (County Other) are expected to experience a second positive increase in its growth rate between 2040 and 2050.

Since the TWDB projections do not address cities and towns with populations of less than 1,000, the population records at the TWDB for the years 1990 and 1993 for these communities were reviewed. Population projections for these smaller communities were made with the concurrence of the TWDB to identify smaller water service areas in Medina County. These projections are shown in Table 2-4. The total population for County Other in Table 2-4 is the same number identified as County Other on Table 2-2.

Table 2-4. County Other Population Projections

City	1990	2000	2010	2020	2030	2040	2050
D'Hanis	119	168	197	219	234	251	266
Dunlap	119	168	197	219	234	251	266
Mico	98	138	161	180	192	204	219
Quihi	104	128	149	166	178	187	202
Rio Medina	98	121	141	156	167	177	190
Yancey	202	249	290	323	346	365	393
Rural	11,890	14,678	17,083	19,012	20,356	21,462	23,082
Total	**12,630**	**15,650**	**18,218**	**20,275**	**21,707**	**22,897**	**24,618**

The projected population for all of the small communities was made based on their prorated share of the total population in the historical record. The total projected population estimate was a control number that was not exceeded. The projected population for the communities of D'Hanis, Dunlap and Mico were then adjusted upward by 15% based on an expected increase in migration rates due to their proximity to Federal Highway 90 (D'Hanis and Dunlap) and the recreational / retirement area near Medina Lake (Mico). This created a new total population from which new shares for each city were recalculated. A reduction in the population for the Rural Category was then made to preserve the original total control estimate.

WATER DEMANDS

The Technical Advisory Committee for the Water Demand / Drought Management Committee of the TWDB approved a most likely series for population and water demand forecasts for use as the basis for developing the 1996 Consensus Texas Water Plan. This Consensus Water Plan is used for state planning and determining regulatory processes. The most likely high and low series were used in this project. The most likely high series considers water usage during below normal rainfall and expected conservation, while most likely low series considers normal rainfall and advanced conservation. The 1996 Consensus Texas Water Plan was used to estimate the water demands for the period 2000 to 2050.

Demand forecasting requires estimating the municipal, irrigation, mining, livestock, manufacturing and steam electric demand. An explanation of these water use categories are as follows:

- **Municipal Water Demand:** The quantity of fresh water required for use in homes, offices, public buildings, restaurants and stores for drinking, preparing food, bathing, flushing toilets, laundering clothes, watering lawns, washing cars, cooling, filling swimming pools, eliminating fires, washing streets and other sanitation and aesthetic uses.
- **Manufacturing Water Demand:** The amount of water used in the normal operation of an industry for cooling water, process / product makeup, sanitation and landscaping.
- **Irrigation Water Demand:** The quantity of water required to meet the consumptive use requirements of agricultural crops cultivated in Medina County.
- **Mining Water Demand:** The amount of water used in sand and gravel washing operations and in the recovery of oil and gas.
- **Livestock Water Demand:** The total amount of water required for drinking and sanitation that is associated with various livestock operations.
- **Steam Electric Demand:** The quantity of water needed to replace steam or induced evaporation generated through the operation of boilers and cooling equipment and for general plant uses.

Regional Water Demands

<u>Per Capita Demands</u>

Water demand was calculated by multiplying the per capita demands, which is the average volume of water used in gallons per day, by the total population. To estimate the demands for the Medina Regional Water Management Plan, accepted norms, water conservation goals and economic impacts were considered.

<u>Municipal Demands</u>

Municipal water use requirements were based on the projected population and the per capita water use. Data reported by the suppliers of municipal and commercial water provided the necessary information to compute historical per capita water use for the planning area. Per capita water use for the high series forecast considers the highest recorded per capita water use for each supplier and should reflect demands during periods of below average rainfall conditions. The low series forecast reflects per capita water use representative of average rainfall conditions.

Manufacturing Demands

Manufacturing water use was estimated using national and state wide growth outlooks developed for each industrial category in the state, historical water use, known facility expansions or construction, the industry base of the county and potential savings through recirculation and approved water use technology.

Irrigation Demands

Irrigated agricultural water requirements depend on the acreage that is currently in irrigated production, the current water usage per acre, the water costs and the availability of water supplies. Projections of irrigation water reflect quantities of water associated with typical Texas irrigated farming operations.

Mining Demands

Mining water requirements were based on water use coefficients. These coefficients were representative of each type of mining operation in the region and historical national and state trends in mineral production. The mining demand reflects substitutions of mineral fuels for energy production.

Livestock Demands

Daily water requirements for the different classes of livestock were developed using nutritional data. The rate of use was then determined based on the daily water requirements and the livestock census data. Future livestock water needs were based on forecasts of livestock production and water use rates.

Steam-Electric Demands

Present and forecasted steam electric demands are considered insignificant in Medina County and were therefore not considered for this study.

Water Use And Demand Comparisons

Municipal

Per capita water demands, or the average volume of water used in gallons per person per day, was multiplied by the population to project future demand for municipal or domestic use. The TWDB maintains records of the volume of water that has been supplied for municipal use to the larger cities in Medina County. These records were then reviewed to determine historical water use on a gallons per capita per day basis (GPCD). Table 2-5 lists the historical per capita municipal water use. The County-Wide figures include all established cities, communities and rural areas in the county.

Table 2-5. Historical Per Capita Municipal Water Use, GPCD

Year	Castroville	Devine	Hondo	LaCoste	Natalia	Lytle	County-Wide
1976	280	136	186	*nd	54	131	nd
1977	301	133	214	nd	62	167	151
1978	307	146	217	nd	79	189	nd
1979	360	113	216	nd	69	182	nd
1980	394	166	254	nd	86	202	179
1981	320	159	220	nd	73	195	nd
1982	282	178	263	nd	67	179	nd
1983	270	171	232	nd	73	159	nd
1984	412	179	291	nd	128	193	208
1985	229	168	234	nd	145	183	176
1986	197	145	236	nd	155	170	183
1987	172	141	214	nd	129	157	160
1988	254	165	248	nd	122	188	190
1989	402	206	265	nd	228	237	207
1990	322	143	216	200	216	191	172
1991	259	176	173	172	216	165	161
1992	179	158	165	145	212	157	151
1993	206	152	228	130	204	167	168
1994	214	125	214	137	61	155	nd
Average	**282**	**156**	**226**	**157**	**125**	**177**	**176**

*nd - No data available.
Source: TWDB Planning Division - Historical Summary of City Water Use.

The GPCD values under the County-Wide category were derived from TWDB historical water use records and represent municipal and domestic use in all the cities and rural areas of the County. The larger cities (Castroville and Hondo) have recorded higher GPCD values indicating a trend toward greater demand in more urban areas.

Municipal water use records from the TWDB, summarized on Table 2-6, were reviewed to evaluate historical demand within each municipal service area. These historical demands include service to the residents of the particular city and to domestic users outside of the city limits. The County-Wide category includes reported water use in the entire county including the smaller communities and rural areas.

Table 2-6. Historical Municipal Water Use, Ac-Ft./Year

Year	Castroville	Devine	Hondo	LaCoste	Natalia	Lytle	County-Wide
1976	579	546	1,215	153	77	238	*nd
1977	621	539	1,411	180	89	318	3,771
1978	630	599	1,445	202	113	374	nd
1979	737	471	1,451	157	98	375	nd
1980	804	698	1,724	205	122	434	4,649
1981	678	676	1,464	179	112	432	nd
1982	605	767	1,767	190	105	405	nd
1983	597	751	1,579	192	118	369	nd
1984	937	802	1,999	243	216	464	5,724
1985	591	770	1,624	231	249	455	4,901
1986	576	678	1,663	205	272	439	5,363
1987	551	663	1,532	155	231	418	4,865
1988	894	780	1,804	185	221	516	5,738
1989	957	902	1,785	259	312	589	6,233
1990	784	640	1,771	231	294	552	5,254
1991	661	823	1,545	213	313	497	5,061
1992	461	759	1,453	199	297	483	4,812
1993	550	752	1,775	184	290	515	5,593
1994	597	644	1,797	193	94	494	6,061
1995	594	776	1,887	201	310	536	nd
Average	**670**	**702**	**1,585**	**204**	**197**	**445**	**5,233**

*nd - No data available
Source: TWDB Water Use Database, 1996, Norman Alford.

All of the water supplied in 1994 (6,061 acre-feet) was taken from groundwater sources. Approximately 95% of the 1994 total was removed from the Edwards Aquifer. Four percent (4%) of the water was from the Carrizo-Wilcox Aquifer and approximately 1% was from the Trinity Aquifer.

Table 2-7 shows the municipal demand projections for the cities of Medina County. The high demand represents the most likely water use scenario with below normal rainfall conditions and expected conservation, while the low demand represents the most likely water use with normal rainfall conditions and advanced conservation.

Table 2-7. Projected Water System Demands For Municipal Uses

	Year	Population	High Demand (Acre-Feet/Year)	High Demand (GPCD)	Low Demand (Acre-Feet/Year)	Low Demand (GPCD)
Castroville	2000	2,632	996	338	764	259
	2010	2,950	1,067	323	783	237
	2020	3,289	1,135	308	803	218
	2030	3,469	1,185	305	839	216
	2040	3,583	1,216	303	863	215
	2050	3,701	1,252	302	887	214
Devine	2000	4,524	993	196	765	151
	2010	4,921	1,025	186	755	137
	2020	5,310	1,047	176	749	126
	2030	5,515	1,069	173	766	124
	2040	5,686	1,083	170	783	123
	2050	5,862	1,110	169	795	121
Hondo	2000	7,032	2,103	267	1,615	205
	2010	7,880	2,242	254	1,659	188
	2020	8,782	2,390	243	1,721	175
	2030	9,268	2,492	240	1,796	173
	2040	9,574	2,542	237	1,845	172
	2050	9,890	2,614	236	1,894	171
LaCoste	2000	1,426	297	186	257	161
	2010	1,789	345	172	273	136
	2020	2,092	377	161	274	117
	2030	2,307	408	158	297	115
	2040	2,463	430	156	315	114
	2050	2,630	457	155	333	113

Table 2-7 (Continued). Projected Water System Demands For Municipal Uses

	Year	Population	High Demand (Acre-Feet/Year)	High Demand (GPCD)	Low Demand (Acre-Fee/Year)	Low Demand (GPCD)
Lytle	2000	2,698	*677	*224	*520	*172
	2010	3,124	*741	*212	*546	*156
	2020	3,542	*801	*202	*572	*144
	2030	3,916	*873	*199	*628	*143
	2040	4,214	*925	*196	*666	*141
	2050	4,535	*996	*196	*717	*141
Natalia	2000	1,703	412	216	315	165
	2010	1,909	441	206	323	151
	2020	2,126	467	196	333	140
	2030	2,244	485	193	347	138
	2040	2,318	493	190	356	137
	2050	2,394	507	189	365	136
County Other	2000	15,650	2,507	143	2,086	119
	2010	18,218	2,720	133	2,170	106
	2020	20,275	2,836	125	2,200	97
	2030	21,707	2,957	122	2,300	95
	2040	22,897	3,063	119	2,396	93
	2050	24,618	3,259	118	2,542	92
County-Wide	2000	35,665	*7,985	*200	*6,322	*158
	2010	40,791	*8,581	*188	*6,509	*142
	2020	45,416	*9,053	*178	*6,652	*131
	2030	48,426	*9,469	*175	*6,973	*129
	2040	50,735	*9,752	*172	*7,224	*127
	2050	53,630	*10,195	*170	*7,533	*125

* Includes the entire Lytle demand including the parts in Atascosa and Bexar counties.
Source: TWDB Planning Division - 1996 Consensus Texas Water Plan, Population and Consumptive Water Demand Forecasts.

The City of Lytle covers area in Medina, Bexar and Atascosa Counties, however all of the historical water use has come from wells located in Medina County. Therefore, the entire population of the City of Lytle was considered for the projected water demands in Table 2-7. The County Other category represents the smaller communities in the county as in Table 2-2.

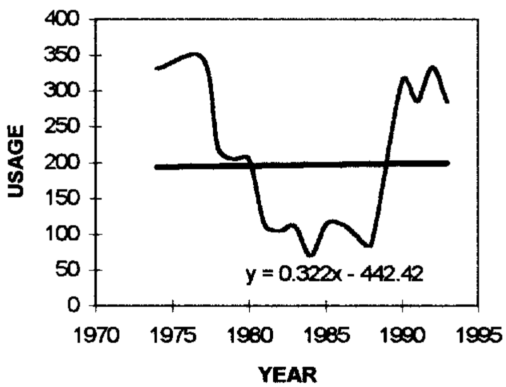
Manufacturing

Historical records at the TWDB indicate relatively low water demand for manufacturing use in Medina County. The primary users were tenants at the Hondo Industrial park, west of Hondo, who have purchased water from the City of Hondo since at least 1974. The manufacturing water use ranged from 43 to 346 acre-feet per year. Table 2-8 shows the historical water use patterns through 1994.

Table 2-8. Historical Manufacturing Water Use, Ac-Ft.

Year	Water Use
1974	331
1977	346
1980	205
1984	70
1985	114
1986	115
1987	99
1988	86
1989	315
1990	286
1991	334
1992	285
1993	43
1994	52

Source: TWDB Planning Division - County Summary Historical Water Use.



A substantial reduction in water use was reported during 1993 due to the downsizing of Gary Air Force Base. Water use survey results for 1994 also indicate substantially less demand at the Hondo Industrial Park, which has been the largest manufacturing user of water in the county. The TWDB water demand projections through the planning period, shown in Table 2-9, assumed demands similar to those experienced between 1989-1992.

Table 2-9. Manufacturing Demand Projections, Ac-Ft.

Year	Demand
2000	302
2010	319
2020	339
2030	361
2040	384
2050	411

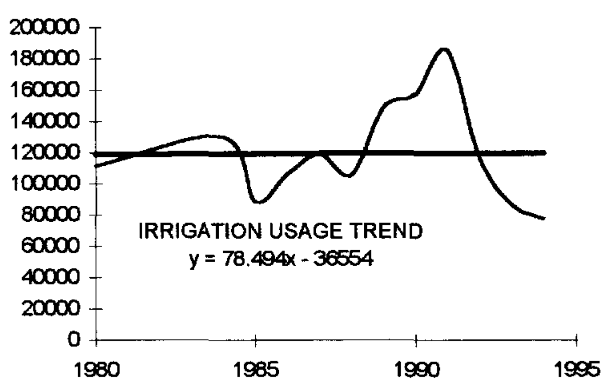
Irrigation

Historical water use for irrigation purposes has consistently accounted for approximately 90 to 95% of all of the water used in Medina County. Irrigated land totaled 41,604 acres in 1994 with 8,185 acres irrigated with surface water, 33,021 acres irrigated with groundwater and 398 acres irrigated with both surface water and groundwater. Table 2-10 shows the historical water use record.

Table 2-10. Historical Irrigation Water Use, Ac-Ft.

Year	Groundwater			Surface Water	Total
	Edwards	Carrizo	Total		
1974	---	---	41,033	28,634	69,667
1977	---	---	40,000	26,000	66,000
1980	66,377	7,787	74,164	37,445	111,609
1984	66,659	18,252	84,911	45,411	130,322
1985	56,905	424	57,329	31,062	88,391
1986	94,180	702	94,882	11,714	106,596
1987	81,049	797	81,846	37,144	118,990
1988	93,354	696	94,050	11,611	105,661
1989	95,676	746	96,422	52,611	149,033
1990	77,120	574	77,694	79,686	157,380
1991	102,120	760	102,880	82,778	185,658
1992	96,518	718	97,236	19,065	116,301
1993	---	---	64,435	22,229	86,664
1994	---	---	60,170	19,298	79,468

Source: TWDB Planning Division - County Summary Historical Water Use and TWDB Groundwater Pumpage Summary by Major Aquifer.



The average percentage of groundwater used for irrigation purposes between 1974 and 1994 is approximately 69%. The percentage of groundwater needed ranged from 49% in 1990 to 89% in 1988. The average percentage of groundwater used during 1992 to 1994 was approximately 78%. The increased average use during this three-year period coincides with a reduction in irrigation demand from surface water sources. Ninety-nine percent (99%) of the groundwater used for irrigation comes from the Edwards Aquifer.

The TWDB projections for irrigation water use through the planning period is shown on Table 2-11. This table indicates that demands will be somewhat equivalent to the historical record during 1989-1990.

Table 2-11. Irrigation Demand Projections, Ac-Ft.

Year	Demand
2000	155,085
2010	148,548
2020	142,287
2030	136,291
2040	130,546
2050	125,044

These projections reflect about a 5% decrease per decade in total water demand for irrigation purposes between 2000 and 2050. It is probable that groundwater sources will continue to provide the majority of the water supply for irrigated acreage in Medina County.

Mining

The water demands for mining use in Medina County are primarily for dimension stone and crushed stone operations. Minor amounts of water have been used in clay excavation operations to maintain dust control. Table 2-12 shows the historical water use for mining operations as reported in the TWDB surveys and in estimates prepared by the TWDB. Estimates were based on water use coefficients representative of the type of mining in the county and historical national and state trends in mineral production. Groundwater supplied all of the historical mining water use demands.

Table 2-12. Groundwater Historical Mining Water Use, Ac-Ft.

Year	Edwards	Carrizo	Trinity	Total
1974	*nd	nd	nd	26
1977	nd	nd	nd	0
1980	2	0	0	2
1984	109	24	0	133
1985	90	31	19	140
1987	79	28	17	124
1988	83	28	18	129
1989	77	26	17	120
1990	77	26	17	120
1991	76	24	18	118
1992	76	24	18	118

*nd - No data available
Source: TWDB Planning Division - County Summary Historical Water Use and TWDB Groundwater Pumpage Summary by Major Aquifer.

The average historical annual water demand for mining uses as reported since 1984 is 125 acre-feet. Projections for future water demand, shown on Table 2-13, indicate slightly decreased demand through the planning period.

Table 2-13. Mining Demand Projections, Ac-Ft.

Year	Demand
2000	143
2010	128
2020	128
2030	129
2040	132
2050	136

Livestock

Water demand for livestock use in Medina County has been relatively constant since 1980 according to county records (Table 2-14). Livestock water use was estimated by tabulating the numbers of livestock and multiplying daily water use rates obtained from animal nutrition data. In Medina County, roughly 85 to 90% of livestock water demands were met from stock ponds that hold rainfall.

Table 2-14. Historical Livestock Use, Ac-Ft.

Year	Edwards	Carrizo	Trinity	Total Groundwater	Surface Water	Total
1974	*nd	nd	nd	1,676	174	1,850
1977	nd	nd	nd	282	1,406	1,688
1980	114	90	42	246	1,207	1,453
1984	76	60	28	164	1,482	1,646
1985	64	50	22	136	1,239	1,375
1986	63	49	22	134	1,216	1,350
1987	76	59	26	161	1,446	1,606
1988	92	56	25	173	1,390	1,544
1989	71	56	25	152	1,370	1,521
1990	73	57	25	155	1,405	1,560
1991	75	58	25	158	1,432	1,591
1992	91	70	30	191	1,722	1,914
1993	nd	nd	nd	239	2,152	2,391
1994	nd	nd	nd	195	1,754	1,949

*nd - No data available,
Source: TWDB Planning Division - County Summary Historical Water Use and TWDB Groundwater Pumpage Summary by Major Aquifer.

The TWDB has projected an annual demand of 1,914 acre-feet for livestock use through the year 2050. This future demand is expected to be fulfilled by water sources similar to that of the historical record.

Table 2-15. Livestock Demand Projections, Ac-Ft.

Year	Demand
2000	1914
2010	1914
2020	1914
2030	1914
2040	1914
2050	1914

Total Demands

Total demands for water uses in Medina County are shown in Table 2-16.

Table 2-16. Projected Total Water Demand In Medina County, Ac-Ft.

	2000	2010	2020	2030	2040	2050
Municipal						
High Demand	7,404	7,935	8,348	8,693	8,925	9,300
w/ Entire Lytle	7,985	8,581	9,053	9,469	9,752	10,195
Low Demand	5,876	6,033	6,149	6,415	6,629	6,889
w/ Entire Lytle	6,322	6,509	6,652	6,973	7,224	7,533
Manufacturing	302	319	339	361	384	411
Irrigation	155,085	148,548	142,287	136,291	130,546	125,044
Mining	143	128	128	129	132	136
Livestock	1,914	1,914	1,914	1,914	1,914	1,914
Totals						
High Demand	164,848	158,844	153,016	147,388	141,901	136,805
w/ Entire Lytle	165,429	159,490	153,721	148,164	142,728	137,700
Low Demand	163,320	156,942	150,817	145,110	139,605	134,394
w/ Entire Lytle	163,766	157,418	151,320	145,668	140,200	135,038

Water use in Medina County is projected to increase through the planning period for municipal-high demand, municipal-low demand and manufacturing purposes by approximately 28%, 19% and 36% respectively. A decrease in water use is projected for irrigation and mining purposes by about 19% and 5% respectively. Livestock uses were projected to be unchanged throughout the project period. The projected demands for the period 2000 through 2050 indicate that irrigation uses will consume approximately 90 to 95% of all water use in the county and that municipal demands will require about 5 to 7%.

The following table (Table 2-17) describes the public water suppliers and the amount of water that was used in 1992. As it can be seen from this table, most of the public water suppliers get their water from the Edwards Aquifer. The amount of water pumped from each aquifer is shown in Tables 2-18 and 2-19. Figure 2-2 shows graphically the amount of groundwater pumped each year between 1980 and 1990.

Table 2-17. Public Water Suppliers In Medina County for 1994

City	Water Type	Source	Avg. Annual Use, Ac-ft.	Water Loss, Ac-Ft.	Population Served	Total Connections	% Residential / Commercial / Industrial
City of Castroville	*ss gw	E**	596	---	2,159	941	87% Res,13% Com
City of Devine	ss gw	E	644	88	3,950	1,476	89% Res,11% Com
City of Hondo	ss gw	E	1,797	411	8,000	2,320	84% Res,15% Com,1% Ind
City of LaCoste	ss gw	E	193	---	1,021	384	97% Res 3% Com
City of Lytle	ss gw	E	495	75	3,000	1,014	92% Res 8% Com
City of Natalia	ss gw	E	94	---	1,216	400	100% Res
New Alsace Water Co.	ss gw	E	24	---	144	48	100% Res
Rio Medina Water Corp.	ss gw	E	27	---	175	70	100% Res
Cattleman's Crossing Sys.	ss gw	E	34	13	261	87	100% Res
U.S. Air Force	ss gw	T**	---	---	300	24	---
West Medina WSC	ss gw	E	134	---	370	288	100% Res
Yancey WSC	ss gw	E	425	---	5,000	1,255	100% Res
Zinsmeyer Trailer Park	ss gw	E	5	---	---	9	---
Benton City WSC	ss gw	C**	220	75	2,850	1,350	---
Hill Country Utilities	ss gw	T	18	---	159	53	---
Creekwood WSC	ss gw	E	29	---	339	113	100% Res
Devine Golf Association	ss gw	C	41	---	---	---	---
D'Hanis Water System	ss gw	E	152	21	500	210	90% Res,9% Com,1% Ind
East Medina County WSC	ss gw	E	664	---	4,737	1,579	98% Res,1% Com,1% Ind
Gusville Trailer Park	ss gw	C	5	---	100	28	100% Res
Hwy 90 Ranch	ss gw	E	42	---	---	86	100% Res
Medina River West WS	ss gw	E	75	---	---	240	100% Res
Medina Valley High School	ss gw	E	24	---	2,200	1	---
Valley Mobile Home Prop.	ss gw	E	26	---	292	73	100% Res

* ss gw : self-supplied groundwater
** E: Edwards, T: Trinity, C: Carrizo-Wilcox Aquifers
Source: TWDB Planning Division - Groundwater Pumpage Summary by Major Aquifer.

Table 2-18. Groundwater Pumpage Summary By Major Aquifer, Ac-Ft.

Year	Aquifer	Municipal	Manufact.	Power	Mining	Irrigation	Livestock	Total
1980	Carrizo-Wilcox	97	0	0	0	7,787	90	7,974
	Edwards	4,650	0	0	2	66,377	114	71,143
	Trinity	26	0	0	0	0	42	68
	Total	4,773	0	0	2	74,164	246	79,185
1984	Carrizo-Wilcox	203	0	0	24	18,252	60	18,539
	Edwards	5,522	0	0	109	66,659	76	72,366
	Trinity	33	0	0	0	0	28	61
	Total	5,758	0	0	133	84,911	164	90,966
1985	Carrizo-Wilcox	207	0	0	31	424	50	712
	Edwards	4,763	0	0	90	56,905	64	61,822
	Trinity	31	0	0	19	0	22	72
	Total	5,001	0	0	140	57,329	136	62,606
1986	Carrizo-Wilcox	201	0	0	0	702	49	952
	Edwards	5,203	0	0	0	94,180	63	99,446
	Trinity	36	0	0	0	0	22	58
	Total	5,440	0	0	0	94,882	134	100,456
1987	Carrizo-Wilcox	202	0	0	28	797	59	1,086
	Edwards	4,701	0	0	79	81,049	76	85,905
	Trinity	24	0	0	17	0	26	67
	Total	4,927	0	0	124	81,846	161	87,058
1988	Carrizo-Wilcox	221	0	0	28	696	56	1,001
	Edwards	5,527	0	0	83	93,354	92	99,056
	Trinity	27	0	0	18	0	25	70
	Total	5,775	0	0	129	94,050	173	100,127
1989	Carrizo-Wilcox	159	0	0	26	746	56	987
	Edwards	6,288	0	0	77	95,676	71	102,112
	Trinity	30	0	0	17	0	25	72
	Total	6,477	0	0	120	96,422	152	103,171
1990	Carrizo-Wilcox	110	0	0	26	574	57	767
	Edwards	5,343	0	0	77	77,120	73	82,613
	Trinity	29	0	0	17	0	25	71
	Total	5,482	0	0	120	77,694	155	83,451
1991	Carrizo-Wilcox	109	0	0	24	760	58	951
	Edwards	5,190	0	0	76	102,120	75	107,461
	Trinity	41	0	0	18	0	25	84
	Total	5,340	0	0	118	102,880	158	108,496
1992	Carrizo-Wilcox	117	0	0	24	718	70	929
	Edwards	4,871	0	0	76	96,518	91	101,556
	Trinity	58	0	0	18	0	30	106
	Total	5,046	0	0	118	97,236	191	102,591
Avg.		**5,402**						**91,811**

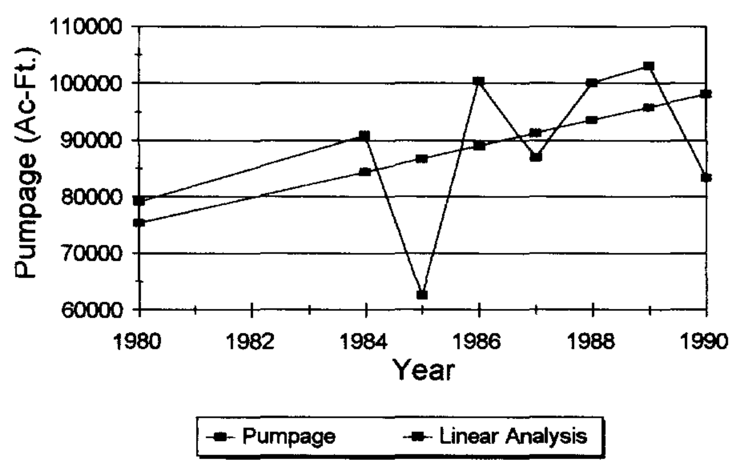
Source: TWDB Planning Division - Groundwater Pumpage Summary by Major Aquifer.

Table 2-19. Medina County Groundwater Pumpage, Ac-Ft.

Year	Pumped
1980	79,185
1984	90,966
1985	62,606
1986	100,456
1987	87,058
1988	100,127
1989	103,171
1990	83,451
1991	108,496
1992	102,591
Average	**91,811**

Source: TWDB Planning Division - Groundwater Pumpage Summary by Major Aquifer.

Figure 2-2. Medina County Groundwater Pumpage



According to the above table, an average of 91,811 acre-feet of groundwater was pumped each year in Medina County. Of this amount, 88,322 acre-feet was from the Edwards Aquifer, while 3,397 acre-feet was from the Carrizo-Wilcox Aquifer and 92 acre-feet was from the Trinity Aquifer. Figure 2-3 shows the average percentages of groundwater pumped from each aquifer in Medina County.

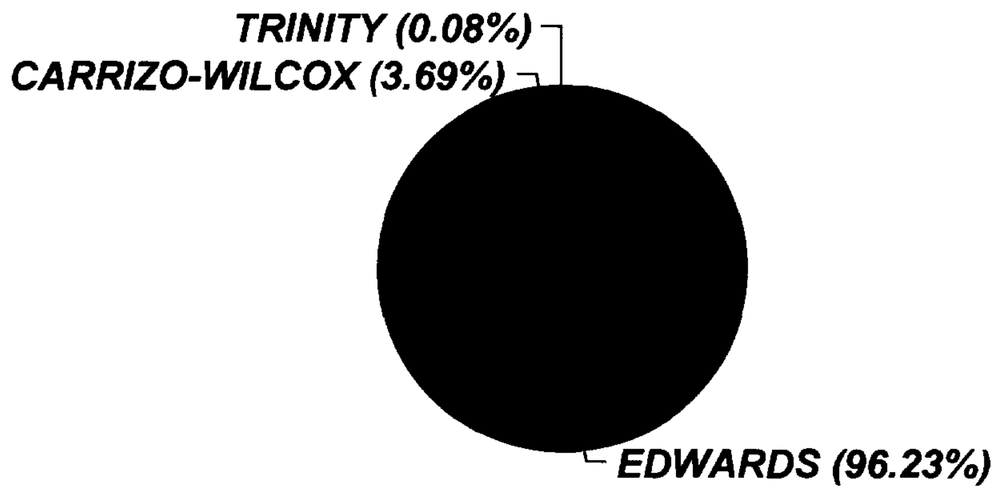


Figure 2-3. Average Percentage Of Groundwater Pumped From Each Aquifer In Medina County

SECTION 3
EXISTING GROUNDWATER SOURCES

INTRODUCTION

This section provides a summary and evaluation of the current groundwater resources available within Medina County. The information will be used to determine future groundwater availability and to formulate the Water Resource Management Plan.

METHODOLOGY

This section was prepared using published data and reports from the Texas Water Development Board (TWDB), United States Geological Survey (USGS), University of Texas Bureau of Economic Geology and Edwards Aquifer Authority (EAA).

OVERVIEW OF THE REGIONAL HYDROGEOLOGY

In Medina County, groundwater is the result of precipitation in the form of rain or snow. The precipitation either runs off into streams, returns to the atmosphere through evaporation and transpiration or enters the soil. A small portion of the water that enters the soil sinks into the zone of saturation. Water can also reach the zone of saturation from streams that flow over an aquifer outcrop.

Both artesian and water table conditions are observed in Medina County. Under water table conditions, the water is unconfined and as a result, will not rise above the level at which it is encountered in wells. This level is the upper surface of the zone of saturation. These conditions are usually found in the outcrops of permeable, water-bearing beds. Under artesian conditions, an overlying relatively impermeable bed confines the water below. Therefore, in wells, the water will rise above the level at which it is encountered.

The water table is not a level surface. It generally slopes from areas of recharge toward areas of discharge. If the land surface dips lower than the water table, some of the groundwater will emerge as springs. This has occurred in several places along Hondo Creek where the stream channel has cut below the level of the water table in the Leona Formation.

Groundwater moves under the influence of gravity from recharge areas to discharge areas in a slow but steady flow. In the more permeable rocks, such as coarse sand, gravel and cavernous limestone, the water moves with relative freedom. Such rocks are capable of yielding ample supplies of water to wells. In less permeable rocks, such as fine sand, silt, shale or clay, molecular attraction slows the flow of the water toward a well. The result is water that will not recharge as fast as it is withdrawn.

Table 3-1 presents the geologic (stratigraphy) and hydrological units of Medina County aquifers along with their water bearing properties.

The hydrology of the limestone aquifers is highly effected by the solubility of limestone in water. Changes in the solubility of limestone alters the permeability and porosity. The permeability and porosity determine the amount of discharge, recharge, quality, availability and movement of water within an aquifer. However, these changes in characteristics are considered insignificant over a long period of time.

Table 3-1. Geologic And Hydrological Units And Their Water Bearing Properties

System	Series	Group	Formation	Approximate Thickness (Ft.)	Lithologic Character	Water-Bearing Properties
Quaternary	Recent		Alluvium	0-30	Silt, sand, clay and gravel. Confined to stream valleys.	Not known to yield large supplies of water.
Quaternary	Pleistocene		Leona Formation	0-65	Silt, sand and fine gravel, occurring beneath terraces along larger streams.	Yields moderate to large supplies of potable water.
Tertiary	Pliocene		Uvalde Gravel	0-30	Coarse flint gravel and caliche on hilltops and divides.	Not known to yield water in Medina County.
Tertiary	Eocene	Claiborne	Mount Selman Formation	0-100	Sandstone and shale with limonite and calcite concentrations.	Furnishes large supplies of good water in Frio County. Only the lowest portion crops out in Medina County.
Tertiary	Eocene	Claiborne	Carrizo Sand	240-300	Coarse to medium grained nonmicaceous reddish sandstone. Locally crossbedded.	Yields moderate to large supplies of potable water.
Tertiary	Eocene	Wilcox	Indio Formation	440-710	Thin-bedded sandstone, siltstone and shale. Contains lignite and calcareous nodules.	Yields moderate supplies of moderately mineralized water.
Tertiary	Paleocene	Midway	Kincaid Formation	80-155	Marine limestone, sandstone and shale. Lower part contains glauconite.	Not a fresh water aquifer in Medina County.

Table 3-1 (Continued). Geologic And Hydrological Units And Their Water Bearing Properties

System	Series	Group	Formation	Approximate Thickness (Ft.)	Lithologic Character	Water-Bearing Properties
Cretaceous	Gulf	Navarro	Escondido Formation	550-740	Shale, sandstone and some limestone. Increasingly arenaceous to west.	Yields moderate supplies of moderately mineralized water.
Cretaceous	Gulf	Navarro	Corsicana Marl	30-55	Limestone and shale; thickens to east.	Not a freshwater aquifer in Medina County.
Cretaceous	Gulf		Taylor Marl	0-150	Clay and marl; thickens to east.	Not a fresh-water aquifer in Medina County.
Cretaceous	Gulf		Anacacho Limestone	350-530	Fossiliferous limestone, marl and clay. Increasingly calcareous to west.	Yields small supplies of water locally.
Cretaceous	Gulf		Austin Chalk	210-290	White to buff chalk, marl and limestone.	Yields small supplies of water.
Cretaceous			Eagle Ford Shale	20-65	Black shale and gray arenaceous limestone; weathers to yellow clay and brown flagstones.	Not known to yield water in Medina County.
Cretaceous	Comanche	Washita	Buda Limestone	35-110	Dense, massive limestone, light yellow to buff. Veined calcite.	Generally not water bearing.
Cretaceous	Comanche	Washita	Grayson Shale (Formerly Del Rio Clay)	35-95	Blue clay; weathers to yellow. Contains thin beds of limestone.	Yields no water to wells in Medina County.

Table 3-1 (Continued). Geologic And Hydrological Units And Their Water Bearing Properties

System	Series	Group	Formation	Approximate Thickness (Ft.)	Lithologic Character	Water-Bearing Properties
Cretaceous	Comanche	Washita	Georgetown Limestone	20-75	Hard white limestone. Thin-bedded limestone and marl near top.	May be water-bearing but does not furnish entire supply to any known well in Medina County. If and where water bearing, it forms a part of the principal limestone reservoir.
Cretaceous	Comanche	Fredericksburg	Edwards Limestone	400-620	Hard, massive white limestone with flint nodules. Cavernous in places.	Yields large supplies of potable water.
Cretaceous	Comanche	Fredericksburg	Comanche Peak Limestone	25-45	Sandy marl and limestone. Contains no flint.	Not a fresh water aquifer in Medina County.
Cretaceous	Comanche	Fredericksburg	Walnut Clay	12-42	Fossiliferous, sandy marl and limestone.	Not known to yield water in Medina County.
Cretaceous	Comanche	Trinity	Glen Rose Limestone	800-1175	Alternating beds of hard limestone and softer marl.	Yields moderate supplies of potable but rather hard water.
Cretaceous	Comanche	Trinity	Travis Peak Formation	220-650	Shale, silt, sandstone and limestone.	Probably contains moderate supplies of water of undetermined quality.
Cretaceous	Coahuila (Mexico)	Nuevo Leon and Durango (Mexico)	Sligo Formation	0-208	Gray limestone, black shale and sandstone.	Not known to yield water in Medina County.
Cretaceous	Coahuila (Mexico)	Nuevo Leon and Durango (Mexico)	Hosston Formation	0-440	Red sandstone and shale. Some limestone.	Not known to yield water in Medina County.
Pre-Cretaceous				190+	Hard, black, lignitic shale. Some anhydrite.	Not known to yield water in Medina County.

Source: Holt, Charles L.R., Second Printing March 1976, Geology and Ground-Water Resources of Medina County, Texas: U.S. Geological Survey Bulletin 5601.

Recharge

Medina County has large outcrops of several aquifers. These outcrops extend east and west beyond the borders of the county. Direct penetration of rainfall and streamflow over the outcrops recharges the aquifers within Medina County. The drainage areas of the Seco, Hondo and Verde Creeks and the Medina River cross these aquifers.

Streamflow and rainfall data for Medina County was collected by the United States Geological Survey, Edwards Aquifer Authority and the National Oceanic and Atmospheric Administration. This data as well as the runoff characteristics of these gauged areas were used as the basis for the annual groundwater recharge estimates.

Edwards Aquifer

The average estimated annual recharge for the period 1934 through 1995 is 674,200 acre-feet. Between the years 1934 and 1995, the estimated annual recharge ranged from 43,700 acre-feet in 1956 to 2,486,000 acre-feet in 1992. The estimated annual recharge of the Edwards Aquifer in the San Antonio area was 531,300 acre-feet in 1995.

The total recharge area of the Edwards Aquifer in Medina County is 200 square miles. Water enters the Edwards Limestone through openings caused by the dissolution of the limestone, jointing and fracturing. These openings extend into a network of cavernous solution channels. Therefore, large quantities of water may enter the aquifer within a comparatively small area.

The average annual infiltration to the Edwards Limestone from the Seco, Hondo and Verde Creeks is estimated to be about 35,000 acre-feet. This estimate is based on discharge measurements, rainfall records and the average number of days per year that these streams are reported to flow along their entire length.

A considerable amount of recharge enters the Edwards Limestone from the Diversion and Medina Lakes located on the Medina River. Diversion Lake lies on rocks of the Kainer Formation in the Edwards Aquifer recharge zone. Medina Lake is located on the outcrop of Glen Rose Limestone which is part of the Trinity Aquifer. The amount of recharge has increased in the area as a result of Medina and Diversion Lakes. The increased height of the surface of water results in an increased volume of water which flows to the water table. The seepage loss from the diversion and storage reservoirs was estimated to be nearly 72,000 acre-feet in 1930. All of the water lost from these lakes is assumed to enter the Edwards Aquifer. The water either seeps directly into the Edwards Limestone or travels through the Glen Rose Limestone to the Edwards Aquifer. Movement of water from the Glen Rose Limestone (Trinity Aquifer) to the Edwards Limestone (Edwards Aquifer) is believed to occur along the faults.

The estimated combined annual average recharge of the Edwards Limestone from the Nueces, Frio, Dry Frio, Medina, Sabinal Rivers and Hondo Creek is 150,000 acre-feet per year. The recharge from all of the streams that cross the outcrop of Edwards Limestone in Medina County is estimated to be about 90,000 acre-feet per year. In addition to the recharge from streams, a considerable quantity of precipitation entering the formation is needed to recharge the aquifer each year.

Carrizo Aquifer

Direct penetration of rainfall and water entering from streams crossing the outcrops of the aquifer are sources of recharge to the Carrizo Aquifer in Medina County. In addition, the Carrizo Aquifer is recharged by percolation from upper formations and in some cases, upward movement of water from lower formations. The Carrizo sand has a high coefficient of transmissivity, which is very favorable for recharge. The high coefficient of transmissivity is due to the high degree of sorting of sand grains and the lack of cementing material.

The streams crossing the outcrop of Carrizo sand are the Chacon, Francisco Perez, Hondo, Black and Tehuacana Creeks. The Leona Formation overlies the Carrizo sand in a large area near Devine. Water enters the Carrizo Aquifer through the gravel of the Leona Formation. This results in an increase in recharge to the aquifer in this area. In some areas the sands from the Wilcox group becomes hydraulically connected to the Carrizo sands. Therefore the aquifer is sometimes referred to as the Carrizo-Wilcox Aquifer. The Wilcox Group generally has a lower coefficient of transmissivity and lower quality water than the Carrizo sand.

Trinity Aquifer

The Glen Rose Formation provides the most water in Medina County of the Trinity Group rocks. Medina Lake is assumed to overlay the Trinity Aquifer. In most other areas, the Glen Rose Limestone acts as one of the confining layers of the Edwards Aquifer. The outcrop covers 84 square miles in northern Medina County. However, rainfall from adjacent counties is generally the main source of recharge due to the larger croppings of permeable layers in these other counties.

The Trinity Aquifer provides only small to moderate amounts of water to Medina County. Most of the water contained in the aquifer is only acceptable for stock and domestic uses. The Trinity Aquifer does supply some recharge to the Edwards Aquifer but would not make an effective water supply of itself.

Artificial Recharge

The amount of recharge to an aquifer can be increased by artificial recharge methods. Spreading water over the outcrop of a reservoir and injecting water through wells are two possible methods of artificial recharge.

In Medina County, recharge can be increased by impounding excess floodwaters on streams located on the outcrop of Edwards Aquifer, sinkholes such as Woodard Cave or a fractured portion of the aquifer. However, the mud and slime carried by the streams could restrict the infiltration of water. Intermittent flooding followed by drying and scarification could alleviate this problem.

Indio sandstone and Carrizo sand outcrops are exposed in some areas of Medina County. Excess floodwater could also be spread over areas where the more permeable sands crop out for the Carrizo-Wilcox Aquifer.

Aquifer Storage Recovery is another possible method of artificial recharge. Aquifer Storage Recovery involves treating water to drinking water standards and then injecting the water into an aquifer formation for storage using dual-purpose wells. The water can then be recovered by pumping as needed.

The net recharge of the Edwards and related aquifers by Medina Lake is currently being studied in the ongoing Medina Lake Recharge Study. Increasing the height of the surface water increases the volume of water which reaches the zone of saturation.

WATER BEARING CHARACTERISTICS AND AQUIFER USE

Annual groundwater discharge estimates were compiled from the following by the USGS:

- Streamflow data that was collected by the USGS;

- Pumpage data for public water supply, industry and military use as reported by the water suppliers to the Texas Water Development Board, Edwards Aquifer Authority and the USGS;
- Pumpage data for domestic supply, stock and miscellaneous use as estimated by the USGS;
- Pumpage data from irrigation wells that was obtained by the Nueces-Frio-Sabinal Soil and Water Conservation District, Medina Valley Soil and Water Conservation District and the United States Department of Agriculture;
- Irrigated acreage data supplied by the United States Department of Agriculture and irrigated acreage estimates from the Bexar-Medina-Atascosa Water Control and Improvement District No. 1 (BMA).

An average of 91,811 acre-feet of water is being pumped from the aquifers in Medina County annually. Ninety-six percent (96.2%) of the discharge comes from the Edwards Aquifer, 3.7% comes from the Carrizo-Wilcox Aquifer and the remaining 0.1% comes from the Trinity Aquifer. All of the major cities in Medina County supply their domestic water needs from the Edwards Aquifer.

Domestic supply and stock water are obtained from wells and springs. Springs and seepage areas are especially important sources of stock water in the northern part of the County where there are large cattle ranches. In the southern part of the County, domestic supply and stock water requirements are supplied by wells equipped with windmills or small-capacity electric or gas driven pumps.

The estimated discharge from the Edwards Aquifer through wells and springs in 1995 was 761,000 acre-feet. The average estimated annual discharge is 657,400 acre-feet. The estimated annual well discharge ranged from 101,900 acre-feet in 1934 to 542,000 acre-feet in 1989. Table 3-2 shows the average daily and annual discharge values from the Edwards Aquifer in Medina County for the year 1991. Fifty-two percent (52%) of the 1995 discharge was from groundwater wells. Nine percent (35,615 acre-feet) of the 1995 well discharge from the Edwards Aquifer occurred in Medina County.

Table 3-2. Calculated Average Daily And Total Annual Discharge From The Edwards Aquifer In Medina County By Water Use For The Year 1991.

Springs	Municipal Supply and Military Use	Irrigation	Industrial Use	Domestic Supply, Stock and Misc. Use	Total, MG/Year	Total, Ac-Ft/Yr.
No Data	4.63 mgd	91.16 mgd	No Data	0.14 mgd	35,014	107,461

Source: Texas Water Development Board Planning Division - Groundwater Pumpage Summary by Major Aquifer.

Approximately 95% of the water discharged from the Edwards Aquifer in Medina County is used for irrigation purposes. The remaining five percent (5%) is used for municipal purposes with small amounts being used for mining and livestock.

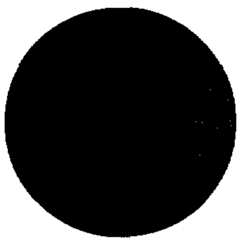
EDWARDS AQUIFER

The Edwards Aquifer in the San Antonio area is one of the most productive carbonate aquifers in the United States. The extensively faulted and cavernous limestone aquifer is the main source of water for Bexar, Comal, Hays, Medina and Uvalde Counties.

The areal extent of the Edwards Aquifer is about 3,180 square miles. Of this, 1,170 square miles is unconfined. Thirty-three percent (33%) of the Edwards Aquifer lies in Medina County. The areal extent of the unconfined and confined areas of the Edwards Aquifer in Medina County is given in Table 3-3.

Table 3-3. Areal Extent Of The Edwards Aquifer In Medina County

Unconfined Area (mi^2)	Confined Area (mi^2)	Total Area (mi^2)
219	834	1,053



Source: U.S. Geological Survey, September 1996, Ground-Water Storage in the Edwards Aquifer, San Antonio Area, Texas: Open File Report.

The confined area of the Edwards Aquifer has an average saturated thickness of 500 feet and 150 feet in the unconfined part. The effective porosity ranges from two (2) to fourteen (14) percent. The average porosity is six (6) percent. The bulk volume of freshwater in storage in the Edwards Aquifer can be calculated as follows:

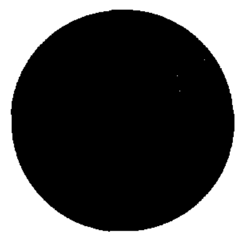
Bulk Volume of Water = Area x Saturated Thickness x Porosity

Using this equation, the total volume of circulating freshwater in the Edwards Aquifer is 45.4 million acre-feet. The confined section of the Edwards Aquifer contains 38.6 million acre-feet of freshwater, while the unconfined area only holds 6.8 million acre-feet. However, much of this water is located at depths which make it uneconomical to access.

The bulk volume of freshwater in storage in the Edwards Aquifer within Medina County is about 17.3 million acre-feet, of which 1.3 million acre-feet is in the unconfined part and 16 million acre-feet is in the confined part. The bulk volume of freshwater storage in the Edwards Aquifer in Medina County is shown in Table 3-4.

Table 3-4. Bulk Freshwater Volume Of Edwards Aquifer In Storage In Medina County

Water in Unconfined Area of Edwards Aquifer (Million acre-ft)	Water in Confined Area of Edwards Aquifer (Million acre-ft)	Total (Million acre-ft)
1.3	16.0	17.3



Source: U.S. Geological Survey, September 1996, Ground-Water Storage in the Edwards Aquifer, San Antonio Area, Texas: Open File Report.

The confined and unconfined areas of an aquifer have different storage coefficients. This difference results in water loss from the unconfined part of the aquifer when water levels decrease.

Distribution

Medina County has two (2) depositional provinces. The provinces are the Devils River Trend and the San Marcos Platform. There is also an outcrop of lower Cretaceous rocks within the county. The Devils River Trend consists of Devils River Limestone. The limestone thickness ranges from 400 to 800 feet but it is typically about 550 feet. The lower part consists of marine to supratidal deposits, while the upper part contains complex reefal and inter-reefal deposits. There is about 90 feet of poorly permeable, nodular, dense, shaley limestone above the Glen Rose Limestone. This layer grades up to about 220 feet of wackestone and mudstone containing burrowed beds. The wackestone and mudstone layers can be highly permeable. These rocks lie beneath 60 feet of mudstone and permeable, collapse breccia. Shallow marine deposits, which are made of biohermal rudist constitute the upper 180 feet.

The lowest stratigraphic unit of the Edwards Group on the San Marcos Platform is the Kainer Formation. This layer is typically about 300 feet thick but it ranges in thickness from 260 to 310 feet in Medina County. A dense, nodular stylolitic wackestone makes up the basal nodular member. The dolomitic member is made up of mostly tidal, burrowed and dolomitized wackestone. This layer has a high permeability. Leached, evaporitic deposits of the Kirschberg evaporite are contained within the dolomitic member. The uppermost member is the grainstone member. This member consists of well cemented, miliolid grainstone and has lesser beds of mudstone and wackestone. This layer is slightly to moderately permeable.

The upper stratigraphic unit of the Edwards Group on the San Marcos Platform is the Person Formation. This layer is typically about 200 feet thick. The lowest member is a laterally extensive, marine deposit. The deposit consists of poorly permeable, dense, carbonate mudstone. The leached and collapsed members, which overlie the basal member, basically consist of limestone and dolomite. Collapse breccia and dolomitized and burrowed wackestone within the layer form highly permeable units. The uppermost member is the marine member. This basically consists of limestone and dolomite, and more specifically of rudist-bearing wackestone and packstone and shell fragment grainstone. The cyclic member might be eroded in the area (Holt, 1959).

The top stratigraphic unit of the Edwards Aquifer in the San Marcos platform is the Georgetown Formation that typically ranges in thickness from 20 to 60 feet. Dense, argillaceous limestone form this member.

The Edwards Aquifer is confined by the relatively impermeable underlying Glen Rose Limestone and the overlying Del Rio Clay. Faults that extend upward cut through these confining layers. However, these fractures tend to be closed and have low permeability. The approximate thickness of the Edwards Aquifer in Medina County is 450 feet.

Flow Directions and Water Levels

The Balcones Fault zone causes the groundwater flow pattern to be highly compartmentalized. In Medina County, the groundwater flow is diverted eastward toward the artesian springs at lower altitudes. Barrier faults force the groundwater laterally along the faults. These faults direct the groundwater flow from the northeast to the southeast.

The most apparent effects caused by faults is in northern Medina County. Here the potentiometric contours are controlled by the Medina Lake fault. As much as 90 feet of head difference across faults was shown in this region. The direction of the groundwater flow in the Edwards aquifer in this area is southwestward, approximately along the strike of the faults. These faults prevent groundwater from moving directly downdip into the confined part of the aquifer. In western Medina County, obstruction of the groundwater flow by the faults is not evident (Maclay, 1995).

Aquifer Characteristics

Many wells in the Edwards Aquifer can yield more than 1,000 gallons of water per minute. This indicates that the Edwards Aquifer has a large transmissivity. In addition, small hydraulic gradients, large spring discharges and water which is relatively uniform in quality and temperature further indicate a large transmissivity.

The confined area of the Edwards Aquifer has an estimated transmissivity of 1,000,000 to 2,000,000 square feet per day. The freshwater zone has a transmissivity range of 430,000 to 2,200,000 square feet per day. A transmissivity of less than 430,000 square feet per day is generally found in the recharge area of the aquifer. Anisotropy ratios ranged between 0.0:1 and 1:1.

Although the specific yield of the unconfined Edwards Aquifer is not known, it is assumed to range from less than 0.05 to 0.20. The exact value depends on the textural rock types. The storage coefficient is determined by the porosity and thickness of the aquifer. The storage coefficient of the confined area of the aquifer is estimated to range between $1x10^{-4}$ and $1x10^{-5}$. Table 3-5 shows the porosity and permeability features of each hydrostratigraphic zone for the San Marcos Platform.

Table 3-5. Porosity And Permeability Features Of The Hydrostratigraphic Zones In The Edwards Aquifer Within The San Marcos Platform In The San Antonio Area, Texas

Hydrostratigraphic Zone	Total Porosity (Percent)	Relative Matrix Permeability	Fractures
I	<5	Very Small	Few, Closed
II	5-15	Moderate to Large	Many, Open
III	5-20	Moderate to Large	Many, Open
IV	<5	Very Small	Closed
V	5-15	Moderate	Few, Open
VI	5-25	Large	Undetermined
VII	5-20	Moderate	Many, Open
VIII	<10	Very Small	Few, Open

Source: Maclay, Robert W., 1995, Geology and Hydrology of Edwards Aquifer in San Antonio Area, Texas: U.S. Geological Survey Water-Resources Investigations Report 95-4186.

Water Quality

The quality of groundwater is affected by many factors. The factors which have the greatest effect on water quality are the relative solubility of the rocks, time of contact, pressure and temperature. The amount of ion exchange which takes place between the ions dissolved in water and the rock minerals also affects quality.

The water contained in the Edwards Aquifer is generally of uniform quality. The dissolved solids concentration remains uniform as long as the movement of the water remains unrestricted. The Castroville area has a potential for the development of good quality water. If the circulation is obstructed the concentration of dissolved solids increases. A large area in southern Medina County contains highly mineralized water.

Table 3-6 summarizes the results of the water quality testing from Edwards Aquifer wells in Medina County.

Table 3-6. Water Quality Of The Edwards Aquifer Within Medina-Bexar Hydrologic Subarea

Constituents	Minimum Concentration, mg/l	Maximum Concentration, mg/l
Dissolved Solids	171	470
Nitrite+Nitrate	0.02	11.0
Organic Nitrogen	0.03	3.5
Ammonia	<0.01	0.18
Nitrogen	0.38	11.3
Phosphorus	<0.01	0.13
Lead	<0.001	0.016
Arsenic	<0.001	0.001
DDE	<0.01 µg/l	<0.01 µg/l
DDT	<0.01 µg/l	<0.01 µg/l
Dieldrin	<0.01 µg/l	<0.01 µg/l
Endosulfan	<0.01µg/l	<0.01µg/l
Malathion	<0.01µg/l	<0.01µg/l
Diazinon	<0.01µg/l	<0.01µg/l
Fecal Coliform	Varies by site	

Source: Roddy, W.R., 1992, Water Quality of the Edwards Aquifer and Streams Recharging the Aquifer in the San Antonio Region, Texas: U.S. Geological Survey Hydrologic Investigation Atlas.

Groundwater Development and Aquifer Criticality

The water level in the Edwards Limestone has fallen below 100 feet of the surface in most parts of Medina County. It would be necessary to drill more than 1200 feet in many areas to reach useable water. Senate Bills 1477 and 3162 require a reduction of pumpage from the Edwards Aquifer beginning in 2008. The pumpage will be set at a maximum of 400,000 acre-feet per year. Each entity will only be allowed to pump their prorated share of the annual pumpage. The purpose of this bill is to protect the endangered species of the Comal and San Marcos springs by preventing further reduction to their natural stream flow.

ADDITIONAL GROUNDWATER SOURCES

The Edwards and associated limestone constitute the principal ground-water resources in the study area. However, other water bearing formations located within, or in the proximity of, the study area have been evaluated as possible sources of water supply and as possible locations for Aquifer Storage Recovery projects (ASR). The sources considered include the Leona Formation, Glen Rose Limestone, Travis Peak Formation, Austin Chalk, Hosston-Sligo Formations, select facies of the Taylor and Navarro Groups and the Carrizo-Wilcox Sands. While some of these water bearing materials are generally considered to be of localized value as good quality, ground-water sources, and therefore not acceptable for regional supply, they may be suitable for underground storage, i.e., ASR.

The following information has been collected from existing sources and evaluated to determine whether other groundwater resources may be useful in Medina County as a water supply source or a potential ASR reservoir:

- Depth, thickness and porosity of the water-bearing / storing section;
- Potentiometric, or water table, surface;
- Lithologic nature of the porous media (acid solubility);
- Water quality characteristics;
- Current yield and use;
- Areal distribution;
- Stratigraphic position relative to the Edwards and associated limestone.

Carrizo-Wilcox Sands

The name "Carrizo" was first applied to the thick, massive sand beds that unconformably overlie the sand, silt and clay of the Wilcox group in the vicinity of Carrizo Springs, Texas. The area of Texas southwest of the San Marcos River and within the San Antonio, Nueces and Rio Grande River Basins is called the Winter Garden area. The Carrizo Aquifer is the most continuous water-bearing aquifer in the Winter Garden region. It contains fresh to slightly saline water that is acceptable for most irrigation, public supply and industrial purposes. Some portion of the outcrop of Carrizo sand lies within Medina County. The Wilcox Group also has an outcrop in Medina County. This group stores groundwater which is more variable in quality and quantity than the Carrizo sands.

The Carrizo sand forms a belt extending south from the Atascosa County line southwest to the Frio County line. The approximate thickness of the Carrizo sand is 230 to 330 feet and its rocks are characterized by coarse to fine sand, massive, cross-bedded with carbonaceous clay. Carrizo sand yields moderate to large quantities of fresh to slightly saline water to wells, in the range of 50 to over 500 gallons per minute. The thickness of the Carrizo in the downdip artesian areas range from about 400 feet in Gonzales and Caldwell Counties to more than 1000 feet in Atascosa County. The maximum thickness of the Carrizo aquifer in this area is about 2,500 ft.

The Wilcox Group (Indio Formation) has an approximate thickness ranging from 0 to 2,800 feet. The Wilcox Group consists mainly of thinly bedded argillaceous sandstone and laminated arenaceous shale. The Wilcox Group yields small to moderate quantities of fresh to slightly saline water to wells in the northern and western parts of the Winter Garden area. The outcrop covers 245 square miles in Medina County. However, the recharge area is only a fraction of this area due to large amounts of shale and clay which have low permeability.

The Carrizo sand overlies the Wilcox Group. Some of the sands in the Wilcox Group may become hydraulically connected with the Carrizo sand therefore, the term "Carrizo-Wilcox Aquifer" is often used. Although there is some mixing of the sands and water, in general the Wilcox Group sands tend to be less permeable and the water is of lower quality.

Annual recharge to the Carrizo Aquifer is about 100,000 acre-feet per year in the Winter Garden area. The groundwater in the Carrizo Aquifer flows from the recharge areas to the zone of saturation. The water then follows the slope of the piezometric surface. The piezometric surface corresponds with the static water levels.

The Carrizo-Wilcox aquifer is recharged by precipitation in the outcrop area and in certain situations by seepage from lakes, streams and rivers crossing the outcrop area. Hydraulic characteristics (coefficients of transmissivity and storage) were determined for the Carrizo and Wilcox Aquifers and are a measure of an aquifer's ability to transmit and store water. The coefficient of storage depends upon the water conditions in the Carrizo Aquifer. Under water table conditions, the average coefficient is approximately 0.25. The average coefficient of storage drops to 0.0005 when the water is under artesian conditions. The TWDB conducted a test-hole drilling program and the results for Medina County are shown in Table 3-7.

Table 3-7. The Hydraulic Characteristics Of The Carrizo Aquifer In Medina County

No. Of Test Holes	Avg. Sand Grain Diameter, 50 % Retained (Inch)	Avg. Sand Grain Diameter, 90 % Retained (Inch)	Average Uniformity Coefficient	Avg. Coefficient Of Permeability Cores	Avg. Coefficient Of Permeability Cuttings
2	.0086	.0051	1.85	748	626

Source: Klent, William, Gayle Duffin and Glenward I. Elden, September 1976, Groundwater Resources of the Carrizo Aquifer in the Winter Garden Area of Texas: Texas Water Development Board Report 210 Volume 1.

The coefficients of permeability obtained from analysis of pumping tests from wells in the Carrizo sand outcrop are generally higher than the ones shown in the Table 3-7. Based on a pumping test from well J-7-21, the outcrop of Carrizo sand in Medina County has a coefficient of transmissivity of more than 100,000 gallons per day per foot which is favorable for recharge. The high coefficient is the result of a high degree of sorting of sand grains and the lack of cementing material in the outcrop. The coefficient of transmissivity of the Wilcox Group is much lower. It ranges from 10,000 to 20,000 gallons per day per foot.

Near Devine, the Carrizo sand is covered by the Leona formation and some stream loss to the permeable Leona gravel during high water is likely. The water from the Leona gravel may percolate to the Carrizo sand and therefore, increase its recharge.

In most areas of the Wilcox region, water quality diminishes with greater depth. The dissolved solids concentration generally varies between 348 and 11,200 parts per million. The water quality of the Carrizo Aquifer is much higher. The concentration ranges for selected chemical constituents for Carrizo Aquifer are given in Table 3-8.

Table 3-8. Chemical Quality Of The Carrizo Aquifer

Constituent	Concentration, mg/l
Iron	< 1- 68.62
Sodium	8 - 1,310
Sulfate	< 1 - 1,160
Potassium	<1-23
Hardness (CaCO3)	1 - 2,027
Dissolved Solids	6 - 3,139

Source: Klent, William, Gayle Duffin and Glenward I. Elden, September 1976, Groundwater Resources of the Carrizo Aquifer in the Winter Garden Area of Texas: Texas Water Development Board Report 210 Volume 1.

In the outcrop, the Carrizo Aquifer contains hard water that is otherwise low in dissolved solids. In areas of downdip the water is softer, has a higher temperature and contains more dissolved solids. The Carrizo Aquifer water has a low to high salinity hazard for irrigation use and the sodium (alkali) hazard is generally low to medium.

The Carrizo-Wilcox yields fresh to slightly saline water which is acceptable for most irrigation, public supply and industrial purposes in Texas (Muller and Price, 1979). In the outcrop, the aquifer contains hard (high calcium and magnesium) water that is usually low in dissolved solids content. In general, the water from the Carrizo-Wilcox is good and meets National Primary Drinking Water Regulations, however, secondary standards for pH and iron may not be met - posing an aesthetic problem, not a health risk. In addition, hydrogen sulfide and methane gas may be found locally within the aquifer.

Pumpage from the Carrizo Aquifer remained nearly constant between 1930 and 1938. Since the late 1930's, the aquifer has undergone generally steady development to provide increasingly larger amounts of groundwater, mostly for irrigation needs. Other reasons for increased development include population growth, industrial expansion and the widespread drought conditions of the early 1950's.

The annual recharge to the Carrizo Aquifer in the area southeast of San Antonio is estimated to be approximately 26,000 acre-feet. The areas least favorable for future groundwater development from the Carrizo Aquifer are the underdeveloped areas, including portions of southeastern Medina County.

A digital computer simulation of the Carrizo Aquifer for the period 1970 through 2020 indicates that water levels within the Winter Garden Area, including the portion in Medina County, will slowly decline if pumpage remains unregulated and occurs at predicted rates. Also, based on the simulation, approximately 330,000 acre-feet per year of groundwater can be pumped from the Carrizo Aquifer through the year 2020 as long as the water levels were no more than 400 feet below the land surface. This represents an increase of 58,000 acre-feet per year over the average withdrawals of 1963 and 1969.

Theoretically, 200,000 acre-feet of water per year can be transmitted by the Wilcox Aquifer, east of the Frio River. The amount of water available in storage is calculated as 244,000 acre-feet in the Wilcox Aquifer. This amount can be pumped from storage all at once.

Glen Rose Limestone

The Glen Rose Limestone, stratigraphically the youngest formation in the Trinity Aquifer, crops out over the northern part of Medina and Bandera Counties. The Glen Rose Formation provides the most water in Medina County of the Trinity Group rocks. The Medina Lake area is assumed to lie directly over the Glen Rose Limestone. In other areas, the Glen Rose Limestone acts as the underlying, confining layer of the Edwards Aquifer.

The thickness of this formation is about 820 feet and it is divided into two members. The upper and lower members are separated by a bed of fossiliferous limestone. The limestone bed has profuse numbers of small fossil clams, Corbula martinae.

The upper Glen Rose Limestone layer is about 320 feet thick. This layer consists of alternating beds of shale and nodular marl. This member also has thin beds of impure limestone and two evaporative zones. The evaporative zones are located near the middle and at the base of the upper member. These zones have significant amounts of minerals such as anhydrite and gypsum. These minerals cause the water to be slightly saline and have a high sulfate content. At the outcrop, the minerals have been leached by downward moving groundwater producing uneven claystone beds. In addition, collapse breccia zones have developed. These zones produce areas of high porosity and permeability that is apparent by the sinkholes and caverns in the lower Glen Rose Limestone outcrop.

The lower Glen Rose Limestone is a massive layer composed of fossiliferous limestone. The massive lower layer is more susceptible to the development of secondary porosity that results from faulting and jointing. This layer also has very small quantities of evaporite minerals. These two factors result in a prolific water-bearing zone containing higher quality water than the upper Glen Rose Limestone.

Limestones and sandy marls of the Glen Rose crop out in northern Medina County and the surrounding counties of Uvalde, Real, Bandera, Kerr and Kendall. The outcrop of the Trinity Aquifer covers 84 square miles in northern Medina County. The main source of recharge to the aquifer in the County is thought to be the rainfall from the adjacent counties since the Glen Rose Limestone in those counties have larger croppings of the permeable layers.

Caves and springs are found in the limestone in the outcrop area of the Glen Rose Formation. The flows of the San Geronimo, West Verde and Hondo Creeks are maintained by these springs in Medina County.

In areas of Medina County, groundwater is moving from the Glen Rose Limestone to the streams. The water will eventually recharge the Edwards Aquifer as the streams cross the Edwards Aquifer outcrop. In the Edwards Aquifer recharge zone, where the Edwards Limestone is directly above the Glen Rose Limestone, the groundwater flows directly from the Trinity Aquifer across the faults. The factors which determine the amount of water entering the Edwards Aquifer from the Trinity Aquifer are the length of the fault, the water level gradient across the fault plane and the effective transmissivity within the Glen Rose Limestone.

The Trinity Aquifer has a steep water level gradient above the Balcones Fault zone. In this region, the direction of flow is generally to the southeast towards the Edwards Aquifer. In the Balcones fault zone, the potentiometric surface of the Edwards-Trinity Aquifer system is a much less effective indicator of the specific direction of groundwater flow than in other areas due to the anisotropy of the series of southwest to northeast trending faults and secondarily developed karst conduits. In addition, static water levels in the Glen Rose Formation generally reflect the combined influences of the different water-bearing units open to wells (LBG-Guyton, 1995).

The Haby Crossing Fault also effects the flow of groundwater through the Trinity Aquifer. The Glen Rose Limestone has a much steeper water level gradient upgradient from the fault. The gradient is estimated to be about 75 to 100 feet per mile. The flow of groundwater is generally toward the fault and most major discharge is along the fault.

The porosity and permeability of the Glen Rose Limestone are much less than that observed in the most porous and permeable units of the Edwards Aquifer. Wells drilled into the Glen Rose Limestone in Medina County supply small to moderate amounts of fresh to slightly saline water from the lower Glen Rose Limestone and potable but highly mineralized water sufficient for stock and domestic use from the upper Glen Rose Limestone. Few wells in the area produce more than 50 gallons per minute.

The lower member of the Glen Rose Limestone, exposed in the outcrop in the Medina Lake area, has good permeability and porosity associated with patch reefs and caves. Most of the porosity associated with the patch reefs is fabric selective moldic porosity. The porosity associated with caves is not fabric selective. Fabric selective porosity is secondary porosity that preferentially developed along specific sedimentary structures, strata or mineralogy. Non-fabric selective porosity is secondary porosity that developed generally without the influence of sedimentary structures and preferentially along fractures or faults not associated with the original sedimentary or diagenetic processes (Holt, 1959). The upper member of the Glen Rose Limestone is relatively impermeable and usually acts as a lower confining unit of the Edwards Aquifer.

The water from the Trinity Aquifer in Medina County contains moderate to large amounts of dissolved solids. The dissolved solids concentration ranges from 223 to 4,110 parts per million. The average dissolved solids content from the springs and wells of the Glen Rose Limestone is about 1,870 parts per million. Deeper wells yield water higher in dissolved solids than the springs and shallow wells. These wells generally contain highly mineralized waters which are very hard and high in sulfate content. The deeper wells which are able to penetrate the interconnected solutional channels generally have water which is low in sulfate concentration. The channels enable the free movement of water which produces higher quality water.

Table 3-9 shows the amount of groundwater available from the Trinity and Carrizo-Wilcox Aquifers in Medina County.

Table 3-9. Medina County Groundwater Availability, Ac-Ft.

Aquifer	1990	2000	2010	2020	2030	2040
Trinity	860	860	860	860	860	860
Carrizo-Wilcox	6966	6966	6966	6966	2617	2617
Total	**7826**	**7826**	**7826**	**7826**	**3417**	**3477**

Source: Texas Water Development Board, David Thorkildsen, 1/15/97

Leona Formation

The outcrop of the Leona Formation extends along the Balcones fault zone and overlies the Edwards Aquifer. The Leona is composed of lenticular beds of sand, gravel, silt, and clay. Gravel is found primarily near the base of the formation, while silt is predominate in the upper portion of the formation. Caliche is also found within the Leona Formation. The average formation thickness in Medina County is about 30 feet. Because the formation is relatively thin throughout Medina and Bexar Counties, the well yield is generally only a few gallons per minute.

Groundwater occurs in the Leona formation in partially separated areas of Medina County. The total area of the surface exposures of the formation is approximately 218 square miles. Of this area, the Leona along Seco Creek covers 23 square miles, along Hondo and Verde Creeks, more than 109 square miles, and along the Medina stretch on the Frio River, 5 square miles.

The Leona formation consists of deposits forming broad terraces in the valleys of the present streams. These terraces are topographically lower than those formed by the Uvalde gravel. The terraces extend to distances ranging from several hundred feet to 3 or 4 miles on one or both sides of the major streams. Generally, the formation is thickest near the present stream channels or the older, abandoned meandering channels. The terraces range in thickness from 0 to 70 or 80 feet thick. Rio Medina, Quihi, and D'Hanis obtain their water supply from the formation, and private supplies in Hondo, Castroville, and LaCoste are obtained from the gravel. (Public supplies for Hondo, Castroville, and LaCoste are obtained from the Edwards).

Recharge to the Leona Formation in Medina County is from precipitation on the outcrops, discharge of springs and streamflow. The Leona Formation is also recharged by the perennial flow of the Medina River and floods that periodically fill the Seco, Hondo, Verde and Chacon Creeks and the Frio River. Measurements of water levels in wells in each of the aquifers indicate that the water table fluctuates with the amount of precipitation and the rate of streamflow. The piezometric surfaces of the underlying formations are below the base of the Leona and those formations do not contribute to its recharge. Conversely, the Leona formation contributes to the recharge of the underlying permeable formations. In the area, the Leona Formation contributes to the recharge of the Edwards Limestone and the Carrizo Sands.

In general, the Leona formation contains little water where the underlying formations are permeable, but contains large amounts of water where it overlies less permeable strata, primarily where it is thick. In most areas of outcrop in the county, the Leona formation furnishes an adequate supply of water for domestic and stock uses. This formation supplies the water demand for D'Hanis, Quihi and LaCoste. In many areas, the Leona has the thickness and lateral extent necessary to store large amounts of water.

In Medina County, the sands, silts and gravels of the Leona Formation parallel the major streams. The groundwater contained in the Leona formation is typically under water table conditions. However, small localized areas may be under artesian water conditions due to impermeable layers of silt and clay. Along the main reservoir are small bodies of water that are not connected to the main reservoir. These isolated water bodies are easily emptied through pumping.

In chemical quality, the water from the Leona formation is satisfactory for most purposes. The nitrate content of the water is high in many places, with observed readings ranging from 2 to 400 parts per million. The water is generally very hard, with hardness ranging from 116 parts per million to 516 parts per million.

Travis Peak Formation

The Travis Peak formation is the lowest formation of the Trinity group and does not crop out in Medina County. The closest reported exposures are along the Guadalupe River in the northwestern part of Comal County. (Holt, 1959) Logs of wells completed in the Travis Peak formation indicate a series of fine-grained sandstones, limestones, and multicolored shales. Historically, it has been very expensive to drill to this formation, however, with increased water needs further exploration of Travis Peak may be necessary.

The Travis Peak Formation underlies the Glen Rose Limestone in Medina County. The thickness of the formation ranges from 100 feet to over 400 feet in Bexar and Medina Counties. The wells in this formation generally yield small to moderate amounts of water. The wells yield less than 30 gallons per minute and the water contains large amounts of dissolved solids. A well drilled near the Uvalde-Medina County line, south of D'Hanis contained 2,220 parts per million of dissolved solids and excessive amounts of sulfate, chloride, and fluoride. However, since this is the only analysis performed on water obtained from the Travis Peak formation, it may not be representative of water contained elsewhere in the formation. The water in the Travis Peak Formation is only acceptable for localized domestic and livestock water demand.

The water of the Travis Peak formation is derived from precipitation over a large area north of Medina County. Water enters the sands of the formation in the outcrop area and travels downdip to Medina County.

Austin Chalk

The lithologic character of Austin Chalk can be described as white to buff chalk, marl and limestone. This formation tends to yield small supplies of water (less than 10 gallons per minute) and is typically from 210 to 290 feet in thickness, with a range of 225 to 350 feet in Medina County. Austin Chalk consists of limestone, chalk, marl, and thin beds of clay. In Medina County, nine (9) wells are known to obtain water from the Austin Chalk, only one of which produces more than three (3) gallons per minute. This well, however, is believed to get its water through local recharge from gravel of the overlying Leona formation. Other wells completed in the Austin Chalk have very small yields of water containing large amounts of hydrogen sulfide. The sulfur is probably derived from the pyrite and marcasite in the formation. A large solutional cavity exists east of Hondo Creek, approximately 8 miles north of Hondo, but is the only known evidence of subsurface solution in this formation in Medina County.

Hosston-Sligo

The Hosston-Sligo Formation underlies the Travis Peak Formation. The Hosston Formation, part of the Nuevo Leon and Durango group, consists of Red sandstone and shale, with some limestone. This formation is not known to yield water in Medina County, and ranges in thickness from 0 to 440 ft. The Sligo Formation consists of gray limestone with shale partings. Near the confluence of the Perdenales and Colorado Rivers, the lower Trinitian rocks (Glen Rose Limestone, Hensel Sand and Cow Creek Limestone) are exposed, and the Hosston and Sligo formations serve as the most productive units of the Trinity. Wells in these two formations yield a small volume of water that is not acceptable as a regional water supply.

Navarro

The Navarro group consists of the Escondido Formation, Corsicana Marl, Taylor Marl, Anacacho Limestone, Austin Chalk and Eagle Ford Shale formations, further described in Table 3-10. The Taylor Marl, Anacacho Limestone and the Escondido Formation supply small amounts of water. This water is suitable for domestic and livestock purposes but not as a regional water supply.

Localized areas of water acceptable for domestic purposes are found in the Anacacho Limestone. However, the water may be very hard. The dissolved solids content in the Escondido Formation ranges from 480 to 3,330 parts per million.

Table 3-10. Geologic And Hydrological Units And Their Water Bearing Properties

System	Series	Group	Formation	Approximate Thickness (Ft.)	Lithologic Character	Water-Bearing Properties
Cretaceous	Gulf	Navarro	Escondido Formation	550-740	Shale, sandstone and some limestone. Increasingly arenaceous to west.	Yields moderate supplies of moderately mineralized water.
Cretaceous	Gulf	Navarro	Corsicana Marl	30-55	Limestone and shale; thickens to east.	Not a freshwater aquifer in Medina County.
Cretaceous	Gulf		Taylor Marl	0-150	Clay and marl; thickens to east.	Not a fresh-water aquifer in Medina County.
Cretaceous	Gulf		Anacacho Limestone	350-530	Fossiliferous limestone, marl and clay. Increasingly calcareous to west.	Yields small supplies of water locally.
Cretaceous	Gulf		Austin Chalk	210-290	White to buff chalk, marl and limestone.	Yields small supplies of water.
Cretaceous			Eagle Ford Shale	20-65	Black shale and gray arenaceous limestone; weathers to yellow clay and brown flagstones.	Not known to yield water in Medina County.

As shown above, the Escondido formation is the thickest (550-740 ft), consists of shale, sandstone and some limestone. This formation is generally the best for water yield, when compared to other formations within the Navarro group.

There are 553 registered wells in Medina County. About 64% of all the wells are in the Edwards Aquifer, 5% are in the Glen Rose Limestone, 12% are in the Carrizo Aquifer, 9% are in the Wilcox Aquifer and 2% are in the Carrizo-Wilcox Aquifer. The remaining 8% are in the minor aquifers.

Of the 553 wells, 14 are springs, four (4) are observation wells, six (6) are test holes and one (1) is an oil and gas well. The rest are wells that are used for water withdrawal. The depth of the wells varies from 24 to 3,194 feet below the ground surface.

Forty-eight (48) of the 553 wells are used for public water supply purposes, while 118 wells are used for domestic purposes, 107 are used for stock water, 1 is used for commercial purposes, 1 is for aquaculture, 79 are unused, 5 are used for industrial purposes and 256 are used for irrigation. Seventy-three (73) of the wells are used for more than one purpose, usually for supplying both stock and domestic supply water. One well is used for stock, domestic and aquaculture use. The use of the remaining 11 wells is unknown.

Thirty-one (31) of the wells have water level measurements available. Only 12 of these wells were sampled for water quality. The water quality sampling results for these wells are listed in Table 3-11.

Table 3-11. Water Quality Of Water Wells Within Medina County

Name of System	Well No.	Area Served	Connect-ed to Other Systems	Supplier Source	Retail Popula-tion	Well Capacity (GPM)	Quality	Storage Capacity (MGD)
City of Hondo	1630002	City of Hondo, Prison	No	Self-Supplied (4 Wells)	7800	4800	Pass	2.300
City of LaCoste	1630004	City of LaCoste	No	Self-Supplied (2 Wells)	1326	2020	Pass	0.245
City of Castroville	1630005	Castroville and fringe area	Yes.	Self-Supplied (3 Wells)	2808	1500	Pass	0.500
Medina County WCID #2	1630008	D'Hanis	Yes	Self-Supplied (1 Well)	530	280	Pass	0.050
City of Natalia	1630009	City of Natalia	No	Self-Supplied (2 Wells)	1524	800	Pass	0.354
Valley Mobile Home Properties	1630011	Valley MHP	No	Self-Supplied (1 Well)	243	63	Pass	0.020
Rio Medina Estates	1630023	Rio Medina Estates	No	Rio Medina Water Corp. (1 Well)	192	140	Pass	0.013
New Alsace Water Co.	1630024	Castroville near Quihi	No	Self-Supplied (1 Well)	111	250	Pass	0.010
Zinsmeyer Trailer Park	1630025	Zinsmeyer Trailer Park & 2 Businesses	No	Self-Supplied (1 Well)	25	100	Pass	0.010
West Medina WSC	1630027	City of D'Hanis	No	Self-Supplied (1 Well)	900	600	Pass	0.140
Creekwood Water Supply	1630029	Creekwood Subdivision	No	Self-Supplied (1 Well)	336	150	Fail	0.063
Cattleman's Crossing	1630030	Cattleman's Crossing Subdivision	No	Self-Supplied (2 Wells)	450	400	Pass	0.160 (Elevated Storage)
Gusville Trailer Park	1630031	Gusville Trailer Park	No	Self-Supplied (2 Wells)	96	40	Pass	0.010

Source: Public Water Supply Regulatory Program - Water System Data Sheets, Form TNRCC-0077A (9/1/95)

SUMMARY

The Edwards Aquifer is the main source of groundwater in Medina County. Approximately 96% of the current groundwater usage is taken from this aquifer. The other main aquifers are the Carrizo-Wilcox and the Trinity Aquifers. Their usage of these three aquifers within Medina County is given in Table 3-12.

Table 3-12. Summary Of Aquifer Usage In Medina County

Aquifer	Typical Use	Area Of Use	Amount Used (Acre-Ft.)	% Of Total County
Edwards	Irrigation, Municipal	Central	88,322	96.2
Carrizo-Wilcox	Domestic	South-Southwest	3,397	3.7
Trinity	Municipal, Domestic	Northeast	92	0.1
Total			**91,811**	**100**

SECTION 4

EXISTING SURFACE WATER SOURCES

INTRODUCTION

This section provides a summary and evaluation of the current surface water resources available within Medina County. This information will be used to determine future surface water availability and to formulate the Water Resource Management Plan.

EXISTING SURFACE WATER USE

The Medina River and the Chacon, Hondo, Francisco Perez, Quihi, San Geronimo, Seco and Verde Creeks are the major streams which flow through Medina County. A short part of the Frio River flows just inside the southwestern part of the County. In addition, there are minor streams such as the Live Oak, Parkers and Unnamed Creeks also within the County. All of the streams flow in a south to southeast direction.

Precipitation in Medina County generally drains to the south and southeast which coincides with the slope of the area. The northern and western parts of the county are drained by the Squirrel, Seco, Hondo, Verde and Quihi Creeks. These creeks are only intermittently full and drain into the Frio River. The northern and eastern parts of the county are drained by the Medina River. The Medina River is the only perennial stream flowing through Medina County and it is the main source of surface water flowing through the County. The southeastern part of the County is drained by the Black, Francisco Perez and Chacon Creeks which join the Frio River in McMullen County. The entire area is subject to heavy rains and floods which can fill the usually dry stream channels and occasionally overflow.

Medina and Diversion Lakes

The Medina Lake System is comprised of two separate lakes or impoundments. The larger lake, Medina Lake, is described as being located 18.5 miles northeast of Hondo in Medina County. The originators of Medina Lake chose this location for two primary reasons. First, Medina Lake sits in a steep canyon, whose walls provide a natural basin for impoundment. Second, the base geologic formations are relatively impermeable which helps reduce the incidental loss of impounded water to underlying aquifers.

While the canyon walls provided a choice location to erect a dam, the canyon walls were not amenable toward constructing a diversion canal for the impounded water. For that reason, the designing engineers opted to construct a second impoundment, Diversion Lake. Diversion Dam is located in an area approximately 4 miles downstream from Medina Dam where the topography flattened out, as opposed to the steep canyon walls. BMA releases water from Medina Lake through two release gates at Medina Dam and the water then flows down into Diversion Lake. Because Diversion Lake is at a lower elevation than is Medina Lake, the water must be lifted approximately 40 feet in order to divert the water into the canals. BMA's method of diverting water and serving its irrigation customers is by lifting the water level in Diversion Lake into its gravity feed system (the Main Diversion Canal) and then through a series of manmade canals which run through Bexar, Medina and Atascosa Counties. This has been the method of operation since the inception of the Medina Lake System.

Medina Lake was constructed in 1911 to supplement existing irrigation supplies. The Medina River is impounded behind the 164 foot high concrete gravity dam located 14 miles upstream of Castroville. Inflows to the lake originate over a 653 square mile drainage area. When the water surface elevation is 1,072 feet, the lake is approximately 18 miles long and about three (3) miles wide at the widest part. Medina Lake has a maximum capacity of 254,000 acre-feet (at elevation 1,072.0 feet) and a surface area 5,575 acres. When the dam was built, the large amount of storage was created to conserve the largest possible percentage of the runoff from Medina Basin.

Water from Medina Lake is discharged down a four (4) mile canyon to a smaller impoundment, Diversion Lake. The 50 foot tall dam was built in 1913. The average inflow into the lake between the years 1940 and 1986 was 3,413 acre-feet. At the surface water elevation of 926.5, the lake has a volume of 2,555 acre-feet and a surface area of 169 acres. From Diversion Lake, the water is diverted into a system of irrigation canals also owned and operated by BMA. BMA is authorized to divert up to 66,000 acre-feet per year for irrigation, municipal and industrial purposes from the lakes. Annual diversions have averaged 30,280 acre-feet between 1957 and 1994.

Seepage of the impounded water in both lakes into the underlying bedrock has been documented by various sources. Qualitative assessments have shown that the channel connecting both lakes experience large seepage losses. Quantitative estimates have shown that seepage losses from Medina and Diversion Lakes averages about 72,000 acre-feet per year. The loss on the Medina Lake varies with the stage in the reservoir, however, the loss from Diversion Lake is relatively constant. Medina Lake leakage losses average about 22,710 acre-feet per year most of which is captured by Diversion Dam.

The average annual inflow to Medina Lake was estimated to be about 94,500 acre-feet measured at the United States Geological Survey (USGS) Pipe Creek gauge located on the Medina River near the upper end of the lake. An average of 2.5 feet of net evaporation occurs each year.

Pearson Dam And Reservoir

Pearson Lake is a small reservoir located off of the main BMA canal. This reservoir provides storage for any water remaining in the canal at the end of the irrigation season or when the water is not used due to adequate rainfall. The water diverted from the canal can then be stored until needed. The Pearson reservoir is also used to fill small water orders instead of filling the entire canal system. An earth dam diverts the water from the canals into a 23 acre impoundment. The estimated capacity is 250 acre-feet.

Chacon Dam and Lake

The Chacon Dam is an earth dam across the Chacon Creek. Chacon Lake is also used to store excess water from the canal system. In addition to the diverted water, the lake also receives runoff from the 17 square mile Chacon Creek watershed. A spillway allows excess water to continue down Chacon Creek and a gated outlet releases water back into the lower canal system.

Jungman, Kirby, Dubose and Ball Lakes

These lakes were all originally built as storage lakes for the canal system. Jungman Lake is still being used for excess water storage. Kirby Lake is located near the end of the canal system. Operation of Kirby Lake in this manner would require pumps to transport the water back up the system. Ball and Dubose Lakes both would require extensive repairs prior to use.

AVAILABLE WATER RIGHTS

Bexar-Medina-Atascosa Water Control and Improvement District No. 1 is a water conservation and improvement district created pursuant to the "conservation amendment" to the Texas Constitution. BMA is a political subdivision of the State of Texas and it holds certificates of Adjudication Nos. 19-2130 and 19-2131 which are based upon certified filings No. 18 and 19. These certificates authorize the impoundment of state water in and diversion of water from Medina, Diversion and Chacon Lakes. This includes the transfer of water from the Medina River Basin, a sub-basin of the San Antonio River Basin, into the Nueces River Basin. BMA holds a water right that allows storage of approximately 260,000 acre-feet of water in two lakes, with annual diversion of 66,000 acre-feet for irrigation, municipal and industrial purposes. BMA's irrigation right allows for the irrigation of 34,000 acres within the district.

BMA's Certificates have a priority date of November 1910, through the initiation of construction of the dams, diversion works and the irrigation canals presently in place and utilized by BMA. Certificate of Adjudication No. 19-230 authorizes BMA to impound up to 4,500 acre-feet of water per year in Medina Lake and to impound, divert and use up to 66,000 acre-feet of water per year from the reservoirs for irrigation, municipal and industrial purposes. BMA is authorized to divert water from its reservoir system at a point located on the Diversion Dam at a rate not to exceed 450 cubic feet per second. BMA's Certificate of Adjudication has no minimum stream flow requirement restricting its diversion rights. The contractual obligations of BMA are:

- 5,000 acre-feet reserved for Bandera County;
- Contracts with Bexar Metropolitan Water District;

- Commitments made to the Edwards Aquifer Authority, San Antonio Water System and Texas Parks and Wildlife Department during the course of the hearing on BMA's amendment to its Certificate of Adjudication.

Table 4-1 shows the existing surface water rights within Medina County for the year 1996. Most of the available surface water within the County is currently accounted for. Some of the authorized users are not currently using all of the authorized water.

Table 4-1. Existing Surface Water Rights for Medina County in 1996

Stream	Basin	Type Of User	Authorized Amount, Ac-Ft.	Water Used, Ac-Ft.
Chacon Creek	Lower Nueces	Irrigation	4	0
		Irrigation	2,000	845
	San Antonio	Irrigation	2,000	0
	Upper Nueces	Irrigation	132	0
Total for Chacon Creek			**4,136**	**845**
Hondo Creek	Lower Nueces	Irrigation	70	0
		Irrigation	40	0
	Upper Nueces	Mining	100	71
Total for Hondo Creek			**210**	**71**
Live Oak Creek	Lower Nueces	Storage	13	0
Total for Live Oak Creek			**13**	**0**
Medina River	San Antonio	Irrigation	160	0
		Irrigation	112	0
		Irrigation	16	0
		Storage	14	0
		Irrigation	17	0
		Irrigation	18	0
		Irrigation	65,830	59,378
		Municipal	170	0
		Domestic	750	0
		Storage	4,500	0
Total for Medina River			**71,587**	**59,378**
Middle Verde Creek	Lower Nueces	Recharge	585	0
Total for Middle Verde Creek			**585**	**0**
Parkers Creek	Upper Nueces	Recharge	520	0
Total for Parkers Creek			**520**	**0**
San Geronimo Creek	San Antonio	Irrigation	5	0
Total for San Geronimo Creek			**5**	**0**

Table 4-1. Existing Surface Water Rights for Medina County in 1996

Stream	Basin	Type Of User	Authorized Amount, Ac-Ft.	Water Used, Ac-Ft.
Seco Creek	Lower Nueces	Recharge	1,185	0
		Irrigation	20	0
Total for Seco Creek			**1,205**	**0**
Unnamed	Lower Nueces	Irrigation	80	0
Total for Unnamed Creek			**80**	**0**
Total for Medina County			**78,341**	**60,293**

SECTION 5
WATER RESOURCE MANAGEMENT OPTIONS

INTRODUCTION

Potential water supply sources in Medina County include groundwater, surface water and wastewater reuse sources. The allocation of future water demands to available supplies were analyzed using the future demands forecasts located in Section 2. The purpose of this section is to present options for managing the available water resources in the County.

MANAGEMENT OF SURFACE WATERS – MEDINA LAKE WATERS

Over the years, BMA's delivery system has experienced significant water losses. The exact figures on the unaccounted for water have been unavailable due to the lack of accurate flow measurement equipment within the canal system. Until recently, the expense of analyzing and repairing the system to minimize the losses was not considered justifiable. In fact, prior to 1992, maintenance, repair and upkeep on the system was ignored and performed only on an emergency basis. Consequently, the delivery system experiences very severe water losses.

A current example of the losses is representative of the fact that during the calendar year of 1996 (a year of moderate to severe drought), BMA diverted approximately 60,000 Acre Feet of water for irrigation uses, but was only able to delivery to the farmer 15,000 acre feet. The remaining 45,000 Acre-Feet (75% of the amount diverted) of water was lost in the system to seepage, evaporation and waste.

In the late 1980's, the Directors of BMA realized that these amounts of water losses were unacceptable; however, funds for the repair of the system were not available and could not be made available without severely increasing either the BMA tax base or the user fees. When the Board studied the problem, three options became available to them, which were:

1. Do nothing - Continue to operate the system as it had been done in the past.

2. Increase revenues by either increasing taxes or increasing user fees; and

3. Sell excess waters to other water purveyors and use the revenues to repair the system.

OPTION 1 - DO NOTHING

This option would continue the present course of action at BMA. Repairs and maintenance would only be performed on "an emergency basis". The district would continue to operate with large losses and the tax and user fees could be kept to a minimum. This option would eventually lead to the complete deterioration of the system. As an example, the Holland Texas Dam & Irrigation Company, located just south of Cotulla, Texas has a system very similar to that of BMA. For instance, they have two dams located on the Nueces River. Both dams were constructed in 1910, about the same time that BMA's dam were built. The company uses the impounded water for irrigation of croplands adjacent to the impoundments. For the past 40 or so years, the Holland Texas Dam & Irrigation Company has also ignored the system and has provided maintenance on an "emergency basis" only. Consequently, on New Years Day, 1997, the main dam failed due to lack of maintenance on the facility. The reason given for the lack of maintenance "We as farmers just couldn't afford the maintenance and repair costs". The cost to rebuild the system is still unknown, but a 2-3 million price tag would not be out of the question.

If BMA continued to ignore the maintenance problems, and continued to "waste water", the State of Texas would more than likely end up taking over the water system, because water in this area of the state is that valuable. In the 1994 Texas Legislative Session, Representative David Counts presented a bill to the legislature that would do exactly that - take over the BMA water system. In this Bill, the Texas Water Development Board was given two years to negotiate a price to purchase the system from BMA. If after two years BMA and the TWDB could not reach an agreement on the cost of the system, then the system purchase price would be equal to the unrecovered capital cost, which at that time was zero. After testimony before the Texas Natural Resource Commission by Messrs. Johnny Ward, A.V. Thurman, Ed McCarthy, Bob Wilson and Representative Pete Nieto, Representative Counts withdrew his bill.

OPTION 2 - RAISE TAXES AND INCREASE WATER USER FEES

This option could virtually put the farmer out of business. To raise the required capital needed to perform the improvements on the system would result in a tax and user fee that would prohibit the farmer from being able to compete in a very tight industry, and for all practical purposes, would put the farmer out of business.

OPTION 3 - SELL EXCESS WATERS TO OTHER WATER PURVEYORS AND USE THE REVENUES TO REFURBISH THE SYSTEM

In taking this option, the BMA Board wanted to protect the farmers rights and needs to available water. Therefore, BMA set out on a program to sell only "Excess Water" to other purveyors of water in the region. **Excess Water was defined as that water that was not needed to meet the day to day needs of the farmer.** If the losses (now known to be 75% of the water diverted) could be reduced, then BMA would have a tremendous resource available to them, a resource that could be sold to other water suppliers and the revenues then used to pay for the improvements needed to refurbish and maintain the system.

This was the option taken by BMA.

BEXAR METROPOLITAN WATER DISTRICT

In 1991, BMA entered into a series of agreements with Bexar Metropolitan Water District (Bexar-Met). These agreements provide for the sale of water from the District's water system to Bexar-Met and for payments by Bexar-Met to BMA to help fund needed improvements throughout the district.

Long-Term Water Sales Agreement

The first agreement, the 1991 water agreement, provides for the sale of excess water from the District's adjudication of 66,000 acre-feet of water per year. The agreement is effective from September 1, 1991, for a period of twenty years with the option to extend the agreement for an additional ten years.

Excess water is determined at the District's sole discretion. The agreement requires the District to evaluate the availability of excess water at least twice a year in the months of February and August. Bexar-Met agrees to purchase during each contract year all excess water as determined by the District whether or not Bexar-Met takes delivery of the water. The price of the water for the first term contract years shall be $56.00 for each metered acre-foot, subject to adjustments thereafter and for water resold by the District. The District is committed to deliver the excess water only by gravity flows to Bexar-Met's designated point of diversion from the District's system.

1992 Water Conservation Agreement

In 1992, the District entered into a water conservation agreement with Bexar-Met as a result of the water sales agreement. This agreement provides that the District will take certain steps to ensure future excess waters, as defined in the water sales agreement, including measures to conserve water in the District's irrigation system. The agreement became effective September 1, 1992, for a period of five years. Bexar-Met will pay BMA $300,000 each year that the contract is in effect.

This water conservation agreement requires BMA to waive its right to declare excess water during the five-year term of the agreement. Bexar-Met will receive credits against future billings for excess water under the water sales agreement to the extent of 85% of the first year's conservation agreement payment and 100% of future years' payments. Total credits to be given by the District will not exceed $1,455,000, and the credit applied to future water purchases in any year may not be more than one-fifth of total credits.

BMA may use the payments from the conservation agreement for only certain purposes, which may be for expenses relating to conservation or for capital improvements that ensure conservation of water. Any unearned amount will be held by the District as restricted cash until earned. The District records a deferred credit for the annual conservation agreement payments. It recognizes intergovernmental revenues from the conservation agreement to the extent it incurs expenses allowable under the agreement.

1995 Water Availability Contract

In 1995, the District completed an agreement with Bexar-Met to make additional water available to Bexar-Met. The parties agreed that, in addition to other water deliverable to Bexar-Met as excess water pursuant to the 1991 agreement, the District would deliver on a priority basis up to 6,000 acre-feet of water per year, to the extent water is available in accordance with conditions stated in The 1995 agreement. The potential availability of excess water pursuant to the 1991 agreement is directly reduced on an acre-foot basis.

On each anniversary date, Bexar-Met will pay the District the purchase price for the entire quantity of water deliverable under the 1995 agreement during the twelve months following November 1, 1996. the District is entitled to the entire purchase price for the stated quantity of priority water whether or not Bexar-Met accepts the District's tender of the water.

In consideration of the District's obligation to ensure the phased-in delivery to Bexar-Met of 6,000 acre-feet of water annually on a priority basis rather than on an excess water basis, Bexar-Met paid the District $500,000 in 1995.

With the establishment of these contracts to sell excess water, BMA now has a revenue stream in place to be able to effect the repairs needed on the system so that water conservation can be accomplished. BMA can then sell the water they conserve through these improvements.

In 1993, BMA started an aggressive effort to repair the canals. They started by removing trees, vegetation, and other obstructions that impaired the flow of water, as well as, repairing the side and bottom slopes of canals that were in need of repair. This has improved the flow of water through the canal system, and has dramatically cut losses due to seepage from the canals.

Consequently, the analysis of the main canal in conjunction with a review of operational procedures was necessary to improve the efficiency of the system overall and conservation of water by reducing losses.

NATURAL RESOURCE PLAN (NRP)

In 1993, BMA, in conjunction with the Natural Resource Conservation Commission (formerly the US Soil Conservation Commission), the Medina County Soil and Water Conservation District and the Alamo Area Soil and Water Conservation District developed a Natural Resource Plan (**NRP**) which specifically analyzed the BMA conveyance system efficiency, water quality within the canal system(s) and municipal water demands within the region. The **NRP** report details viable alternatives for optimization of BMA's canal system, and reviews critical water quality issues within this system. The report specifically recommends conveyance improvements designed to increase water availability for agricultural, municipal and industrial uses within the BMA service area and adjacent communities.

Pursuant to BMA's proposed PL 83-566 watershed project, BMA plans to repair and refurbish approximately 23 miles of its main canal from the Diversion Dam down to the Pearson Junction in Medina County. This work will include clearing and reshaping of canals with installation of improved liner materials and/or concrete lining or piping of the canal system to reduce transportation losses. **The estimated annual water savings to be achieved pursuant to these improvements, as detailed in the NRP, are in excess of 30,000 acre-feet of water per year.** It should be further noted that these are waters that are currently lost due to the leakage in the canal system. If BMA can recover this "lost water" and sell it at their current rate of $56 per acre foot, this would amount to income to BMA of $1,680,000 per year.

That additional revenue is more than sufficient to fund the District's share of the cost to complete the PL-566 Canal Delivery System Renovation Project. Once the Project is paid for, those additional revenues would be available to further reduce the cost to Landowners to maintain and operate the District each year.

TWDB/USGS WATER BALANCE STUDY

In July of 1994, BMA, in conjunction with the TWDB, BMWD and the USGS began a Water Balance Study to identify the quantities of inflows and losses in Medina and Diversion Lakes themselves. The goal of the Study is to continue ongoing efforts to better manage the BMA waters. The Study is being co-sponsored by the Texas Water Development Board, the U.S. Geological Survey and Bexar Metropolitan Water District.

The Study, when completed, will identify both how much and where water is being lost. The Study will also provide BMA with valuable information that will help them better manage their resources in the future.

MEDINA LAKE SPILLWAY

Since the 1920's the Medina River Valley has benefited from the construction of Medina Lake and its irrigation canals to satisfy agricultural demands for water. As the area urbanizes, demands for water shift from agricultural uses to municipal and industrial uses. In the past, the Edwards Aquifer has been utilized to satisfy the demands for M&I uses throughout the region, however, the aquifer can supply only so much water before it is endanger of depletion. Therefore, recent regulations have placed restrictions on the continued development of the area's Edwards groundwater resources. This change has focused new attention to Medina Lake and it is ability to meet this new challenge.

Currently BMA owns 66,000 acre feet per year of water rights to be used for irrigation purposes. Recently BMA applied for an amended adjudication which would allow BMA to use their 66,000 acre feet of water for either irrigation or M&I uses. This permit change will allow BMA to sell their valuable resource to wholesale water users throughout the region, and thereby help alleviate the depletion of the Edwards Underground Aquifer.

EXCESS WATER

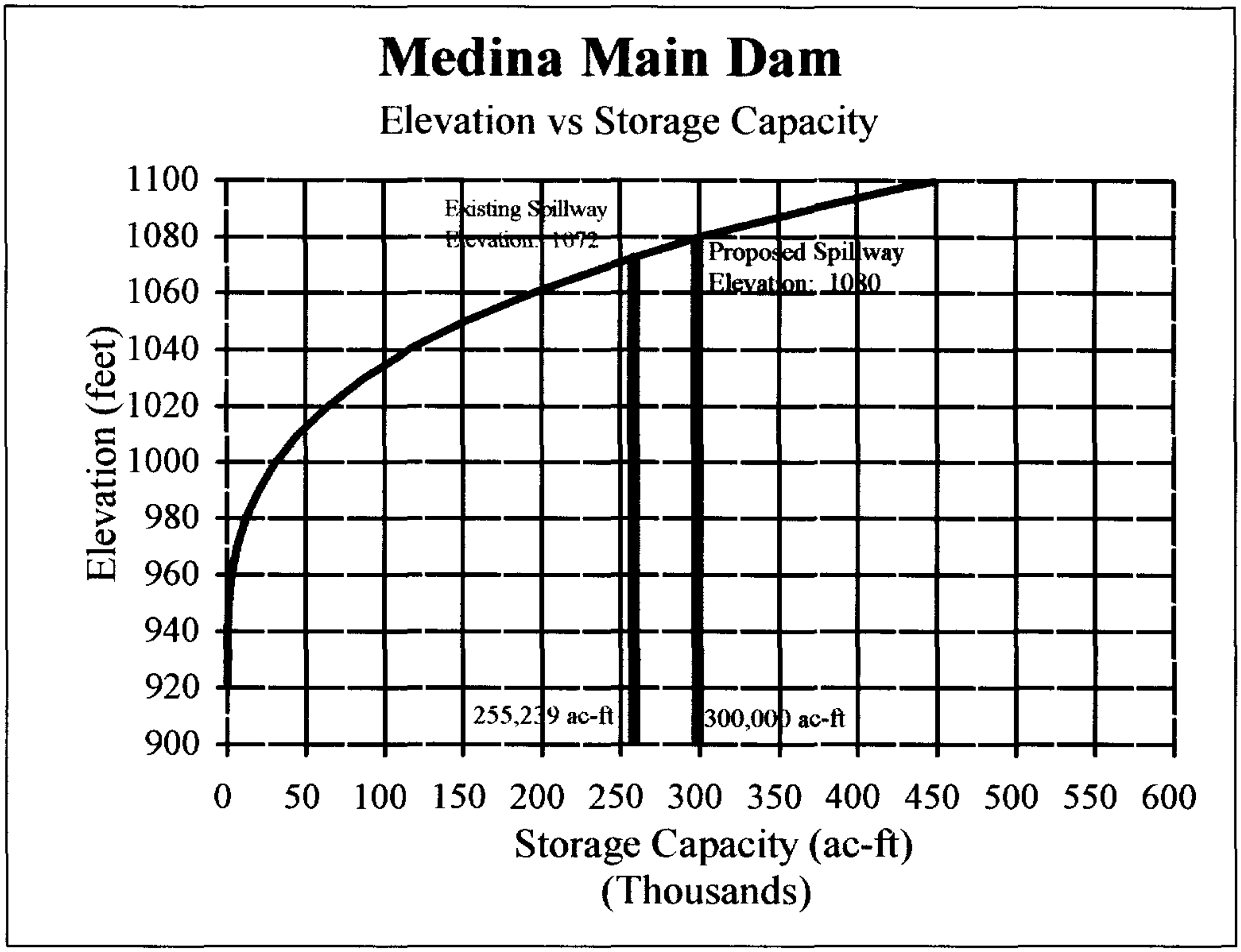
Another valuable resource that has gone untapped is excess waters generated during major storm events. These waters generally are lost due to insufficient lake volumes needed to trap and store these waters. The current volume of Medina Lake is approximately 254,000 acre feet when the level of the lake is at the 1072 msl spillway elevation.

When the lake receives waters from major storms, all water generated over the 254,000 acre feet volume is lost downstream. A method of retaining, or capturing these excess waters would be to increase the height of the spillway.

HEIGHT INCREASE OF SPILLWAY

Figure 5-1 represents the stage vs volume curve of the Medina Main Dam. As previously mentioned, Medina Lake was designed to withstand the impact of an additional eight (8) feet of water impounded within the reservoir. The original designers anticipated using wooden battens to increase the height of the spillway.

FIGURE 5-1



If the Main Dam Spillway is increased by eight feet, this would allow approximately 50,000 acre feet of additional storage to be used for M&I uses. Obviously, this will help dramatically in the reduction of dependence on the Edwards Underground Aquifer as a viable means of potable water in the region.

WATER MANAGEMENT – SIMYDL-II COMPUTER MODELING

As previously mentioned, surface water resources are available from the BMA Medina Lake Water System, and depending on implementation of water resource and conservation options outlined, BMA has the capacity to provide a good percentage of water in this region. In order to understand the extent of water resources available from the BMA Medina Lake System, a computer model was utilized to determine the quantity that could be made available.

The SIMYLD-II computer program, which was developed in 1972 by the TWDB for analyzing reservoir systems, was applied to describe and simulate the operations and behavior of the various elements of the BMA Medina Lake water resources system that presently are available, or to be developed, to serve Medina County. This water resources system operations model includes the following components:

1. Medina Lake;
2. Diversion Lake;
3. Pearson Lake;
4. Ground Water Resources;
5. Aquifer Storage Recovery

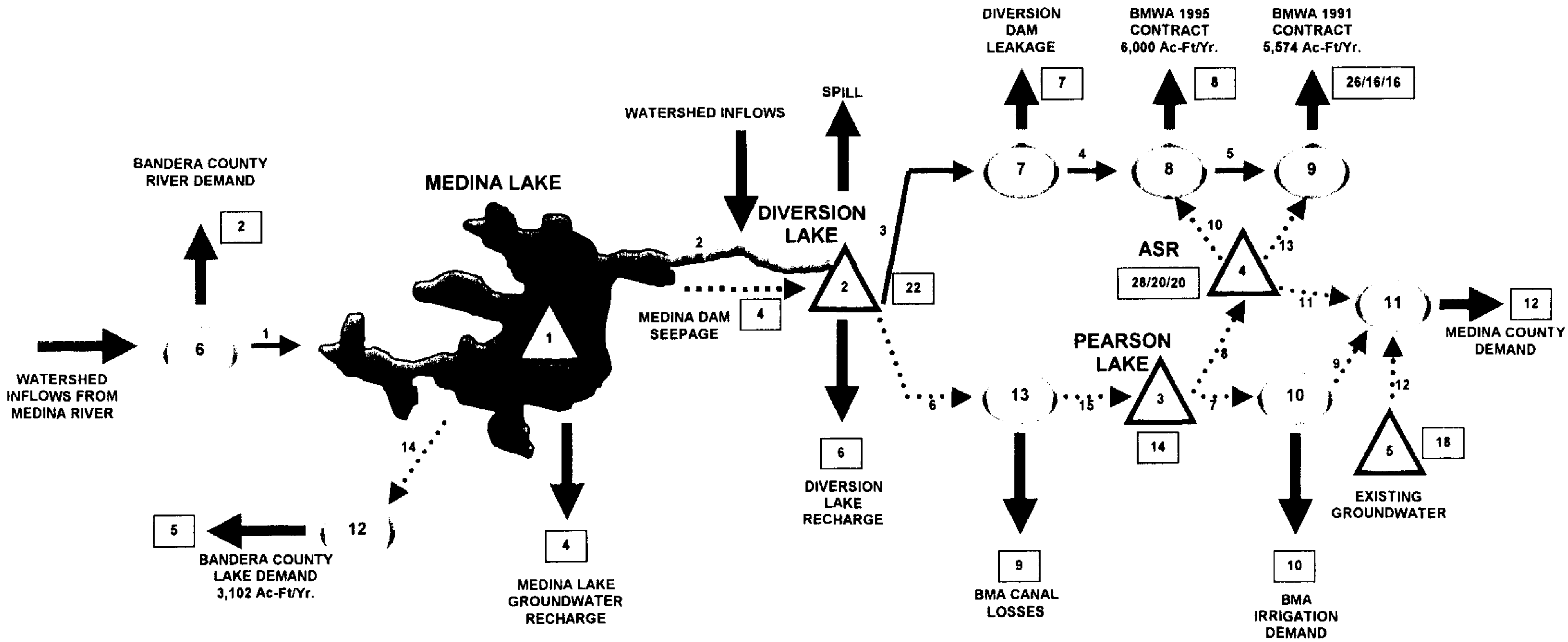
The physical and hydrologic characteristics of Medina Lake, Diversion Lake and Pearson Lake are described in the model, and the hydraulic behavior of these reservoirs, under a defined set of specified annual withdrawals and operating rules (including provisions for environmental water needs), have been simulated with the SIMYLD model using a monthly time step over a prescribed period of 50 years with historical watershed inflows and Rainfall evaporation conditions. Ground water resources have also been included in the model as a defined source(s) of water, with specified allowable annual withdrawal amounts. The aquifer storage-recovery (ASR) project was linked to the availability of water from Medina Lake and Pearson Lake, after treatment at the proposed Pearson Junction water treatment plant.

The SIMYLD model was structured to accommodate the analysis and simulation of the following water supply scenarios:

1. Medina Lake System without Pearson Lake and ASR, and without water conservation (PL-566 Canal Refurbishment Program).
2. Medina Lake System with Pearson Lake and ASR, but without water conservation (PL-566 Canal Refurbishment Program).
3. Medina Lake without Pearson Lake and ASR, but with water conservation (PL-566 Canal Refurbishment Program).
4. Medina Lake System with Pearson Lake and ASR, and with water conservation (PL-566 Canal Refurbishment Program).

For each of these scenarios, the SIMYLD model was operated to determine the characteristics of the system based on the period from 1940 to 1989, which includes the historical drought of the 1950's.

Figure 5-2 represents the basis of the model for the system.



LEGEND

26/16/16	Numbers in Boxes Reflect Dry/Average/Wet Priorities Assigned to Water Demands and Storage Operations.
——▶	River Channel Deliveries
••••••••▶	Canal & Pipeline Deliveries

FIGURE 5-2
SIMYLD NETWORK CONFIGURATION FOR WATER SUPPLY OPERATION
MODEL PREPARED BY R. J. BRANDES CO.

The operating rules for the model are as follows:

1. Uncontrolled Medina Lake Water Losses*

- Recharge water losses diverted from system (Node 1 Demand)
- Dam leakage water losses transferred to Diversion Lake (Link 2 Minimum Flow)

* Based on storage-recharge and storage-leakage relationships used in Trans Texas Study with adjustments for BMA datum.

2. Uncontrolled Diversion Lake Water Losses

- Recharge water losses diverted from system* (Node 2 Demand)
- Dam leakage water losses diverted from system** (Node 7 Demand)

* Based on storage-recharge relationship used in Trans Texas Study with adjustments for BMA datum.

** Based on storage-leakage relationship developed by BMA based on historical data.

3. Bandera County Municipal Demand - 5,170 ac-ft/year

- 40% (2,068 ac-ft/year) supplied by Medina River diversions* (Node 6 Demand)
- 60% (3,102 ac-ft/year) supplied by Medina Lake diversions* (Node 12 Demand)

* Based on estimated population distribution.

4. Bexar M.W.D. 1995 Contract Municipal Demand - 6,000 ac-ft/year (Node 8 Demand)

- Supplied by Medina Lake water when Lake storage > 3,000 ac-ft*
- Either not supplied at all or supplied by ASR water when Medina Lake storage < 3,000 ac-ft*

* Last 3,000 ac-ft of storage in Medina Lake is available for BMA Irrigation Demand.

5. Bexar M.W.D. 1991 Contract Municipal Demand - 5,574 ac-ft/year (Node 9 Demand)

- Supplied by Medina Lake water when Lake storage > 76,929 ac-ft (> Elev. 1030)*
- Either not supplied at all or supplied by ASR water when Medina Lake storage < 76,929 ac-ft (> Elev. 1030)*

* BMA/BMWD 1991 contract provision.

6. Medina County Municipal Demand - 3,400 ac-ft/year (Node 11 Demand)

- Supplied by Medina Lake water when Lake storage > 76,929 ac-ft (> Elev. 1030)
- Supplied by ASR water when Medina Lake storage < 76,929 ac-ft (> Elev. 1030)
- Supplied by Groundwater when neither Medina Lake nor ASR water is available*

* 4,000 ac-ft of Groundwater is assumed available for Medina County Municipal Demand each year.

7. Historical Annual Diversions Into BMA Canal - Varies With Medina Lake Inflows (MLQ)*

- When MLQ < 110,000 ac-ft/yr, Diversion = 70,000 - 0.33636 * MLQ
- When MLQ > 110,000 ac-ft/yr, Diversion = 33,000 - 0.023077 * (MLQ-110,000)

* Based on 1958-1989 historical data.

8. Historical BMA Canal Loss % - Varies With Historical Diversions Into BMA Canal*

- Percent Loss = 41.714 + 0.00004286 * Historical Diversion Into BMA Canal

* Based on following estimated historical irrigation demands and canal diversions:

DIVERSION INTO CANAL Ac-Ft/Year	IRRIGATION DEMAND Ac-Ft/Year	CANAL LOSS Ac-Ft/Year	PERCENT CANAL LOSS %
66,000	19,800	46,200	70.00
35,000	15,150	19,850	56.72
24,000	11,520	12,480	52.00

9. Annual BMA Irrigation Demand* (Node 10 Demand)

- BMA Irrigation Demand = (100 - Percent Loss) * Historical Diversion Into BMA Canal

Average = 15,846 ac-ft/yr

* Subject to limitation of available water rights after satisfying total municipal water demands (usually 20,144 ac-ft/yr) and canal losses.

10. BMA Canal Losses Without Conservation (CV) and Without Pearson Lake & ASR (PA) Plus Canal Losses Associated With Medina County Municipal Deliveries (Node 13 Demand)

- BMA Canal Loss W/O CV & PA = Percent Loss * Historical Diversion Into BMA Canal
  \+ [100/(100-Percentage Loss) - 1] * Medina County Municipal Demand

Average = 24,189 ac-ft/yr

11. BMA Canal Losses Without Conservation (CV) and With Pearson Lake & ASR (PA) (Node 13 Demand)

- BMA Canal Loss W/O CV & W/ PA = BMA Canal Loss W/O CV & PA - 3,000*
  \+ [100/(100-Percentage Loss) - 1] * ASR Injection Amount
  \+ [100/(100-Percentage Loss) - 1] * Medina County Municipal Demand

Average = 25,712 ac-ft/yr

* Reregulation of canal flows with Pearson Lake is projected to save ~ 3,000 ac-ft/yr.

12. Annual BMA Canal Losses With Conservation (CV) and With Pearson Lake & ASR (PA) (Node 13 Demand)

- BMA Canal Loss W/ CV & PA = 0.1765 * BMA Irrigation Demand*
  \+ [100/(100-Percentage Loss) - 1] * ASR Injection Amount
  \+ [100/(100-Percentage Loss) - 1] * Medina County Municipal Demand

Average = 4,222 ac-ft/yr

* Based on constant 15% canal loss factor.

13. Annual BMA Canal Losses With Conservation (CV) and Without Pearson Lake & ASR (PA) (Node 13 Demand)

- BMA Canal Loss W/ CV & W/O PA = BMA Canal Loss W/CV & PA + 3,000*

Average = 6,959 ac-ft/yr

* Without reregulation of canal flows with Pearson Lake, canal loss increases by 3,000 ac-ft/yr.

14. Aquifer Storage-Recovery Injection - Varies With Availability of Unused Water Rights* (Link 8 Minimum Flow)

- Supplied by Medina Lake water when Lake storage > 76,929 ac-ft (> Elev. 1030)
- No injection when Lake storage < 76,929 ac-ft (< Elev. 1030)
- Injection limited to 3,000 ac-ft/month (22,630 gpm)
- Total ASR storage limited to 175,000 ac-ft

* Subject to limitation of available water rights after satisfying total municipal water demands (usually 20,144 ac-ft/yr), irrigation water demand and total canal losses.

15. Order of Priorities For System Demand-Storage Activities

- When Medina Lake storage > 76,929 ac-ft (> Elev. 1030):

1. Satisfy Bandera County Municipal Demand From Medina River
2. Provide for Medina Lake Recharge Water Losses
3. Provide for Medina Dam Leakage Water Losses
4. Satisfy Bandera County Municipal Demand From Medina Lake
5. Provide for Medina Lake Recharge Water Losses
6. Provide for Medina Dam Leakage Water Losses
7. Satisfy Bexar M.W.D. 1995 Contract Municipal Demand
8. Provide for BMA Canal Water Losses
9. Satisfy BMA Irrigation Demand
10. Satisfy Medina County Municipal Demand
11. Store Water in Pearson Lake
12. Satisfy Bexar M.W.D. 1991 Contract Municipal Demand
13. Inject Water into Aquifer Storage-Recovery Reservoir
14. Preserve Water in Aquifer Storage-Recovery Reservoir
15. Store Water in Diversion Lake
16. Store Water in Medina Lake

- When Medina Lake storage < 76,929 ac-ft (< Elev. 1030):

    1. Satisfy Bandera County Municipal Demand From Medina River
    2. Provide for Medina Lake Recharge Water Losses
    3. Provide for Medina Dam Leakage Water Losses
    4. Satisfy Bandera County Municipal Demand From Medina Lake
    5. Provide for Medina Lake Recharge Water Losses
    6. Provide for Medina Dam Leakage Water Losses
    7. Satisfy Bexar M.W.D. 1995 Contract Municipal Demand
    8. Provide for BMA Canal Water Losses
    9. Satisfy BMA Irrigation Demand
    10. Satisfy Medina County Municipal Demand
    11. Store Water in Pearson Lake
    12. Store Water in Diversion Lake
    13. Store Water in Medina Lake
    14. Satisfy Bexar M.W.D. 1991 Contract Municipal Demand
    15. Preserve Water in Aquifer Storage-Recovery Reservoir

For the modeling period (1940 to 1989), the relationship between historical annual irrigation canal diversions (BMA Irrigation Demand) and the historical inflows to Medina Lake were developed with and without conservation measures, and with and without the use of Pearson lake (See Figures 5-3 to 5-6). This relationship was used to determine the projected Irrigation Demand for any given inflow quantity to the lake (See Figure 5-7).

FIGURE 5-3

RELATIONSHIPS BETWEEN
HISTORICAL MEDINA LAKE DIVERSIONS INTO BMA CANAL
AND BMA CANAL LOSSES AND IRRIGATION USEAGE
WITHOUT CONSERVATION MEASURES OR PEARSON LAKE

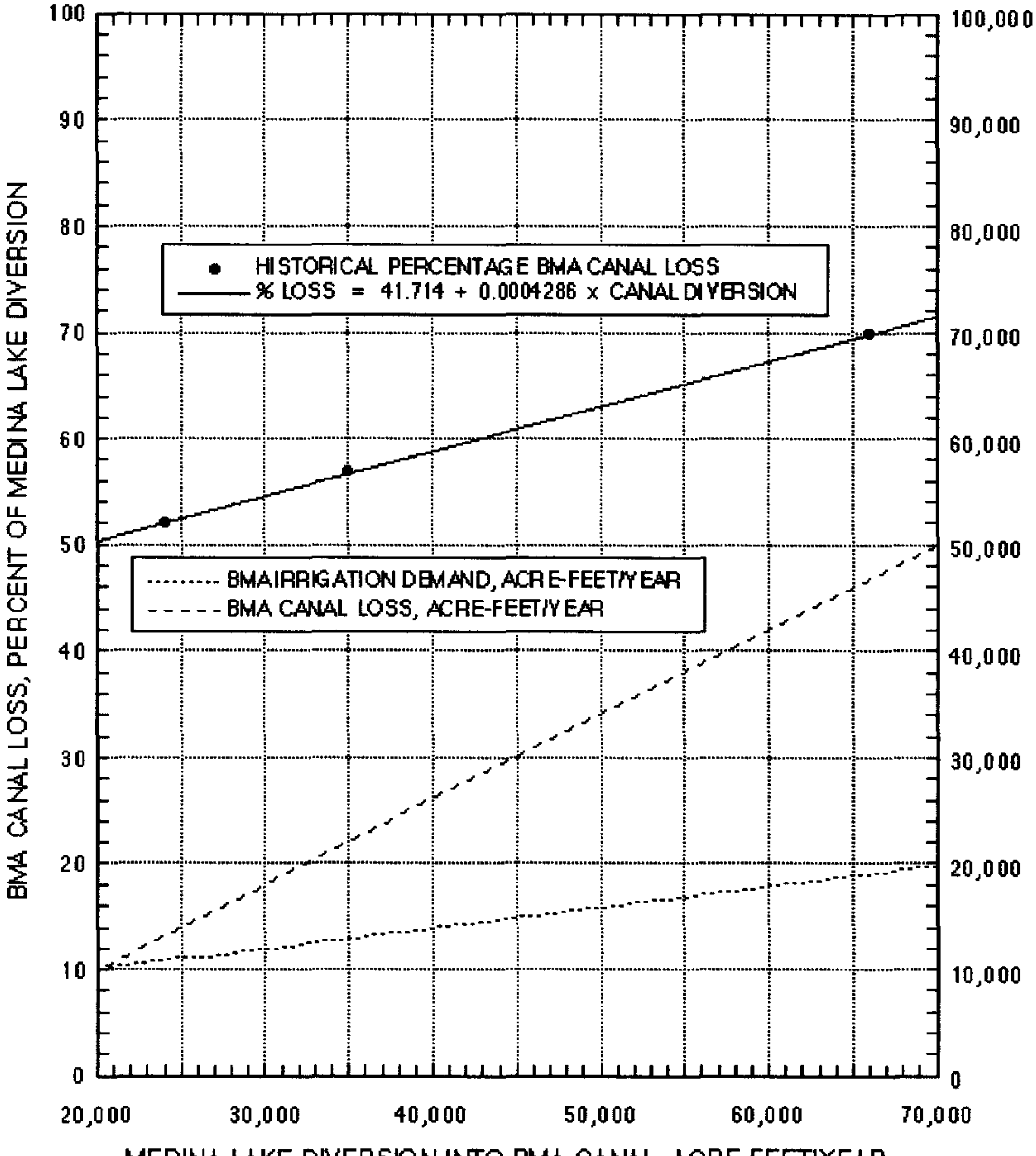


FIGURE 5-4

RELATIONSHIPS BETWEEN HISTORICAL IRRIGATION USEAGE AND BMA CANAL LOSSES AND MEDINA LAKE DIVERSIONS INTO BMA CANAL WITHOUT CONSERVATION MEASURES OR PEARSON LAKE

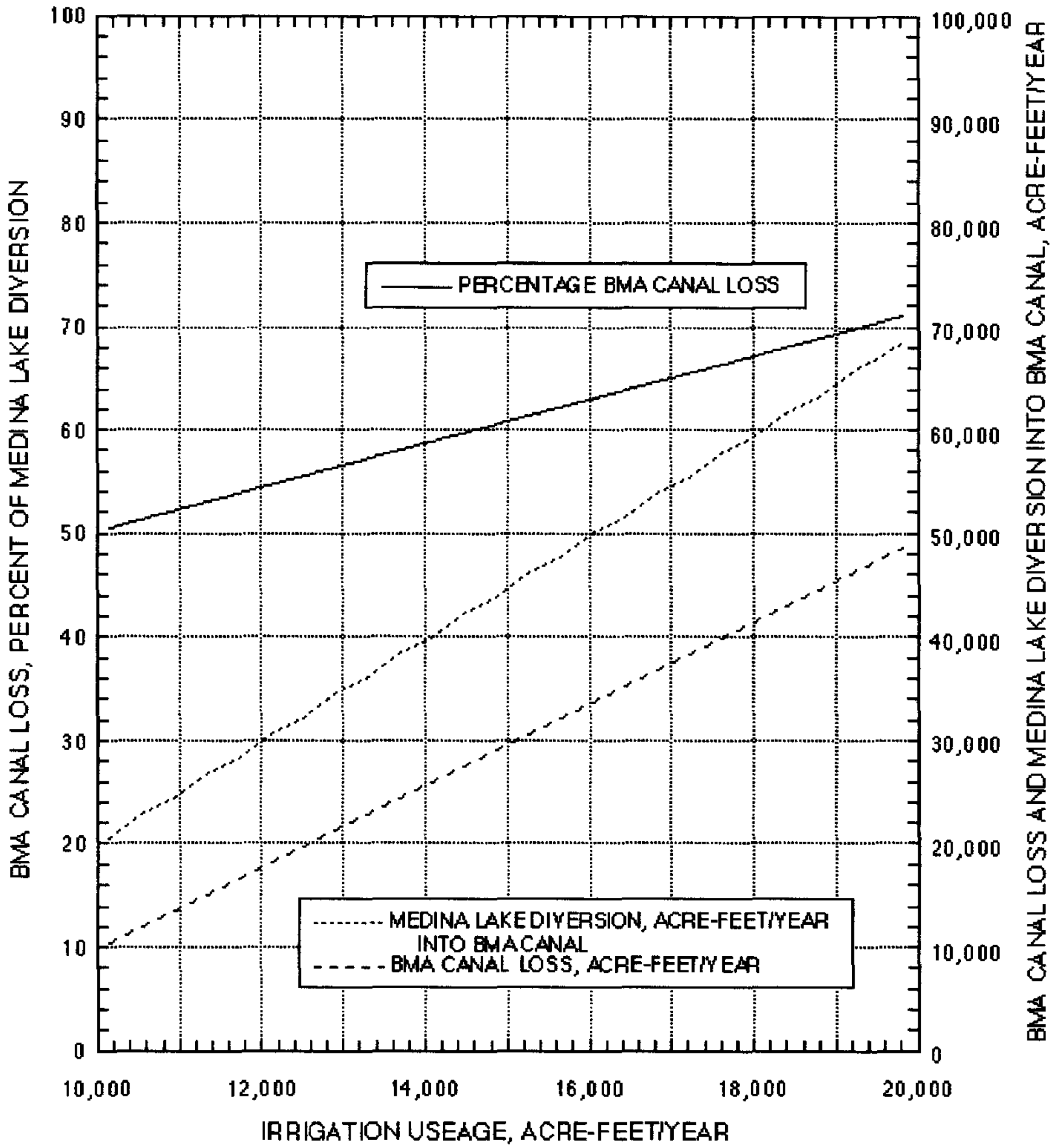


FIGURE 5-5

RELATIONSHIPS BETWEEN IRRIGATION USEAGE AND BMA CANAL LOSSES AND MEDINA LAKE DIVERSIONS INTO BMA CANAL WITH CONSERVATION MEASURES BUT WITHOUT PEARSON LAKE

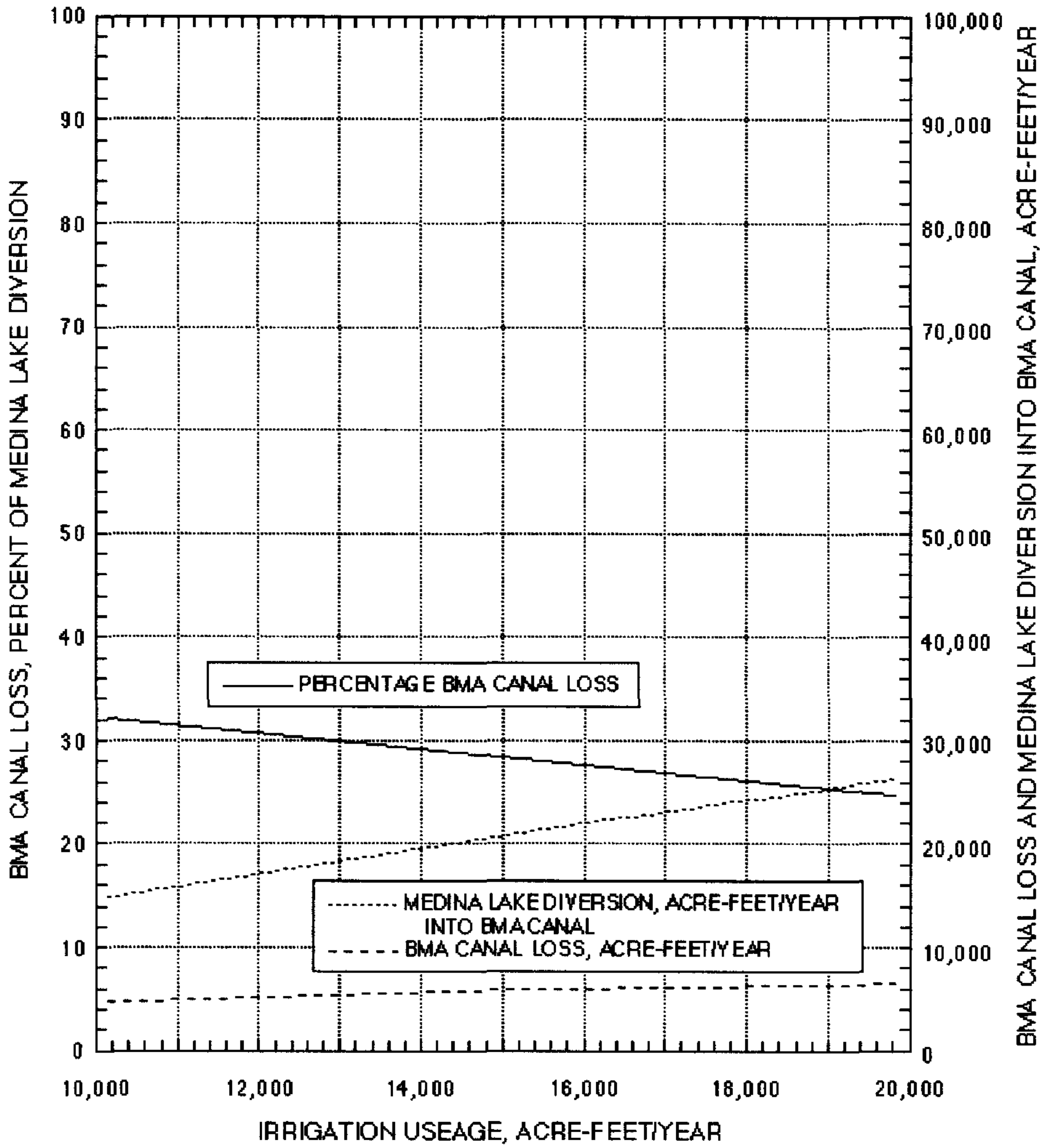


FIGURE 5-6

RELATIONSHIPS BETWEEN IRRIGATION USEAGE AND
BMA CANAL LOSSES AND MEDINA LAKE DIVERSIONS INTO BMA CANAL
WITH CONSERVATION MEASURES AND WITH PEARSON LAKE

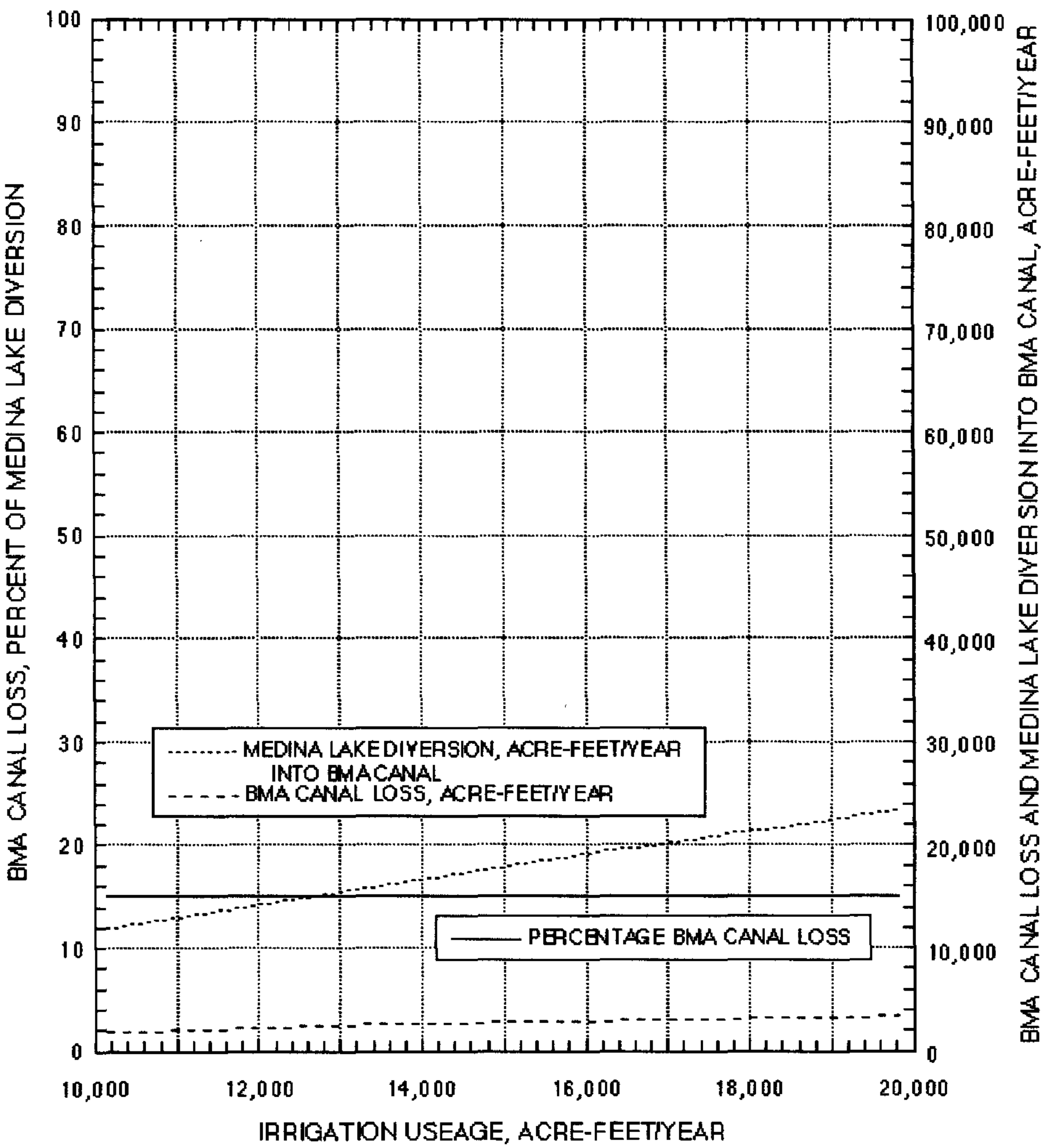
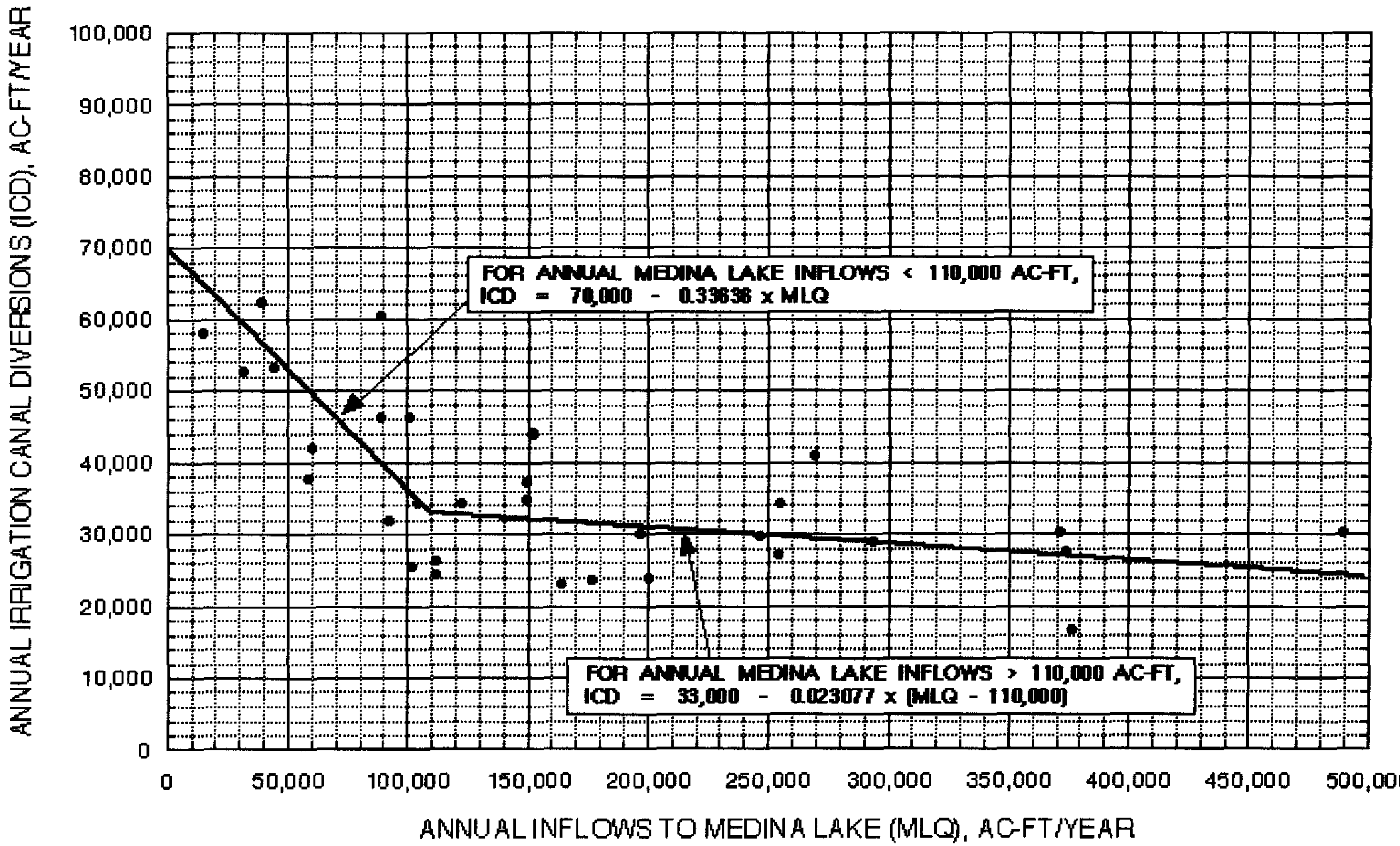


FIGURE 5-7

RELATIONSHIP BETWEEN HISTORICAL ANNUAL IRRIGATION CANAL DIVERSIONS AND HISTORICAL ANNUAL INFLOWS TO MEDINA LAKE
Bexar-Medina-Atascosa Counties WCID No. 1



For the given scenarios:

1. Medina Lake System without Pearson Lake and ASR, and without water conservation (PL-566 Canal Refurbishment Program).
2. Medina Lake System with Pearson Lake and ASR, but without water conservation (PL-566 Canal Refurbishment Program).
3. Medina Lake without Pearson Lake and ASR, but with water conservation (PL-566 Canal Refurbishment Program).
4. Medina Lake System with Pearson Lake and ASR, and with water conservation (PL-566 Canal Refurbishment Program).

The results are as shown in Figures 5-8 to 5-11.

The summary of the results are tabulated in Appendix B as follows:

TABLE #	SCENARIO
TABLE B-1	Medina Lake System without Pearson Lake and ASR, and without water conservation (PL-566 Canal Refurbishment Program).
TABLE B-2	Medina Lake System with Pearson Lake and ASR, but without water conservation (PL-566 Canal Refurbishment Program).
TABLE B-3	Medina Lake without Pearson Lake and ASR, but with water conservation (PL-566 Canal Refurbishment Program).
TABLE B-4	Medina Lake System with Pearson Lake and ASR, and with water conservation (PL-566 Canal Refurbishment Program).

ANNUAL WATER USE FROM MEDINA LAKE - WITHOUT PEARSON LAKE, ASR AND IRRIGATION CONSERVATION

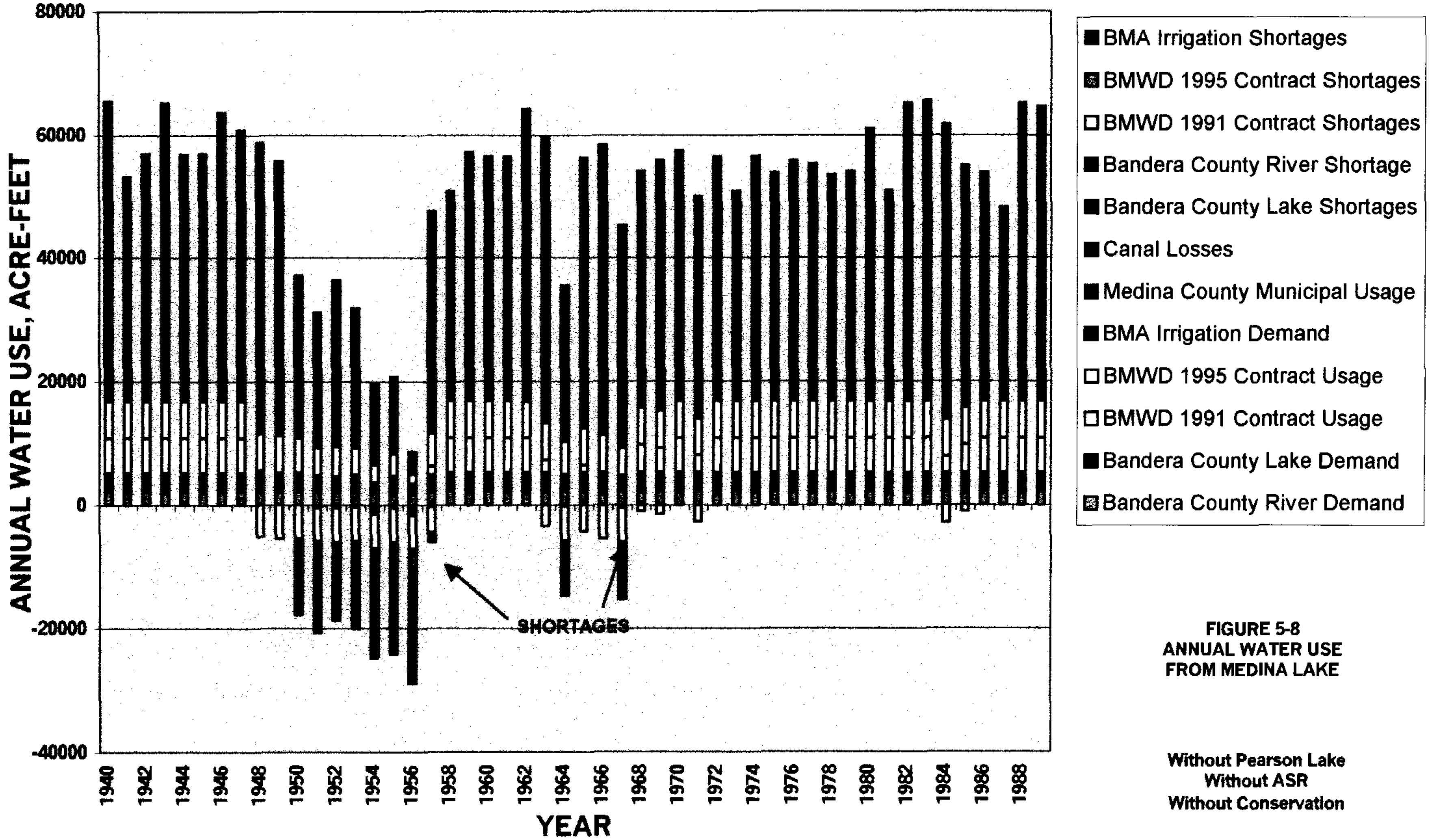


FIGURE 5-8
ANNUAL WATER USE FROM MEDINA LAKE

Without Pearson Lake
Without ASR
Without Conservation

ANNUAL WATER USE FROM MEDINA LAKE - WITH PEARSON LAKE, ASR BUT WITHOUT IRRIGATION CONSERVATION

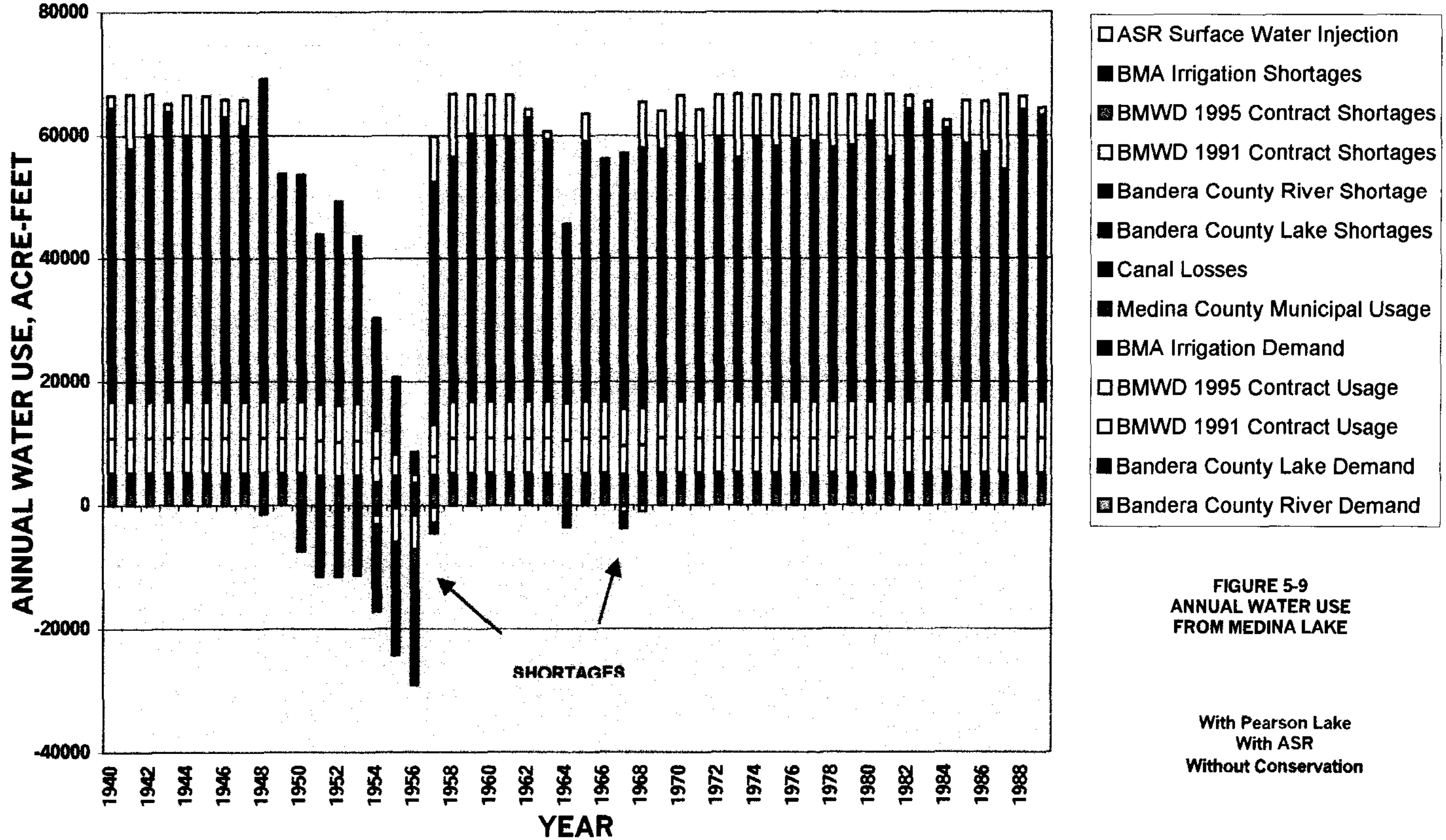


FIGURE 5-9
ANNUAL WATER USE FROM MEDINA LAKE

With Pearson Lake
With ASR
Without Conservation

ANNUAL WATER USE FROM MEDINA LAKE - WITHOUT PEARSON LAKE, ASR BUT WITH IRRIGATION CONSERVATION

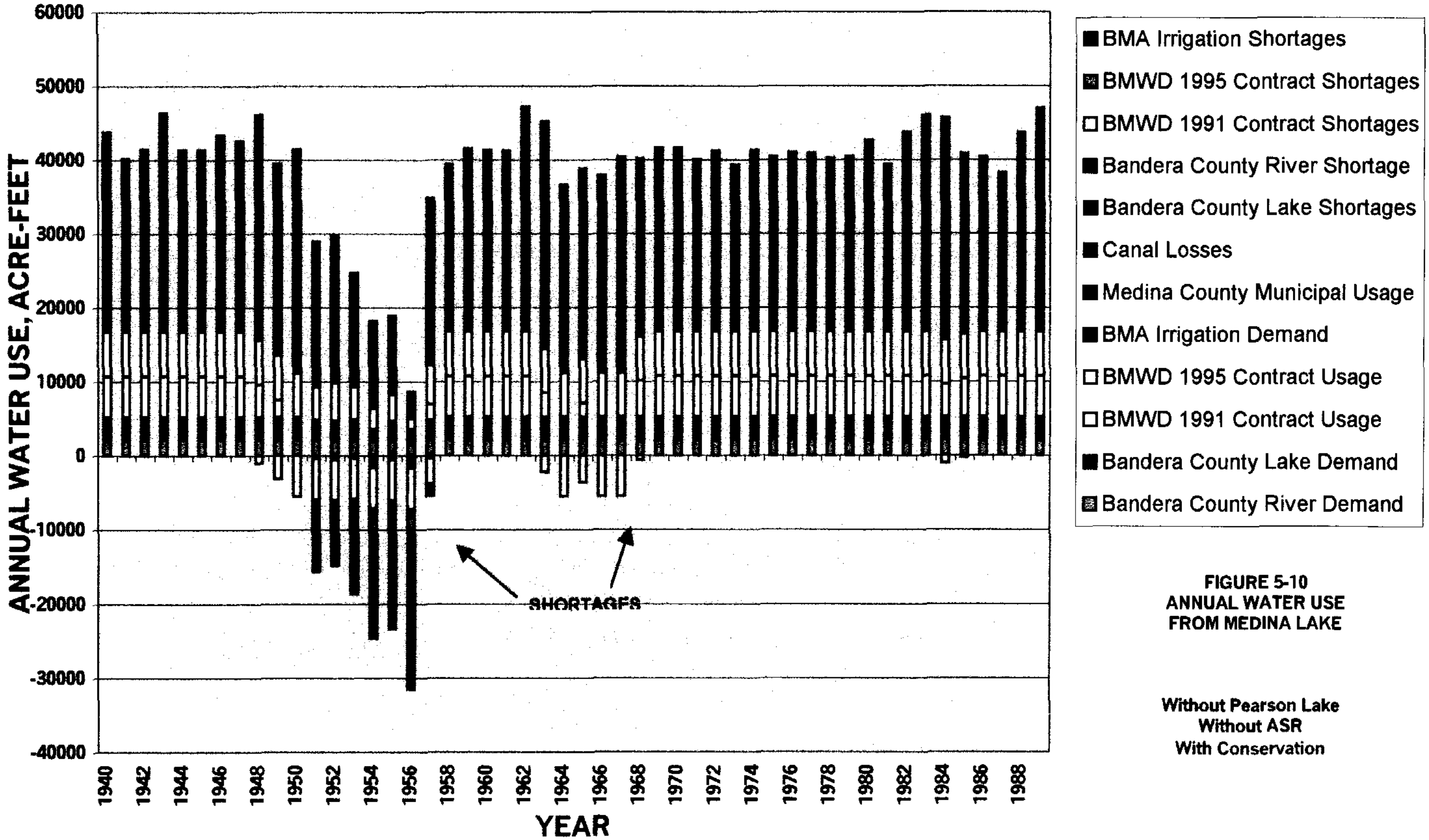


FIGURE 5-10
ANNUAL WATER USE
FROM MEDINA LAKE

Without Pearson Lake
Without ASR
With Conservation

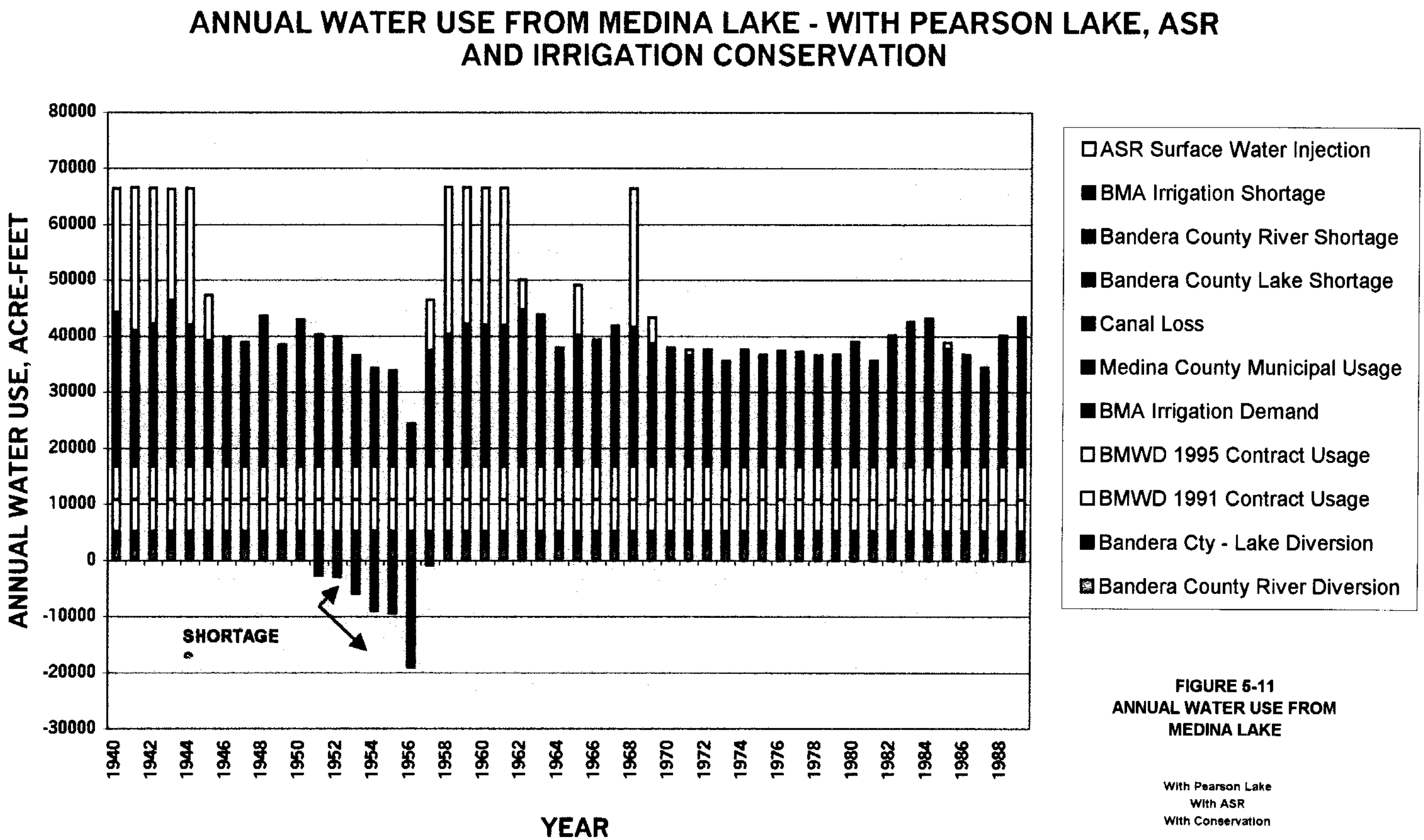


FIGURE 5-11
ANNUAL WATER USE FROM MEDINA LAKE

With Pearson Lake
With ASR
With Conservation

SECTION 6

DEMAND VERSUS SUPPLY COMPARISONS

INTRODUCTION

This section provides a summary and evaluation of the expected demands on the water resources in Medina County. The information will be used to determine the future water availability and to formulate the Water Resource Management Plan.

The projected total water demand for Medina County is shown in Table 6-1. The totals shown include both groundwater and surface water demands.

Table 6-1. Projected Total Water Demand In Medina County, Ac-Ft.

	2000	2010	2020	2030	2040	2050
Municipal						
High Demand	7,404	7,935	8,348	8,693	8,925	9,300
w/ Entire Lytle	7,985	8,581	9,053	9,469	9,752	10,195
Low Demand	5,876	6,033	6,149	6,415	6,629	6,889
w/ Entire Lytle	6,322	6,509	6,652	6,973	7,224	7,533
Manufacturing	302	319	339	361	384	411
Irrigation	155,085	148,548	142,287	136,291	130,546	125,044
Mining	143	128	128	129	132	136
Livestock	1,914	1,914	1,914	1,914	1,914	1,914
Totals						
High Demand	164,848	158,844	153,016	147,388	141,901	136,805
w/ Entire Lytle	165,429	159,490	153,721	148,164	142,728	137,700
Low Demand	163,320	156,942	150,817	145,110	139,605	134,394
w/ Entire Lytle	163,766	157,418	151,320	145,668	140,200	135,038

The amount of surface water used in Medina County in 1996 was 60,293 acre-feet. The maximum amount of surface water authorized to be used was 78,341 acre-feet. The largest user of surface water is the Bexar-Medina-Atascosa Water Control and Improvement District No. 1 (BMA). BMA owns and operates both Medina and Diversion Lakes and is authorized to use up to 66,000 acre-feet of surface water per year. The majority of surface water is used for irrigation with small amounts being used for municipal and industrial purposes. The water demand from the current surface water sources is expected to increase following enactment of Senate Bill 1477 which limits the amount of groundwater which can be pumped from the Edwards Aquifer.

The following provisions were set out for maximum pumpage of Edwards Aquifer in Senate Bill 1477:

- *Except as provided by Subsections (d), (f) and (h) of this section and Section 1.26 of this article, for the period ending December 31, 2007, the amount of permitted withdrawals from the aquifer may not exceed 450,000 acre-feet of water for each calendar year.*
- *Except as provided by Subsections (d), (f) and (h) of this section and Section 1.26 of this article, for the period beginning January 1, 2008, the amount of permitted withdrawals from the aquifer may not exceed 400,000 acre-feet of water for each calendar year.*
- *If on or after January 1, 2008, the overall volume of water authorized to be withdrawn from the aquifer under regular permits is greater than 400,000 acre-feet a year or greater than the adjusted amount determined under Subsection (d) of Section 1.14 of this article, the maximum authorized withdrawal of each regular permit shall be immediately reduced by an equal percentage as is necessary to reduce overall maximum demand to 400,000 acre-feet a year or the adjusted amount, as appropriate.*

Approximately 96% of all of the groundwater used in Medina County comes from the Edwards Aquifer. Therefore, large deficits are expected between the water required for Medina County and the water that will be available after the pumpage from the Edwards Aquifer is limited. Therefore, alternative sources of water are necessary to provide the additional water needed each year.

The total amount of water claimed by all current users of the Edwards Aquifer is 792,864 acre-feet. Each entities claim was multiplied by the ratios 450,000/792,864 (until 2008) and 400,000/792,864 (after 2008) and compared to that users average historical use. It appears as though the historical average use will be larger than the factored claims for most if not all users. Each entity is allowed the larger of either the percentage of their claim or their historical use. If the sum of the factored requests / historical uses of each entity is higher than the allowable pumpage, each entities allowed usage will be lowered by an equal percentage as stated in Senate Bill 1477.

MAJOR MUNICIPALITIES IN MEDINA COUNTY

Medina County has a historical average use of 88,322 acre-feet. The estimated allowed pumpage from Edwards Aquifer in Medina County is shown in Table 6-2. These numbers were based on the provisions of Senate Bill 1477 and the requested pumpage ratios stated above. Table 6-3 shows the corresponding river basins where the pumpage would be taken from in Medina County.

Table 6-2. Average Historical And Estimated Allowed Pumpage Based On Senate Bill 1477 For Medina County, Ac-Ft.

Avg. Edwards Aquifer Pumpage	450,000 Ac-Ft. Pumpage Limit	400,000 Ac-Ft. Pumpage Limit
88,322	50,128	44,559

Table 6-3. Pumpage By River Basin For Medina County, Ac-Ft.

450,000 Ac-Ft Pumpage Limit				400,000 Ac-Ft Pumpage Limit			
	River Basin				River Basin		
Total	Nueces	San Antonio	Guadalupe	Total	Nueces	San Antonio	Guadalupe
50,128	38,799	11,329	---	**44,559**	34,489	10,070	---

Table 6-4 shows the projected system demands and deficits for the major municipalities in Medina County. All of the water demand from Lytle is taken from wells in Medina County and therefore, the entire demand of Lytle is shown in the table. The first table for each town and Medina County shows the projected total water demands. The second table for each city and Medina County only shows the expected demand and allowable pumpage from the Edwards Aquifer and the corresponding deficits.

Table 6-4. Projected System Demands And Deficits In The Major Municipalities In Medina County, Ac-Ft.

Castroville

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	2,159	779	779
2000	2,632	996	764
2008	---	1,053	779
2010	2,950	1,067	783
2020	3,289	1,135	803
2030	3,469	1,185	839
2040	3,583	1,216	863
2050	3,701	1,252	887

Until the year 2008 - 604 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for Castroville and in the year 2008 - 598 Ac-Ft is the maximum allowable pumpage.

Castroville

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	604	735.2	131.2	958.5	354.5
2008	598	749.6	151.6	1,013.3	415.3
2010	598	753.5	155.5	1,026.8	428.8
2020	598	772.7	174.7	1,092.2	494.2
2030	598	807.4	209.4	1,140.3	542.3
2040	598	830.5	232.5	1,170.2	572.2
2050	598	853.6	255.6	1,204.8	606.8

Devine

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	3,928	630	630
2000	4,524	993	765
2008	---	1,019	757
2010	4,921	1,025	755
2020	5,310	1,047	749
2030	5,515	1,069	766
2040	5,686	1,083	783
2050	5,862	1,110	795

637 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for Devine.

Table 6-4 (Continued). Projected System Demands And Deficits In The Major Municipalities In Medina County, Ac-Ft.

Devine

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	637	736.2	99.2	955.6	318.6
2008	637	728.5	91.5	980.6	343.6
2010	637	726.5	89.5	986.4	349.4
2020	637	720.8	83.8	1,007.5	370.5
2030	637	737.1	100.1	1,028.7	391.7
2040	637	753.5	116.5	1,042.2	405.2
2050	637	765.0	128.0	1,068.2	431.2

Hondo

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	6,018	1,456	1,456
2000	7,032	2,103	1,615
2008	---	2,214	1,650
2010	7,880	2,242	1,659
2020	8,782	2,390	1,721
2030	9,268	2,492	1,796
2040	9,574	2,542	1,845
2050	9,890	2,614	1,894

1466 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for Hondo.

Hondo

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	1,466	1,554.1	88.1	2,023.7	557.7
2008	1,466	1,587.8	121.8	2,130.5	664.5
2010	1,466	1,596.5	130.5	2,157.5	691.5
2020	1,466	1,656.1	190.1	2,299.9	833.9
2030	1,466	1,728.3	262.3	2,398.1	932.1
2040	1,466	1,775.4	309.4	2,446.2	980.2
2050	1,466	1,822.6	356.6	2,515.5	1,049.5

Table 6-4 (Continued). Projected System Demands And Deficits In The Major Municipalities In Medina County, Ac-Ft.

LaCoste

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	1,021	229	229
2000	1,426	297	257
2008	---	329	270
2010	1,789	345	273
2020	2,092	377	274
2030	2,307	408	297
2040	2,463	430	315
2050	2,630	457	333

176 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for LaCoste.

LaCoste

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	176	247.3	71.3	285.8	109.8
2008	176	259.8	83.8	316.6	140.6
2010	176	262.7	86.7	332.0	156.0
2020	176	263.7	87.7	362.8	186.8
2030	176	285.8	109.8	392.6	216.6
2040	176	303.1	127.1	413.8	237.8
2050	176	320.4	144.4	439.8	263.8

Lytle

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	---	483	483
2000	2,698	677	520
2008	---	728	541
2010	3,124	741	546
2020	3,542	801	572
2030	3,916	873	628
2040	4,214	925	666
2050	4,535	996	717

396 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for Lytle.

Table 6-4 (Continued). Projected System Demands And Deficits In The Major Municipalities In Medina County, Ac-Ft.

Lytle

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	396	500.4	104.4	651.5	255.5
2008	396	520.6	124.6	700.6	304.6
2010	396	525.4	129.4	713.1	317.1
2020	396	550.4	154.4	770.8	374.8
2030	396	604.3	208.3	840.1	444.1
2040	396	640.9	244.9	890.1	494.1
2050	396	690.0	294.0	958.5	562.5

Natalia

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	1216	294	294
2000	1703	412	315
2008	---	435	321
2010	1,909	441	323
2020	2,126	467	333
2030	2,244	485	347
2040	2,318	493	356
2050	2,394	507	365

171 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for Natalia.

Natalia

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	171	303.1	132.1	396.5	225.5
2008	171	308.9	137.9	418.6	247.6
2010	171	310.8	139.8	424.4	253.4
2020	171	320.4	149.4	449.4	278.4
2030	171	333.9	162.9	466.7	295.7
2040	171	342.6	171.6	474.4	303.4
2050	171	351.2	180.2	487.9	316.9

MEDINA COUNTY

Table 6-3 shows the total demands for municipal uses county wide. If alternatives are not found to the Edwards Aquifer, Medina County is expected to have a deficit between 68,813 acre-feet and

70,283 acre-feet by the year 2000. The deficit is expected to decrease by the year 2050. The first table for Medina County shows the projected total water demands. The second table only shows the expected demand and allowable pumpage from the Edwards Aquifer and the corresponding deficits.

Table 6-5. Projected System Demands And Deficits In Medina County, Ac-Ft.

County-Wide

Year	Population	High Demand (Ac-Ft)	Low Demand (Ac-Ft)
1990	27,312	164,600	164,600
2000	33,349	164,848	163,320
2008	---	160,045	158,218
2010	38,069	158,844	156,942
2020	42,299	153,016	150,817
2030	44,945	147,388	145,110
2040	46,945	141,901	139,605
2050	49,556	136,805	134,394

In the year 2000 - 88,322 Ac-Ft is the maximum allowable Edwards Aquifer pumpage for Medina County.

County-Wide

Year	Allowed (Ac-Ft)	Low Edwards (Ac-Ft)	Deficit, Low (Ac-Ft)	High Edwards (Ac-Ft)	Deficit, High (Ac-Ft)
2000	88,322	157,163	68,813	158,633	70,283
2008	88,322	154,011	63,903	154,011	65,661
2010	88,322	152,856	62,675	152,856	64,506
2020	88,322	147,247	56,781	147,247	58,897
2030	88,322	141,832	51,289	141,832	53,482
2040	88,322	136,551	45,992	136,551	48,201
2050	88,322	131,648	40,977	131,648	43,298

SECTION 7
WATER SUPPLY ALTERNATIVES

INTRODUCTION

The comparison of supply and demand in Section 6 has provided a basis for the formulation of alternatives that have optional implementation strategies. These alternatives are described as:

- Alternative 1 – Continue present policies or "no action".
- Alternative 2 – Establish a regional water system using ASR and provisions of Senate Bill 1477 as conjunctive management tools.
- Alternative 3 – Establish a regional treated water supply system using the BMA canal system for delivery of raw water to a central location for a water treatment facility, and develop off-channel storage of treated water.

The development and evaluation of these alternatives are as follows:

ALTERNATIVE 1 – CONTINUE PRESENT POLICIES

Currently water users within Medina County are utilizing 88,322 acre feet of water from the Edwards Aquifer (See Table 6-2). After the implementation of Senate Bill 1477, the allowable usage from the Edwards Aquifer will drop to 50,128 acre feet at the 450,000 acre feet pumpage limit through the year 2007, and afterwards to 44,559 acre feet at the 400,000 acre feet limit. Consequently, the county will not be able to rely 100% on the Edwards Aquifer for their water needs, as they have in the past. The majority of these waters is irrigation water.

To continue the present policy of reliance on the Edwards Aquifer for all of the county's water needs would be foolish. Because of court mandates and the creation of the EAA, the availability of water from the aquifer will be approximately one-half of what is today.

ALTERNATIVE 2 – ESTABLISH A REGIONAL WATER SYSTEM USING ASR AND PROVISIONS OF SENATE BILL 1477 AS CONJUNCTIVE MANAGEMENT TOOLS.

This alternative is based on the following:

Raw water is delivered to a central treatment facility via the BMA Canal system to the Pearson Lake area;

1. Pearson Lake is constructed to store the raw water from Medina Lake;
2. A central water treatment plant is constructed at Pearson Lake and water is treated for ASR purposes;
3. The treated water is injected into the Edwards Aquifer and stored for future use;
4. Municipalities withdraw water from the Edwards Aquifer, via their existing wells. The amount withdrawn shall not to exceed the amount stored within the ASR field(s) minus any estimated transfer losses within the Aquifer.

This alternative utilizes the Edwards Aquifer to store and transport treated water to the various municipalities throughout the County. The provisions of Senate Bill 1477 would be utilized as the mechanism for delivery of treated water. Although this alternative initially appears to be a reasonable alternative, it has many unknowns that could ultimately make it unfeasible.

Currently, the specific rules which would pertain to the storage, treatment and transportation of ASR waters within the Edwards Aquifer have not been written, and are therefore unknown, especially rules that would pertain to the free transportation of waters within the Aquifer. It is impossible to be able to calculate the costs associated with this alternative and perform a comparison with other alternatives without knowing (1) the losses that would be associated with waters that travel within the aquifer, (2) the direction of flows within the aquifer and (3) the time required to travel within the aquifer in order to reach the demand point.

A recent preliminary study of the Edwards Aquifer by the USGS indicate that waters in the Edwards in the area of Diversion Lake will travel to the southwest before turning back into the direction of the municipalities within Medina County. This preliminary model also indicates that time required to make this journey is in the neighborhood of 200 years. Therefore, waters that may have been recharged through the Medina Lake System has yet to reach the municipalities within the county.

Until the EAA has more definitive rules for this type of delivery, this alternative is not feasible to consider.

ALTERNATIVE 3 – ESTABLISH REGIONAL DISTRIBUTED WATER SYSTEM

This alternative utilizes a central treatment facility to be located at Pearson Lake, and is based on the following:

1. Raw water is delivered to a central storage facility via the BMA Canal system to the Pearson Lake area;
2. Pearson Lake is constructed to store the raw water from Medina Lake;
3. A Water Treatment Plant is constructed at the Pearson Lake Site;
4. Treated water is delivered to the municipalities and participating water districts.

For purposes of exploring this alternative, the raw water would be transported from Medina Lake Diversion Dam via the BMA main canal to Pearson Lake. Raw water would be stored in Pearson Lake, treated and then transported by pipeline to the general demand area.

The capital improvements required for the construction of the proposed Pearson Lake Water Treatment Plant can be divided into five separate and distinct phases, which are:

1. Irrigation Canal Improvements to deliver the raw water from Medina Diversion Dam to the proposed treatment facility at Pearson Lake;
2. Pearson Lake is constructed to store 3,400 Acre-Feet of Raw Water to be used for Municipal and Irrigation uses;
3. A 4 Million Gallon per Day Water Treatment Plant to be located at Pearson Lake;
4. Booster Pump and Ground Storage Facilities; and
5. Treated Water Delivery System.

These phases are needed in order to deliver treated water to the consumer.

IRRIGATION CANAL IMPROVEMENTS

The loss of water by evaporation in an operation canal is usually a small percentage of the water flowing through the canal. However, the exfiltration losses through the bottom and sides of the canal can be very large. Exfiltration loss is related to permeability of the soil, thickness of the soil and the hydraulic gradient of the water flowing through the soil.

The canals used by BMA are constructed in natural materials that are susceptible to erosion and leakage. In addition, the properties of these soils are extremely variable. Some canal properties change with respect to age such as their resistance to erosion or their permeability. The water transported in the canal has the ability to erode, transport and/or deposit sediment depending upon more variables than can be handled with any rigor. The only practical engineering approach to the this problem is to rely heavily on empirical data and observations. The appropriate slope, cross section, velocity, and soils stability can be easily observed in the existing canal system where they have either been proven successful or not.

The permeability of soils range from highly permeable (clean coarse uniform grain sized sand) to practically impermeable (well compacted saturated clay). The following table gives a verbal classification of permeability related to a numerical value of permeability.

Degree of Permeability	K, cm/sec
High	$> 1^{10-1}$
Medium	$1^{10-1} - 1^{10-3}$
Low	$1^{10-3} - 1^{10-5}$
Very Low	$1^{10-5} - 1^{10-7}$
Practically impermeable	$< 1^{10-7}$

LINER CONSTRUCTION ECONOMICS

A change in magnitude of the permeability of the canal soil in a long canal from medium permeability to a high permeability can change the exfiltration losses from the total flow to an acceptable level. However, changing the permeability by two to five orders of magnitude can make an otherwise economic operation completely unsatisfactory. This is assuming a constant liner thickness and hydraulic gradient. A maintenance program can be designed to bring about a change of soil thickness, soil type, and a change in permeability. Unfortunately, these changes may also bring about an unsatisfactory change in hydraulic gradient in the liner. Since water transported by an irrigation canal has a very low market value, only a relatively small amount of money can be expended per acre-foot of water deserved.

Construction of a soil liner for a canal with a permeability in the very low to low range is much easier (and much cheaper) than one in the practically impermeable range. Due to the installation techniques required, there is little or no cost differential between the very low to low range liners and those liners in the medium to high range of permeability. A liner constructed of clay with a permeability of 1*10-7 cm/sec may cost twice as much as a sand/silt/clay mixture of soil with a permeability of 1*10-5 cm/sec. Depending on the installation, one liner constructed of a sand/silt/clay mixture with a permeability of 1*10-5 cm/sec may cost the same as another constructed of the same material with a permeability of 1*10-2 cm/sec. This cost differential is due to the difference in the equipment and effort required to construct liners with the different materials.

Liners constructed of dirty sands, dirty gravel, and of mixtures of sand/silt/clay are easier to construct than clay liners due to the difference in workability of the materials. Clays have a workability factor that is classified as poor while dirty sands, dirty gravel and mixtures of sand/silt/clay have workability factors classified as good to excellent. Light rubber tired compactors with vibrations work well on these soils while clays require heavy sheep's foot rollers and much higher moisture contents during compaction. Clay used for liners also has a tendency to form clods that are very difficult to break up. This means that clay soils used for liner construction cannot be easily stockpiled unless it is heavily disked or ground before use. Dirty sand, dirty gravel, and mixtures of sand/silt/clay do not tend to form clods. The difficulties caused by poor workability and clod formation are two major cost factors that are amplified by the fact that much of the liner is constructed on a slope. While it is difficult to operate heavy compactors on a slope, the high moisture contents required for the proper compaction of clays makes the work even more demanding.

SIPHON REPLACEMENT

The main irrigation canal was designed and constructed between 1910 and 1915. Numerous siphons and flumes were utilized in the original system to traverse the rough terrain along the route from Diversion Dam to farm lands near Natalia. Over the years, deterioration of the creosoted timbers and galvanized metal necessitated the removal of the flumes. These structures were replaced with either an inverted siphon along the original alignment or canal cut into the hillside around the head of the flume canyon. The decisions between these alternatives were typically based upon the lowest initial construction cost. Long-term maintenance was apparently not considered in the economical evaluation of the two options. It was felt that the slopes along canal sections cut into the hillside around the head of the canyon would stabilize after the early years of life. However, soil conditions along the route of the diversions in combination with the high precipitation in recent years have caused numerous slope failures or landslides. These slides have severely reduced the capacity of the canal in certain areas while increasing the cost of maintenance by necessitating emergency clearing. The material removed during maintenance is normally placed within the Right of Way, however this space is limited and the spoil will eventually have to be hauled away at a higher cost to the District. The diversion canal around the Flume 11 site has significant sections with slope failures.

SLOPE STABILITY

For all natural and man-made slopes there is a maximum slope angle at which the friction between the soil grains can resist the weight of the soil and prevent a slope failure or landslide. If an embankment is on the verge of sliding, these forces are equal. Cohesive soils (clays) generally have the highest amount of internal friction due to the very small size of the individual soil grains. This is why slopes in clay areas can be steeper than those where granular (sandy) soils are predominant. High water content in a soil due to rain or exfiltration from a source such as the irrigation canal can change the stability of a slope dramatically by adding weight and acting as a lubricant. The increased number of slides along the canal are an example of this effect on areas with marginal slopes.

The following are the typical methods employed for slope stabilization:

- Reduce the slope angle by filling;
- Reduce the slope angle by installing a retaining wall;
- Increase the friction of the soil with a Geogrid;
- Increase the friction of the soil with an additive;

Due to the lengths of the canal sections in question, reducing the angle of the slope by filling is the only viable method. Within this method the District's problem can be addressed by either bypassing the areas completely with an inverted siphon or piping the canal through the areas with failures and regrading the route back to the original grade. Outlined below are several advantages of the bypass over the piping option:

1) The inverted siphon can be constructed without interruption to service of the canal. In order to pipe the canal, the system will be required to be out of service and dewatered for extended periods of time.

2) Since the alignment of the siphons would follow that of the more direct route of the flumes, their lengths would be significantly less than the canal around the head of the canyon. This increases the available slope which reduces the size of the pipe necessary to carry the same amount of water. In the case of Flume 11 canyon, the inverted siphon would require an 84" diameter pipe versus a box with internal dimensions larger than 9' X 6' for piping the canal.

3) Excess material from the construction of the siphons could be used to fill the canal in the slide areas. The remainder of the abandoned section of canal could be filled in over time with material excavated during normal maintenance operations. The piping alternative will probably require the purchase of additional fill.

4) Without further evaluation, it is difficult to determine if piping the canal and the addition of fill would be sufficient to stabilize the slope.

Canal Improvement Costs

The proposed Canal Improvements for the delivery of Raw Water to the Pearson Lake Water Treatment Plant are as indicated in the attached tables.

TABLE 7 –1

CANAL IMPROVEMENT COSTS

Description	Unit	Quantity	Unit Price	Total Cost
Siphon at Flume 6				
Land	AC	-	$ 1,000	$ -
labor & Equipment	LF	700	$ 55	$ 38,500
Pipe	LF	700	$ 160	$ 112,000
Bedding	LF	700	$ 9	$ 6,300
Grassing	AC	1	$ 2,375	$ 2,375
Misc. Site work	LS	1	$ 10,000	$ 10,000
Subtotal				$ 169,175
Engineering				$ 12,000
10% Contingency				$ 16,918
Total Estimated Cost				**$ 198,093**
Siphon at Flume 11				
Land	AC	-	$ 1,000	$ -
labor & Equipment	LF	1,650	$ 50	$ 82,500
Pipe	LF	1,650	$ 160	$ 264,000
Bedding	LF	1,650	$ 9	$ 14,850
Grassing	AC	3	$ 1,900	$ 5,700
Misc. Site work	LS	1	$ 10,000	$ 10,000
Subtotal				$ 377,050
Engineering				$ 29,500
10% Contingency				$ 37,705
Total Estimated Cost				**$ 444,255**

TABLE 7-1 (CONT'D)

Description	Unit	Quantity	Unit Price	Total Cost
Main Canal Lining				
Land	AC	-	$ 1,000	$ -
Earthwork	LF	89,760	$ 5	$ 448,800
Concrete Lining	LF	89,760	$ 70	$ 6,283,200
Crossings	EA	10	$ 6,000	$ 60,000
Grassing	AC	62	$ 1,900	$ 117,800
Subtotal				$ 6,909,800
Engineering				$ 552,784
10% Contingency				$ 690,980
Total Estimated Cost				**$ 8,153,564**
Main Canal Piping				
Land	AC	-	$ 1,000	$ -
Labor & Equipment	LF	21,120	$ 100	$ 2,112,000
9 X 6 Box	LF	21,120	$ 210	$ 4,435,200
Bedding	LF	21,120	$ 10	$ 211,200
Grassing	AC	-	$ 1,900	$ -
Subtotal				$ 6,758,400
Engineering				$ 540,672
10% Contingency				$ 675,840
Total Estimated Cost				**$ 7,974,912**
Main Canal Control & Overflow Structures				
Land	AC	2	$ 1,000	$ 2,000
Structure Valves & Overflow	LS	5	$ 35,000	$ 175,000
Grassing	AC	4	$ 1,900	$ 7,600
Misc. Site work	LS	5	$ 10,000	$ 50,000
Subtotal				$ 234,600
Engineering				$ 18,768
10% Contingency				$ 23,460
Total Estimated Cost				**$ 276,828**

TABLE 7 - 2
Medina Main Dam Gate Repair

Phase 1 -	**Investigative Work and Preliminary Engineering**	
1.1	Phase management and related expenses	$24,000
1.2	Wet side site investigation work including general site management and support activities, soundings, underwater survey of gates and trash grates, geotechnical borings of lake floor, concrete coring of dam wet face and confirmation of dimensions and measurements	$47,000
1.3	Preliminary engineering including: a) Review of investigative materials, preliminary calculations and drawings for isolation structure design alternatives, review of major equipment options, costs and availability b) Review of regulatory requirements and initial contacts with TNRCC Dam Safety Section, Corps of Engineers to review any Section 404 jurisdiction, Texas Department of Fish and Wildlife c) Development of definitive Phase 2 scope-of-work, schedule and final budgets for design alternatives d) Preparation and presentation of above information and resulting recommendations	$34,000
Phase 1 Total		**$105,000**

TABLE 7-2 (CONT'D)

Phase 2 -	**Design Engineering and Construction of Isolation Structure and Restoration of Exiting Wet Side Slide Gates**	
2.1	Phase management and related expenses including bonds and special insurance coverages	$85,000
2.2	Final engineering for isolation structure, its connection system to the wet side dam face, ballast, slide gates, operation deck and controls and electrical including calculations, construction drawings, specifications, final budgets and schedules	$48,000
2.3	Mobilization for construction, site work including temporary storage areas and field office, access improvements, temporary fencing and security measures	$45,000
2.4	Construction and installation of the isolation structure, slide gates and operation deck including fabrication, coatings, cathodic protection system, connection to dam face, caulk system, ballast and controls and electrical and also including associated freight, non-destructive and other testing and associated miscellaneous construction costs	$751,000
2.5	Existing wet side slide gate rehabilitation including repair or replacement of trash guards, removal of gates and recasting and refacing of brass seats, replacing seating wedges, recoating and reinstallation, repair of gate operating stems and retaining brackets, installation of electric operators and controls and electrical	$155,000
Phase 2 Total		**$1,190,000**
Phase 3 -	**Investigation and Assessment of Dam Piping and Outlet Piping, Valves and Associated Structures**	
3.1	Phase management and related expenses and field support activities including some demolition work for access for pipe interior inspection	$54,000
3.2	Outlet (dry) side site investigation work including general site management and support activities, internal inspection of discharge piping through dam, geotechnical borings and testing, and confirmation of dimensions and measurements	$25,000
3.3	Preliminary engineering including review of investigative materials, preliminary calculations, sizing and drawings for discharge piping, valve selection options, review of support structure options, development of definitive Phase 4 scope-of-work, schedule and final budgets and preparation and presentation of recommendations	$18,000
Phase 3 Total		**$97,000**

TABLE 7-2 (CONT'D)

Phase 4 -	**Design Engineering and Construction of Pipe, Valves and Structure Replacement or Restoration**	
4.1	Phase management and related expenses including bonds and special insurance coverages	$65,000
4.2	Final engineering, construction drawings and specifications for design of discharge piping through dam, valve selection and specifications, design of valve and pipe support structures and thrust blocks and final budgets and schedules	$26,000
4.3	Mobilization for construction, site work including temporary storage areas, field office, drainage improvements and access road improvements	$38,000
4.4	Construction and installation of new piping through the dam including connections to existing thimbles, coatings, cathodic protection and grouting, demolition and reconstruction of valve support and operating structures, installation of new valves and discharge pipe sections, construction of supports and thrust blocks, electric operators, controls and electrical and non-destructive and other testing and associated miscellaneous construction costs	$635,000
Phase 4 Total		**$864,000**
Suggested Contingency		$200,000
Total Preliminary Budget		**$2,250,000**

PEARSON LAKE

The irrigation canal system along the Medina River, downstream of Medina Dam, was designed in 1910 with a capacity of 600 cubic feet per second. Its alignment generally follows along the west side of the Medina River past Castroville to a point north of the Southern Pacific Railroad near Pearson. At this location, the canal begins to branch providing irrigation to BMA's farmers.

In order to conserve water left in the canal system at times that irrigation waters are not needed, an off-system reservoir was constructed in the vicinity of Pearson. Water is diverted to the reservoir as the main canal is being turned off and stored until needed at the first of the next irrigation period. This allows the District to conserve water that would otherwise be lost at the end of the irrigation season and fill initial small water orders without filling the entire system prematurely. The dam consists of an earthen embankment structure with a gated outlet. Water is diverted into the reservoir by lowering a gate into the concrete-lined chute which raises the level to a point that it overflows into the twenty-three (23) acre impoundment. The embankment dam is approximately thirty (30) feet tall, ten (10) feet wide at the top, ninety (90) feet wide at the bottom, and seventeen hundred (1700) feet along the crest. Side slopes of the structure are one and a half (horizontal) to one (vertical).

Presently large amounts of water are lost downstream during heavy rainfall events, when the need for irrigation water does not exist. Because of the limited storage capacity of Pearson Lake (approximately 350 acre feet), excess water is lost downstream. With increased storage capacity, this water could be captured and sold at a later date, when there's a demand for water downstream. BMA WCID No. 1 has purchased additional acreage surrounding Pearson Lake so that the lake may be enlarged to have a capacity of 3400 acre-feet of storage. Increasing the storage capacity would assist the District in providing for the increased needs for service downstream and would enable the District to more efficiently impound water during heavy rainfall events. In short, the District will be able to conserve those waters that are currently lost when the system shuts down, and also to be able to provide irrigation waters to the farmer in a shorter time interval because water is stored closer to the farms.

TABLE 7 – 3
PEARSON LAKE DAM - PRELIMINARY CONSTRUCTION COST SCHEDULE
3400 Acre-Foot Capacity

Item No.	Description	3400 Ac-Ft Quantity	Unit	Unit Cost	3400 Ac-Ft Total
1	**Mobilization/Demobilization**-Includes the move in (and out) of all equipment, offices, staff, and posting of all required bonds, insurances in accordance with project contract, plans and specifications.	1	LS	85,000	85,000
2	**Clearing & Grubbing**-Removal of all vegetative cover from excavation and backfill areas and appropriate disposal of waste materials and stockpiling of useable topsoil in accordance with project contract, plans and specifications.	100	Acres	700	70,000
3	**Construction Surveying**-Provide all necessary surveying, construction staking, and as-builts. Services to be performed by licensed registered surveyor in the State of Texas, in accordance with project contract, plans and specifications.	1	LS	---	48,000
4	**Unclassified Excavation-Includes excavation to foundation grade, separation of excavated materials by classification, stockpiling of useable materials and disposal on unusable materials at designated locations in accordance with project contract, plans, and specifications.**	2,500,000	CY	1.25	3,125,000
5	**Liner, Embankment and Select Backfill Construction**-Includes placement, compaction and final grading of all liner, embankment and select backfill materials in accordance with project contract, plans and specifications.	950,000	CY	0.35	332,500
6	**Final Cover/Top Fill Construction**-Includes the placement, grading and compaction of final cover/top fill materials to final grade in accordance with the project contract, plans and specifications.	50,000	CY	1.80	90,000
7	**Primary Outlet Works Construction**-Includes the preparation, installation and completion of all structural appurtenances associated with the outlet works structure in accordance to project contract, plans and specifications.	1	LS	100,000	100,000

TABLE 7 – 3
PEARSON LAKE DAM - PRELIMINARY CONSTRUCTION COST SCHEDULE
3400 Acre-Foot Capacity

Item No.	Description	3400 Ac-Ft Quantity	Unit	Unit Cost	3400 Ac-Ft Total
8	**Primary Outlet Pipe Installation**-Include the preparation, installation and completion of the 48" reinforced concrete pipe including bedding material, pipe placement and backfilling in accordance to project contract, plans and specifications.	600	LF	75	45,000
9	**Primary Outlet Works Energy Dissipation Basin-Includes the preparation, construction, and completion of the energy dissipation basin for the primary outlet works including all associated structural appurtenances in accordance to project contract, plans and specifications.**	1	LS	35,000	35,000
10	**Spillway Construction**-Includes the preparation and construction of all structural appurtenances associated with the Spillway in accordance to project contract, plans and specifications.	1	LS	20,000	20,000
11	**Inlet Works Construction**-Includes the preparation and construction of all features associated with the Inlet structure in accordance to project contract, plans and specifications.	1	LS	45,000	45,000
12	**Diversion Structure Construction**-Includes the preparation and construction of all features associated with the Diversion structure in accordance to project contract, plans and specifications.	1	LS	20,000	20,000
13	**Chimney Filter Construction-Includes the preparation and construction of all features associated with the chimney filter in accordance to project contract, plans and specifications. Includes 4,500 cy fine filter, 1,500 cy coarse filter, and 3000 lf 8" perforated drainage pipe (Sch 40 is adequate).**	3,000	LF	31	93,000
14	**Irrigation Canal Reconstruction**-Includes the preparation and construction of all features associated with the Irrigation Canal Reconstruction in accordance to project contract, plans and specifications.	2,300	LF	52	119,600

TABLE 7 – 3
PEARSON LAKE DAM - PRELIMINARY CONSTRUCTION COST SCHEDULE
3400 Acre-Foot Capacity

Item No.	Description	3400 Ac-Ft Quantity	Unit	Unit Cost	3400 Ac-Ft Total
15	**Drop Structure Reconstruction**-Includes the preparation and construction of all features associated with the Drip structure in accordance to project contract, plans and specifications.	3	LS	10,000	30,000
16	**Embankment Revegetation**-Includes the preparation, placement and establishment of embankment vegetative cover in accordance to project contract, plans and specifications.	60	Acres	700	42,000
17	**Pollution Control**-Includes the installation, maintenance, construction of all features associated with the pollution control measures in accordance to project contract, plans and specifications.	1	LS	10,000	10,000
18	**Waste Area Pollution Control**-Includes the installation, maintenance, construction of all features associated with the pollution control measures in accordance to project contract, plans and specifications.	1	LS	10,000	10,000
19	**Waste Area Revegetation**-Includes the preparation, placement and establishment of waste area vegetative cover in accordance to project contract, plans and specifications.	50	Acres	700	35,000
20	**Construction Oversight**-Includes engineering support, QA/QC, and on-site personnel.	1		4%	174,204

Subtotal	**4,529,304**
Contingency @ 5%	**226,465**
Total	**4,755,769**

PEARSON LAKE WATER TREATMENT PLANT

A water treatment plant site at Pearson Lake has previously been selected by earlier studies. The site offers:

1. A central location between the consumer and the raw water storage facility (Medina Main and Diversion Lakes);
2. BMA owns the property which the treatment facility will be located on, and;
3. The site is presently used as a storage facility for irrigation waters and can be easily adapted to provide flow equalization during peaks and lows.

As previously mentioned, the central Texas region typically receives low amounts of precipitation while having relatively high evapotranspiration rates. These conditions, combined with soils possessing a low permeability rate, result in only small amounts of continuous runoff. Heavy runoff for limited periods during times of intense storms is also representative of the area. The intense groundwater use throughout the region has significantly reduced both the levels of and well pumpage yields from the Edwards Aquifer. This has led to a severe decline of spring flows in recent history which has threatened the habitats of many endangered species of wildlife. These events have increased the public's awareness of the fact that our water resources are limited and the trends of its use is changing. The State's total yield of ground and surface water resources is estimated to be 16 million acre feet per year and are currently 75 to 80 percent developed. Texas has experienced a state-wide decline in the total irrigated acreage (approximately 670,000 acres during the period between 1985 and 1989) while the population has continued to increase, causing a shift in water use from agricultural to municipal and industrial (M&I).

In the past, the Edwards Aquifer has been utilized to satisfy the demands for M&I uses throughout the region, however, the aquifer can only supply a limited amount of water before it is in danger of depletion. Because of the recent decline in Aquifer levels, new regulations have placed restrictions on continued development within the Edwards Underground Aquifer. This change has focused new attention to Medina Lake and its ability to meet this challenge.

The proposed plan of development of the Pearson Lake Water Treatment Plant is to initially serve designated customers by reducing their 1993 pumpage by 25% and serving all new growth through a surface water supply. The water utilized here will be delivered to the well production plants (existing well sites currently pumping out of the Edwards) for distribution through their existing facilities.

Table 7-4 is a summary of the projected connections, customers to be served, WTP capacity and projected water usage. Water Treatment Plant sizing is based on the Texas Natural Resource Conservation Commission's (TNRCC) minimum criteria of 0.6 Gallons Per Minute per Connection, for peak day water needs. Average water usage through the plant, was based on the average daily demand of 390 Gallons per Connection per Day, plus a 10% add on factor for system water loss in the delivery system. The average water use in this situation equates to approximately one-half of the peak day usage requirements.

TABLE 7-4

PROPOSED TREATMENT PLANT CAPACITY

YEAR	TOTAL SERVICE CONNECTIONS (1)	INITIAL SERVICE CONNECTIONS (25% OF TOTAL) (2)	TNRCC CRITERIA FOR CAPACITY (MGD) (3)	AVERAGE WATER USE (MGD) (4)
1995	13,440	3,360	2.90	1.63
2000	14,295	3,574	3.09	1.73
2010	17,400	4,350	3.76	2.11
2015	20,030	5,008	4.33	2.43

1) From Table 1-2
2) From Table 1-2 utilizing 25% of 1993 connections plus an additional 2% annual growth for new connections
3) Projection based on TNRCC criteria of 0.6 Gallons per Minute per Connection for minimum peak day production
4) Projection based on 1993 average usage of 390 Gallons per Connection per Day with 10% water loss through the proposed system.

Based on the projected demands a 4 Million Gallon per Day initial water treatment plant is required to meet the proposed demands. Subsequent plant additions are sized at 2 Million Gallons per Day, and can be added on, as treatment modules.

The initial treatment capacity of 4 MGD will provide system capacity until the year 2015. At this time a 2 MGD module will be required for additional capacity.

On-site storage of approximately seven (7) days has been planned for it to provide flexibility in the operation of the delivery system from Medina Diversion Lake and the Irrigation Canals. Sizing of the treatment units is based on TNRCC criteria for public water system design. Coagulant chemicals of aluminum or iron salts (alum or ferric chloride) and polymers are proposed for sedimentation. The turbidity and sediments will be removed by addition of the coagulant chemicals and settling through an upflow, solids contact clarifier. This unit minimizes process sizing, while saving chemical costs, by its ability to recirculate settled sludge to aid in water treatment. Final treatment will be through mixed media gravity filters to insure thorough treatment performance. Chlorine and ammonia will be used as disinfectants prior to on-site storage of the treated water in a .5 MG clearwell.

BOOSTER PUMP AND GROUND STORAGE FACILITIES

The third stage of the treatment process is the Ground Storage and Booster Pump Station Facilities. Although it is proposed to deliver water to existing users (municipalities and water districts) who already have storage facilities and pumping stations, additional booster pumps and storage facilities are needed

TREATED WATER DELIVERY SYSTEM

Delivery of the water to the individual customers will be through a network of transmission mains. Table 7-5 is a preliminary sizing and description of the proposed transmission main facilities. Sizing is based on delivery of 1 gpm/connection with minimum pressure maintenance of 40 PSI residual. Design year is projected at 2075. Final sizing and location will depend on system requirements. The delivery points to each customer will be to their existing water production facilities. Preliminary sizing is based on $2.5/in-ft and $3/in-ft pipe diameter for 24" and larger and less than 24" pipe sizing. Unit costs include contingency, engineering and survey.

TABLE 7-5

PROPOSED TRANSMISSION MAINS

Description	Size	Unit Cost	Length	Total Cost
Line A - From Pearson to Castroville	20"	$ 60	32,000	$ 1,920,000
Line B - From Castroville to Hondo	16"	$ 48	80,300	$ 3,854,400
Line C - From Hondo To D'Hanis	8'"	$ 24	43,800	$ 1,051,200
Line D - From Castroville to Rio Medina	8"	$ 24	38,600	$ 926,400
Line E - From Pearson to La Coste	8"	$ 24	22,200	$ 532,800
Line F - From Pearson to Natalia	12"	$ 36	31,200	$ 1,123,200
Line G - From Natalia to Lytle	8"	$ 24	17,300	$ 415,200
Line H - From Natalia to Devine	10"	$ 30	21,640	$ 649,200
Line I - From Devine to Yancy	8"	$ 24	76,750	$ 1,842,000
				$ 12,314,400

PROJECT COST

The proposed facilities have been analyzed to prepare a financing plan based on a revenue bond issue. In lieu of the collection of capital recovery fees to retire system capital debt and operational cost, a unit cost per 1000 gallons has been prepared.

Table 7-6 is an estimation of the total costs of the system, which include:

1. Canal Liner for Raw Water Transmission
2. MGD Water Treatment Plant
3. Booster Pumps and Ground Storage Facilities, and
4. Treated Water Delivery System

TABLE 7 - 6

CAPITAL COSTS

I. Canal Liner Reconstruction & Pearson Lake		
Siphon at Flume 6	198,000	
Siphon at Flume 11	445,000	
Main Canal Lining	8,150,000	
Main Canal Piping	7,975,000	
Main Canal Control and Overflow Structure	277,000	
Outlet Structure Repairs	2,250,000	
Pearson Lake	4,750,000	
Total Canal & Lake Cost	24,045,000	
Distributed Cost Between Irrigation and M&I Usage= 20,000/66,000		7,286,364
II. Pearson Water Treatment Plant		
4,700 Customers @ 0.6 GPM/Connection	4,000,000	
= 4 Million Gallons per Day		4,000,000
III. Booster Pump/Ground Storage Facilities		
Pearson Water Treatment Site	1,450,000	
Highway 90 @ Castroville	850,000	
Lytle Booster	150,000	
Devine Booster	215,000	
Devine to Yancy	175,000	
		2,840,000
IV. Treated Water Transmission Mains		
Line A - From Pearson to Castroville	1,920,000	
Line B - From Castroville to Hondo	3,854,400	
Line C - From Hondo To D'Hanis	1,051,200	
Line D - From Castroville to Rio Medina	926,400	
Line E - From Pearson to La Coste	532,800	
Line F - From Pearson to Natalia	1,123,200	
Line G - From Natalia to Lytle	415,200	
Line H - From Natalia to Devine	649,200	
Line I - From Devine to Yancy	1,842,000	
		12,314,400
TOTAL CAPITAL COSTS		26,440,764

TABLE 7-7

OPERATIONAL COSTS

Description	Costs	
Raw Water Costs	0.17	Per 1,000 Gallons
Delivery Costs	0.15	Per 1,000 Gallons
Chemical Costs	0.06	Per 1,000 Gallons
Electric Costs	0.28	Per 1,000 Gallons
Labor Costs	0.75	Per 1,000 Gallons
Other Operational Costs	0.20	Per 1,000 Gallons
Total Operational Costs	$1.61	Per 1,000 Gallons

TABLE 7-8

CAPITAL COSTS PER 1,000 GALLONS

Description	Costs	
Canal Lining	0.49	Per 1,000 Gallons
Pearson WTP	0.27	Per 1,000 Gallons
Booster Pumps & Ground Storage	0.19	Per 1,000 Gallons
Transmission Mains	0.82	Per 1,000 Gallons
Total Operational Costs	$1.77	Per 1,000 Gallons

The total capital and operational costs to deliver water is $3.38 per 1,000 Gallons.

APPENDIX A1

WATER CONSERVATION / DROUGHT CONTINGENCY PLAN

INTRODUCTION

Several areas within Medina County presently practice water conservation under approved Water Conservation Plans. Water conservation in Medina county is necessary to assure adequate supplies of a most valued natural resource. The 69th Texas Legislature passed House Bill (HB) 2 and House Joint Resolution (HJR) 6 in 1986 requiring a Water Conservation Plan and Drought Contingency Plan from political subdivisions seeking financial assistance from the State Water Loan Assistance Fund or the Texas Water Development Board (TWDB). Approved in November of 1985, House Bill 2 became an amendment to the Texas State Constitution. Guidelines for the Water Conservation and Drought Contingency Plan were developed by the Texas Water Development Board.

Planning Area

The planning area will include all of Medina County, Texas. Medina County is located in south-central Texas and is bounded by Bandera County on the north, by Bexar and Atascosa Counties on the east, by Frio County on the south and by Uvalde County on the west. The County has a surface area of 1,331 square miles.

Needs and Goals

According to the 1990 Census, the population of Medina County was approximately 27,312. The population is expected to increase by about two percent (2%) each year. The population is expected to increase to 53,630 by the year 2050. The population is expected to be affected by the migration of people who work in the San Antonio area and will chose to live in these smaller urban areas.

A main focus of the Water Conservation Plan will be education in order to comply with the requirements of House Bill 2 and House Joint Resolution 6. The guidelines established by the Texas Water Development Board were used.

If an adequate reduction in water usage and wastewater requirements is to be accomplished, education of the customers must be achieved. In addition, proper planning, operation and maintenance will also be essential to the Water Conservation Plan. The goals of Medina County will be to cut back on water consumption by five percent (5%) per capita and rescue the amount of unaccounted for water by five percent (5%) within three years of adoption of this plan. These two goals can be reached by the implementation of the outlined planning objectives. If Medina County can achieve these goals, water will be conserved and preserved for service to additional customers without major expenditures to infrastructure.

LONG TERM WATER CONSERVATION PLAN

Planning Objectives

The requirements listed in the Texas Water Development Board Guidelines were followed to prepare this Water Conservation Plan.

Education and Information

Medina County will notify users of various recommended methods for implementing a reduction in water usage. The educational material below will be directed toward residential customers who are the majority of water consumers.

First Year Program

- Educational materials will be distributed to all customers.
- Articles about water conservation and the available educational materials will be placed in the newspaper.
- New customers will be provided with a "Homeowner's Guide to Water Use and Conservation".

Long Term Activities

This program consists of four activities each year after the first year:

- Customers will be sent information on new or innovative means for conserving water.
- Newspaper articles targeting particular household water conservation techniques will be put in local newspapers.
- Mail to customers a pamphlet relating to exterior household usage such as car washing and hours for lawn watering correlating to weather predictions.

- Continued distribution of the Homeowner's Guide to customers.

Leak Detection and Repair

The water meter audits schedule found in this Plan will provide effective leak detection for the County. The TWDB staff can provide assistance in leak detection surveys. The agency has portable leak detectors available for loan. Also, personnel can be available demonstrate the equipment.

Unaccounted for water will be reduced by five percent (5%) within three years after adoption of this plan. If unaccounted water cannot be reduced five percent (5%) or more within three years, the plan will be amended to include more proactive measures.

Water Conservation Landscaping

Information concerning low water use landscaping will be distributed. Builders and developers will be provided with this information at the time building permits are acquired. Local nurseries will also receive the same educational literature.

Plumbing Codes

Builders, developers, plumbers and municipalities will be encouraged to adopt and use water conservation fixtures in new construction and remodeling projects including recirculation equipment for swimming pools and insulated hot water piping. Those entities will be provided with water conservation literature and examples of plumbing fixture standards. Municipalities will be encouraged to adopt these requirements as part of their plumbing codes.

Recycling and Reuse

Industrial customers within the County will be contacted to determine if reuse and recycling are being employed. Industrial customers will be encouraged to begin recycling programs if they do not already have one.

Retrofit Program

Customers in existing buildings that do not have water saving devices will be encouraged to replace their old plumbing fixtures. Through the pamphlet mailout system and newspaper articles, customers will be advised of low water demand items. The local plumbing suppliers will be asked to stock low water use fixtures.

Conservation Water Rate Structure

The water rate structure that will be adopted will encourage water conservation by increasing the amount paid for increasing water use.

Meter Repair and Replacement

All meters that appear to have an abnormally high or low water usage will be tested. The following meter testing schedule will be set up:

- Production Meter - Test once every two (2) years;
- Meters Large than one inch (1") - Test once every five (5) years;
- Meters one inch (1") and smaller - Test once every ten (10) years.

All meters will be replaced each fifteen (15) / 1,000,000 gallons, or at the warranty period expiration.

Implementing and Enforcement

Enforcement will be furnished by:

- Current water rates will be examined and the rates adjusted to eliminate Conservation Plan abuse.
- Customers who do not meet requirements for Water Conservation fixtures will not be given taps until they conform to the water conservation requirements in each city's plumbing codes.
- Customers who do not pay their water bills will have prompt discontinuation of service. Disconnection of service shall follow.

Contracts With Other Political Subdivisions

A wholesale customer or political subdivision contracting for water in Medina County must officially adopt applicable provisions of the Medina County Water Conservation and Drought Contingency Plan and approved Texas Water Development Board Water Conservation and Drought Contingency Plan.

Annual Reporting

A report will be filed with the Executive Director of the Texas Water Development Board each year within sixty (60) days of the anniversary date of the loan closing. This report will address the progress and effectiveness of the Water Conservation Plan. This report will include the following:

- Progress in Conservation Plan Implementation;
- Response by public to Plan implementation;
- Effectiveness with of the Plan with references to reduction in customer per capita use;
- List of information released during the year to the customers.

DROUGHT CONTINGENCY PLAN

Threshold Condition

In the guidelines that the Texas Water Development Board provided there are three (3) levels of conditions for determining the degree of urgency for initiation of the Drought Contingency Plan.

Mild Drought Conditions

- Average daily water consumption reaches one hundred percent (100%) of rated production capacity for a three (3) day period.
- Ninety percent (90%) consumption spans a period of three (3) days. Drought classification determined for weather conditions - long or cold dry periods are to be considered in the impact analysis.

Moderate Drought Conditions

- Average daily water consumption reaches one hundred percent (100%) for rated production capacity for a three (3) day period.
- Weather conditions indicate mild drought conditions will exist for five (5) days or more.
- A ground storage tank or one clear well is taken out of service during mild drought conditions.
- Storage capacity is not being maintained during the period of one hundred percent (100%) rated production period.
- Existence of any one (1) listed condition for a duration of thirty-six (36) hours.

Severe Drought Conditions

- Average daily water consumption reaches one hundred and ten percent (110%) of production capacity.
- Average daily water consumption will not enable storage levels to be maintained.
- System demands exceed available high service pump capacity.
- Any two (2) conditions listed in the moderate drought classification occurs at the same time for a twenty-four (24) hour period.
- Water system is contaminated either accidentally or intentionally.
- Water system fails due to an act of nature or man.

Drought Contingency Measures

The Water Conservation and Drought Contingency Ordinance, adopted and included in this Plan, will enable Medina County to initiate action. The following steps are recommended:

<u>Step One</u>

Step One measures are enacted during mild drought conditions and consist of the following listed actions.

- Develop Information Center and designate an information person;
- Advise public of condition and publicize availability of information from the Information Center;
- Encourage voluntary reduction of water use;
- Contact commercial and industrial users and explain necessity for the initiation of strict conservation methods;
- Implementation of system oversight and make adjustments as required to meet changing conditions.

<u>Step Two</u>

Step Two measures are enacted during moderate drought conditions. Listed action is compulsory on users and is intended to prohibit water waste. Water waste is defined as: washing house windows, sidings, eaves and roof with a hose, without the use of a bucket; washing driveway, streets, curbs and gutters, washing vehicles without cutoff valve and bucket and unattended sprinkler, draining and filling swimming pools and flushing water system.

- Outdoor residential use of water will be permitted on alternate days; even numbered houses on even numbered days of the month and odd numbered houses on odd numbered days.

Outdoor residential uses consist of washing vehicles, boats, trailers, landscape sprinkler systems and irrigation, recreational use of sprinkler, etc.;

- Visitation of commercial and industrial use will take place to ensure volunteered conservation is being executed;
- Hours will be determined for outside water use based on monitor system functions and system performance;
- Public shall stay advised via the Information Center on curtailment status.

Step Three

Step Three curtailment measures are enacted during severe drought conditions. Ban of the following for water use will be imposed:

- Window washing, vehicle washing, outside watering, faucet dripping, etc.;
- Non essential public uses which are not vital to health; filling pools, dust control, fire hydrant flushing, watering of athletic fields;
- Industrial and commercial uses not listed will be related to the degree;
- Businesses demanding water as a main function of the business, such as car washes, laundromats, nurseries, etc. must receive written permission.

The users in order of priority are as follows:

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

Education and Information

The public will be made aware of the conservation actions needed by information and data transfer through the County's annual program. During the first year, the most effective methods for getting information to the customers will be determined. Radio coverage, posting notices, newspaper articles and direct mail to the customers will be utilized during the first year activities.

Initiation Procedures

The County will initiate each action deemed necessary based on the current conditions. The actions which will be taken in each phase are listed in the Plan. The County will initiate curtailment by giving notice to the public and implementing the steps of curtailment.

Curtailment Termination

Termination of the separate drought phases will begin when that specific condition has been improved to the level that an upgraded condition can be declared. This process will continue until full service can be restored. System priority will be considered in return to upgraded condition.

Modification, Deletion and Amendment

The County has the ability to add, delete and amend rules, regulations and implementations as needed.

Means of Implementation

Utilization of this Plan, the Drought Contingency Ordinance and modification of individual city Plumbing Code Ordinances will enable the County to implement and carry out enforcement of enacted ordinances to conserve the County's water resources.

APPENDIX A2
UTILITY EVALUATION

A. Population of Service Area: 30,000 (According to Medina County Courthouse estimate for 1995)

B. Area of Service Area: 1,331 $mi.^2$

C. Number and Type of Connections in Service Area:

D. Rate of New Connection Additions per Year: Approximately

E. Water Use Information:

1. Water Production in 1996:
2. Annual Average Water Production for the Last Two (2) Years:
3. Monthly Average Water Production for the Last Two (2) Years:
4. Monthly Water Sales for the Period January 1996 through December 1996:

Month	Water Sold (Gallons)
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Total	

5. Average Daily Water Use:
6. Peak Daily Use (Monthly Avg. X 1.8/30):
7. Peak to Average Use Ratio (Avg. Daily Summer Use / Avg. Annual Daily Use):
8. Unaccounted for Water (% of Water Population):

F. Dependable Annual Yield of Water Supply:

G. Peak Daily Capacity of Water System:

H. Major High Volume Customers:

I. Population and Water Use Projections:

Year	Daily Avg. (Gal.)	Daily Max. (Gal.)	Meters
1996			
2000			
2005			

J. Percent of Connections in System Metered:

K. 1996 Budgeted Annual Revenues from Water Sales:

L. 1996 Budgeted Annual Revenue Non-Rate Derived Sources:

M. 1996 Budgeted Annual Cost of Operation:

N. Applicable Local Regulations:

Those areas of the system which are within the jurisdiction of municipalities are subject to the local ordinances governing utilities which are in force.

O. Applicable State, Federal or Other Regulations:

As a public water supply, Medina County must abide by the rules of the following agencies:

1. Texas Natural Resource Conservation Commission
2. USDA - Farmer's Home Administration

APPENDIX B

SIMYLD – II ANALYSIS / SUMMARY OF RESULTS

TABLES B-1

WITHOUT IRRIGATION CONSERVATION
WITHOUT ASR
WITHOUT PEARSON LAKE

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

NUMBER OF MONTHS WITH SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
			.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
6	BANDCO R	2068	588.	2.	1.	1.	5.	0.	1.	0.	1.	1.	0.	12.
8	BMWA1995	6000	562.	1.	1.	0.	0.	1.	1.	3.	2.	2.	27.	38.
9	BMWA1991	5574	411.	0.	0.	0.	0.	0.	0.	0.	0.	0.	189.	189.
10	BMA IRRI	VARIES	526.	1.	0.	0.	0.	0.	1.	1.	0.	1.	70.	74.
11	MEDINACO	3400	600.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	BANDCO L	3102	574.	0.	1.	1.	3.	2.	0.	2.	2.	1.	14.	26.

DEMAND FAILURE PROBABILITIES FOR SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
			.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
6	BANDCO R	2068	98.0	.3	.2	.2	.8	.0	.2	.0	.2	.2	.0	2.0
8	BMWA1995	6000	93.7	.2	.2	.0	.0	.2	.2	.5	.3	.3	4.5	6.3
9	BMWA1991	5574	68.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	31.5	31.5
10	BMA IRRI	VARIES	87.7	.2	.0	.0	.0	.0	.2	.2	.0	.2	11.7	12.3
11	MEDINACO	3400	100.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
12	BANDCO L	3102	95.7	.0	.2	.2	.5	.3	.0	.3	.3	.2	2.3	4.3

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 1 MEDINA L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	254823	0	63294	0	16305	0	199038
2	199038	0	51149	0	11044	113589	238580
3	238580	0	54885	0	11070	1782	235761
4	235761	0	63060	0	20768	0	140482
5	140482	0	54727	0	12771	0	148167
6	148167	0	54813	0	19285	0	144966
7	144966	0	61530	0	7953	0	111416
8	111416	0	58684	0	17215	0	78144
9	78144	0	56719	5221	5544	0	0
10	0	0	53699	5572	2188	0	9836
11	9836	0	59506	30120	436	0	0
12	0	0	58344	34914	240	0	0
13	0	0	59302	30438	193	0	0
14	0	0	59753	35571	459	0	6021
15	6021	0	57460	45362	161	0	0
16	0	0	56757	43672	17	0	0
17	0	0	55768	54444	16	0	0
18	0	0	48543	7229	5581	0	107918
19	107918	0	48864	0	6063	108363	254823
20	254823	0	55067	0	9931	2748	243036
21	243036	0	54396	0	12439	5312	254822
22	254822	0	54333	0	15260	56635	214138
23	214138	0	62190	0	15293	0	106730
24	106730	0	57686	3533	7039	0	7076
25	7076	0	49962	22167	1504	0	53682
26	53682	0	54197	4363	5586	0	44784
27	44784	0	56332	5572	3575	0	31629
28	31629	0	62137	24570	1758	0	20738
29	20738	0	52037	1103	9913	0	104193
30	104193	0	53763	1583	3949	0	103010
31	103010	0	55344	0	12418	0	88722
32	88722	0	47995	2831	6308	16827	254823
33	254823	0	54332	0	14272	38564	235447
34	235447	0	48787	0	2903	242761	254823
35	254823	0	54396	0	15037	14732	254823
36	254823	0	51807	0	16672	145549	229110
37	229110	0	53718	0	6947	25702	254823
38	254823	0	53219	0	20382	94009	218688
39	218688	0	51433	0	11584	105779	254823
40	254823	0	51985	0	15688	145709	222954
41	222954	0	58898	0	17158	0	183941
42	183941	0	48925	0	10216	177201	254823
43	254823	0	63023	0	18681	895	195730
44	195730	0	63414	0	12635	0	116569
45	116569	0	59640	2998	11283	0	37274
46	37274	0	52924	1103	7516	0	87843
47	87843	0	51787	0	5291	0	230814
48	230814	0	46014	0	11426	357703	242736
49	242736	0	62971	0	24967	0	178982
50	178982	0	62454	0	16394	0	79395
PERIOD TOTALS		0	2782023	362366	481334	1653860	
PERIOD AVERAGES		0	55640	7247	9626	33077	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 2 DIVRSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	1506	957	60194	0	346	0	1506
2	1506	731	48049	0	219	0	1506
3	1506	1163	51785	0	225	0	1506
4	1506	78	59960	0	473	0	1506
5	1506	302	51627	0	329	0	1506
6	1506	817	51713	0	473	0	1506
7	1506	1487	58430	0	261	0	1506
8	1506	115	55584	0	594	0	1506
9	1506	118	53619	5221	478	0	659
10	659	438	50599	5572	247	0	1506
11	1506	129	56406	30120	109	0	0
12	0	164	55244	34503	91	0	0
13	0	436	56202	30012	98	0	0
14	0	329	56653	35273	107	0	1506
15	1506	79	54360	43937	80	0	0
16	0	80	53657	43133	0	0	0
17	0	34	52668	53144	0	0	0
18	0	1990	45443	6897	255	0	1506
19	1506	1258	45764	0	109	0	1506
20	1506	294	51967	0	197	0	1506
21	1506	449	51296	0	258	0	1506
22	1506	136	51233	0	305	0	1506
23	1506	60	59090	0	412	0	1506
24	1506	46	54586	3533	458	0	1506
25	1506	686	46862	21893	137	0	1506
26	1506	1523	51097	4363	292	0	1506
27	1506	69	53232	5572	320	0	1506
28	1506	391	59037	24015	237	0	1506
29	1506	1095	48937	1103	303	0	1506
30	1506	353	50663	1583	189	0	1506
31	1506	410	52244	0	424	0	1506
32	1506	257	44895	2831	302	0	1506
33	1506	2515	51232	0	280	0	1506
34	1506	3432	45687	0	65	0	1506
35	1506	1358	51296	0	295	0	1506
36	1506	1033	48707	0	327	0	1506
37	1506	1011	50618	0	145	0	1506
38	1506	1192	50119	0	408	0	1506
39	1506	594	48333	0	268	0	1506
40	1506	1479	48885	0	311	0	1506
41	1506	262	55798	0	406	0	1506
42	1506	1802	45825	0	203	0	1506
43	1506	719	59923	0	380	0	1506
44	1506	269	60314	0	346	0	1506
45	1506	185	56540	2998	551	0	1506
46	1506	1524	49824	1103	302	0	1506
47	1506	2570	48687	0	224	0	1506
48	1506	4266	42914	0	225	0	1506
49	1506	223	59871	0	538	0	1506
50	1506	39	59354	0	506	0	1506
PERIOD TOTALS		40947	2627023	356806	14108	0	
PERIOD AVERAGES		818	52540	7136	282	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 3 PEARSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	19936	0	0	0	0
2	0	0	16718	0	0	0	0
3	0	0	17830	0	0	0	0
4	0	0	19884	0	0	0	0
5	0	0	17785	0	0	0	0
6	0	0	17808	0	0	0	0
7	0	0	19536	0	0	0	0
8	0	0	18849	0	0	0	0
9	0	0	19633	0	0	0	0
10	0	0	18995	0	0	0	0
11	0	0	20960	11852	0	0	0
12	0	0	20923	13187	0	0	0
13	0	0	20976	11383	0	0	0
14	0	0	21016	12612	0	0	0
15	0	0	20717	14478	0	0	0
16	0	0	20747	15690	0	0	0
17	0	0	20595	17196	0	0	0
18	0	0	17349	906	0	0	0
19	0	0	15984	0	0	0	0
20	0	0	17882	0	0	0	0
21	0	0	17691	0	0	0	0
22	0	0	17672	0	0	0	0
23	0	0	19691	0	0	0	0
24	0	0	19466	0	0	0	0
25	0	0	18522	8151	0	0	0
26	0	0	18816	0	0	0	0
27	0	0	19624	0	0	0	0
28	0	0	21153	7812	0	0	0
29	0	0	17322	0	0	0	0
30	0	0	17959	0	0	0	0
31	0	0	17959	0	0	0	0
32	0	0	16616	0	0	0	0
33	0	0	17671	0	0	0	0
34	0	0	15959	0	0	0	0
35	0	0	17691	0	0	0	0
36	0	0	16921	0	0	0	0
37	0	0	17492	0	0	0	0
38	0	0	17346	0	0	0	0
39	0	0	16807	0	0	0	0
40	0	0	16976	0	0	0	0
41	0	0	18902	0	0	0	0
42	0	0	16004	0	0	0	0
43	0	0	19875	0	0	0	0
44	0	0	19962	0	0	0	0
45	0	0	19790	0	0	0	0
46	0	0	17583	0	0	0	0
47	0	0	16914	0	0	0	0
48	0	0	15010	0	0	0	0
49	0	0	19864	0	0	0	0
50	0	0	19749	0	0	0	0
PERIOD TOTALS		0	927130	113267	0	0	
PERIOD AVERAGES		0	18542	2265	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 4 ASR PROJ

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
PERIOD TOTALS		0	0	0	0	0	
PERIOD AVERAGES		0	0	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 5 GROUNDWT

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	4000	0	0	0	0	0	4000
2	4000	0	0	0	0	0	4000
3	4000	0	0	0	0	0	4000
4	4000	0	0	0	0	0	4000
5	4000	0	0	0	0	0	4000
6	4000	0	0	0	0	0	4000
7	4000	0	0	0	0	0	4000
8	4000	0	0	0	0	0	4000
9	4000	0	0	0	0	0	4000
10	4000	0	0	0	0	0	4000
11	4000	0	2155	0	0	0	1845
12	1845	2155	2777	0	0	0	1223
13	1223	2777	2452	0	0	0	1548
14	1548	2452	2185	0	0	0	1815
15	1815	2185	2679	0	0	0	1321
16	1321	2679	3399	0	0	0	601
17	601	3399	3399	0	0	0	601
18	601	3399	428	0	0	0	3572
19	3572	428	0	0	0	0	4000
20	4000	0	0	0	0	0	4000
21	4000	0	0	0	0	0	4000
22	4000	0	0	0	0	0	4000
23	4000	0	0	0	0	0	4000
24	4000	0	0	0	0	0	4000
25	4000	0	1451	0	0	0	2549
26	2549	1451	0	0	0	0	4000
27	4000	0	0	0	0	0	4000
28	4000	0	1155	0	0	0	2845
29	2845	1155	0	0	0	0	4000
30	4000	0	0	0	0	0	4000
31	4000	0	0	0	0	0	4000
32	4000	0	0	0	0	0	4000
33	4000	0	0	0	0	0	4000
34	4000	0	0	0	0	0	4000
35	4000	0	0	0	0	0	4000
36	4000	0	0	0	0	0	4000
37	4000	0	0	0	0	0	4000
38	4000	0	0	0	0	0	4000
39	4000	0	0	0	0	0	4000
40	4000	0	0	0	0	0	4000
41	4000	0	0	0	0	0	4000
42	4000	0	0	0	0	0	4000
43	4000	0	0	0	0	0	4000
44	4000	0	0	0	0	0	4000
45	4000	0	0	0	0	0	4000
46	4000	0	0	0	0	0	4000
47	4000	0	0	0	0	0	4000
48	4000	0	0	0	0	0	4000
49	4000	0	0	0	0	0	4000
50	4000	0	0	0	0	0	4000
PERIOD TOTALS		22080	22080	0	0	0	
PERIOD AVERAGES		441	441	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 6 BANDCO R

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	88206	2068	0	0	0	0
2	0	280700	2068	0	0	0	0
3	0	129781	2068	0	0	0	0
4	0	52471	2068	0	0	0	0
5	0	135945	2068	0	0	0	0
6	0	132321	2068	0	0	0	0
7	0	93033	2068	0	0	0	0
8	0	100863	2068	0	0	0	0
9	0	28201	2068	0	0	0	0
10	0	99238	2068	0	0	0	0
11	0	36968	2068	0	0	0	0
12	0	33095	2068	0	0	0	0
13	0	38081	2068	148	0	0	0
14	0	45448	2068	67	0	0	0
15	0	15085	2068	171	0	0	0
16	0	17246	2068	0	0	0	0
17	0	5140	2068	391	0	0	0
18	0	196689	2068	44	0	0	0
19	0	373403	2068	0	0	0	0
20	0	122193	2068	0	0	0	0
21	0	149458	2068	0	0	0	0
22	0	151894	2068	0	0	0	0
23	0	31876	2068	18	0	0	0
24	0	14396	2068	0	0	0	0
25	0	104311	2068	0	0	0	0
26	0	101197	2068	0	0	0	0
27	0	92017	2068	0	0	0	0
28	0	60202	2068	0	0	0	0
29	0	200136	2068	0	0	0	0
30	0	111118	2068	0	0	0	0
31	0	111168	2068	0	0	0	0
32	0	293824	2068	0	0	0	0
33	0	151925	2068	0	0	0	0
34	0	376657	2068	0	0	0	0
35	0	149540	2068	0	0	0	0
36	0	254094	2068	0	0	0	0
37	0	176836	2068	0	0	0	0
38	0	196868	2068	0	0	0	0
39	0	269262	2068	0	0	0	0
40	0	246755	2068	0	0	0	0
41	0	100276	2068	0	0	0	0
42	0	370983	2068	0	0	0	0
43	0	88939	2068	0	0	0	0
44	0	58203	2068	0	0	0	0
45	0	44188	2068	0	0	0	0
46	0	164261	2068	0	0	0	0
47	0	254878	2068	0	0	0	0
48	0	489532	2068	0	0	0	0
49	0	89087	2068	0	0	0	0
50	0	39287	2068	0	0	0	0
PERIOD TOTALS		6967275	103400	839	0	0	
PERIOD AVERAGES		139345	2068	16	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 7 DIV LEAK

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	12540	0	0	0	0
2	0	0	12539	0	0	0	0
3	0	0	12540	0	0	0	0
4	0	0	12540	0	0	0	0
5	0	0	12540	0	0	0	0
6	0	0	12540	0	0	0	0
7	0	0	12540	0	0	0	0
8	0	0	12540	0	0	0	0
9	0	0	9604	0	0	0	0
10	0	0	5562	0	0	0	0
11	0	0	2284	0	0	0	0
12	0	0	827	0	0	0	0
13	0	0	433	0	0	0	0
14	0	0	1373	0	0	0	0
15	0	0	893	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	8866	0	0	0	0
19	0	0	12539	0	0	0	0
20	0	0	12540	0	0	0	0
21	0	0	12540	0	0	0	0
22	0	0	12540	0	0	0	0
23	0	0	12540	0	0	0	0
24	0	0	10574	0	0	0	0
25	0	0	5006	0	0	0	0
26	0	0	12540	0	0	0	0
27	0	0	10053	0	0	0	0
28	0	0	4767	0	0	0	0
29	0	0	12065	0	0	0	0
30	0	0	12540	0	0	0	0
31	0	0	12540	0	0	0	0
32	0	0	12413	0	0	0	0
33	0	0	12540	0	0	0	0
34	0	0	12537	0	0	0	0
35	0	0	12540	0	0	0	0
36	0	0	12540	0	0	0	0
37	0	0	12539	0	0	0	0
38	0	0	12540	0	0	0	0
39	0	0	12540	0	0	0	0
40	0	0	12540	0	0	0	0
41	0	0	12540	0	0	0	0
42	0	0	12539	0	0	0	0
43	0	0	12540	0	0	0	0
44	0	0	12540	0	0	0	0
45	0	0	11668	0	0	0	0
46	0	0	12408	0	0	0	0
47	0	0	12540	0	0	0	0
48	0	0	12540	0	0	0	0
49	0	0	12540	0	0	0	0
50	0	0	12540	0	0	0	0
PERIOD TOTALS		0	510069	0	0	0	
PERIOD AVERAGES		0	10201	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 8 BMWA1995

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	6000	0	0	0	0
2	0	0	6000	0	0	0	0
3	0	0	6000	0	0	0	0
4	0	0	6000	0	0	0	0
5	0	0	6000	0	0	0	0
6	0	0	6000	0	0	0	0
7	0	0	6000	0	0	0	0
8	0	0	6000	0	0	0	0
9	0	0	6000	0	0	0	0
10	0	0	6000	0	0	0	0
11	0	0	6000	427	0	0	0
12	0	0	6000	1577	0	0	0
13	0	0	6000	1218	0	0	0
14	0	0	6000	1545	0	0	0
15	0	0	6000	3150	0	0	0
16	0	0	6000	2408	0	0	0
17	0	0	6000	4499	0	0	0
18	0	0	6000	726	0	0	0
19	0	0	6000	0	0	0	0
20	0	0	6000	0	0	0	0
21	0	0	6000	0	0	0	0
22	0	0	6000	0	0	0	0
23	0	0	6000	0	0	0	0
24	0	0	6000	0	0	0	0
25	0	0	6000	726	0	0	0
26	0	0	6000	0	0	0	0
27	0	0	6000	0	0	0	0
28	0	0	6000	1447	0	0	0
29	0	0	6000	0	0	0	0
30	0	0	6000	0	0	0	0
31	0	0	6000	0	0	0	0
32	0	0	6000	0	0	0	0
33	0	0	6000	0	0	0	0
34	0	0	6000	0	0	0	0
35	0	0	6000	0	0	0	0
36	0	0	6000	0	0	0	0
37	0	0	6000	0	0	0	0
38	0	0	6000	0	0	0	0
39	0	0	6000	0	0	0	0
40	0	0	6000	0	0	0	0
41	0	0	6000	0	0	0	0
42	0	0	6000	0	0	0	0
43	0	0	6000	0	0	0	0
44	0	0	6000	0	0	0	0
45	0	0	6000	0	0	0	0
46	0	0	6000	0	0	0	0
47	0	0	6000	0	0	0	0
48	0	0	6000	0	0	0	0
49	0	0	6000	0	0	0	0
50	0	0	6000	0	0	0	0
PERIOD TOTALS		0	300000	17723	0	0	
PERIOD AVERAGES		0	6000	354	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 9 BMWA1991

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	5572	0	0	0	0
2	0	0	5572	0	0	0	0
3	0	0	5572	0	0	0	0
4	0	0	5572	0	0	0	0
5	0	0	5572	0	0	0	0
6	0	0	5572	0	0	0	0
7	0	0	5572	0	0	0	0
8	0	0	5572	0	0	0	0
9	0	0	5572	5221	0	0	0
10	0	0	5572	5572	0	0	0
11	0	0	5572	5572	0	0	0
12	0	0	5572	5572	0	0	0
13	0	0	5572	5572	0	0	0
14	0	0	5572	5572	0	0	0
15	0	0	5572	5572	0	0	0
16	0	0	5572	5572	0	0	0
17	0	0	5572	5572	0	0	0
18	0	0	5572	4157	0	0	0
19	0	0	5572	0	0	0	0
20	0	0	5572	0	0	0	0
21	0	0	5572	0	0	0	0
22	0	0	5572	0	0	0	0
23	0	0	5572	0	0	0	0
24	0	0	5572	3533	0	0	0
25	0	0	5572	5572	0	0	0
26	0	0	5572	4363	0	0	0
27	0	0	5572	5572	0	0	0
28	0	0	5572	5572	0	0	0
29	0	0	5572	1103	0	0	0
30	0	0	5572	1583	0	0	0
31	0	0	5572	0	0	0	0
32	0	0	5572	2831	0	0	0
33	0	0	5572	0	0	0	0
34	0	0	5572	0	0	0	0
35	0	0	5572	0	0	0	0
36	0	0	5572	0	0	0	0
37	0	0	5572	0	0	0	0
38	0	0	5572	0	0	0	0
39	0	0	5572	0	0	0	0
40	0	0	5572	0	0	0	0
41	0	0	5572	0	0	0	0
42	0	0	5572	0	0	0	0
43	0	0	5572	0	0	0	0
44	0	0	5572	0	0	0	0
45	0	0	5572	2998	0	0	0
46	0	0	5572	1103	0	0	0
47	0	0	5572	0	0	0	0
48	0	0	5572	0	0	0	0
49	0	0	5572	0	0	0	0
50	0	0	5572	0	0	0	0
PERIOD TOTALS		0	278600	88184	0	0	
PERIOD AVERAGES		0	5572	1763	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 10 BMA IRRI

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	NET USEAGE	HIST USEAGE
1	0	0	16537	0	0	16537	16536
2	0	0	13319	0	0	13319	13319
3	0	0	14431	0	0	14431	14430
4	0	0	16485	0	0	16485	18767
5	0	0	14386	0	0	14386	14386
6	0	0	14409	0	0	14409	14411
7	0	0	16137	0	0	16137	16139
8	0	0	15450	0	0	15450	15449
9	0	0	16234	0	0	16234	19576
10	0	0	15596	0	0	15596	15596
11	0	0	17561	11852	0	5709	19349
12	0	0	17524	13187	0	4337	19459
13	0	0	17577	11383	0	6194	19316
14	0	0	17617	12612	0	5005	19060
15	0	0	17318	14478	0	2840	19776
16	0	0	17348	15690	0	1658	19754
17	0	0	17196	17196	0	0	19816
18	0	0	13950	906	0	13044	13949
19	0	0	12585	0	0	12585	12585
20	0	0	14483	0	0	14483	14483
21	0	0	14292	0	0	14292	14290
22	0	0	14273	0	0	14273	14273
23	0	0	16292	0	0	16292	19490
24	0	0	16067	0	0	16067	19782
25	0	0	15123	8151	0	6972	15125
26	0	0	15417	0	0	15417	15417
27	0	0	16225	0	0	16225	16225
28	0	0	17754	7812	0	9942	18389
29	0	0	13923	0	0	13923	13924
30	0	0	14560	0	0	14560	14559
31	0	0	14560	0	0	14560	14559
32	0	0	13217	0	0	13217	13217
33	0	0	14272	0	0	14272	14272
34	0	0	12560	0	0	12560	12558
35	0	0	14292	0	0	14292	14290
36	0	0	13522	0	0	13522	13522
37	0	0	14093	0	0	14093	14094
38	0	0	13947	0	0	13947	13948
39	0	0	13408	0	0	13408	13407
40	0	0	13577	0	0	13577	13577
41	0	0	15503	0	0	15503	15502
42	0	0	12605	0	0	12605	12604
43	0	0	16476	0	0	16476	16477
44	0	0	16563	0	0	16563	18493
45	0	0	16391	0	0	16391	19107
46	0	0	14184	0	0	14184	14185
47	0	0	13515	0	0	13515	13516
48	0	0	11611	0	0	11611	11611
49	0	0	16465	0	0	16465	16465
50	0	0	16350	0	0	16350	19277
PERIOD TOTALS		0	757180	113267	0	643913	792311
PERIOD AVERAGES		0	15143	2265	0	12878	15846

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 11 MEDINACO

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3399	0	0	0	0
2	0	0	3399	0	0	0	0
3	0	0	3399	0	0	0	0
4	0	0	3399	0	0	0	0
5	0	0	3399	0	0	0	0
6	0	0	3399	0	0	0	0
7	0	0	3399	0	0	0	0
8	0	0	3399	0	0	0	0
9	0	0	3399	0	0	0	0
10	0	0	3399	0	0	0	0
11	0	0	3399	0	0	0	0
12	0	0	3399	0	0	0	0
13	0	0	3399	0	0	0	0
14	0	0	3399	0	0	0	0
15	0	0	3399	0	0	0	0
16	0	0	3399	0	0	0	0
17	0	0	3399	0	0	0	0
18	0	0	3399	0	0	0	0
19	0	0	3399	0	0	0	0
20	0	0	3399	0	0	0	0
21	0	0	3399	0	0	0	0
22	0	0	3399	0	0	0	0
23	0	0	3399	0	0	0	0
24	0	0	3399	0	0	0	0
25	0	0	3399	0	0	0	0
26	0	0	3399	0	0	0	0
27	0	0	3399	0	0	0	0
28	0	0	3399	0	0	0	0
29	0	0	3399	0	0	0	0
30	0	0	3399	0	0	0	0
31	0	0	3399	0	0	0	0
32	0	0	3399	0	0	0	0
33	0	0	3399	0	0	0	0
34	0	0	3399	0	0	0	0
35	0	0	3399	0	0	0	0
36	0	0	3399	0	0	0	0
37	0	0	3399	0	0	0	0
38	0	0	3399	0	0	0	0
39	0	0	3399	0	0	0	0
40	0	0	3399	0	0	0	0
41	0	0	3399	0	0	0	0
42	0	0	3399	0	0	0	0
43	0	0	3399	0	0	0	0
44	0	0	3399	0	0	0	0
45	0	0	3399	0	0	0	0
46	0	0	3399	0	0	0	0
47	0	0	3399	0	0	0	0
48	0	0	3399	0	0	0	0
49	0	0	3399	0	0	0	0
50	0	0	3399	0	0	0	0
PERIOD TOTALS		0	169950	0	0	0	
PERIOD AVERAGES		0	3399	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 12 BANDCO L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3100	0	0	0	0
2	0	0	3100	0	0	0	0
3	0	0	3100	0	0	0	0
4	0	0	3100	0	0	0	0
5	0	0	3100	0	0	0	0
6	0	0	3100	0	0	0	0
7	0	0	3100	0	0	0	0
8	0	0	3100	0	0	0	0
9	0	0	3100	0	0	0	0
10	0	0	3100	0	0	0	0
11	0	0	3100	0	0	0	0
12	0	0	3100	411	0	0	0
13	0	0	3100	426	0	0	0
14	0	0	3100	298	0	0	0
15	0	0	3100	1425	0	0	0
16	0	0	3100	539	0	0	0
17	0	0	3100	1300	0	0	0
18	0	0	3100	332	0	0	0
19	0	0	3100	0	0	0	0
20	0	0	3100	0	0	0	0
21	0	0	3100	0	0	0	0
22	0	0	3100	0	0	0	0
23	0	0	3100	0	0	0	0
24	0	0	3100	0	0	0	0
25	0	0	3100	274	0	0	0
26	0	0	3100	0	0	0	0
27	0	0	3100	0	0	0	0
28	0	0	3100	555	0	0	0
29	0	0	3100	0	0	0	0
30	0	0	3100	0	0	0	0
31	0	0	3100	0	0	0	0
32	0	0	3100	0	0	0	0
33	0	0	3100	0	0	0	0
34	0	0	3100	0	0	0	0
35	0	0	3100	0	0	0	0
36	0	0	3100	0	0	0	0
37	0	0	3100	0	0	0	0
38	0	0	3100	0	0	0	0
39	0	0	3100	0	0	0	0
40	0	0	3100	0	0	0	0
41	0	0	3100	0	0	0	0
42	0	0	3100	0	0	0	0
43	0	0	3100	0	0	0	0
44	0	0	3100	0	0	0	0
45	0	0	3100	0	0	0	0
46	0	0	3100	0	0	0	0
47	0	0	3100	0	0	0	0
48	0	0	3100	0	0	0	0
49	0	0	3100	0	0	0	0
50	0	0	3100	0	0	0	0
PERIOD TOTALS		0	155000	5560	0	0	
PERIOD AVERAGES		0	3100	111	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @919 W/O CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 13 CAN LOSS

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	28686	0	0	0	0
2	0	0	19759	0	0	0	0
3	0	0	22383	0	0	0	0
4	0	0	28504	0	0	0	0
5	0	0	22270	0	0	0	0
6	0	0	22333	0	0	0	0
7	0	0	27322	0	0	0	0
8	0	0	25163	0	0	0	0
9	0	0	27635	0	0	0	0
10	0	0	25604	0	0	0	0
11	0	0	29446	12269	0	0	0
12	0	0	28321	14167	0	0	0
13	0	0	29226	11839	0	0	0
14	0	0	29637	15544	0	0	0
15	0	0	27643	20737	0	0	0
16	0	0	26910	19463	0	0	0
17	0	0	26073	25877	0	0	0
18	0	0	20679	1108	0	0	0
19	0	0	18208	0	0	0	0
20	0	0	22513	0	0	0	0
21	0	0	22033	0	0	0	0
22	0	0	21989	0	0	0	0
23	0	0	27827	0	0	0	0
24	0	0	27081	0	0	0	0
25	0	0	22340	7444	0	0	0
26	0	0	25072	0	0	0	0
27	0	0	27608	0	0	0	0
28	0	0	31884	9184	0	0	0
29	0	0	21146	0	0	0	0
30	0	0	22715	0	0	0	0
31	0	0	22713	0	0	0	0
32	0	0	19538	0	0	0	0
33	0	0	21989	0	0	0	0
34	0	0	18156	0	0	0	0
35	0	0	22033	0	0	0	0
36	0	0	20214	0	0	0	0
37	0	0	21554	0	0	0	0
38	0	0	21201	0	0	0	0
39	0	0	19954	0	0	0	0
40	0	0	20337	0	0	0	0
41	0	0	25324	0	0	0	0
42	0	0	18249	0	0	0	0
43	0	0	28476	0	0	0	0
44	0	0	28780	0	0	0	0
45	0	0	28176	0	0	0	0
46	0	0	21772	0	0	0	0
47	0	0	20201	0	0	0	0
48	0	0	16332	0	0	0	0
49	0	0	28435	0	0	0	0
50	0	0	28033	0	0	0	0
PERIOD TOTALS		0	1209477	137632	0	0	
PERIOD AVERAGES		0	24189	2752	0	0	

TABLES B-2

WITHOUT IRRIGATION CONSERVATION
WITH ASR
WITH PEARSON LAKE

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

NUMBER OF MONTHS WITH SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
			------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
6	BANDCO R	2068	588.	2.	1.	1.	5.	0.	1.	0.	1.	1.	0.	12.
8	BMWA1995	6000	577.	1.	0.	0.	0.	1.	1.	3.	0.	1.	16.	23.
9	BMWA1991	5574	560.	0.	0.	0.	0.	0.	0.	0.	0.	1.	39.	40.
10	BMA IRRI	VARIES	532.	5.	0.	0.	1.	1.	0.	2.	0.	5.	54.	68.
11	MEDINACO	3400	600.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	BANDCO L	3102	575.	0.	1.	1.	3.	2.	0.	2.	2.	1.	13.	25.

DEMAND FAILURE PROBABILITIES FOR SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
			------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
6	BANDCO R	2068	98.0	.3	.2	.2	.8	.0	.2	.0	.2	.2	.0	2.0
8	BMWA1995	6000	96.2	.2	.0	.0	.0	.2	.2	.5	.0	.2	2.7	3.8
9	BMWA1991	5574	93.3	.0	.0	.0	.0	.0	.0	.0	.0	.2	6.5	6.7
10	BMA IRRI	VARIES	88.7	.8	.0	.0	.2	.2	.0	.3	.0	.8	9.0	11.3
11	MEDINACO	3400	100.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
12	BANDCO L	3102	95.8	.0	.2	.2	.5	.3	.0	.3	.3	.2	2.2	4.2

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 1 MEDINA L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	254823	0	62469	0	16192	0	197916
2	197916	0	57930	0	11167	97163	240339
3	240339	0	59605	0	10898	0	230043
4	230043	0	61711	0	20308	0	135253
5	135253	0	59480	0	11740	0	135078
6	135078	0	59443	0	17376	0	125374
7	125374	0	59623	0	6641	0	94145
8	94145	0	58899	0	14435	0	61464
9	61464	0	61270	3158	3568	0	0
10	0	0	42721	0	2463	0	17031
11	17031	0	63666	21104	762	0	0
12	0	0	61681	28902	50	0	0
13	0	0	63289	24996	142	0	0
14	0	0	60812	28303	392	0	5390
15	5390	0	61861	41716	149	0	0
16	0	0	54960	41875	17	0	0
17	0	0	53881	52557	16	0	0
18	0	0	52473	5451	5295	0	96364
19	96364	0	57735	0	6053	81854	254823
20	254823	0	59698	0	9746	0	236732
21	236732	0	59383	0	11880	0	244955
22	244955	0	59324	0	15304	33744	216779
23	216779	0	60794	0	15396	0	108900
24	108900	0	51476	0	7282	0	12703
25	12703	0	41014	6582	1771	0	54204
26	54204	0	50658	0	5415	0	45051
27	45051	0	45151	0	4069	0	40310
28	40310	0	57001	10511	2550	0	20843
29	20843	0	57696	1103	9066	0	94214
30	94214	0	50503	0	3351	0	93874
31	93874	0	59496	0	10783	0	73547
32	73547	0	49124	0	5608	0	250621
33	250621	0	59338	0	14177	22538	237245
34	237245	0	57722	0	2814	229083	254823
35	254823	0	59361	0	14717	5172	254823
36	254823	0	58178	0	16697	131380	230376
37	230376	0	59145	0	6826	16588	254823
38	254823	0	58781	0	20412	80815	220373
39	220373	0	58039	0	11117	95086	254823
40	254823	0	58270	0	15706	131737	224207
41	224207	0	60797	0	16805	0	180079
42	180079	0	57705	0	10351	157881	254823
43	254823	0	62333	0	18581	0	195203
44	195203	0	62079	0	12527	0	115997
45	115997	0	54143	0	11140	0	40435
46	40435	0	55829	0	7178	0	83138
47	83138	0	54102	0	4677	0	219158
48	219158	0	56735	0	11432	326203	244052
49	244052	0	62228	0	24857	0	178796
50	178796	0	61076	0	16233	0	79097
PERIOD TOTALS		0	2870688	266258	466132	1409244	
PERIOD AVERAGES		0	57413	5325	9322	28184	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 2 DIVRSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	1506	957	59369	0	346	0	1506
2	1506	731	54830	0	219	0	1506
3	1506	1163	56505	0	225	0	1506
4	1506	78	58611	0	473	0	1506
5	1506	302	56380	0	329	0	1506
6	1506	817	56343	0	473	0	1506
7	1506	1487	56523	0	261	0	1506
8	1506	115	55799	0	594	0	1506
9	1506	118	58170	3158	369	0	0
10	0	438	39621	0	248	0	1506
11	1506	129	60566	21104	132	0	0
12	0	164	58581	28491	85	0	0
13	0	436	60189	24570	41	0	0
14	0	329	57712	28005	88	0	1506
15	1506	79	58761	40291	88	0	0
16	0	80	51860	41336	0	0	0
17	0	34	50781	51257	0	0	0
18	0	1990	49373	5119	255	0	1506
19	1506	1258	54635	0	109	0	1506
20	1506	294	56598	0	197	0	1506
21	1506	449	56283	0	258	0	1506
22	1506	136	56224	0	305	0	1506
23	1506	60	57694	0	412	0	1506
24	1506	46	48376	0	458	0	1506
25	1506	686	37914	6308	175	0	1506
26	1506	1523	47558	0	292	0	1506
27	1506	69	42051	0	320	0	1506
28	1506	391	53901	10323	314	0	1506
29	1506	1095	54596	1103	303	0	1506
30	1506	353	47403	0	189	0	1506
31	1506	410	56396	0	424	0	1506
32	1506	257	46024	0	302	0	1506
33	1506	2515	56238	0	280	0	1506
34	1506	3432	54622	0	65	0	1506
35	1506	1358	56261	0	295	0	1506
36	1506	1033	55078	0	327	0	1506
37	1506	1011	56045	0	145	0	1506
38	1506	1192	55681	0	408	0	1506
39	1506	594	54939	0	268	0	1506
40	1506	1479	55170	0	311	0	1506
41	1506	262	57697	0	406	0	1506
42	1506	1802	54605	0	203	0	1506
43	1506	719	59233	0	380	0	1506
44	1506	269	58979	0	346	0	1506
45	1506	185	51043	0	551	0	1506
46	1506	1524	52729	0	302	0	1506
47	1506	2570	51002	0	224	0	1506
48	1506	4266	53635	0	225	0	1506
49	1506	223	59128	0	538	0	1506
50	1506	39	57976	0	506	0	1506
PERIOD TOTALS		40947	2715688	261065	14064	0	
PERIOD AVERAGES		818	54313	5221	281	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 3 PEARSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	3000	0	20109	0	295	0	3000
2	3000	0	18902	0	186	0	3000
3	3000	0	19453	0	192	0	3000
4	3000	0	20012	0	405	0	3000
5	3000	0	19420	0	282	0	3000
6	3000	0	19416	0	405	0	3000
7	3000	0	19235	0	222	0	3000
8	3000	0	19109	0	507	0	3000
9	3000	0	19111	1541	350	0	0
10	0	0	15596	0	206	0	3000
11	3000	0	19350	7509	168	0	0
12	0	0	19156	11223	88	0	0
13	0	0	19314	11038	124	0	1242
14	1242	0	19059	10966	191	0	3000
15	3000	0	19842	12635	186	0	0
16	0	0	20959	15841	0	0	0
17	0	0	20826	17427	0	0	0
18	0	0	18273	906	221	0	3000
19	3000	0	19408	0	94	0	3000
20	3000	0	19481	0	169	0	3000
21	3000	0	19383	0	220	0	3000
22	3000	0	19367	0	261	0	3000
23	3000	0	19816	0	352	0	3000
24	3000	0	17440	0	392	0	3000
25	3000	0	15123	3387	231	0	3000
26	3000	0	16896	0	250	0	3000
27	3000	0	16225	0	273	0	3000
28	3000	0	18841	2610	288	0	3000
29	3000	0	19191	0	258	0	3000
30	3000	0	16996	0	164	0	3000
31	3000	0	19298	0	363	0	3000
32	3000	0	16443	0	260	0	3000
33	3000	0	19369	0	240	0	3000
34	3000	0	19407	0	54	0	3000
35	3000	0	19377	0	252	0	3000
36	3000	0	18991	0	280	0	3000
37	3000	0	19295	0	123	0	3000
38	3000	0	19194	0	349	0	3000
39	3000	0	18943	0	228	0	3000
40	3000	0	19019	0	268	0	3000
41	3000	0	19608	0	348	0	3000
42	3000	0	19400	0	174	0	3000
43	3000	0	20058	0	324	0	3000
44	3000	0	20089	0	296	0	3000
45	3000	0	18089	0	471	0	3000
46	3000	0	18405	0	259	0	3000
47	3000	0	17857	0	192	0	3000
48	3000	0	19479	0	193	0	3000
49	3000	0	20044	0	460	0	3000
50	3000	0	19877	0	432	0	3000
PERIOD TOTALS		0	947551	95083	12546	0	
PERIOD AVERAGES		0	18951	1901	250	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 4 ASR PROJ

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	50000	2082	0	0	0	0	52082
2	52082	8741	0	0	0	0	60823
3	60823	6500	0	0	0	0	67323
4	67323	1321	0	0	0	0	68644
5	68644	6543	0	0	0	0	75187
6	75187	6430	0	0	0	0	81617
7	81617	2961	1445	0	0	0	83133
8	83133	4270	1193	0	0	0	86210
9	86210	0	10735	0	0	0	75475
10	75475	0	9727	0	0	0	65748
11	65748	0	12199	0	0	0	53549
12	53549	0	14395	0	0	0	39154
13	39154	0	14539	0	0	0	24615
14	24615	0	14173	0	0	0	10442
15	10442	0	10442	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	7561	2549	0	0	0	5012
19	5012	10274	0	0	0	0	15286
20	15286	6403	0	0	0	0	21689
21	21689	6766	0	0	0	0	28455
22	28455	6781	0	0	0	0	35236
23	35236	1335	0	0	0	0	36571
24	36571	1350	5688	0	0	0	32233
25	32233	0	11545	0	0	0	20688
26	20688	4455	7025	0	0	0	18118
27	18118	0	8971	0	0	0	9147
28	9147	0	9147	0	0	0	0
29	0	7483	0	0	0	0	7483
30	7483	6250	6648	0	0	0	7085
31	7085	6153	0	0	0	0	13238
32	13238	8907	6333	0	0	0	15812
33	15812	6790	0	0	0	0	22602
34	22602	10348	0	0	0	0	32950
35	32950	6750	0	0	0	0	39700
36	39700	8283	0	0	0	0	47983
37	47983	7211	0	0	0	0	55194
38	55194	7392	0	0	0	0	62586
39	62586	8543	0	0	0	0	71129
40	71129	8178	0	0	0	0	79307
41	79307	4234	0	0	0	0	83541
42	83541	10190	0	0	0	0	93731
43	93731	2196	0	0	0	0	95927
44	95927	1316	0	0	0	0	97243
45	97243	1328	4827	0	0	0	93744
46	93744	6960	2422	0	0	0	98282
47	98282	8340	3014	0	0	0	103608
48	103608	12217	0	0	0	0	115825
49	115825	2160	0	0	0	0	117985
50	117985	1331	0	0	0	0	119316
PERIOD TOTALS		226333	157017	0	0	0	
PERIOD AVERAGES		4526	3140	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 5 GROUNDWT

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	4000	0	0	0	0	0	4000
2	4000	0	0	0	0	0	4000
3	4000	0	0	0	0	0	4000
4	4000	0	0	0	0	0	4000
5	4000	0	0	0	0	0	4000
6	4000	0	0	0	0	0	4000
7	4000	0	0	0	0	0	4000
8	4000	0	0	0	0	0	4000
9	4000	0	0	0	0	0	4000
10	4000	0	0	0	0	0	4000
11	4000	0	0	0	0	0	4000
12	4000	0	0	0	0	0	4000
13	4000	0	0	0	0	0	4000
14	4000	0	0	0	0	0	4000
15	4000	0	1000	0	0	0	3000
16	3000	1000	3399	0	0	0	601
17	601	3399	3399	0	0	0	601
18	601	3399	428	0	0	0	3572
19	3572	428	0	0	0	0	4000
20	4000	0	0	0	0	0	4000
21	4000	0	0	0	0	0	4000
22	4000	0	0	0	0	0	4000
23	4000	0	0	0	0	0	4000
24	4000	0	0	0	0	0	4000
25	4000	0	0	0	0	0	4000
26	4000	0	0	0	0	0	4000
27	4000	0	0	0	0	0	4000
28	4000	0	0	0	0	0	4000
29	4000	0	0	0	0	0	4000
30	4000	0	0	0	0	0	4000
31	4000	0	0	0	0	0	4000
32	4000	0	0	0	0	0	4000
33	4000	0	0	0	0	0	4000
34	4000	0	0	0	0	0	4000
35	4000	0	0	0	0	0	4000
36	4000	0	0	0	0	0	4000
37	4000	0	0	0	0	0	4000
38	4000	0	0	0	0	0	4000
39	4000	0	0	0	0	0	4000
40	4000	0	0	0	0	0	4000
41	4000	0	0	0	0	0	4000
42	4000	0	0	0	0	0	4000
43	4000	0	0	0	0	0	4000
44	4000	0	0	0	0	0	4000
45	4000	0	0	0	0	0	4000
46	4000	0	0	0	0	0	4000
47	4000	0	0	0	0	0	4000
48	4000	0	0	0	0	0	4000
49	4000	0	0	0	0	0	4000
50	4000	0	0	0	0	0	4000
PERIOD TOTALS		8226	8226	0	0	0	
PERIOD AVERAGES		164	164	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 6 BANDCO R

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	88206	2068	0	0	0	0
2	0	280700	2068	0	0	0	0
3	0	129781	2068	0	0	0	0
4	0	52471	2068	0	0	0	0
5	0	135945	2068	0	0	0	0
6	0	132321	2068	0	0	0	0
7	0	93033	2068	0	0	0	0
8	0	100863	2068	0	0	0	0
9	0	28201	2068	0	0	0	0
10	0	99238	2068	0	0	0	0
11	0	36968	2068	0	0	0	0
12	0	33095	2068	0	0	0	0
13	0	38081	2068	148	0	0	0
14	0	45448	2068	67	0	0	0
15	0	15085	2068	171	0	0	0
16	0	17246	2068	0	0	0	0
17	0	5140	2068	391	0	0	0
18	0	196689	2068	44	0	0	0
19	0	373403	2068	0	0	0	0
20	0	122193	2068	0	0	0	0
21	0	149458	2068	0	0	0	0
22	0	151894	2068	0	0	0	0
23	0	31876	2068	18	0	0	0
24	0	14396	2068	0	0	0	0
25	0	104311	2068	0	0	0	0
26	0	101197	2068	0	0	0	0
27	0	92017	2068	0	0	0	0
28	0	60202	2068	0	0	0	0
29	0	200136	2068	0	0	0	0
30	0	111118	2068	0	0	0	0
31	0	111168	2068	0	0	0	0
32	0	293824	2068	0	0	0	0
33	0	151925	2068	0	0	0	0
34	0	376657	2068	0	0	0	0
35	0	149540	2068	0	0	0	0
36	0	254094	2068	0	0	0	0
37	0	176836	2068	0	0	0	0
38	0	196868	2068	0	0	0	0
39	0	269262	2068	0	0	0	0
40	0	246755	2068	0	0	0	0
41	0	100276	2068	0	0	0	0
42	0	370983	2068	0	0	0	0
43	0	88939	2068	0	0	0	0
44	0	58203	2068	0	0	0	0
45	0	44188	2068	0	0	0	0
46	0	164261	2068	0	0	0	0
47	0	254878	2068	0	0	0	0
48	0	489532	2068	0	0	0	0
49	0	89087	2068	0	0	0	0
50	0	39287	2068	0	0	0	0
PERIOD TOTALS		6967275	103400	839	0	0	
PERIOD AVERAGES		139345	2068	16	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 7 DIV LEAK

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	12540	0	0	0	0
2	0	0	12539	0	0	0	0
3	0	0	12540	0	0	0	0
4	0	0	12540	0	0	0	0
5	0	0	12540	0	0	0	0
6	0	0	12540	0	0	0	0
7	0	0	12540	0	0	0	0
8	0	0	12540	0	0	0	0
9	0	0	7296	0	0	0	0
10	0	0	5986	0	0	0	0
11	0	0	2738	0	0	0	0
12	0	0	438	0	0	0	0
13	0	0	433	0	0	0	0
14	0	0	1340	0	0	0	0
15	0	0	893	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	8502	0	0	0	0
19	0	0	12539	0	0	0	0
20	0	0	12540	0	0	0	0
21	0	0	12540	0	0	0	0
22	0	0	12540	0	0	0	0
23	0	0	12540	0	0	0	0
24	0	0	10869	0	0	0	0
25	0	0	5902	0	0	0	0
26	0	0	12540	0	0	0	0
27	0	0	11118	0	0	0	0
28	0	0	5614	0	0	0	0
29	0	0	12068	0	0	0	0
30	0	0	12444	0	0	0	0
31	0	0	12540	0	0	0	0
32	0	0	12131	0	0	0	0
33	0	0	12540	0	0	0	0
34	0	0	12537	0	0	0	0
35	0	0	12540	0	0	0	0
36	0	0	12540	0	0	0	0
37	0	0	12539	0	0	0	0
38	0	0	12540	0	0	0	0
39	0	0	12540	0	0	0	0
40	0	0	12540	0	0	0	0
41	0	0	12540	0	0	0	0
42	0	0	12539	0	0	0	0
43	0	0	12540	0	0	0	0
44	0	0	12540	0	0	0	0
45	0	0	11809	0	0	0	0
46	0	0	12464	0	0	0	0
47	0	0	12540	0	0	0	0
48	0	0	12540	0	0	0	0
49	0	0	12540	0	0	0	0
50	0	0	12540	0	0	0	0
PERIOD TOTALS		0	510778	0	0	0	
PERIOD AVERAGES		0	10215	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 8 BMWA1995

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	6000	0	0	0	0
2	0	0	6000	0	0	0	0
3	0	0	6000	0	0	0	0
4	0	0	6000	0	0	0	0
5	0	0	6000	0	0	0	0
6	0	0	6000	0	0	0	0
7	0	0	6000	0	0	0	0
8	0	0	6000	0	0	0	0
9	0	0	6000	0	0	0	0
10	0	0	6000	0	0	0	0
11	0	0	6000	0	0	0	0
12	0	0	6000	0	0	0	0
13	0	0	6000	0	0	0	0
14	0	0	6000	0	0	0	0
15	0	0	6000	1438	0	0	0
16	0	0	6000	2408	0	0	0
17	0	0	6000	4499	0	0	0
18	0	0	6000	726	0	0	0
19	0	0	6000	0	0	0	0
20	0	0	6000	0	0	0	0
21	0	0	6000	0	0	0	0
22	0	0	6000	0	0	0	0
23	0	0	6000	0	0	0	0
24	0	0	6000	0	0	0	0
25	0	0	6000	0	0	0	0
26	0	0	6000	0	0	0	0
27	0	0	6000	0	0	0	0
28	0	0	6000	0	0	0	0
29	0	0	6000	0	0	0	0
30	0	0	6000	0	0	0	0
31	0	0	6000	0	0	0	0
32	0	0	6000	0	0	0	0
33	0	0	6000	0	0	0	0
34	0	0	6000	0	0	0	0
35	0	0	6000	0	0	0	0
36	0	0	6000	0	0	0	0
37	0	0	6000	0	0	0	0
38	0	0	6000	0	0	0	0
39	0	0	6000	0	0	0	0
40	0	0	6000	0	0	0	0
41	0	0	6000	0	0	0	0
42	0	0	6000	0	0	0	0
43	0	0	6000	0	0	0	0
44	0	0	6000	0	0	0	0
45	0	0	6000	0	0	0	0
46	0	0	6000	0	0	0	0
47	0	0	6000	0	0	0	0
48	0	0	6000	0	0	0	0
49	0	0	6000	0	0	0	0
50	0	0	6000	0	0	0	0
PERIOD TOTALS		0	300000	9071	0	0	
PERIOD AVERAGES		0	6000	181	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 9 BMWA1991

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	5572	0	0	0	0
2	0	0	5572	0	0	0	0
3	0	0	5572	0	0	0	0
4	0	0	5572	0	0	0	0
5	0	0	5572	0	0	0	0
6	0	0	5572	0	0	0	0
7	0	0	5572	0	0	0	0
8	0	0	5572	0	0	0	0
9	0	0	5572	0	0	0	0
10	0	0	5572	0	0	0	0
11	0	0	5572	0	0	0	0
12	0	0	5572	0	0	0	0
13	0	0	5572	0	0	0	0
14	0	0	5572	0	0	0	0
15	0	0	5572	1638	0	0	0
16	0	0	5572	5572	0	0	0
17	0	0	5572	5572	0	0	0
18	0	0	5572	2574	0	0	0
19	0	0	5572	0	0	0	0
20	0	0	5572	0	0	0	0
21	0	0	5572	0	0	0	0
22	0	0	5572	0	0	0	0
23	0	0	5572	0	0	0	0
24	0	0	5572	0	0	0	0
25	0	0	5572	0	0	0	0
26	0	0	5572	0	0	0	0
27	0	0	5572	0	0	0	0
28	0	0	5572	1076	0	0	0
29	0	0	5572	1103	0	0	0
30	0	0	5572	0	0	0	0
31	0	0	5572	0	0	0	0
32	0	0	5572	0	0	0	0
33	0	0	5572	0	0	0	0
34	0	0	5572	0	0	0	0
35	0	0	5572	0	0	0	0
36	0	0	5572	0	0	0	0
37	0	0	5572	0	0	0	0
38	0	0	5572	0	0	0	0
39	0	0	5572	0	0	0	0
40	0	0	5572	0	0	0	0
41	0	0	5572	0	0	0	0
42	0	0	5572	0	0	0	0
43	0	0	5572	0	0	0	0
44	0	0	5572	0	0	0	0
45	0	0	5572	0	0	0	0
46	0	0	5572	0	0	0	0
47	0	0	5572	0	0	0	0
48	0	0	5572	0	0	0	0
49	0	0	5572	0	0	0	0
50	0	0	5572	0	0	0	0
PERIOD TOTALS		0	278600	17535	0	0	
PERIOD AVERAGES		0	5572	350	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 10 BMA IRRI

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	NET USEAGE	HIST USEAGE
1	0	0	16537	0	0	16537	16536
2	0	0	13319	0	0	13319	13319
3	0	0	14431	0	0	14431	14430
4	0	0	16613	0	0	16613	18767
5	0	0	14386	0	0	14386	14386
6	0	0	14409	0	0	14409	14411
7	0	0	16137	0	0	16137	16139
8	0	0	15450	0	0	15450	15449
9	0	0	19111	1541	0	17570	19576
10	0	0	15596	0	0	15596	15596
11	0	0	19350	7509	0	11841	19349
12	0	0	19156	11223	0	7933	19459
13	0	0	19314	11038	0	8276	19316
14	0	0	19059	10966	0	8093	19060
15	0	0	19093	12635	0	6458	19776
16	0	0	17560	15841	0	1719	19754
17	0	0	17427	17427	0	0	19816
18	0	0	13950	906	0	13044	13949
19	0	0	12585	0	0	12585	12585
20	0	0	14483	0	0	14483	14483
21	0	0	14292	0	0	14292	14290
22	0	0	14273	0	0	14273	14273
23	0	0	16417	0	0	16417	19490
24	0	0	16196	0	0	16196	19782
25	0	0	15123	3387	0	11736	15125
26	0	0	15417	0	0	15417	15417
27	0	0	16225	0	0	16225	16225
28	0	0	18389	2610	0	15779	18389
29	0	0	13923	0	0	13923	13924
30	0	0	14560	0	0	14560	14559
31	0	0	14560	0	0	14560	14559
32	0	0	13217	0	0	13217	13217
33	0	0	14272	0	0	14272	14272
34	0	0	12560	0	0	12560	12558
35	0	0	14292	0	0	14292	14290
36	0	0	13522	0	0	13522	13522
37	0	0	14093	0	0	14093	14094
38	0	0	13947	0	0	13947	13948
39	0	0	13408	0	0	13408	13407
40	0	0	13577	0	0	13577	13577
41	0	0	15503	0	0	15503	15502
42	0	0	12605	0	0	12605	12604
43	0	0	16476	0	0	16476	16477
44	0	0	16690	0	0	16690	18493
45	0	0	16519	0	0	16519	19107
46	0	0	14184	0	0	14184	14185
47	0	0	13515	0	0	13515	13516
48	0	0	11611	0	0	11611	11611
49	0	0	16465	0	0	16465	16465
50	0	0	16478	0	0	16478	19277
PERIOD TOTALS		0	770275	95083	0	675192	792311
PERIOD AVERAGES		0	15405	1901	0	13503	15846

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 11 MEDINACO

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3399	0	0	0	0
2	0	0	3399	0	0	0	0
3	0	0	3399	0	0	0	0
4	0	0	3399	0	0	0	0
5	0	0	3399	0	0	0	0
6	0	0	3399	0	0	0	0
7	0	0	3399	0	0	0	0
8	0	0	3399	0	0	0	0
9	0	0	3399	0	0	0	0
10	0	0	3399	0	0	0	0
11	0	0	3399	0	0	0	0
12	0	0	3399	0	0	0	0
13	0	0	3399	0	0	0	0
14	0	0	3399	0	0	0	0
15	0	0	3399	0	0	0	0
16	0	0	3399	0	0	0	0
17	0	0	3399	0	0	0	0
18	0	0	3399	0	0	0	0
19	0	0	3399	0	0	0	0
20	0	0	3399	0	0	0	0
21	0	0	3399	0	0	0	0
22	0	0	3399	0	0	0	0
23	0	0	3399	0	0	0	0
24	0	0	3399	0	0	0	0
25	0	0	3399	0	0	0	0
26	0	0	3399	0	0	0	0
27	0	0	3399	0	0	0	0
28	0	0	3399	0	0	0	0
29	0	0	3399	0	0	0	0
30	0	0	3399	0	0	0	0
31	0	0	3399	0	0	0	0
32	0	0	3399	0	0	0	0
33	0	0	3399	0	0	0	0
34	0	0	3399	0	0	0	0
35	0	0	3399	0	0	0	0
36	0	0	3399	0	0	0	0
37	0	0	3399	0	0	0	0
38	0	0	3399	0	0	0	0
39	0	0	3399	0	0	0	0
40	0	0	3399	0	0	0	0
41	0	0	3399	0	0	0	0
42	0	0	3399	0	0	0	0
43	0	0	3399	0	0	0	0
44	0	0	3399	0	0	0	0
45	0	0	3399	0	0	0	0
46	0	0	3399	0	0	0	0
47	0	0	3399	0	0	0	0
48	0	0	3399	0	0	0	0
49	0	0	3399	0	0	0	0
50	0	0	3399	0	0	0	0
PERIOD TOTALS		0	169950	0	0	0	
PERIOD AVERAGES		0	3399	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 12 BANDCO L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3100	0	0	0	0
2	0	0	3100	0	0	0	0
3	0	0	3100	0	0	0	0
4	0	0	3100	0	0	0	0
5	0	0	3100	0	0	0	0
6	0	0	3100	0	0	0	0
7	0	0	3100	0	0	0	0
8	0	0	3100	0	0	0	0
9	0	0	3100	0	0	0	0
10	0	0	3100	0	0	0	0
11	0	0	3100	0	0	0	0
12	0	0	3100	411	0	0	0
13	0	0	3100	426	0	0	0
14	0	0	3100	298	0	0	0
15	0	0	3100	1425	0	0	0
16	0	0	3100	539	0	0	0
17	0	0	3100	1300	0	0	0
18	0	0	3100	332	0	0	0
19	0	0	3100	0	0	0	0
20	0	0	3100	0	0	0	0
21	0	0	3100	0	0	0	0
22	0	0	3100	0	0	0	0
23	0	0	3100	0	0	0	0
24	0	0	3100	0	0	0	0
25	0	0	3100	274	0	0	0
26	0	0	3100	0	0	0	0
27	0	0	3100	0	0	0	0
28	0	0	3100	188	0	0	0
29	0	0	3100	0	0	0	0
30	0	0	3100	0	0	0	0
31	0	0	3100	0	0	0	0
32	0	0	3100	0	0	0	0
33	0	0	3100	0	0	0	0
34	0	0	3100	0	0	0	0
35	0	0	3100	0	0	0	0
36	0	0	3100	0	0	0	0
37	0	0	3100	0	0	0	0
38	0	0	3100	0	0	0	0
39	0	0	3100	0	0	0	0
40	0	0	3100	0	0	0	0
41	0	0	3100	0	0	0	0
42	0	0	3100	0	0	0	0
43	0	0	3100	0	0	0	0
44	0	0	3100	0	0	0	0
45	0	0	3100	0	0	0	0
46	0	0	3100	0	0	0	0
47	0	0	3100	0	0	0	0
48	0	0	3100	0	0	0	0
49	0	0	3100	0	0	0	0
50	0	0	3100	0	0	0	0
PERIOD TOTALS		0	155000	5193	0	0	
PERIOD AVERAGES		0	3100	103	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIV. L. @ 919 W/O CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 13 CAN LOSS

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	27688	0	0	0	0
2	0	0	24356	0	0	0	0
3	0	0	25480	0	0	0	0
4	0	0	27027	0	0	0	0
5	0	0	25388	0	0	0	0
6	0	0	25355	0	0	0	0
7	0	0	26613	0	0	0	0
8	0	0	25859	0	0	0	0
9	0	0	33059	1617	0	0	0
10	0	0	18025	0	0	0	0
11	0	0	35216	13595	0	0	0
12	0	0	33425	17268	0	0	0
13	0	0	34875	13532	0	0	0
14	0	0	32653	17039	0	0	0
15	0	0	32919	24580	0	0	0
16	0	0	24901	17515	0	0	0
17	0	0	23955	23759	0	0	0
18	0	0	23685	913	0	0	0
19	0	0	23655	0	0	0	0
20	0	0	25545	0	0	0	0
21	0	0	25328	0	0	0	0
22	0	0	25285	0	0	0	0
23	0	0	26306	0	0	0	0
24	0	0	22897	0	0	0	0
25	0	0	16791	2921	0	0	0
26	0	0	23453	0	0	0	0
27	0	0	19826	0	0	0	0
28	0	0	29060	6637	0	0	0
29	0	0	24936	0	0	0	0
30	0	0	22964	0	0	0	0
31	0	0	25526	0	0	0	0
32	0	0	21943	0	0	0	0
33	0	0	25297	0	0	0	0
34	0	0	23643	0	0	0	0
35	0	0	25312	0	0	0	0
36	0	0	24515	0	0	0	0
37	0	0	25178	0	0	0	0
38	0	0	24915	0	0	0	0
39	0	0	24424	0	0	0	0
40	0	0	24579	0	0	0	0
41	0	0	26517	0	0	0	0
42	0	0	23633	0	0	0	0
43	0	0	27603	0	0	0	0
44	0	0	27318	0	0	0	0
45	0	0	24380	0	0	0	0
46	0	0	24256	0	0	0	0
47	0	0	23445	0	0	0	0
48	0	0	22584	0	0	0	0
49	0	0	27512	0	0	0	0
50	0	0	26527	0	0	0	0
PERIOD TOTALS		0	1285632	139376	0	0	
PERIOD AVERAGES		0	25712	2787	0	0	

TABLES B-3

WITH IRRIGATION CONSERVATION
WITHOUT ASR
WITHOUT PEARSON LAKE

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

NUMBER OF MONTHS WITH SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
			.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
6	BANDCO R	2068	588.	2.	1.	1.	5.	0.	1.	0.	1.	1.	0.	12.
8	BMWA1995	6000	567.	1.	1.	0.	0.	1.	0.	2.	3.	2.	23.	33.
9	BMWA1991	5574	441.	0.	0.	0.	0.	0.	0.	0.	0.	0.	159.	159.
10	BMA IRRI	VARIES	550.	1.	0.	1.	0.	1.	3.	2.	0.	2.	40.	50.
11	MEDINACO	3400	600.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	BANDCO L	3102	578.	0.	1.	0.	3.	1.	0.	2.	1.	1.	13.	22.

DEMAND FAILURE PROBABILITIES FOR SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
			.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
6	BANDCO R	2068	98.0	.3	.2	.2	.8	.0	.2	.0	.2	.2	.0	2.0
8	BMWA1995	6000	94.5	.2	.2	.0	.0	.2	.0	.3	.5	.3	3.8	5.5
9	BMWA1991	5574	73.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	26.5	26.5
10	BMA IRRI	VARIES	91.7	.2	.0	.2	.0	.2	.5	.3	.0	.3	6.7	8.3
11	MEDINACO	3400	100.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
12	BANDCO L	3102	96.3	.0	.2	.0	.5	.2	.0	.3	.2	.2	2.2	3.7

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 1 MEDINA L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	254823	0	41745	0	16784	0	219594
2	219594	0	38107	0	11015	140000	245416
3	245416	0	39352	0	11217	13522	245897
4	245897	0	44292	0	22023	0	167096
5	167096	0	39303	0	14419	0	186537
6	186537	0	39332	0	22246	0	193289
7	193289	0	41290	0	10749	0	173239
8	173239	0	40507	0	24992	0	145624
9	145624	0	44083	1142	12576	0	59739
10	59739	0	37481	3192	5140	0	63034
11	63034	0	39390	5572	5671	0	8596
12	8596	0	38956	17708	644	0	0
13	0	0	38839	16643	409	0	0
14	0	0	38398	21337	563	0	11533
15	11533	0	39082	28402	654	0	0
16	0	0	38838	27633	23	0	0
17	0	0	38812	37488	16	0	0
18	0	0	35177	5790	6056	0	119401
19	119401	0	37290	0	5975	131083	254823
20	254823	0	39413	0	10008	9068	252121
21	252121	0	39200	0	12937	28385	254822
22	254822	0	39178	0	15416	61379	224217
23	224217	0	45126	0	16746	0	131268
24	131268	0	43131	2324	9981	0	37185
25	37185	0	34565	5572	3528	0	60995
26	60995	0	36791	3677	6612	0	66545
27	66545	0	35817	5572	5844	0	64415
28	64415	0	38290	5572	4865	0	36613
29	36613	0	38083	702	11414	0	130197
30	130197	0	39501	0	5152	0	138940
31	138940	0	39501	0	16315	0	133418
32	133418	0	37993	0	8758	65161	254823
33	254823	0	39177	0	14374	45507	243419
34	243419	0	37260	0	2957	261938	254823
35	254823	0	39200	0	15108	29739	254823
36	254823	0	38336	0	16747	153737	234260
37	234260	0	38974	0	7108	45047	254823
38	254823	0	38813	0	20543	100641	226195
39	226195	0	38203	0	11972	125728	254823
40	254823	0	38393	0	15768	153969	228148
41	228148	0	40568	0	17970	0	205895
42	205895	0	37312	0	10249	210190	254823
43	254823	0	41674	0	18963	7869	209542
44	209542	0	43979	0	14180	0	146857
45	146857	0	43541	1142	15405	0	74611
46	74611	0	38726	351	10405	0	132382
47	132382	0	38328	0	7750	27700	254822
48	254822	0	36210	0	11481	387990	246069
49	246069	0	41663	0	25954	0	201950
50	201950	0	44879	0	19493	0	114709
PERIOD TOTALS		0	1972099	189819	555175	1998653	
PERIOD AVERAGES		0	39441	3796	11103	39973	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 2 DIVRSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	1506	957	38645	0	346	0	1506
2	1506	731	35007	0	219	0	1506
3	1506	1163	36252	0	225	0	1506
4	1506	78	41192	0	473	0	1506
5	1506	302	36203	0	329	0	1506
6	1506	817	36232	0	473	0	1506
7	1506	1487	38190	0	261	0	1506
8	1506	115	37407	0	594	0	1506
9	1506	118	40983	1142	482	0	1506
10	1506	438	34381	3192	241	0	1506
11	1506	129	36290	5572	474	0	1506
12	1506	164	35856	17297	238	0	0
13	0	436	35739	16261	193	0	911
14	911	329	35298	21039	134	0	1506
15	1506	79	35982	26977	215	0	0
16	0	80	35738	27094	71	0	0
17	0	34	35712	36188	0	0	0
18	0	1990	32077	5458	255	0	1506
19	1506	1258	34190	0	109	0	1506
20	1506	294	36313	0	197	0	1506
21	1506	449	36100	0	258	0	1506
22	1506	136	36078	0	305	0	1506
23	1506	60	42026	0	412	0	1506
24	1506	46	40031	2324	458	0	1506
25	1506	686	31465	5572	365	0	1506
26	1506	1523	33691	3677	292	0	1506
27	1506	69	32717	5572	320	0	1506
28	1506	391	35190	5572	376	0	1506
29	1506	1095	34983	702	303	0	1506
30	1506	353	36401	0	189	0	1506
31	1506	410	36401	0	424	0	1506
32	1506	257	34893	0	302	0	1506
33	1506	2515	36077	0	280	0	1506
34	1506	3432	34160	0	65	0	1506
35	1506	1358	36100	0	295	0	1506
36	1506	1033	35236	0	327	0	1506
37	1506	1011	35874	0	145	0	1506
38	1506	1192	35713	0	408	0	1506
39	1506	594	35103	0	268	0	1506
40	1506	1479	35293	0	311	0	1506
41	1506	262	37468	0	406	0	1506
42	1506	1802	34212	0	203	0	1506
43	1506	719	38574	0	380	0	1506
44	1506	269	40879	0	346	0	1506
45	1506	185	40441	1142	551	0	1506
46	1506	1524	35626	351	302	0	1506
47	1506	2570	35228	0	224	0	1506
48	1506	4266	33110	0	225	0	1506
49	1506	223	38563	0	538	0	1506
50	1506	39	41779	0	506	0	1506
PERIOD TOTALS		40947	1817099	185132	15313	0	
PERIOD AVERAGES		818	36341	3702	306	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 3 PEARSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	19936	0	0	0	0
2	0	0	16718	0	0	0	0
3	0	0	17830	0	0	0	0
4	0	0	22166	0	0	0	0
5	0	0	17785	0	0	0	0
6	0	0	17808	0	0	0	0
7	0	0	19536	0	0	0	0
8	0	0	18849	0	0	0	0
9	0	0	22975	0	0	0	0
10	0	0	18995	0	0	0	0
11	0	0	22749	0	0	0	0
12	0	0	22857	8155	0	0	0
13	0	0	22713	7891	0	0	0
14	0	0	22458	11306	0	0	0
15	0	0	23175	14352	0	0	0
16	0	0	23153	14884	0	0	0
17	0	0	23215	19816	0	0	0
18	0	0	17349	906	0	0	0
19	0	0	15984	0	0	0	0
20	0	0	17882	0	0	0	0
21	0	0	17691	0	0	0	0
22	0	0	17672	0	0	0	0
23	0	0	22889	0	0	0	0
24	0	0	23179	0	0	0	0
25	0	0	18522	0	0	0	0
26	0	0	18816	0	0	0	0
27	0	0	19624	0	0	0	0
28	0	0	21788	0	0	0	0
29	0	0	17322	0	0	0	0
30	0	0	17959	0	0	0	0
31	0	0	17959	0	0	0	0
32	0	0	16616	0	0	0	0
33	0	0	17671	0	0	0	0
34	0	0	15959	0	0	0	0
35	0	0	17691	0	0	0	0
36	0	0	16921	0	0	0	0
37	0	0	17492	0	0	0	0
38	0	0	17346	0	0	0	0
39	0	0	16807	0	0	0	0
40	0	0	16976	0	0	0	0
41	0	0	18902	0	0	0	0
42	0	0	16004	0	0	0	0
43	0	0	19875	0	0	0	0
44	0	0	21892	0	0	0	0
45	0	0	22506	0	0	0	0
46	0	0	17583	0	0	0	0
47	0	0	16914	0	0	0	0
48	0	0	15010	0	0	0	0
49	0	0	19864	0	0	0	0
50	0	0	22677	0	0	0	0
PERIOD TOTALS		0	962260	77310	0	0	
PERIOD AVERAGES		0	19245	1546	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 4 ASR PROJ

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
PERIOD TOTALS		0	0	0	0	0	
PERIOD AVERAGES		0	0	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 5 GROUNDWT

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	4000	0	0	0	0	0	4000
2	4000	0	0	0	0	0	4000
3	4000	0	0	0	0	0	4000
4	4000	0	0	0	0	0	4000
5	4000	0	0	0	0	0	4000
6	4000	0	0	0	0	0	4000
7	4000	0	0	0	0	0	4000
8	4000	0	0	0	0	0	4000
9	4000	0	0	0	0	0	4000
10	4000	0	0	0	0	0	4000
11	4000	0	0	0	0	0	4000
12	4000	0	1693	0	0	0	2307
13	2307	1693	1590	0	0	0	2410
14	2410	1590	1971	0	0	0	2029
15	2029	1971	2430	0	0	0	1570
16	1570	2430	3103	0	0	0	897
17	897	3103	3399	0	0	0	601
18	601	3399	428	0	0	0	3572
19	3572	428	0	0	0	0	4000
20	4000	0	0	0	0	0	4000
21	4000	0	0	0	0	0	4000
22	4000	0	0	0	0	0	4000
23	4000	0	0	0	0	0	4000
24	4000	0	0	0	0	0	4000
25	4000	0	0	0	0	0	4000
26	4000	0	0	0	0	0	4000
27	4000	0	0	0	0	0	4000
28	4000	0	0	0	0	0	4000
29	4000	0	0	0	0	0	4000
30	4000	0	0	0	0	0	4000
31	4000	0	0	0	0	0	4000
32	4000	0	0	0	0	0	4000
33	4000	0	0	0	0	0	4000
34	4000	0	0	0	0	0	4000
35	4000	0	0	0	0	0	4000
36	4000	0	0	0	0	0	4000
37	4000	0	0	0	0	0	4000
38	4000	0	0	0	0	0	4000
39	4000	0	0	0	0	0	4000
40	4000	0	0	0	0	0	4000
41	4000	0	0	0	0	0	4000
42	4000	0	0	0	0	0	4000
43	4000	0	0	0	0	0	4000
44	4000	0	0	0	0	0	4000
45	4000	0	0	0	0	0	4000
46	4000	0	0	0	0	0	4000
47	4000	0	0	0	0	0	4000
48	4000	0	0	0	0	0	4000
49	4000	0	0	0	0	0	4000
50	4000	0	0	0	0	0	4000
PERIOD TOTALS		14614	14614	0	0	0	
PERIOD AVERAGES		292	292	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 6 BANDCO R

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	88206	2068	0	0	0	0
2	0	280700	2068	0	0	0	0
3	0	129781	2068	0	0	0	0
4	0	52471	2068	0	0	0	0
5	0	135945	2068	0	0	0	0
6	0	132321	2068	0	0	0	0
7	0	93033	2068	0	0	0	0
8	0	100863	2068	0	0	0	0
9	0	28201	2068	0	0	0	0
10	0	99238	2068	0	0	0	0
11	0	36968	2068	0	0	0	0
12	0	33095	2068	0	0	0	0
13	0	38081	2068	148	0	0	0
14	0	45448	2068	67	0	0	0
15	0	15085	2068	171	0	0	0
16	0	17246	2068	0	0	0	0
17	0	5140	2068	391	0	0	0
18	0	196689	2068	44	0	0	0
19	0	373403	2068	0	0	0	0
20	0	122193	2068	0	0	0	0
21	0	149458	2068	0	0	0	0
22	0	151894	2068	0	0	0	0
23	0	31876	2068	18	0	0	0
24	0	14396	2068	0	0	0	0
25	0	104311	2068	0	0	0	0
26	0	101197	2068	0	0	0	0
27	0	92017	2068	0	0	0	0
28	0	60202	2068	0	0	0	0
29	0	200136	2068	0	0	0	0
30	0	111118	2068	0	0	0	0
31	0	111168	2068	0	0	0	0
32	0	293824	2068	0	0	0	0
33	0	151925	2068	0	0	0	0
34	0	376657	2068	0	0	0	0
35	0	149540	2068	0	0	0	0
36	0	254094	2068	0	0	0	0
37	0	176836	2068	0	0	0	0
38	0	196868	2068	0	0	0	0
39	0	269262	2068	0	0	0	0
40	0	246755	2068	0	0	0	0
41	0	100276	2068	0	0	0	0
42	0	370983	2068	0	0	0	0
43	0	88939	2068	0	0	0	0
44	0	58203	2068	0	0	0	0
45	0	44188	2068	0	0	0	0
46	0	164261	2068	0	0	0	0
47	0	254878	2068	0	0	0	0
48	0	489532	2068	0	0	0	0
49	0	89087	2068	0	0	0	0
50	0	39287	2068	0	0	0	0
PERIOD TOTALS		6967275	103400	839	0	0	
PERIOD AVERAGES		139345	2068	16	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 7 DIV LEAK

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	12540	0	0	0	0
2	0	0	12539	0	0	0	0
3	0	0	12540	0	0	0	0
4	0	0	12540	0	0	0	0
5	0	0	12540	0	0	0	0
6	0	0	12540	0	0	0	0
7	0	0	12540	0	0	0	0
8	0	0	12540	0	0	0	0
9	0	0	12540	0	0	0	0
10	0	0	12540	0	0	0	0
11	0	0	10139	0	0	0	0
12	0	0	2563	0	0	0	0
13	0	0	1569	0	0	0	0
14	0	0	1522	0	0	0	0
15	0	0	2094	0	0	0	0
16	0	0	163	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	8866	0	0	0	0
19	0	0	12539	0	0	0	0
20	0	0	12540	0	0	0	0
21	0	0	12540	0	0	0	0
22	0	0	12540	0	0	0	0
23	0	0	12540	0	0	0	0
24	0	0	12481	0	0	0	0
25	0	0	8976	0	0	0	0
26	0	0	12540	0	0	0	0
27	0	0	12539	0	0	0	0
28	0	0	9714	0	0	0	0
29	0	0	12433	0	0	0	0
30	0	0	12540	0	0	0	0
31	0	0	12540	0	0	0	0
32	0	0	12540	0	0	0	0
33	0	0	12540	0	0	0	0
34	0	0	12537	0	0	0	0
35	0	0	12540	0	0	0	0
36	0	0	12540	0	0	0	0
37	0	0	12539	0	0	0	0
38	0	0	12540	0	0	0	0
39	0	0	12540	0	0	0	0
40	0	0	12540	0	0	0	0
41	0	0	12540	0	0	0	0
42	0	0	12539	0	0	0	0
43	0	0	12540	0	0	0	0
44	0	0	12540	0	0	0	0
45	0	0	12540	0	0	0	0
46	0	0	12540	0	0	0	0
47	0	0	12540	0	0	0	0
48	0	0	12540	0	0	0	0
49	0	0	12540	0	0	0	0
50	0	0	12540	0	0	0	0
PERIOD TOTALS		0	547032	0	0	0	
PERIOD AVERAGES		0	10940	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 8 BMWA1995

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	6000	0	0	0	0
2	0	0	6000	0	0	0	0
3	0	0	6000	0	0	0	0
4	0	0	6000	0	0	0	0
5	0	0	6000	0	0	0	0
6	0	0	6000	0	0	0	0
7	0	0	6000	0	0	0	0
8	0	0	6000	0	0	0	0
9	0	0	6000	0	0	0	0
10	0	0	6000	0	0	0	0
11	0	0	6000	0	0	0	0
12	0	0	6000	1535	0	0	0
13	0	0	6000	869	0	0	0
14	0	0	6000	1545	0	0	0
15	0	0	6000	3150	0	0	0
16	0	0	6000	2427	0	0	0
17	0	0	6000	4499	0	0	0
18	0	0	6000	726	0	0	0
19	0	0	6000	0	0	0	0
20	0	0	6000	0	0	0	0
21	0	0	6000	0	0	0	0
22	0	0	6000	0	0	0	0
23	0	0	6000	0	0	0	0
24	0	0	6000	0	0	0	0
25	0	0	6000	0	0	0	0
26	0	0	6000	0	0	0	0
27	0	0	6000	0	0	0	0
28	0	0	6000	0	0	0	0
29	0	0	6000	0	0	0	0
30	0	0	6000	0	0	0	0
31	0	0	6000	0	0	0	0
32	0	0	6000	0	0	0	0
33	0	0	6000	0	0	0	0
34	0	0	6000	0	0	0	0
35	0	0	6000	0	0	0	0
36	0	0	6000	0	0	0	0
37	0	0	6000	0	0	0	0
38	0	0	6000	0	0	0	0
39	0	0	6000	0	0	0	0
40	0	0	6000	0	0	0	0
41	0	0	6000	0	0	0	0
42	0	0	6000	0	0	0	0
43	0	0	6000	0	0	0	0
44	0	0	6000	0	0	0	0
45	0	0	6000	0	0	0	0
46	0	0	6000	0	0	0	0
47	0	0	6000	0	0	0	0
48	0	0	6000	0	0	0	0
49	0	0	6000	0	0	0	0
50	0	0	6000	0	0	0	0
PERIOD TOTALS		0	300000	14751	0	0	
PERIOD AVERAGES		0	6000	295	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 9 BMWA1991

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	5572	0	0	0	0
2	0	0	5572	0	0	0	0
3	0	0	5572	0	0	0	0
4	0	0	5572	0	0	0	0
5	0	0	5572	0	0	0	0
6	0	0	5572	0	0	0	0
7	0	0	5572	0	0	0	0
8	0	0	5572	0	0	0	0
9	0	0	5572	1142	0	0	0
10	0	0	5572	3192	0	0	0
11	0	0	5572	5572	0	0	0
12	0	0	5572	5572	0	0	0
13	0	0	5572	5572	0	0	0
14	0	0	5572	5572	0	0	0
15	0	0	5572	5572	0	0	0
16	0	0	5572	5572	0	0	0
17	0	0	5572	5572	0	0	0
18	0	0	5572	3471	0	0	0
19	0	0	5572	0	0	0	0
20	0	0	5572	0	0	0	0
21	0	0	5572	0	0	0	0
22	0	0	5572	0	0	0	0
23	0	0	5572	0	0	0	0
24	0	0	5572	2324	0	0	0
25	0	0	5572	5572	0	0	0
26	0	0	5572	3677	0	0	0
27	0	0	5572	5572	0	0	0
28	0	0	5572	5572	0	0	0
29	0	0	5572	702	0	0	0
30	0	0	5572	0	0	0	0
31	0	0	5572	0	0	0	0
32	0	0	5572	0	0	0	0
33	0	0	5572	0	0	0	0
34	0	0	5572	0	0	0	0
35	0	0	5572	0	0	0	0
36	0	0	5572	0	0	0	0
37	0	0	5572	0	0	0	0
38	0	0	5572	0	0	0	0
39	0	0	5572	0	0	0	0
40	0	0	5572	0	0	0	0
41	0	0	5572	0	0	0	0
42	0	0	5572	0	0	0	0
43	0	0	5572	0	0	0	0
44	0	0	5572	0	0	0	0
45	0	0	5572	1142	0	0	0
46	0	0	5572	351	0	0	0
47	0	0	5572	0	0	0	0
48	0	0	5572	0	0	0	0
49	0	0	5572	0	0	0	0
50	0	0	5572	0	0	0	0
PERIOD TOTALS		0	278600	71721	0	0	
PERIOD AVERAGES		0	5572	1434	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 10 BMA IRRI

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	NET USEAGE	HIST USEAGE
1	0	0	16537	0	0	16537	16536
2	0	0	13319	0	0	13319	13319
3	0	0	14431	0	0	14431	14430
4	0	0	18767	0	0	18767	18767
5	0	0	14386	0	0	14386	14386
6	0	0	14409	0	0	14409	14411
7	0	0	16137	0	0	16137	16139
8	0	0	15450	0	0	15450	15449
9	0	0	19576	0	0	19576	19576
10	0	0	15596	0	0	15596	15596
11	0	0	19350	0	0	19350	19349
12	0	0	19458	8155	0	11303	19459
13	0	0	19314	7891	0	11423	19316
14	0	0	19059	11306	0	7753	19060
15	0	0	19776	14352	0	5424	19776
16	0	0	19754	14884	0	4870	19754
17	0	0	19816	19816	0	0	19816
18	0	0	13950	906	0	13044	13949
19	0	0	12585	0	0	12585	12585
20	0	0	14483	0	0	14483	14483
21	0	0	14292	0	0	14292	14290
22	0	0	14273	0	0	14273	14273
23	0	0	19490	0	0	19490	19490
24	0	0	19780	0	0	19780	19782
25	0	0	15123	0	0	15123	15125
26	0	0	15417	0	0	15417	15417
27	0	0	16225	0	0	16225	16225
28	0	0	18389	0	0	18389	18389
29	0	0	13923	0	0	13923	13924
30	0	0	14560	0	0	14560	14559
31	0	0	14560	0	0	14560	14559
32	0	0	13217	0	0	13217	13217
33	0	0	14272	0	0	14272	14272
34	0	0	12560	0	0	12560	12558
35	0	0	14292	0	0	14292	14290
36	0	0	13522	0	0	13522	13522
37	0	0	14093	0	0	14093	14094
38	0	0	13947	0	0	13947	13948
39	0	0	13408	0	0	13408	13407
40	0	0	13577	0	0	13577	13577
41	0	0	15503	0	0	15503	15502
42	0	0	12605	0	0	12605	12604
43	0	0	16476	0	0	16476	16477
44	0	0	18493	0	0	18493	18493
45	0	0	19107	0	0	19107	19107
46	0	0	14184	0	0	14184	14185
47	0	0	13515	0	0	13515	13516
48	0	0	11611	0	0	11611	11611
49	0	0	16465	0	0	16465	16465
50	0	0	19278	0	0	19278	19277
PERIOD TOTALS		0	792310	77310	0	715000	792311
PERIOD AVERAGES		0	15846	1546	0	14300	15846

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 11 MEDINACO

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3399	0	0	0	0
2	0	0	3399	0	0	0	0
3	0	0	3399	0	0	0	0
4	0	0	3399	0	0	0	0
5	0	0	3399	0	0	0	0
6	0	0	3399	0	0	0	0
7	0	0	3399	0	0	0	0
8	0	0	3399	0	0	0	0
9	0	0	3399	0	0	0	0
10	0	0	3399	0	0	0	0
11	0	0	3399	0	0	0	0
12	0	0	3399	0	0	0	0
13	0	0	3399	0	0	0	0
14	0	0	3399	0	0	0	0
15	0	0	3399	0	0	0	0
16	0	0	3399	0	0	0	0
17	0	0	3399	0	0	0	0
18	0	0	3399	0	0	0	0
19	0	0	3399	0	0	0	0
20	0	0	3399	0	0	0	0
21	0	0	3399	0	0	0	0
22	0	0	3399	0	0	0	0
23	0	0	3399	0	0	0	0
24	0	0	3399	0	0	0	0
25	0	0	3399	0	0	0	0
26	0	0	3399	0	0	0	0
27	0	0	3399	0	0	0	0
28	0	0	3399	0	0	0	0
29	0	0	3399	0	0	0	0
30	0	0	3399	0	0	0	0
31	0	0	3399	0	0	0	0
32	0	0	3399	0	0	0	0
33	0	0	3399	0	0	0	0
34	0	0	3399	0	0	0	0
35	0	0	3399	0	0	0	0
36	0	0	3399	0	0	0	0
37	0	0	3399	0	0	0	0
38	0	0	3399	0	0	0	0
39	0	0	3399	0	0	0	0
40	0	0	3399	0	0	0	0
41	0	0	3399	0	0	0	0
42	0	0	3399	0	0	0	0
43	0	0	3399	0	0	0	0
44	0	0	3399	0	0	0	0
45	0	0	3399	0	0	0	0
46	0	0	3399	0	0	0	0
47	0	0	3399	0	0	0	0
48	0	0	3399	0	0	0	0
49	0	0	3399	0	0	0	0
50	0	0	3399	0	0	0	0
PERIOD TOTALS		0	169950	0	0	0	
PERIOD AVERAGES		0	3399	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 12 BANDCO L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3100	0	0	0	0
2	0	0	3100	0	0	0	0
3	0	0	3100	0	0	0	0
4	0	0	3100	0	0	0	0
5	0	0	3100	0	0	0	0
6	0	0	3100	0	0	0	0
7	0	0	3100	0	0	0	0
8	0	0	3100	0	0	0	0
9	0	0	3100	0	0	0	0
10	0	0	3100	0	0	0	0
11	0	0	3100	0	0	0	0
12	0	0	3100	411	0	0	0
13	0	0	3100	382	0	0	0
14	0	0	3100	298	0	0	0
15	0	0	3100	1425	0	0	0
16	0	0	3100	539	0	0	0
17	0	0	3100	1300	0	0	0
18	0	0	3100	332	0	0	0
19	0	0	3100	0	0	0	0
20	0	0	3100	0	0	0	0
21	0	0	3100	0	0	0	0
22	0	0	3100	0	0	0	0
23	0	0	3100	0	0	0	0
24	0	0	3100	0	0	0	0
25	0	0	3100	0	0	0	0
26	0	0	3100	0	0	0	0
27	0	0	3100	0	0	0	0
28	0	0	3100	0	0	0	0
29	0	0	3100	0	0	0	0
30	0	0	3100	0	0	0	0
31	0	0	3100	0	0	0	0
32	0	0	3100	0	0	0	0
33	0	0	3100	0	0	0	0
34	0	0	3100	0	0	0	0
35	0	0	3100	0	0	0	0
36	0	0	3100	0	0	0	0
37	0	0	3100	0	0	0	0
38	0	0	3100	0	0	0	0
39	0	0	3100	0	0	0	0
40	0	0	3100	0	0	0	0
41	0	0	3100	0	0	0	0
42	0	0	3100	0	0	0	0
43	0	0	3100	0	0	0	0
44	0	0	3100	0	0	0	0
45	0	0	3100	0	0	0	0
46	0	0	3100	0	0	0	0
47	0	0	3100	0	0	0	0
48	0	0	3100	0	0	0	0
49	0	0	3100	0	0	0	0
50	0	0	3100	0	0	0	0
PERIOD TOTALS		0	155000	4687	0	0	
PERIOD AVERAGES		0	3100	93	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/ CONV W/O PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 13 CNA LOSS

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	7137	0	0	0	0
2	0	0	6717	0	0	0	0
3	0	0	6850	0	0	0	0
4	0	0	7454	0	0	0	0
5	0	0	6846	0	0	0	0
6	0	0	6852	0	0	0	0
7	0	0	7082	0	0	0	0
8	0	0	6986	0	0	0	0
9	0	0	7578	0	0	0	0
10	0	0	7006	0	0	0	0
11	0	0	7541	0	0	0	0
12	0	0	6999	2035	0	0	0
13	0	0	7026	1929	0	0	0
14	0	0	6840	2616	0	0	0
15	0	0	6807	3903	0	0	0
16	0	0	6585	4211	0	0	0
17	0	0	6497	6301	0	0	0
18	0	0	6627	355	0	0	0
19	0	0	6634	0	0	0	0
20	0	0	6859	0	0	0	0
21	0	0	6837	0	0	0	0
22	0	0	6834	0	0	0	0
23	0	0	7565	0	0	0	0
24	0	0	7604	0	0	0	0
25	0	0	6943	0	0	0	0
26	0	0	6980	0	0	0	0
27	0	0	7093	0	0	0	0
28	0	0	7402	0	0	0	0
29	0	0	6791	0	0	0	0
30	0	0	6870	0	0	0	0
31	0	0	6870	0	0	0	0
32	0	0	6705	0	0	0	0
33	0	0	6834	0	0	0	0
34	0	0	6629	0	0	0	0
35	0	0	6837	0	0	0	0
36	0	0	6743	0	0	0	0
37	0	0	6810	0	0	0	0
38	0	0	6795	0	0	0	0
39	0	0	6724	0	0	0	0
40	0	0	6745	0	0	0	0
41	0	0	6994	0	0	0	0
42	0	0	6636	0	0	0	0
43	0	0	7127	0	0	0	0
44	0	0	7415	0	0	0	0
45	0	0	7505	0	0	0	0
46	0	0	6822	0	0	0	0
47	0	0	6742	0	0	0	0
48	0	0	6528	0	0	0	0
49	0	0	7127	0	0	0	0
50	0	0	7530	0	0	0	0
PERIOD TOTALS		0	347960	21350	0	0	
PERIOD AVERAGES		0	6959	427	0	0	

TABLE B-4

WITH IRRIGATION CONSERVATION
WITH ASR
WITH PEARSON LAKE

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

NUMBER OF MONTHS WITH SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
			.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
6	BANDCO R	2068	588.	2.	1.	1.	5.	0.	1.	0.	1.	1.	0.	12.
8	BMWA1995	6000	600.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	BMWA1991	5574	600.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	BMA IRRI	VARIES	561.	2.	2.	0.	1.	2.	3.	1.	1.	2.	25.	39.
11	MEDINACO	3400	600.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	BANDCO L	3102	579.	0.	1.	0.	3.	1.	0.	2.	1.	1.	12.	21.

DEMAND FAILURE PROBABILITIES FOR SHORTAGES WITHIN SPECIFIC PERCENTAGE RANGES OF THE FULL MONTHLY DEMAND AMOUNTS

NODE	NAME	FULL DEMAND A-F/YR	------- SHORTAGE EXPRESSED AS A PERCENTAGE RANGE OF THE FULL MONTHLY DEMAND AMOUNTS --------											
			.0% thru .0%	.1% thru 10.0%	10.1% thru 20.0%	20.1% thru 30.0%	30.1% thru 40.0%	40.1% thru 50.0%	50.1% thru 60.0%	60.1% thru 70.0%	70.1% thru 80.0%	80.1% thru 90.0%	90.1% thru 100.0%	0.1% thru 100.0%
6	BANDCO R	2068	98.0	.3	.2	.2	.8	.0	.2	.0	.2	.2	.0	2.0
8	BMWA1995	6000	100.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
9	BMWA1991	5574	100.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10	BMA IRRI	VARIES	93.5	.3	.3	.0	.2	.3	.5	.2	.2	.3	4.2	6.5
11	MEDINACO	3400	100.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
12	BANDCO L	3102	96.5	.0	.2	.0	.5	.2	.0	.3	.2	.2	2.0	3.5

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 1 MEDINA L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	254823	0	56626	232	15998	0	198268
2	198268	0	57857	286	11044	99416	238539
3	238539	0	56908	89	10854	0	228348
4	228348	0	55937	0	19806	0	133182
5	133182	0	56797	0	11594	0	133245
6	133245	0	61403	0	18337	0	141130
7	141130	0	60434	0	8359	0	130212
8	130212	0	60069	0	21002	0	112318
9	112318	0	48897	0	9758	0	38325
10	38325	0	27449	0	4539	0	54441
11	54441	0	31865	0	5312	0	8530
12	8530	0	31992	3269	951	0	0
13	0	0	31822	3885	391	0	170
14	170	0	31524	7326	564	0	11233
15	11233	0	32366	12336	757	0	0
16	0	0	32342	11291	17	0	0
17	0	0	32413	22916	16	0	0
18	0	0	35818	1368	6004	0	113383
19	113383	0	57969	0	6027	98082	254823
20	254823	0	56910	0	9734	0	236715
21	236715	0	56984	0	11871	0	244912
22	244912	0	56922	0	15124	38949	211902
23	211902	0	61860	0	15612	0	117935
24	117935	0	49025	0	9015	0	31041
25	31041	0	26892	0	3467	0	63370
26	63370	0	37947	0	6518	0	64407
27	64407	0	28189	0	6067	0	69247
28	69247	0	30735	0	5446	0	45577
29	45577	0	56620	168	10648	0	114087
30	114087	0	55418	0	4520	0	124664
31	124664	0	60029	0	15409	0	124245
32	124245	0	56758	0	8284	60388	254823
33	254823	0	60087	0	14395	47132	245218
34	245218	0	59944	0	2978	267414	254823
35	254823	0	60086	0	15129	33164	254823
36	254823	0	59925	0	16762	155905	235538
37	235538	0	60153	0	7124	49849	254823
38	254823	0	59933	0	20574	102283	227881
39	227881	0	59945	0	12066	130758	254823
40	254823	0	59940	0	15784	156167	229401
41	229401	0	60214	0	18118	0	210157
42	210157	0	59854	0	10261	217988	254823
43	254823	0	60399	0	19005	9015	211609
44	211609	0	60782	0	14396	0	151750
45	151750	0	56208	0	16056	0	81505
46	81505	0	60267	0	10832	0	140012
47	140012	0	59989	0	8185	37859	254821
48	254821	0	59655	0	11488	390824	246906
49	246906	0	60292	0	26118	0	205664
50	205664	0	60805	0	19959	0	120725
PERIOD TOTALS		0	2573255	63166	532275	1895193	
PERIOD AVERAGES		0	51465	1263	10645	37903	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 2 DIVRSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	1506	957	53526	232	346	0	1506
2	1506	731	54757	286	219	0	1506
3	1506	1163	53808	89	225	0	1506
4	1506	78	52837	0	473	0	1506
5	1506	302	53697	0	329	0	1506
6	1506	817	58303	0	473	0	1506
7	1506	1487	57334	0	261	0	1506
8	1506	115	56969	0	594	0	1506
9	1506	118	45797	0	482	0	1506
10	1506	438	24349	0	241	0	1506
11	1506	129	28765	0	474	0	1506
12	1506	164	28892	3219	249	0	0
13	0	436	28722	3503	196	0	1506
14	1506	329	28424	7028	156	0	1506
15	1506	79	29266	10911	228	0	0
16	0	80	29242	10752	0	0	0
17	0	34	29313	21616	0	0	0
18	0	1990	32718	1036	255	0	1506
19	1506	1258	54869	0	109	0	1506
20	1506	294	53810	0	197	0	1506
21	1506	449	53884	0	258	0	1506
22	1506	136	53822	0	305	0	1506
23	1506	60	58760	0	412	0	1506
24	1506	46	45925	0	458	0	1506
25	1506	686	23792	0	365	0	1506
26	1506	1523	34847	0	292	0	1506
27	1506	69	25089	0	320	0	1506
28	1506	391	27635	0	376	0	1506
29	1506	1095	53520	168	303	0	1506
30	1506	353	52318	0	189	0	1506
31	1506	410	56929	0	424	0	1506
32	1506	257	53658	0	302	0	1506
33	1506	2515	56987	0	280	0	1506
34	1506	3432	56844	0	65	0	1506
35	1506	1358	56986	0	295	0	1506
36	1506	1033	56825	0	327	0	1506
37	1506	1011	57053	0	145	0	1506
38	1506	1192	56833	0	408	0	1506
39	1506	594	56845	0	268	0	1506
40	1506	1479	56840	0	311	0	1506
41	1506	262	57114	0	406	0	1506
42	1506	1802	56754	0	203	0	1506
43	1506	719	57299	0	380	0	1506
44	1506	269	57682	0	346	0	1506
45	1506	185	53108	0	551	0	1506
46	1506	1524	57167	0	302	0	1506
47	1506	2570	56889	0	224	0	1506
48	1506	4266	56555	0	225	0	1506
49	1506	223	57192	0	538	0	1506
50	1506	39	57705	0	506	0	1506
PERIOD TOTALS		40947	2418255	58840	15291	0	
PERIOD AVERAGES		818	48365	1176	305	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 3 PEARSN L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	3000	0	34492	232	295	0	3000
2	3000	0	35706	286	186	0	3000
3	3000	0	34761	89	192	0	3000
4	3000	0	33828	0	405	0	3000
5	3000	0	34669	0	282	0	3000
6	3000	0	42156	0	405	0	3000
7	3000	0	42312	0	222	0	3000
8	3000	0	42069	0	507	0	3000
9	3000	0	32743	0	412	0	3000
10	3000	0	15596	0	206	0	3000
11	3000	0	19350	0	405	0	3000
12	3000	0	19458	2810	280	0	0
13	0	0	19314	3002	286	0	3000
14	3000	0	19059	5988	252	0	3000
15	3000	0	19776	9105	295	0	0
16	0	0	19754	9571	207	0	0
17	0	0	19816	19100	0	0	0
18	0	0	21101	906	221	0	3000
19	3000	0	35811	0	94	0	3000
20	3000	0	34765	0	169	0	3000
21	3000	0	34846	0	220	0	3000
22	3000	0	34790	0	261	0	3000
23	3000	0	42197	0	352	0	3000
24	3000	0	32835	0	392	0	3000
25	3000	0	15123	0	310	0	3000
26	3000	0	22440	0	250	0	3000
27	3000	0	16225	0	273	0	3000
28	3000	0	18389	0	321	0	3000
29	3000	0	34870	168	258	0	3000
30	3000	0	37751	0	164	0	3000
31	3000	0	42187	0	363	0	3000
32	3000	0	39716	0	260	0	3000
33	3000	0	42295	0	240	0	3000
34	3000	0	42455	0	54	0	3000
35	3000	0	42291	0	252	0	3000
36	3000	0	42265	0	280	0	3000
37	3000	0	42392	0	123	0	3000
38	3000	0	42198	0	349	0	3000
39	3000	0	42307	0	228	0	3000
40	3000	0	42272	0	268	0	3000
41	3000	0	42206	0	348	0	3000
42	3000	0	42356	0	174	0	3000
43	3000	0	42219	0	324	0	3000
44	3000	0	42244	0	296	0	3000
45	3000	0	38384	0	471	0	3000
46	3000	0	42279	0	259	0	3000
47	3000	0	42330	0	192	0	3000
48	3000	0	42334	0	193	0	3000
49	3000	0	42112	0	460	0	3000
50	3000	0	42129	0	432	0	3000
PERIOD TOTALS		0	1704973	51257	13688	0	
PERIOD AVERAGES		0	34099	1025	273	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 4 ASR PROJ

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	50000	22311	0	232	0	0	72311
2	72311	25622	0	286	0	0	97933
3	97933	24506	0	89	0	0	122439
4	122439	19992	0	0	0	0	142431
5	142431	24479	0	0	0	0	166910
6	166910	8090	0	0	0	0	175000
7	175000	0	0	0	0	0	175000
8	175000	0	0	0	0	0	175000
9	175000	0	3742	0	0	0	171258
10	171258	0	8971	0	0	0	162287
11	162287	0	8971	0	0	0	153316
12	153316	0	12481	0	0	0	140835
13	140835	0	14539	0	0	0	126296
14	126296	0	13741	0	0	0	112555
15	112555	0	13783	0	0	0	98772
16	98772	0	14971	0	0	0	83801
17	83801	0	14971	0	0	0	68830
18	68830	9000	8367	0	0	0	69463
19	69463	26443	0	0	0	0	95906
20	95906	24479	0	0	0	0	120385
21	120385	24628	0	0	0	0	145013
22	145013	24610	0	0	0	0	169623
23	169623	5377	0	0	0	0	175000
24	175000	0	3742	0	0	0	171258
25	171258	0	8971	0	0	0	162287
26	162287	9000	5921	0	0	0	165366
27	165366	0	8971	0	0	0	156395
28	156395	0	8971	0	0	0	147424
29	147424	24954	565	168	0	0	171813
30	171813	4632	1445	0	0	0	175000
31	175000	0	0	0	0	0	175000
32	175000	1104	1104	0	0	0	175000
33	175000	0	0	0	0	0	175000
34	175000	0	0	0	0	0	175000
35	175000	0	0	0	0	0	175000
36	175000	0	0	0	0	0	175000
37	175000	0	0	0	0	0	175000
38	175000	0	0	0	0	0	175000
39	175000	0	0	0	0	0	175000
40	175000	0	0	0	0	0	175000
41	175000	0	0	0	0	0	175000
42	175000	0	0	0	0	0	175000
43	175000	0	0	0	0	0	175000
44	175000	0	0	0	0	0	175000
45	175000	0	1193	0	0	0	173807
46	173807	1193	0	0	0	0	175000
47	175000	0	0	0	0	0	175000
48	175000	0	0	0	0	0	175000
49	175000	0	0	0	0	0	175000
50	175000	0	0	0	0	0	175000
PERIOD TOTALS		280420	155420	775	0	0	
PERIOD AVERAGES		5608	3108	15	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 5 GROUNDWT

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	4000	0	0	0	0	0	4000
2	4000	0	0	0	0	0	4000
3	4000	0	0	0	0	0	4000
4	4000	0	0	0	0	0	4000
5	4000	0	0	0	0	0	4000
6	4000	0	0	0	0	0	4000
7	4000	0	0	0	0	0	4000
8	4000	0	0	0	0	0	4000
9	4000	0	0	0	0	0	4000
10	4000	0	0	0	0	0	4000
11	4000	0	0	0	0	0	4000
12	4000	0	0	0	0	0	4000
13	4000	0	0	0	0	0	4000
14	4000	0	0	0	0	0	4000
15	4000	0	0	0	0	0	4000
16	4000	0	0	0	0	0	4000
17	4000	0	0	0	0	0	4000
18	4000	0	0	0	0	0	4000
19	4000	0	0	0	0	0	4000
20	4000	0	0	0	0	0	4000
21	4000	0	0	0	0	0	4000
22	4000	0	0	0	0	0	4000
23	4000	0	0	0	0	0	4000
24	4000	0	0	0	0	0	4000
25	4000	0	0	0	0	0	4000
26	4000	0	0	0	0	0	4000
27	4000	0	0	0	0	0	4000
28	4000	0	0	0	0	0	4000
29	4000	0	0	0	0	0	4000
30	4000	0	0	0	0	0	4000
31	4000	0	0	0	0	0	4000
32	4000	0	0	0	0	0	4000
33	4000	0	0	0	0	0	4000
34	4000	0	0	0	0	0	4000
35	4000	0	0	0	0	0	4000
36	4000	0	0	0	0	0	4000
37	4000	0	0	0	0	0	4000
38	4000	0	0	0	0	0	4000
39	4000	0	0	0	0	0	4000
40	4000	0	0	0	0	0	4000
41	4000	0	0	0	0	0	4000
42	4000	0	0	0	0	0	4000
43	4000	0	0	0	0	0	4000
44	4000	0	0	0	0	0	4000
45	4000	0	0	0	0	0	4000
46	4000	0	0	0	0	0	4000
47	4000	0	0	0	0	0	4000
48	4000	0	0	0	0	0	4000
49	4000	0	0	0	0	0	4000
50	4000	0	0	0	0	0	4000
PERIOD TOTALS		0	0	0	0	0	
PERIOD AVERAGES		0	0	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 6 BANDCO R

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	88206	2068	0	0	0	0
2	0	280700	2068	0	0	0	0
3	0	129781	2068	0	0	0	0
4	0	52471	2068	0	0	0	0
5	0	135945	2068	0	0	0	0
6	0	132321	2068	0	0	0	0
7	0	93033	2068	0	0	0	0
8	0	100863	2068	0	0	0	0
9	0	28201	2068	0	0	0	0
10	0	99238	2068	0	0	0	0
11	0	36968	2068	0	0	0	0
12	0	33095	2068	0	0	0	0
13	0	38081	2068	148	0	0	0
14	0	45448	2068	67	0	0	0
15	0	15085	2068	171	0	0	0
16	0	17246	2068	0	0	0	0
17	0	5140	2068	391	0	0	0
18	0	196689	2068	44	0	0	0
19	0	373403	2068	0	0	0	0
20	0	122193	2068	0	0	0	0
21	0	149458	2068	0	0	0	0
22	0	151894	2068	0	0	0	0
23	0	31876	2068	18	0	0	0
24	0	14396	2068	0	0	0	0
25	0	104311	2068	0	0	0	0
26	0	101197	2068	0	0	0	0
27	0	92017	2068	0	0	0	0
28	0	60202	2068	0	0	0	0
29	0	200136	2068	0	0	0	0
30	0	111118	2068	0	0	0	0
31	0	111168	2068	0	0	0	0
32	0	293824	2068	0	0	0	0
33	0	151925	2068	0	0	0	0
34	0	376657	2068	0	0	0	0
35	0	149540	2068	0	0	0	0
36	0	254094	2068	0	0	0	0
37	0	176836	2068	0	0	0	0
38	0	196868	2068	0	0	0	0
39	0	269262	2068	0	0	0	0
40	0	246755	2068	0	0	0	0
41	0	100276	2068	0	0	0	0
42	0	370983	2068	0	0	0	0
43	0	88939	2068	0	0	0	0
44	0	58203	2068	0	0	0	0
45	0	44188	2068	0	0	0	0
46	0	164261	2068	0	0	0	0
47	0	254878	2068	0	0	0	0
48	0	489532	2068	0	0	0	0
49	0	89087	2068	0	0	0	0
50	0	39287	2068	0	0	0	0
PERIOD TOTALS		6967275	103400	839	0	0	
PERIOD AVERAGES		139345	2068	16	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 7 DIV LEAK

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	12540	0	0	0	0
2	0	0	12539	0	0	0	0
3	0	0	12540	0	0	0	0
4	0	0	12540	0	0	0	0
5	0	0	12540	0	0	0	0
6	0	0	12540	0	0	0	0
7	0	0	12540	0	0	0	0
8	0	0	12540	0	0	0	0
9	0	0	12473	0	0	0	0
10	0	0	12290	0	0	0	0
11	0	0	9886	0	0	0	0
12	0	0	3025	0	0	0	0
13	0	0	1707	0	0	0	0
14	0	0	2033	0	0	0	0
15	0	0	2181	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	8866	0	0	0	0
19	0	0	12539	0	0	0	0
20	0	0	12540	0	0	0	0
21	0	0	12540	0	0	0	0
22	0	0	12540	0	0	0	0
23	0	0	12540	0	0	0	0
24	0	0	12265	0	0	0	0
25	0	0	8377	0	0	0	0
26	0	0	12540	0	0	0	0
27	0	0	12539	0	0	0	0
28	0	0	10751	0	0	0	0
29	0	0	12540	0	0	0	0
30	0	0	12540	0	0	0	0
31	0	0	12540	0	0	0	0
32	0	0	12540	0	0	0	0
33	0	0	12540	0	0	0	0
34	0	0	12537	0	0	0	0
35	0	0	12540	0	0	0	0
36	0	0	12540	0	0	0	0
37	0	0	12539	0	0	0	0
38	0	0	12540	0	0	0	0
39	0	0	12540	0	0	0	0
40	0	0	12540	0	0	0	0
41	0	0	12540	0	0	0	0
42	0	0	12539	0	0	0	0
43	0	0	12540	0	0	0	0
44	0	0	12540	0	0	0	0
45	0	0	12540	0	0	0	0
46	0	0	12540	0	0	0	0
47	0	0	12540	0	0	0	0
48	0	0	12540	0	0	0	0
49	0	0	12540	0	0	0	0
50	0	0	12540	0	0	0	0
PERIOD TOTALS		0	547826	0	0	0	
PERIOD AVERAGES		0	10956	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 8 BMWA1995

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	6000	0	0	0	0
2	0	0	6000	0	0	0	0
3	0	0	6000	0	0	0	0
4	0	0	6000	0	0	0	0
5	0	0	6000	0	0	0	0
6	0	0	6000	0	0	0	0
7	0	0	6000	0	0	0	0
8	0	0	6000	0	0	0	0
9	0	0	6000	0	0	0	0
10	0	0	6000	0	0	0	0
11	0	0	6000	0	0	0	0
12	0	0	6000	0	0	0	0
13	0	0	6000	0	0	0	0
14	0	0	6000	0	0	0	0
15	0	0	6000	0	0	0	0
16	0	0	6000	0	0	0	0
17	0	0	6000	0	0	0	0
18	0	0	6000	0	0	0	0
19	0	0	6000	0	0	0	0
20	0	0	6000	0	0	0	0
21	0	0	6000	0	0	0	0
22	0	0	6000	0	0	0	0
23	0	0	6000	0	0	0	0
24	0	0	6000	0	0	0	0
25	0	0	6000	0	0	0	0
26	0	0	6000	0	0	0	0
27	0	0	6000	0	0	0	0
28	0	0	6000	0	0	0	0
29	0	0	6000	0	0	0	0
30	0	0	6000	0	0	0	0
31	0	0	6000	0	0	0	0
32	0	0	6000	0	0	0	0
33	0	0	6000	0	0	0	0
34	0	0	6000	0	0	0	0
35	0	0	6000	0	0	0	0
36	0	0	6000	0	0	0	0
37	0	0	6000	0	0	0	0
38	0	0	6000	0	0	0	0
39	0	0	6000	0	0	0	0
40	0	0	6000	0	0	0	0
41	0	0	6000	0	0	0	0
42	0	0	6000	0	0	0	0
43	0	0	6000	0	0	0	0
44	0	0	6000	0	0	0	0
45	0	0	6000	0	0	0	0
46	0	0	6000	0	0	0	0
47	0	0	6000	0	0	0	0
48	0	0	6000	0	0	0	0
49	0	0	6000	0	0	0	0
50	0	0	6000	0	0	0	0
PERIOD TOTALS		0	300000	0	0	0	
PERIOD AVERAGES		0	6000	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 9 BMWA1991

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	5572	0	0	0	0
2	0	0	5572	0	0	0	0
3	0	0	5572	0	0	0	0
4	0	0	5572	0	0	0	0
5	0	0	5572	0	0	0	0
6	0	0	5572	0	0	0	0
7	0	0	5572	0	0	0	0
8	0	0	5572	0	0	0	0
9	0	0	5572	0	0	0	0
10	0	0	5572	0	0	0	0
11	0	0	5572	0	0	0	0
12	0	0	5572	0	0	0	0
13	0	0	5572	0	0	0	0
14	0	0	5572	0	0	0	0
15	0	0	5572	0	0	0	0
16	0	0	5572	0	0	0	0
17	0	0	5572	0	0	0	0
18	0	0	5572	0	0	0	0
19	0	0	5572	0	0	0	0
20	0	0	5572	0	0	0	0
21	0	0	5572	0	0	0	0
22	0	0	5572	0	0	0	0
23	0	0	5572	0	0	0	0
24	0	0	5572	0	0	0	0
25	0	0	5572	0	0	0	0
26	0	0	5572	0	0	0	0
27	0	0	5572	0	0	0	0
28	0	0	5572	0	0	0	0
29	0	0	5572	0	0	0	0
30	0	0	5572	0	0	0	0
31	0	0	5572	0	0	0	0
32	0	0	5572	0	0	0	0
33	0	0	5572	0	0	0	0
34	0	0	5572	0	0	0	0
35	0	0	5572	0	0	0	0
36	0	0	5572	0	0	0	0
37	0	0	5572	0	0	0	0
38	0	0	5572	0	0	0	0
39	0	0	5572	0	0	0	0
40	0	0	5572	0	0	0	0
41	0	0	5572	0	0	0	0
42	0	0	5572	0	0	0	0
43	0	0	5572	0	0	0	0
44	0	0	5572	0	0	0	0
45	0	0	5572	0	0	0	0
46	0	0	5572	0	0	0	0
47	0	0	5572	0	0	0	0
48	0	0	5572	0	0	0	0
49	0	0	5572	0	0	0	0
50	0	0	5572	0	0	0	0
PERIOD TOTALS		0	278600	0	0	0	
PERIOD AVERAGES		0	5572	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 10 BMA IRRI

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	NET USEAGE	HIST USEAGE
1	0	0	16537	0	0	16537	16536
2	0	0	13319	0	0	13319	13319
3	0	0	14431	0	0	14431	14430
4	0	0	18767	0	0	18767	18767
5	0	0	14386	0	0	14386	14386
6	0	0	14409	0	0	14409	14411
7	0	0	16137	0	0	16137	16139
8	0	0	15450	0	0	15450	15449
9	0	0	19576	0	0	19576	19576
10	0	0	15596	0	0	15596	15596
11	0	0	19350	0	0	19350	19349
12	0	0	19458	2810	0	16648	19459
13	0	0	19314	3002	0	16312	19316
14	0	0	19059	5988	0	13071	19060
15	0	0	19776	9105	0	10671	19776
16	0	0	19754	9571	0	10183	19754
17	0	0	19816	19100	0	716	19816
18	0	0	13950	906	0	13044	13949
19	0	0	12585	0	0	12585	12585
20	0	0	14483	0	0	14483	14483
21	0	0	14292	0	0	14292	14290
22	0	0	14273	0	0	14273	14273
23	0	0	19490	0	0	19490	19490
24	0	0	19780	0	0	19780	19782
25	0	0	15123	0	0	15123	15125
26	0	0	15417	0	0	15417	15417
27	0	0	16225	0	0	16225	16225
28	0	0	18389	0	0	18389	18389
29	0	0	13923	0	0	13923	13924
30	0	0	14560	0	0	14560	14559
31	0	0	14560	0	0	14560	14559
32	0	0	13217	0	0	13217	13217
33	0	0	14272	0	0	14272	14272
34	0	0	12560	0	0	12560	12558
35	0	0	14292	0	0	14292	14290
36	0	0	13522	0	0	13522	13522
37	0	0	14093	0	0	14093	14094
38	0	0	13947	0	0	13947	13948
39	0	0	13408	0	0	13408	13407
40	0	0	13577	0	0	13577	13577
41	0	0	15503	0	0	15503	15502
42	0	0	12605	0	0	12605	12604
43	0	0	16476	0	0	16476	16477
44	0	0	18493	0	0	18493	18493
45	0	0	19107	0	0	19107	19107
46	0	0	14184	0	0	14184	14185
47	0	0	13515	0	0	13515	13516
48	0	0	11611	0	0	11611	11611
49	0	0	16465	0	0	16465	16465
50	0	0	19278	0	0	19278	19277
PERIOD TOTALS		0	792310	50482	0	741828	792311
PERIOD AVERAGES		0	15846	1009	0	14836	15846

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 11 MEDINACO

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3399	0	0	0	0
2	0	0	3399	0	0	0	0
3	0	0	3399	0	0	0	0
4	0	0	3399	0	0	0	0
5	0	0	3399	0	0	0	0
6	0	0	3399	0	0	0	0
7	0	0	3399	0	0	0	0
8	0	0	3399	0	0	0	0
9	0	0	3399	0	0	0	0
10	0	0	3399	0	0	0	0
11	0	0	3399	0	0	0	0
12	0	0	3399	0	0	0	0
13	0	0	3399	0	0	0	0
14	0	0	3399	0	0	0	0
15	0	0	3399	0	0	0	0
16	0	0	3399	0	0	0	0
17	0	0	3399	0	0	0	0
18	0	0	3399	0	0	0	0
19	0	0	3399	0	0	0	0
20	0	0	3399	0	0	0	0
21	0	0	3399	0	0	0	0
22	0	0	3399	0	0	0	0
23	0	0	3399	0	0	0	0
24	0	0	3399	0	0	0	0
25	0	0	3399	0	0	0	0
26	0	0	3399	0	0	0	0
27	0	0	3399	0	0	0	0
28	0	0	3399	0	0	0	0
29	0	0	3399	0	0	0	0
30	0	0	3399	0	0	0	0
31	0	0	3399	0	0	0	0
32	0	0	3399	0	0	0	0
33	0	0	3399	0	0	0	0
34	0	0	3399	0	0	0	0
35	0	0	3399	0	0	0	0
36	0	0	3399	0	0	0	0
37	0	0	3399	0	0	0	0
38	0	0	3399	0	0	0	0
39	0	0	3399	0	0	0	0
40	0	0	3399	0	0	0	0
41	0	0	3399	0	0	0	0
42	0	0	3399	0	0	0	0
43	0	0	3399	0	0	0	0
44	0	0	3399	0	0	0	0
45	0	0	3399	0	0	0	0
46	0	0	3399	0	0	0	0
47	0	0	3399	0	0	0	0
48	0	0	3399	0	0	0	0
49	0	0	3399	0	0	0	0
50	0	0	3399	0	0	0	0
PERIOD TOTALS		0	169950	0	0	0	
PERIOD AVERAGES		0	3399	0	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 12 BANDCO L

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	3100	0	0	0	0
2	0	0	3100	0	0	0	0
3	0	0	3100	0	0	0	0
4	0	0	3100	0	0	0	0
5	0	0	3100	0	0	0	0
6	0	0	3100	0	0	0	0
7	0	0	3100	0	0	0	0
8	0	0	3100	0	0	0	0
9	0	0	3100	0	0	0	0
10	0	0	3100	0	0	0	0
11	0	0	3100	0	0	0	0
12	0	0	3100	50	0	0	0
13	0	0	3100	382	0	0	0
14	0	0	3100	298	0	0	0
15	0	0	3100	1425	0	0	0
16	0	0	3100	539	0	0	0
17	0	0	3100	1300	0	0	0
18	0	0	3100	332	0	0	0
19	0	0	3100	0	0	0	0
20	0	0	3100	0	0	0	0
21	0	0	3100	0	0	0	0
22	0	0	3100	0	0	0	0
23	0	0	3100	0	0	0	0
24	0	0	3100	0	0	0	0
25	0	0	3100	0	0	0	0
26	0	0	3100	0	0	0	0
27	0	0	3100	0	0	0	0
28	0	0	3100	0	0	0	0
29	0	0	3100	0	0	0	0
30	0	0	3100	0	0	0	0
31	0	0	3100	0	0	0	0
32	0	0	3100	0	0	0	0
33	0	0	3100	0	0	0	0
34	0	0	3100	0	0	0	0
35	0	0	3100	0	0	0	0
36	0	0	3100	0	0	0	0
37	0	0	3100	0	0	0	0
38	0	0	3100	0	0	0	0
39	0	0	3100	0	0	0	0
40	0	0	3100	0	0	0	0
41	0	0	3100	0	0	0	0
42	0	0	3100	0	0	0	0
43	0	0	3100	0	0	0	0
44	0	0	3100	0	0	0	0
45	0	0	3100	0	0	0	0
46	0	0	3100	0	0	0	0
47	0	0	3100	0	0	0	0
48	0	0	3100	0	0	0	0
49	0	0	3100	0	0	0	0
50	0	0	3100	0	0	0	0
PERIOD TOTALS		0	155000	4326	0	0	
PERIOD AVERAGES		0	3100	86	0	0	

BMA/MEDINA CO REGIONAL WATER STUDY - DIVERSION @ 919 W/CONV W/ PEARSON L & ASR

SIMULATION PERIOD TOTAL SUMMARY BY NODE 13 CAN LOSS

YEAR	START STRG	UNREG FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG
1	0	0	7462	0	0	0	0
2	0	0	7479	0	0	0	0
3	0	0	7475	0	0	0	0
4	0	0	7437	0	0	0	0
5	0	0	7456	0	0	0	0
6	0	0	4575	0	0	0	0
7	0	0	3450	0	0	0	0
8	0	0	3328	0	0	0	0
9	0	0	3806	0	0	0	0
10	0	0	2753	0	0	0	0
11	0	0	3415	0	0	0	0
12	0	0	3434	409	0	0	0
13	0	0	3408	501	0	0	0
14	0	0	3365	1040	0	0	0
15	0	0	3490	1806	0	0	0
16	0	0	3488	1181	0	0	0
17	0	0	3497	2516	0	0	0
18	0	0	4202	130	0	0	0
19	0	0	7486	0	0	0	0
20	0	0	7473	0	0	0	0
21	0	0	7466	0	0	0	0
22	0	0	7460	0	0	0	0
23	0	0	4991	0	0	0	0
24	0	0	3842	0	0	0	0
25	0	0	2669	0	0	0	0
26	0	0	4512	0	0	0	0
27	0	0	2864	0	0	0	0
28	0	0	3246	0	0	0	0
29	0	0	7429	0	0	0	0
30	0	0	3892	0	0	0	0
31	0	0	3170	0	0	0	0
32	0	0	3056	0	0	0	0
33	0	0	3120	0	0	0	0
34	0	0	2817	0	0	0	0
35	0	0	3123	0	0	0	0
36	0	0	2988	0	0	0	0
37	0	0	3089	0	0	0	0
38	0	0	3063	0	0	0	0
39	0	0	2966	0	0	0	0
40	0	0	2996	0	0	0	0
41	0	0	3336	0	0	0	0
42	0	0	2826	0	0	0	0
43	0	0	3508	0	0	0	0
44	0	0	3866	0	0	0	0
45	0	0	3893	0	0	0	0
46	0	0	3316	0	0	0	0
47	0	0	2987	0	0	0	0
48	0	0	2649	0	0	0	0
49	0	0	3508	0	0	0	0
50	0	0	4004	0	0	0	0
PERIOD TOTALS		0	211131	7583	0	0	
PERIOD AVERAGES		0	4222	151	0	0	

APPENDIX C

TEXAS WATER DEVELOPMENT BOARD COMMENTS

TEXAS WATER DEVELOPMENT BOARD

May 20, 1999

Mr. John W. Ward, III
Vice President and General Manager
Bexar-Medina-Atascosa Counties Water
Control and Improvement District No. 1
P.O. Box 170
Natalia, Texas 78059

Re: Regional Water Supply Planning Contract Between Bexar-Medina-Atascosa Counties Water Control and Improvement District No.1 (District) and the Texas Water Development Board (Board), TWDB Contract No. 96-483-156

Dear Mr. Ward:

Staff members of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 96-483-156. As stated in the above referenced contract, the District will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The District must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Mr. Gilbert Ward, the Board's Contract Manager, at (512) 463-6418 if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles, Ph.D., P.E.
Deputy Executive Administrator
Office of Planning

cc: James E. Blackwell, P.E.
Gilbert R. Ward, TWDB

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P.O. Box 13231 • 1700 N. Congress Avenue • Austin, Texas 78711-3231
Telephone (512) 463-7847 • Telefax (512) 475-2053 • 1-800- RELAY TX (for the hearing impaired)
URL Address: http://www.twdb.state.tx.us • E-Mail Address: info@twdb.state.tx.us

ATTACHMENT 1
TEXAS WATER DEVELOPMENT BOARD

REVIEW COMMENTS:
Bexar-Medina-Atascosa Counties Water Control and Improvement District No. 1
Contract No. 96-483-156

- It appears that all items of the Scope of Work have been addressed. The following are Board Staff comments:

- Pg 1-8, 3rd para. A non-geologist may not understand what a synclinorium or a geosyncline is, perhaps further definition is necessary to help clarify.

- Pg 3-13, 5th para. The last sentence indicates groundwater flows from the northeast to the southeast, please tie this to specific locations within Medina County to help this make more sense. Pg 1-8, 2nd para, says water in the "Edwards usually moves in either a southward or eastward direction, but locally controlled by faults."

- Pg. 3-22, 1st para, last sentence, Please explain or clarify what "prolithic" means....It is assumed that this is a typo and should read "prolific."

- Pg. 4-3 Chacon Dam and Lake --- Last sentence is incomplete.

- Pg 5-6 The study is complete and report finished. The report should provide a better description and detail the results pertinent to this study.

- There should be a report summary with final results and comparisons.

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