

CITY OF ALAMOGORDO

40-YEAR WATER DEVELOPMENT PLAN 2000 - 2040

March 2003



LIVINGSTON ASSOCIATES, P.C.
Consulting Engineers

JOHN SHOMAKER & ASSOCIATES, INC.



in association with
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500 Tenth Street, Ste. 300

Alamogordo, NM 88310

(505) 439-8588

in association with:

JOHN SHOMAKER & ASSOCIATES, INC.



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Table of Contents

0.0.	EXECUTIVE SUMMARY	1
1.0.	INTRODUCTION	5
2.0.	SURFACE WATER RESOURCES	10
	Alamo Canyon	13
	La Luz Creek	13
	Bonito Lake	14
3.0.	GROUND WATER RESOURCES	16
	La Luz Well Field	19
4.0.	WATER DEMAND	22
	Present Demands	22
	Projected Populations	22
	Projected Water Demands	23
5.0.	WATER CONSERVATION PLAN	24
6.0.	WATER BUDGET	26
	Supply vs. Demand	26
	Water Supply Needs	27
7.0.	WATER SUPPLY ALTERNATIVES	29
	Water Quality Considerations	29
	Water Supply Alternative Considerations	29
	Desalination	30
	Water Conservation	30
	Reclaimed Water	31
	Bonito Lake Water	31
	Aquifer Storage and Recovery	32
	Outside Water Purchases	33
	Prather Wells	33
	Other Alternatives Considered Not Feasible at This Time	34
8.0.	WATER DEVELOPMENT PLAN	36
	Water Development Recommendations	36

Figures

Appendix

References

List of Tables

Table 2.1	Summary of Available Surface Water Data in the Region	10
Table 2.2	Major Watersheds in the Eastern Tularosa Basin, and Summary of Watershed Data and Estimated Yield	11
Table 2.3	Historical Diversions Measured at La Luz/Fresnal Flume, Alamo Canyon, and Bonito Lake	12
Table 2.4	Summary of Estimated Yield for Bonito Lake Watershed and Average Annual Runoff Captured by Bonito Lake	15
Table 3.1	Summary of Estimated Ground Water Recharge Rates and Recharge Components for Entire Region	17
Table 3.2	Estimated Total and Recoverable Volume of Ground Water Stored in the Eastern Tularosa Basin Area	18
Table 3.3	List of Well Data for the City of Alamogordo's La Luz Well Field, Otero County, New Mexico	20
Table 4.1	Projected Populations for City of Alamogordo for 2000 to 2040	22
Table 4.2	Projected Water Demands for City of Alamogordo 2000 to 2040	23
Table 6.1	Water Supply Source, Water Right, Firm Supply and Average 2001 Production for City of Alamogordo	26
Table 8.1	Proposed Desalination Well Field Pumping Schedule	36

List of Figures

Figure 1.1	Map of the Tularosa and Salt Basins
Figure 1.2	Graph of Precipitation and Surplus Vs Elevation for the Planning Region
Figure 1.3	Alamogordo and Tularosa Administrative Area Map
Figure 2.1	Alamo Canyon Water Diversions
Figure 2.2	La Luz-Fresnal Water Diversions
Figure 2.3	Bonito Lake Water Diversions
Figure 3.1	Map of Tularosa Basin Showing Distribution of Total Dissolved Solids in Basin-Fill Aquifer
Figure 3.2	Map of the Tularosa and Salt Basins Showing Water-Level Elevation Contours and Ground Water Flow Direction
Figure 3.3	Map of the La Luz Area Within the Tularosa Basin Showing Historic Water-Level Decline Contours
Figure 3.4	La Luz Well Field Pumping
Figure 6.1	Projected Water Supply and Demands
Figure 6.2	Projected Peak Day Supply and Demands
Figure 6.3	Projected Water Supply Deficit

0.0 EXECUTIVE SUMMARY

The population of the City of Alamogordo has increased by more than 20 percent over the last 10 years. The current population of approximately 36,000 is expected to increase to around 56,000 by the year 2040.

The current water demand for the City of Alamogordo averages about 6 million gallons per day (6,400 acre-feet per year), but peak demands in the summer can be as high as 13 million gallons per day. Future demand for water is projected to be more than 9 million gallons per day (10,400 acre-feet per year) by the year 2040, with summer peaks approaching 20 million gallons per day. The Alamogordo water supply comes from the following current sources (amounts are rounded):

Supply Source	Water Rights, AFY	Firm Supply, AFY	Avg. Production 2001, AFY
Bonito Lake	2.3735 cfs	0	742
La Luz- Fresno	891 AFY + 16 cfs	2,557	2,765
Alamo Canyon	3,078	750	887
La Luz Wells	4,573	1,093	2,003
Prather & Golf Course	1,354 & 270	0	0
Total	10,166 + 16 cfs + 2.3735 cfs	4,500	6,397

Seventy seven percent of the City of Alamogordo water supply is from surface water that is susceptible to drought. Expansion of the La Luz Well Field is not possible due to the hydrogeologic and administrative constraints, and would require blending with surface water or treatment to achieve a water quality of 800 mg/L TDS.

The majority of fresh water (less than 1,000 mg/L total dissolved solids) in the region is from surface water that originates in the Sacramento Mountains and from a small pocket of ground water south of Alamogordo. Additional surface water is not available to meet

increasing demand. The pumping of additional fresh ground water is limited by the Office of the State Engineer special administrative rules, physical quantity, and land ownership (more than half of the fresh ground water south of Alamogordo is beneath military lands). It is highly unlikely that the City could obtain water rights for this fresh ground water.

The City of Alamogordo's need for an additional water supply is urgent. Alamogordo has implemented conservation measures and reclaimed water to reduce potable water demands by more than 4 million gallons per day. Besides watering restrictions, landscaping and other measures, an aggressive water rate structure has been implemented to reduce consumption. These measures have resulted in the City of Alamogordo having one of the lowest per capita water use amounts in the State. The City is conserving about everything it can at this point in time. To meet peak summer demands, water is drawn from storage reservoirs at the La Luz Water Treatment Plant, but without stored water there is not enough supply to meet these current peak demands.

A number of alternatives to meeting current and future water demands were evaluated. The feasible alternatives include:

- Desalination of brackish ground water;
- Additional water conservation measures;
- Expanded reclaimed water use on turf irrigation and as industrial water;
- Bonito Lake watershed restoration and management to increase yield;
- Aquifer Storage and Recovery (ASR) using winter spring flows;
- Outside water purchases which meet water quality goals;
- Restore the old Prather wells (T-32 and T-32S).

There were also a number of alternatives evaluated, which were not considered feasible at this time. The feasible alternatives are less drought sensitive and produce real "wet" water in a timely manner, and of the quantity and quality needed by the City.

The most feasible alternative is desalination. There is a large volume of brackish ground water available (1,000 mg/L to 3,000 mg/L TDS) for a sustainable supply without impacting the regional agricultural economy. Desalination of this brackish water is the most feasible alternative for meeting City of Alamogordo future water demands, reducing the reliance on drought-sensitive surface water, and developing a long-term sustainable supply. The development of the desalination alternative is as follows:

- 1) To meet current and future average and peak daily water demands, drought contingency and firm supply, construct a desalination facility and conveyance infrastructure that has the minimum peak day capacity for at least 6.0 MGD initially; expand to a minimum capacity of 8.0 MGD by 2015; expand to a minimum capacity of 10.0 MGD by 2025; and expand to a minimum capacity of 13.0 MGD by 2040.

- 2) Develop well fields and water rights for the desalination facility to meet future 40-year supply demands along with drought protection and firm-yield contingencies. The overall ground water requirements for desalination are greater than the delivered supply amounts due to recovery of the desalination process (assumed at 70%). Develop well field capacity and water rights for up to 10,000 AFY.

- 3) Phase desalination well field pumping with annual maximum demand schedule as follows:

Period	Average Pumping rate AFY*	Average Pumping rate MGD
2000 - 2010	5,000	4.46
2010 - 2020	6,500	5.80
2020 - 2030	8,000	7.14
2030 - 2040	10,000	8.92

* - rounded for contingencies and regional water users

- 4) Develop agreements with water users in the planning region to provide them desalination project water (HAFB, Village of Tularosa, La Luz MDWCA, others) as recommended in the Tularosa Basin and Salt Basin Regional Water Plan, May 2002.

Other recommendations for water supply development are shown in Section 8.0.

This City of Alamogordo 40-Year Water Development Plan 2000 – 2040 is submitted pursuant to NMSA Section 72-1-9 (B) (1985).

1.0 INTRODUCTION

The City of Alamogordo differs from most municipalities in the State of New Mexico in the fact that the large majority of its historical water supply (approximately 70%) comes from surface water. These surface water sources in the Sacramento Mountains north and east of the City are very susceptible to drought and other conditions that diminish supply. In fact, available water from these sources has diminished severely in recent years.

The problem facing the City at this time is the lack of water, even though the City owns an abundance of water rights. For example, the City has surface water rights exceeding 16,000 acre feet per annum. In 2001 only 4,394 acre-feet of surface water was available for diversion and use.

The City's ground water right is very similar in that the City has ground water rights exceeding 4,500 acre feet per annum in a well field that, for many reasons, is now producing on average about 2,000 acre feet/year (2001). To pump at 4,500 acre feet per annum would not be possible for any length of time.

The City has been pro-active in its efforts to supply water. Water salvage through the use of reclaimed treated effluent is the prime example. After almost 10 years and millions of dollars, the reclaimed water project is supplying 3 million gallons per day of water for green space irrigation.

Conservation through the covering and enclosing of the storage reservoirs saves an estimated 650,000 gallons per day in the summer months. The inclining block rate structure has been very successful in reducing residential consumption of water, and efforts identified in the conservation plan will continue to reduce demand.

Over the last six years, the City has reduced its water supply needs by over 40% through these efforts. In doing so, all the rabbits have been pulled out of that hat. It is now time for the City to develop new water resources for current shortfalls and future growth and development.

Because of the large difference between water rights and wet water, a concept of firm supply from the different sources is used to calculate a “firm” supply of water for the City. The firm supply is based on the worst years in the record, which includes hydrologic and system limitations, and ultimately reflects reliability of supply. The difference between that firm supply and the current and future demands is the additional amount of water resources that the City will need to secure and developed under this Plan.

This 40-year water development plan was developed for the City of Alamogordo by Livingston Associates, P.C., and John Shomaker & Associates, Inc. The contents of the plan include analysis of available water resources, existing supplies, water demand, and water supply alternatives.

The purpose of the Plan is to: 1) identify existing water supplies; 2) identify existing water needs; 3) identify future water needs; 4) identify water conservation savings; 5) identify future sources of water; 6) plan for the next 40-years and acquire new sources of water from alternatives to meet future needs.

The water-planning Region for the City of Alamogordo (sub-Region 3 on **Fig. 1.1**) primarily encompasses the eastern part of the Tularosa Underground Water Basin. The water-planning Region will be referred to as the Region, or the water-planning Region, throughout this report. Currently, the City of Alamogordo derives about 70 percent of its water supply from surface water that originates from the Sacramento Mountains (and Bonito Lake), and the remaining 30 percent from the La Luz Well Field completed in the basin-fill aquifer. The Tularosa Underground Water Basin was declared by an order of the New Mexico State Engineer on July 7, 1982 and includes about 6,000 square miles.

Availability of fresh ground water in the Tularosa Basin is limited by State Engineer administrative controls, geology and supply. In addition, all of the surface water has been fully appropriated.

The water-planning Region's eastern boundary is along the crest of the Sacramento Mountains from Three Rivers to the Oro Grande area approximately 40 miles south of Alamogordo. Military boundaries make up the planning Region's western boundary. The water-planning Region is approximately 80 miles long and 20 miles wide and is located only within Otero County. The Region primarily encompasses the New Mexico Office of the State Engineer (NMOSE) Alamogordo-Tularosa Administrative Area (refer to **Figure 1.3**).

Temperature and precipitation vary within the Region because of the differences in land surface altitude. The lower elevation portion of the Region reflects an arid climate and the Sacramento Mountain portion along the eastern boundary of the Region reflects semiarid climates. Most of the precipitation falls during mid-summer as intense thunderstorms and as winter precipitation (rain on the basin floor and snow at higher elevations). Summer precipitation is during July through September. The average annual rainfall is about 12 inches (8 to 11 inches in the basin and 12 to 28 inches at higher altitudes). **Figure 1.2** is a graph showing the relationship between precipitation and surplus precipitation (precipitation in excess of evaporation) with elevation. Surplus precipitation is defined as the remaining precipitation after evapo-transpiration (ET) losses. The major recharge to the Region is through snow pack in the higher elevations. For the last ten years, a substantial reduction in snow pack in the watersheds feeding the spring systems has caused drought conditions (see Appendix for snowfall information and reduction in La Luz-Fresnal spring flows).

The Tularosa Basin is a hydrologic closed basin composed of basin-fill deposits in the center portion and bedrock in the surrounding mountain watersheds. Almost all of the water for the Region is surface water originating from the watersheds along the west side of the Sacramento Mountains, and ground water from the high-yield basin-fill deposits.

Some domestic water supplies are obtained from the bedrock aquifer in the Sacramento Mountains. Ground water flow in the Region is from east to west, originating in the recharge areas along the crest of the Sacramento Mountains, and discharging to the playa lakes in the basin center (see **Fig. 3.2**).

The higher elevation Sacramento Mountain escarpment receives more precipitation and is covered with forests that give rise to several small streams that discharge into the desert. Most of the streams are perennial in their upper reaches and derive their base flow from runoff, primarily as snowmelt, on the western slopes of the Sacramento Mountains. All streams carry flood-flow from infrequent thunderstorms. Only the large drainage areas on the western slope of the Sacramento Mountains contain streams with any appreciable base flow, which is derived largely from snowmelt. These streams include Three Rivers, Rio Tularosa, La Luz Creek, and Alamo Canyon. Part of the total runoff recharges the basin-fill aquifer. Most of the available surface water in the planning Region has been appropriated for use with the exception of surface water in Rinconada Canyon (Temporal Creek). Surface water from Three Rivers, Rio Tularosa, La Luz-Fresnal Canyon, Alamo Canyon, and Sacramento River is diverted for irrigation, domestic, and municipal use.

The water-planning Region is located entirely within the Tularosa Underground Water Basin. In May of 1997, the New Mexico Office of the State Engineer published criteria for water rights administration in the Alamogordo-Tularosa Administrative Area, a sub-area within the Basin centered on Tularosa and Alamogordo. The location of the Alamogordo-Tularosa Administrative Area is shown on **Figure 1.3**. (Each administrative block is ½ square mile. The yellow blocks shown on **Figure 1.3** are deemed critical, orange blocks are near critical and gray blocks represent the Sacramento Mountains in which the administrative criteria do not apply).

New appropriations for fresh ground water are limited or nil, under the current administrative criteria (where model cells are critical or near critical). This places a legal constraint on any further fresh ground water development within the Region.

The majority of the Region is rural, and agriculture and military related enterprises are dominant. As of 1997, the total irrigable area in Otero County was 19,290 acres and the total area irrigated was 8,650 acres. While the water-planning Region encompasses only a small portion of Otero County, most of the irrigated acreage in Otero County is located around Alamogordo, La Luz, Tularosa and Boles Acres, within the planning Region.

The combined population of the Region is about 52,000 persons, including rural water systems and self-supplied homes which represent approximately 8,000 persons.

For the City of Alamogordo, the majority of it's water supply is spring flows from the La Luz-Fresnal Canyon system, which flow via collection structures and pipelines to the La Luz Water Treatment Plant (WTP), located at the north end of Alamogordo. Bonito Lake water also flows via 90 miles of pipeline to the La Luz WTP. Additional spring flows from the Alamo Canyon and Caballero Canyon systems flow via pipeline to the Alamo Canyon Water Treatment Plant, located at the southeastern end of Alamogordo.

Ground water is used primarily during the summer months to augment the surface water supply, and is derived from seven wells within the La Luz Well Field, located at the northern end of the City. Recently, ground water has been used more due to the drought causing reduced surface water supplies.

Raw water storage reservoirs, totaling 188 million gallons (MG) in capacity, are used to store water at the La Luz WTP prior to treatment. Two of the three open-top reservoirs (144 MG) have been covered to eliminate evaporation loss. The third reservoir is scheduled to be covered this fall.

At the Alamogordo Water Reclamation Plant, almost 4 million gallons per day (MGD) of sewage is treated and used for turf and green-space irrigation.

2.0 SURFACE-WATER RESOURCES

The spring flows from the Sacramento Mountains vary seasonally, and are generally greater in the spring months. Spring (and stream) flows generally occur after all of the demands for water in the watershed are satisfied (ie; vegetation use, evaporation, wells, etc.). In wet years, rainfall and snowmelt runoff can be a substantial contributor to the amount of stream flow available for diversion. Storm-water runoff from summer thunderstorms occurs rapidly and is difficult to capture.

The U. S. Geological Survey (USGS) has limited daily base flow and peak flow measurements for Tularosa Creek at Bent and near Tularosa, and for Alamo Creek, La Luz Creek and the Sacramento River. Only peak flow for Three Rivers was measured by the USGS from 1955 to 1977. A summary of available surface-water data is presented as **Table 2.1**, and shows period of record and annual mean stream flow in acre-feet per year (AFY).

Table 2.1 Summary of Available Surface Water Data in the Region

Station Name	Period of Record	Annual Mean Stream Flow, AFY
Tularosa Creek near Bent, NM	1948-95	9,495
Rio Tularosa near Tularosa, NM	1939-46	11,091
Rio La Luz near La Luz, NM	1911-12	8,536
Rio Fresnal near Mountain Park, NM	1911-12	1,050
Rio La Luz at La Luz, NM	1910-13; 1982-89	8,694
Alamo Creek near Alamogordo, NM	1933-50	1,283
Sacramento River near Sunspot, NM	1984-89	2,173

Listed in **Table 2.2** is a comparison of estimated watershed yield and estimated or measured base stream flow for watersheds in the Region along the Sacramento Mountains. The watershed yield decreases to the south as a result of decrease in mean elevation and total area of the watersheds. Total watershed yield for the Region is estimated at 77,619 AFY, and total stream flow is estimated at 47,099 AFY. The difference between watershed yield and stream flow may be considered as losses to

storage in soil (vadose zone) and recharge to the bedrock aquifer in the watershed area above the mountain front. This indicates approximately 60 percent of the watershed yield in the Eastern Tularosa Basin area becomes stream flow, and 40 percent becomes recharge to the mountain bedrock or is lost to soil storage.

Table 2.2. Major Watersheds in the Eastern Tularosa Basin, and Summary of Watershed Data and Estimated Yield

Watershed Name	Map ID ²	Mean Annual Precip, in/yr	Elevation, ft	Watershed area, mi ²	Estimated Mean Annual Stream Flow AFY	Estimated Watershed Yield AFY
Eastern Basin						
Three Rivers at Three R.	17	22.0	6,568	86.5	8,326	9,097
Boone and Salinas Draws	18	21.0	7,300	32.7	na	1,261
Rinconada Canyon	19	21.2	6,840	97.5	9,194	10,897
Tularosa Canyon at Tularosa	20	21.2	7,280	157.0	17,520	25,237
Domingo & Rancheria Canyons	21	17.1	6,410	34.4	na	1,249
Cottonwood Wash	22	18.3	6,750	15.4	na	2,149
La Luz Canyon	23	21.1	7,464	65.2	5,285	10,906
Dry Canyon	24	19.4	7,093	9.0	318	1,276
Beeman Canyon	25	15.3	5,930	2.0	na	87
Watershed between Beeman and Marble Canyons	26	15.5	6,015	4.5	na	175
Marble Canyon	27	17.1	6,237	3.5	72	232
Alamo Canyon	28	21.0	7,146	24.9	1,433	3,462
Mule Canyon	29	16.2	6,207	6.7	159	984
San Andres Canyon	30	21.7	7,467	14.8	746	2,532
Dog Canyon	31	20.8	7,392	10.5	442	1,679
Mountain front between Dog and Escondido Canyons	32	16.8	6,327	2.6	na	173
Escondido Canyon	33	19.9	7,083	11.0	434	1,448
Mountain front between Escondido and Bug Scuffle	34	15.5	6,090	8.6	na	585
Bug Scuffle Canyon	35	19.5	6,730	12.3	492	1,190
Grapevine Canyon	36	19.4	6,415	33.5	1,875	2,293
Pipeline Canyon		14.3	5,353	6.1	116	0
Culp Canyon	37	14.3	5,765	23.2	687	707
Eastern Basin total					47,099	77,619

¹ Waltemeyer, USGS, (2001)
² watershed map ID on Figure 1.1

The City of Alamogordo relies on diversions from La Luz-Fresnal Creek, Alamo Creek, and Bonito Lake for surface water supply. **Table 2.3** summarizes the annual surface water diversions, and shows the average diversion for the period of record, the standard deviation, and the diversion exceeded 95 percent of the time, based on the two-sigma standard deviation.

The firm supplies of these surface-water supply sources were determined from historical gaging records. The diversions that exceeded 95 percent of the time are an estimation of the firm supply from each of these sources. The firm supply may be defined as the maximum annual supply from a given source that is expected to be available on demand, with the understanding that lower yields will occur five percent of the time.

Table 2.3 Historical diversions measured at La Luz/Fresnal Flume, Alamo Canyon, and Bonito Lake

year	La Luz/Fresnal diversion, ac-ft	Alamo Canyon diversion, ac-ft	Bonito Lake diversion, ac-ft
1986	3047	1872	1757
1987	4326	1920	a
1988	5137	1340	1715
1989	4237	1471	a
1990	5032	1414	1359
1991	3869	1623	1637
1992	5782	2081	786
1993	5099	1760	748
1994	5529	1490	b
1995	5389	1368	a
1996	5383	1260	b
1997	5740	1111	1236
1998	4425	1106	1282
1999	3542	1108	788
2000	3334	1121	543
2001	2765	888	1484
average diversion, ac-ft	4540	1433	1212
standard deviation, ac-ft	991	342	431
diversion exceeded 95% of the time, ac-ft	2557	750	350

a no data available
b incomplete record

Alamo Canyon

Alamo Canyon, which has a drainage area of 25 square miles, debouches from the Sacramento Mountains into the lowlands of the Tularosa Basin about 3 miles southeast of Alamogordo. When the City was founded in 1898 its original water supply was brought by pipeline from Alamo Creek. Stream flow measurements from Alamo Creek from 1930 to 1950 indicated an average of 1,283 AFY (**Table 2.1**), and the USGS has estimated stream flow in Alamo Creek to average 1,422 AFY (**Table 2.2**). The chemical quality of the water is generally good; it commonly contains about 500 mg/L dissolved solids and about 130 mg/L sulfate. The water rights of Alamo Creek (3,078 AFY) are owned by the City of Alamogordo. The City has extended its pipeline upstream to utilize springs in Alamo Canyon and its tributaries. A graph showing the diversions from Alamo Canyon is provided as **Figure 2.1**. Diversions from Alamo Canyon have averaged 1,433 AFY over the last 15 years (**Table 2.3** and **Fig. 2.1**). The firm supply is estimated at 750 AFY (**Table 2.3**).

La Luz Creek

La Luz Creek is a perennial stream fed by springs along La Luz and Fresnal Canyons and their tributaries. The drainage area of La Luz Creek above the community of La Luz is about 75 square miles. La Luz, located 6 miles north of Alamogordo, was established in 1864, and later the communities of Mountain Park and High Rolls were established upstream along Fresnal Canyon. The City of Alamogordo owns approximately 12,500 AFY of water rights associated with La Luz Creek. The USGS gauged daily base flow in La Luz Creek from 1982 to 1990, which showed an average daily base flow of 12 CFS or 8,694 AFY (**Table 2.1**). The total dissolved solids content of La Luz Creek water varies from 672 mg/L at a spring in Fresnal Canyon to 1,700 mg/L near the La Luz railway station.

A graph showing the diversions from La Luz Creek is provided as **Figure 2.2**. Diversions from La Luz Creek have averaged 4,540 AFY over the last 15 years (see

Table 2.3), but a significant decline in water diverted from La Luz Creek has occurred for the last four years (**Fig. 2.2**).

The recent decline in diversions from La Luz Creek is largely due to drought conditions and subsequent lack of snow pack, but other water demands (including more than 480 domestic wells) in the La Luz Creek watershed have increased over the last 10 years and contribute to reducing stream flow. The firm supply of La Luz Creek is estimated at 2,557 AFY (**Table 2.3**).

Bonito Lake

Bonito Lake is located approximately 15 miles northwest of the Village of Ruidoso, within the Lower Pecos River Drainage Basin. The lake is owned and operated by the City of Alamogordo as a municipal water supply for Alamogordo, Holloman AFB, Carrizozo, Nogal and Ft. Stanton. Although the Lake is not physically within the Tularosa Basin, a 90-mile long pipeline carries Bonito lake water to Alamogordo and Holloman AFB. The City of Alamogordo and Holloman each own 1,449 AFY of water rights (2,898 AFY combined). Annual quantities of water received from Bonito Lake, less than the combined right, are split evenly between Alamogordo and Holloman. Other Bonito Lake water right holdings total approximately 190 AFY.

Water from Bonito Lake, superior in chemical quality at 300 mg/L TDS, is mixed with the spring and ground water at the La Luz Water Treatment Plant (WTP) to increase the overall supply and improve the quality.

Bonito Lake has a surface area of approximately 100 acres (US Bureau of Reclamation, 1989) with a maximum depth of about 75 feet. The lake was constructed in 1931 and drains a watershed of more than 21,000 acres.

An analysis of yield and potential runoff to Bonito Lake is summarized in **Table 2.4**. It is important to note that the estimated average annual runoff to Bonito Lake is nearly

equal to the total Bonito Lake water rights, and that the runoff (potential water captured) does not account for losses due to reservoir leakage and lake evaporation.

Table 2.4 Summary of Estimated Yield for Bonito Lake Watershed and Average Annual Runoff Captured by Bonito Lake.

Potential average annual yield for Bonito watershed	10,136 AFY
Potential average annual runoff captured by Bonito Lake	3,100 AFY
Runoff captured during drought years (50% avg. runoff)	1,550 AFY

The total water diversions from Bonito Lake to Alamogordo and Holloman AFB are listed in **Table 2.3**, and shown graphically on **Figure 2.3**.

The average annual diversion from Bonito Lake to the City of Alamogordo is only 606 AFY. Firm supply of Bonito Lake was estimated from the watershed analysis and not from the diversion data. The diversion data include periods of no diversion when the Bonito Pipeline was out of service for several of the years between 1986 and 2001, and does not provide a reliable statistical analysis of firm supply. The firm supply of Bonito Lake can be justified as the yield during drought conditions, which is estimated to be 50 percent of the average annual runoff (**Table 2.4**). Assuming one-half of the firm supply would be taken by Holloman AFB and 190 AFY by other users, the firm supply of Alamogordo's share would be about 680 AFY, which is essentially the average received by Alamogordo over the 15 years of record. It should be noted that the diversions from Bonito Lake over the period of record account for only about 5 to 14 percent of the overall water supply to Alamogordo, and is highly subject to drought conditions.

The Bonito Pipeline is currently being replaced, but it is unlikely that the full annual diversion of Bonito Lake water will be realized. For future planning and contingency purposes, it is assumed that the Bonito Lake supply (under extreme drought conditions) is unavailable (see **Table 5.1**).

3.0 GROUND WATER RESOURCES

Ground water in the Region can be divided into two generalized geologic settings: 1) the basin fill aquifer, and 2) the bedrock aquifer. The extent and total dissolved solids content of water in the basin fill aquifer is shown on **Figure 3.1**. The majority of the wells in the planning Region produce from the basin fill aquifer. The basin fill aquifer is known to have the highest well yields in the planning Region, suitable for irrigation and municipal supply. Well yield from the bedrock aquifer varies according to rock type and location, and may range from less than one gpm to over 1,000 gpm.

Recharge to the Eastern Tularosa Basin area was previously estimated at 14,500 AFY by the New Mexico Office of the State Engineer (NMOSE) (Morrison, 1989). Morrison's estimate was based on the stream flow, remaining after diversion, that infiltrated at the mountain front. This is a conservative estimate because it does not account for underflow from the bedrock aquifer to the basin fill or for smaller streams that contribute recharge to the basin fill. For this Plan, the recharge was estimated using the watershed analysis discussed in Section 2.0. Estimated recharge and components of recharge to the entire Region can be referenced from **Table 3.1**. Since development began, a 36-percent reduction in recharge to the basin fill aquifer has occurred as a result of stream flow diversions in the planning Region. It is important to note the reduction in recharge to the basin fill aquifer is concentrated at Tularosa, La Luz, and Alamo Canyon.

Table 3.1 Summary of Estimated Ground Water Recharge Rates and Recharge Components for Entire Region

Component	Estimated Rate, AFY
Prior to Development	
Recharge to basin fill from stream flow	47,000
Underflow from bedrock aquifer to basin fill*	20,000
Recharge to bedrock aquifer from precipitation	30,000
Total recharge to Region	77,000
Present Time	
Recharge to basin fill from stream flow	19,000
Underflow from bedrock aquifer to basin fill*	20,000
Recharge to bedrock aquifer from precipitation	30,000
Total recharge to Region	49,000

* - included in total recharge

Estimates of ground water in storage for different ranges in salinity are provided in **Table 3.2** and the distribution of salinity is shown on **Figure 3.1**. Fresh water storage (<1,000 mg/L TDS) within the Eastern Tularosa Basin area is mainly limited to alluvial fan (basin fill) deposits along the Sacramento Mountain front. The Region is estimated to have approximately 1.9 million acre-feet of recoverable fresh water from the basin fill aquifer. The estimated 3.8 million acre-feet of recoverable fresh water in the bedrock aquifer is located in the mountain watershed areas, and will yield low flows to small diameter wells, but large amounts of fresh water cannot be obtained. These estimates do not account for ground water removed from storage since ground water development began. Practically all of the fresh water in the Region is south of Alamogordo in the NMOSE administrative area or the Fort Bliss military lands (**Fig. 3.1**).

Table 3.2 Estimated Total and Recoverable Volume of Ground Water Stored in the Eastern Tularosa Basin Area

TDS Range (mg/ L)	Basin Fill	Basin Fill	Bedrock	Bedrock
	Total Volume in Storage (acre-feet)	Recoverable Volume in Storage (acre-feet)	Total Volume in Storage (acre-feet)	Recoverable Volume in Storage (acre-feet)
>10,000	2,764,800	691,200	0	0
5,000-10,000	46,786,560	11,696,640	0	0
4,000-5,000	22,256,640	5,564,160	0	0
3,000-4,000	27,095,040	6,773,760	599,040	299,520
2,000-3,000	6,819,840	1,704,960	1,739,520	869,760
1,000-2,000	44,928,000	11,232,000	11,669,760	5,834,880
<1,000	7,879,680	1,969,920	7,637,760	3,818,880
total	158,530,560	39,632,640	21,646,080	10,823,040

Notes:

- Total volume of water stored in basin fill is based on 1000 ft average saturated thickness and porosity of 0.2
- Total volume of water stored in bedrock is based on 1,000 ft average saturated thickness and porosity of 0.05
- Total volume of fresh water stored in basin fill is based on 500 ft average saturated thickness and porosity of 0.2 (area south of Alamogordo)
- Total volume of recoverable water stored in basin fill is based on ability of the aquifer to liberate one half of the total in storage to wells and specific yield of 0.1
- Total volume of recoverable water stored in bedrock is based on ability of the aquifer to liberate one half of the total in storage to wells and storage factor equal to 0.05

The estimate of total recoverable ground water with less than 3,000 mg/L TDS stored in the basin fill aquifer between Three Rivers and Orogrande is 14.9 million acre-feet, of which 3.73 million acre-feet would equal to dewatering the upper 250 ft of the aquifer. This would be equal to a ground-water yield of approximately 37,250 afy for 100 years. The NMOSE Administrative criteria for the Tularosa Basin may allow draw-downs of up to 2.5 feet per year, or, 250 feet over 100 years.

Fresh water in the basin fill aquifer south of Alamogordo is typically less than 500 ft in thickness, and in some areas dewatering 250 ft would remove one half of the thickness or potentially all of the fresh ground water. Besides the hydrologic limitations in this area, the NMOSE Administrative Criteria also limits the

appropriation of ground water. A preliminary administrative model run was attempted for this area and determined that additional appropriations would be difficult (Tularosa Basin and Salt Basin Regional Water Plan 2000 - 2040, May 2002).

Many of the irrigation wells in the Region that have high yields (>100 gpm) are located along the base of the mountain front where sediments are coarse grained. This zone of high well yield is 5 to 10 miles in width and contains ground water with a TDS ranging from 1,500 to 5,000 mg/L north of Alamogordo, and TDS less than 1,000 mg/L south of Alamogordo. Well yield decreases significantly with distance west of the Sacramento Mountain front, potentially from 1,000 down to 100 gpm (McLean, 1970).

Over the last twenty years domestic well drilling in the bedrock aquifer between High Rolls and Bent has significantly increased. Well yields in the bedrock aquifer vary drastically, from less than 1 gpm to over 100 gpm, and are highly dependent on local geologic conditions. Well yields in the bedrock aquifer can be reduced dramatically by a slight lowering of the water table, because of the decrease in permeability that occurs with depth.

La Luz Well Field

Some of the most prolific wells produce from the combined basin fill and bedrock aquifers. One example of production from the basin fill and bedrock aquifers is the City of Alamogordo's La Luz well field, where well yields range from 400 to 1,700 gpm. Alamogordo's La Luz well field is located a few miles north of Alamogordo. La Luz Well Field data are summarized in **Table 3.3**.

Table 3.3 List of Well Data for the City of Alamogordo’s La Luz Well Field, Otero County, New Mexico

Well	Well No. 2	Well No. 3	Well No. 4	Well No. 5	Well No. 6 repl.	Well No. 7	Well No. 8
Date drilled	1956	1957	1964	1965	1992	1971	1999
Total depth, ft	703	700	780	767	844	750	991
Water level, ft bgl	362	391	440	390	359	336	408
Water column, ft	341	309	340	377	485	414	583
pumping level, ft bgl	560	483	516	n/a	500	481	625
production rate, gpm	320	320	320	460	1450	850	250

ft bgl feet below ground level
 gpm/ft gallons per minute per foot
 n/a not available

The La Luz Well Field consists of seven wells, and is used to meet summer water demands when surface-water diversions are low. The well field is pumped approximately six months out of the year from April to September. Annual diversions from the La Luz Well Field have ranged from 147 to 2,674 AFY, with an average of 2,000 AFY over the last 5 years. The fluctuation in diversions from the well field has varied as a result of demand instead of aquifer capacity (see **Figure 3.4**).

Water level declines that have accumulated in the La Luz Well Field area over the last 45 years is shown on **Figure 3.3**. The average water level decline is approximately 0.5 ft/yr, but varies from well to well (see appended hydrographs). It is important to note that the observed water level declines in the La Luz Well Field area are a result of local and regional ground water pumping, and reduced recharge from captured stream flow. Additionally, the water quality diminishes throughout the pumping season.

Firm supply of La Luz Well Field is difficult to estimate because it would depend on management decisions, such as acceptable levels of long term drawdown and pumping rates of individual wells, and it depends on recharge and aquifer management. Recharge has been reduced significantly as a result of diversions from La Luz Creek and increased

demand on the aquifer by other users. The firm supply was estimated at 1,000 AFY by taking the average yield from the well field at peak demand (3,000 AFY) and subtracting the best well (Well 6 at 2,000 AFY).

4.0 WATER DEMAND

Present Demands

The City of Alamogordo average annual water demand is currently about 2.1 billion gallons (6,400 Acre-Feet) per year. Of this, approximately 60% is used by single-family residences; approximately 5% is used by multi-family residences; and about 35% is used by commercial, institutional and other uses. The average daily use approaches 6.0 million gallons per day (MGD) and the daily use during the June to August summer months peaks at about 13.0 MGD (refer to the Appendix for water production graphs).

Projected Populations

The City developed a *Comprehensive Plan 2000*, which projected population growth to the year 2020. In the Plan, population projections for low, medium and high growth scenarios were estimated by the University of New Mexico Bureau of Business and Economic Research (UNM-BBER). After public comment, the medium growth scenario was adopted for planning purposes. For this water plan, population projections from 2020 to 2040 were estimated for a medium growth scenario (also by UNM-BBER).

The following **Table 4.1** shows the projected populations for the City of Alamogordo for the period year 2000 to 2040:

Table 4.1 Projected Populations for City of Alamogordo for 2000 to 2040

Year	Future Projected Population	Difference from Yr 2000 Population	Percent Change from Yr 2000
2000	35,969	0	0%
2010	41,283	5,314	14%
2020	46,366	10,397	28%
2030	51,252	15,283	42%
2040	56,137	20,168	56%

Projected Water Demands

Future water demands for the City of Alamogordo were developed using averaged water use on a per capita basis. This assumes that the ratio of single- and multi-family residential, commercial/industrial and other water uses remain relatively constant for the planning period; however, a larger industrial component can be inferred. Two future water demand scenarios were developed: 1) per capita water use remains at the current level (165 gallons per capita per day, or GPCD) for the next 40-years; and 2) additional water conservation efforts reduces per capita consumption by an additional 10% over the planning period (evenly distributed over 40-years).

The following **Table 4.2** summarizes the projected water demands for both scenarios, and shows use in Acre-Feet/Year, Million Gallons/Year, Average Daily use in MGD and Peak Day use in MGD:

Table 4.2 Projected Water Demands for City of Alamogordo 2000 to 2040

Year	Water Demand at 165 GPCD Use				Water Demand reduced by 10% Conservation			
	AFY	MGalY	Avg MGD	Peak MGD	AFY	MGalY	Avg MGD	Peak MGD
2000	6,648	2,166	5.9	13.1	6,648	2,166	5.9	13.1
2010	7,609	2,479	6.8	14.9	7,419	2,417	6.6	14.6
2020	8,570	2,792	7.7	16.8	8,141	2,653	7.3	16.0
2030	9,473	3,087	8.5	18.6	8,762	2,855	7.8	17.2
2040	10,375	3,381	9.3	20.4	9,338	3,043	8.3	18.3

Note: Peak day use estimated at 2.2 times average day use.

5.0 WATER CONSERVATION PLAN

The City of Alamogordo has an aggressive existing water conservation program. The City's water conservation ordinances outline various policies for conserving water, including inverted block water rates, odd-even day watering, plumbing fixture rebates, higher surcharge rates for excessive use and limitations on car washing, swimming pool filling, restrictions on landscaping and others. The City is also considering a requirement to prohibit evaporative coolers on new home construction. Through conservation and the reclaimed water system (which off-sets potable water demands) the average City-wide (all uses) per capita water consumption has dropped from more than 250 gallons per person each day to less than 165 GPCD during 1994 – 2001. Also of great importance is that the residential-only water consumption has also dropped from more than 130 GPCD to nearly 90 GPCD during the same time period (see the **Appendix** for bar graphs).

In comparison, the City of Las Cruces average consumption is 251 GPCD (2000); Roswell is 283 GPCD; Hobbs is 284 GPCD and Carlsbad at 277 GPCD (Wilson, NMOSE).

Additionally, besides policy directives, the City has endeavored to conserve water (and extend the resources) through various projects. For instance, the City recently installed floating covers on over 1 million square feet of surface area on their raw water storage reservoirs, to inhibit water loss due to evaporation. It is estimated that more than 650,000 gallons per day of evaporation loss is saved during the hottest summer months.

In addition, the City's waterline replacement program has reduced system losses and dropped the unaccounted-for water to less than 12 percent, which is considered very good.

The spring collection systems have also been replaced or rehabilitated over the last 7 years to reduce evaporation loss, and pipe leakage, and improve overall delivery efficiency as well as water quality.

Beginning in about 1992, the reclaimed water system has been expanded to now conserve more than 3 million gallons per day of potable water during the spring to fall months, and beneficially uses this valuable resource on parks, ball fields and the golf course.

Through these water conservation efforts, the City of Alamogordo has reduced the need for additional potable water by more than 4 million gallons per day. The City of Alamogordo is a model community for water conservation and re-use efforts.

It is anticipated that the existing water conservation measures, enhanced with additional public education and water reduction measures, will reduce domestic use demands by an additional 10% over the planning period.

6.0 WATER BUDGET

Supply vs. Demand

For planning future water needs, the available water supply must satisfy the projected demands, plus contingencies. Because the major water supply for Alamogordo is derived from surface water (spring and stream flows) which is highly weather dependent, the average flows cannot be used. Rather, a more conservative (and likely) scenario is used, which considers drought conditions. A “firm” capacity for the water supply assumes reduced available flows due to drought, and that the largest single supply component is out of service. For computing future demands, a City-wide per capita usage of 165 GPCD is assumed. This is an average of the 1999 and 2001 GPCD figures, and is a prudent conservative approach when planning future water supply needs (see Appendix). A graphical representation of the annualized supply and demand (in acre-feet/year) is shown in **Figure 6.1**. **Table 6.1** below summarizes the water rights, firm supply (rounded w/contingency) and maximum diversion since 1990 for each current source of supply (all rounded). See Appendix:

Table 6.1 Water Supply Source, Water Right, Firm supply and Maximum Diversions Since 1990 for City of Alamogordo

Supply Source	Water Rights, AFY	Firm Supply, AFY	Max. Diverted Since 1990 AFY
Bonito Lake	2.3735 cfs	0	822
La Luz- Fresno	891.2	2,557	891
La Luz- Fresno	16 cfs	(with above)	4,892
Alamo Canyon	3,078	750	2,081
La Luz Wells	4,573	1,093	2,674
Prather Well	1,354	0	0
Golf Course Well	270	0	17
Total	10,166 + 16 cfs + 2.3735 cfs	4,500	

As indicated in the table above, the current water rights are substantially greater than the available “firm” supply. In addition, water quality constraints are not reflected in the above data, which in-fact may further limit ground water supply. As previously stated, the firm supply is based on the worst years in the record, which includes hydrologic and system limitations, and ultimately reflects reliability of supply.

The peak water demand during the summer is more than twice the average annual demand. During these peak summer months, the La Luz wells are pumped extensively, and the 188 million-gallon raw water storage reservoirs are drawn down to augment the surface water supply. The peak day “firm” supply assumes this condition, and conservatively uses a higher short-term supply for the wells and a storage reservoir draft of 2.5 million-gallons per day.

The peak day supply and demands are shown graphically (in million gallons per day) on **Figure 6.2**. The peak day demands exceed the supply by more than 3 million gallons per day currently, and more than 11 MGD by 2040.

Water Supply Needs

As shown in the **Figure 6.2**, the projected demands exceed the “firm” supply under current as well as future conditions. The City presently overcomes this shortfall by drawing down the raw water storage reservoirs at the La Luz Water Treatment Plant, and extensive pumping of the La Luz wells. Additionally, the firm supply figures have built-in redundancy and contingency, which indicates that under the current situation, the City is operating at an “all-out” condition, with no real back-up. For planning purposes, it is also assumed that the storage reservoirs will not have full capacity for drafting over extended periods, and the largest well is out of service. These added criteria define the “firm stand-by” available supply, which assumes not only a limited supply but also delivery capability.

Based on the previously discussed criteria, there is a deficit in peak water supply at the current time and it will continue in the future.

Fig. 6.3 shows the various water supply deficit scenarios in millions of gallons per day. It demonstrates that the average annual firm supply is deficient by close to 1.0 million gallons per day (1,120 AFY) now, and will be almost 4.0 million gallons per day (4,375 AFY) short by the year 2040. Additionally, the firm peak day supply is currently deficient by almost 4 million gallons per day, and by the year 2020, projected peak day demands will exceed the firm supply by more than 6 MGD. By the year 2040, an additional 10 MGD of firm supply will be needed. Under the firm stand-by scenario, the current supply is almost 6.0 MGD short, and will be deficient by more than 8.0 MGD by 2020 and 12.0 MGD by 2040.

Desalination

Desalination of the vast reserves of brackish ground water will produce the “wet” water needed to meet current and future demands, off-set the reduction of spring flows due to drought and provide an emergency supply. The quality of the desalinated water will meet the goal of less than 800 mg/L TDS.

A feasibility study for desalination of brackish water is currently under development (Livingston, Shomaker, et. al., 2002), and shows this alternative to be feasible with an acceptable implementation schedule. Of the alternatives considered, desalination is the only one that produces the quantity and quality of new water needed by the City of Alamogordo, in an acceptable time frame.

Additionally, desalination allows other potential users (HAFB, Village of Tularosa, La Luz, etc.) to participate in the project, as a regional municipal water supply. An additional 1.0 to 2.0 MGD capacity should be included in the project to satisfy the potential partner’s water demands. This alternative will produce from 6 MGD to 14 MGD additional water supply.

The costs associated with this alternative may range from \$20M to \$30M capital, and \$0.55 to \$0.65 per 1,000 gallons O&M.

Water Conservation

The City has adopted (and is currently adopting) a fairly aggressive water conservation program. This should be continued, and a goal of reducing water demands by at least another 10% is assumed. Educational programs, rebates for replacing existing plumbing fixtures, landscaping restrictions, change in water rate structure and other strategies will assist in water use reduction. An aggressive conservation program may produce (save) an additional 1 to 2 MGD of water supply over the planning period (see Section 5.0). This alternative cannot, by itself, provide the additional water supply needed by Alamogordo.

In addition, because it is tied to the existing supplies, it does not provide any additional drought protection.

The costs associated with this alternative are variable and are not determined.

Reclaimed Water

The reclaimed water system is a valuable resource. This reclaimed water is used for turf irrigation, and offsets potable water demands. Currently the City uses all of the 3.5 MGD reclaimed water during the summer months, and has plans to expand the system (Boyle, 2002). During the winter months, a large portion of the reclaimed water is not used for irrigation, and is diverted to Section 16 for disposal.

Besides the offset of potable water requirements, the reclaimed water system provides some level of return flow into the ground water system. Furthermore, with additional treatment, the reclaimed water produced during the winter months could be stored in the aquifer and pumped out during the summer irrigation months for turf irrigation, or used as an industrial water supply (depending on the nature of the industry.). Some matching funding is available through the US Bureau of Reclamation for reclaimed water projects. Added reclaimed water use may produce an additional (savings) in water supply of 1 MGD to 3 MGD over the planning period. This alternative cannot, by itself, provide the additional water supply needed by Alamogordo.

The costs associated with this alternative may range from \$3M to \$5M capital. and \$0.40 to \$0.50 per 1,000 gallons O&M

Bonito Lake Water

Currently, the Bonito Lake system does not deliver the full water right for the City of Alamogordo. Drought conditions have substantially reduced the amount of snow pack, and hence, watershed yield to the Lake. Historically, Bonito Lake has contributed only 5% to 15% of the water supply. Additionally, the storage capacity of the reservoir is

In addition, because it is tied to the existing supplies, it does not provide any additional drought protection.

The costs associated with this alternative are variable and are not determined.

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diminished due to sedimentation. A watershed restoration program could be implemented, which may increase the yield from the watershed by as much as 1,000 AFY. Additionally, watershed restoration also helps to protect the water quality. This alternative, however, is a long-term management program and it will take years to realize the additional water yield in the Lake. Additionally, the Bonito Lake watershed is primarily wilderness area, which may prohibit restoration efforts. This alternative cannot, by itself, provide the additional water supply needed by Alamogordo.

The costs associated with this alternative may range from \$6M to \$8M capital.

Aquifer Storage and Recovery (ASR)

Aquifer Storage and Recovery (ASR) will allow the City to store winter and spring flows in the La Luz well field aquifer, for pumping out during the peak summer months. A study was conducted (Livingston, Shomaker, 1997) which showed that an average of 2,000 AFY may be stored and recovered. All diverted and stored winter flows would be under the City's current water rights. This alternative is drought sensitive, however, as there may not be the winter spring flows available to store.

The stored water will maintain the original spring water quality (about 800 mg/L TDS). Additionally, an ASR program will allow for more flexible integrated water resource management, where desalinated water is used and some spring water is stored in the aquifer. Also, the ASR program will help "re-fill" and maintain the La Luz well field. A hybrid injection/recovery well was drilled in 2001 in the La Luz well field for the purpose of ASR, but the project is yet to be implemented. This alternative cannot, by itself, provide the additional water supply needed by Alamogordo.

The costs associated with this alternative may range from \$2M to \$3M capital and \$0.30 to \$0.50 per 1,000 gallons O&M.

Outside Water Purchases

As the market for water expands in the Region, some outside water purchases may be feasible. Any new water, however, should meet the City adopted quality goal of 800 mg/L TDS or less. Additionally, the facilities to convey the water into the City distribution system should be provided. The cost of purchased water should be less than the cost to produce the same quality/quantity of water under the desalination program. Lower TDS water which can be used for blending in the desalination program should also be considered.

The costs associated with this alternative are dependent on each proposal.

Prather Wells

The two old Prather wells (NMOSE No. T-32 and T-32S) are located approximately 6 miles south of Alamogordo, adjacent to and just west of Highway 54. These wells were used by the City of Alamogordo from 1954 to 1971. The wells are about 300 feet deep, and cased with 14-inch steel casing. A 10-inch pipeline was installed from the wells to a booster pumping station at the Highway 54/70 overpass, and then pumped up to Alamo Canyon storage tank. The pump station has been removed and the pipelines are not in working condition. The City pumped the combined wells until the mid 1960's, and then terminated the land lease agreement with the landowner (Dora Prather Cooley Longwell) in 1971. At the time, it was less expensive to pump from the La Luz wells, so the Prather wells were shut-down. These wells should be repaired and placed into service, and new piping installed to Alamogordo. The water quality from these wells is expected to be around 800 mg/L TDS. A report by W. F. Turney and Associates (January, 1955) recommends a maximum pumping rate of 700 GPM for each well, which can be used for summer peaking supply. A combined diversion annually would be about 1,340 AFY.

The costs associated with this alternative may range from \$1M to \$2M capital and \$0.40 to \$0.60 per 1,000 gallons O&M.

- 4) Develop agreements with water users in the planning region to provide them desalination project water (HAFB, Village of Tularosa, La Luz MDWCA, others) as recommended in the Tularosa Basin and Salt Basin Regional Water Plan, May 2002.
- 5) Develop an integrated water resource management plan that will optimize the operation of the various water supply sources, and develop best management practices.
- 6) Continue the water conservation program and reduce consumption by at least 10% more over the next 40 years. Implement covering of north raw water reservoir.
- 7) Expand the reclaimed water system as described in the master plan; evaluate the opportunity for winter water storage and use; evaluate the potential for industrial/economic development uses; evaluate the opportunity for funding improvements.
- 8) Implement a long-term watershed management program for the Bonito Lake watershed. Consider participation in watershed enhancement programs that potentially yield flows in the La Luz-Fresnal and Alamo Canyon systems. Evaluate the opportunity for funding improvements.
- 9) Develop the ASR program; extend the pilot/demonstration program; complete ASR permitting; implement ASR full-scale.
- 10) Evaluate opportunities for outside water purchases that meet the water quality criteria, delivery requirements, blending opportunities and cost comparisons.
- 11) Repair or replace the two old Prather wells to divert approximately 1,340 AFY, install infrastructure to pump into the existing water system.
- 12) Develop the remaining (and permitted) spring diversion on the La Luz-Fresnal system.

- 13) Continue replacement and upgrade of water system infrastructure to reduce losses.

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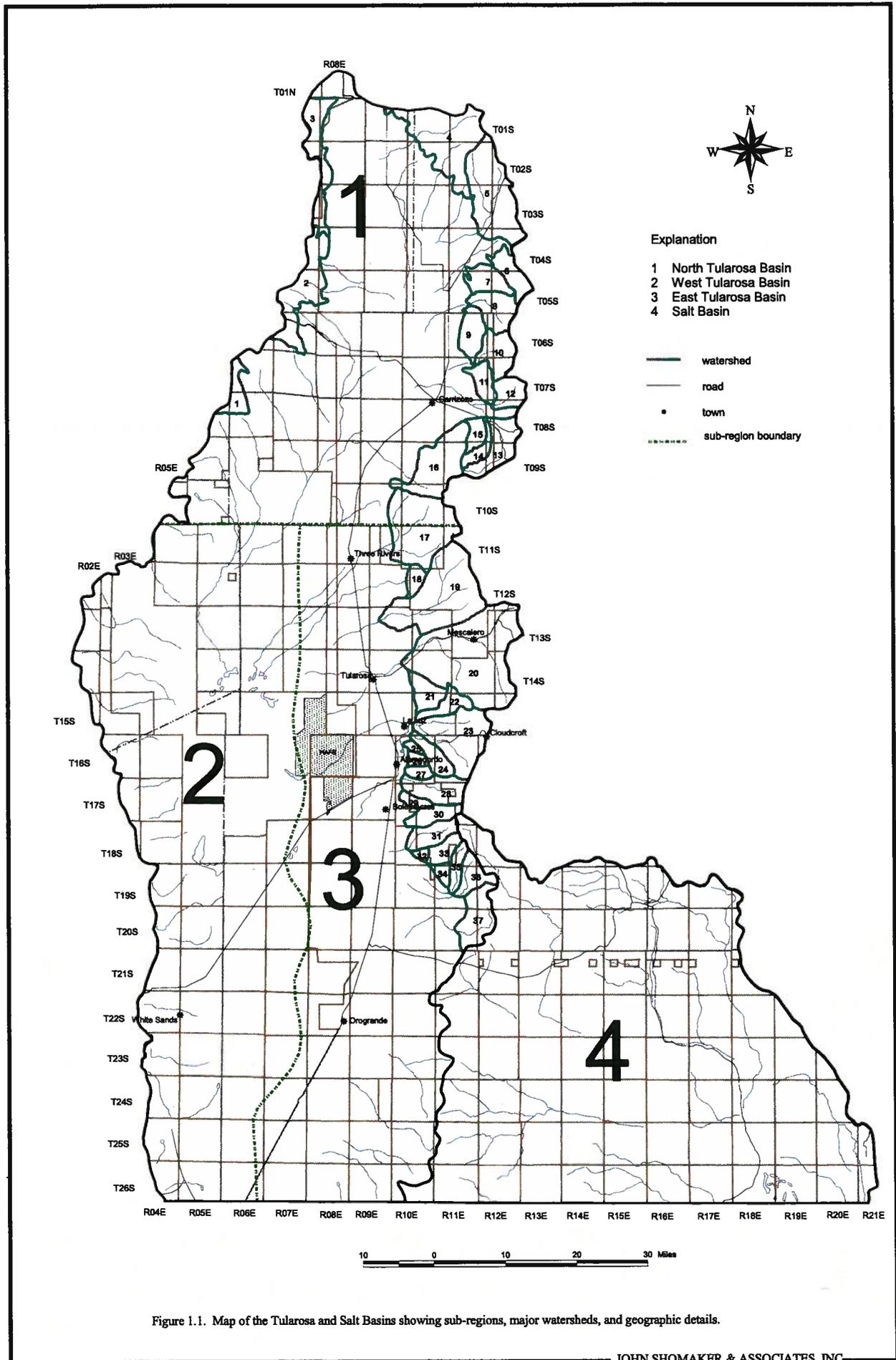


Figure 1.1. Map of the Tularosa and Salt Basins showing sub-regions, major watersheds, and geographic details.

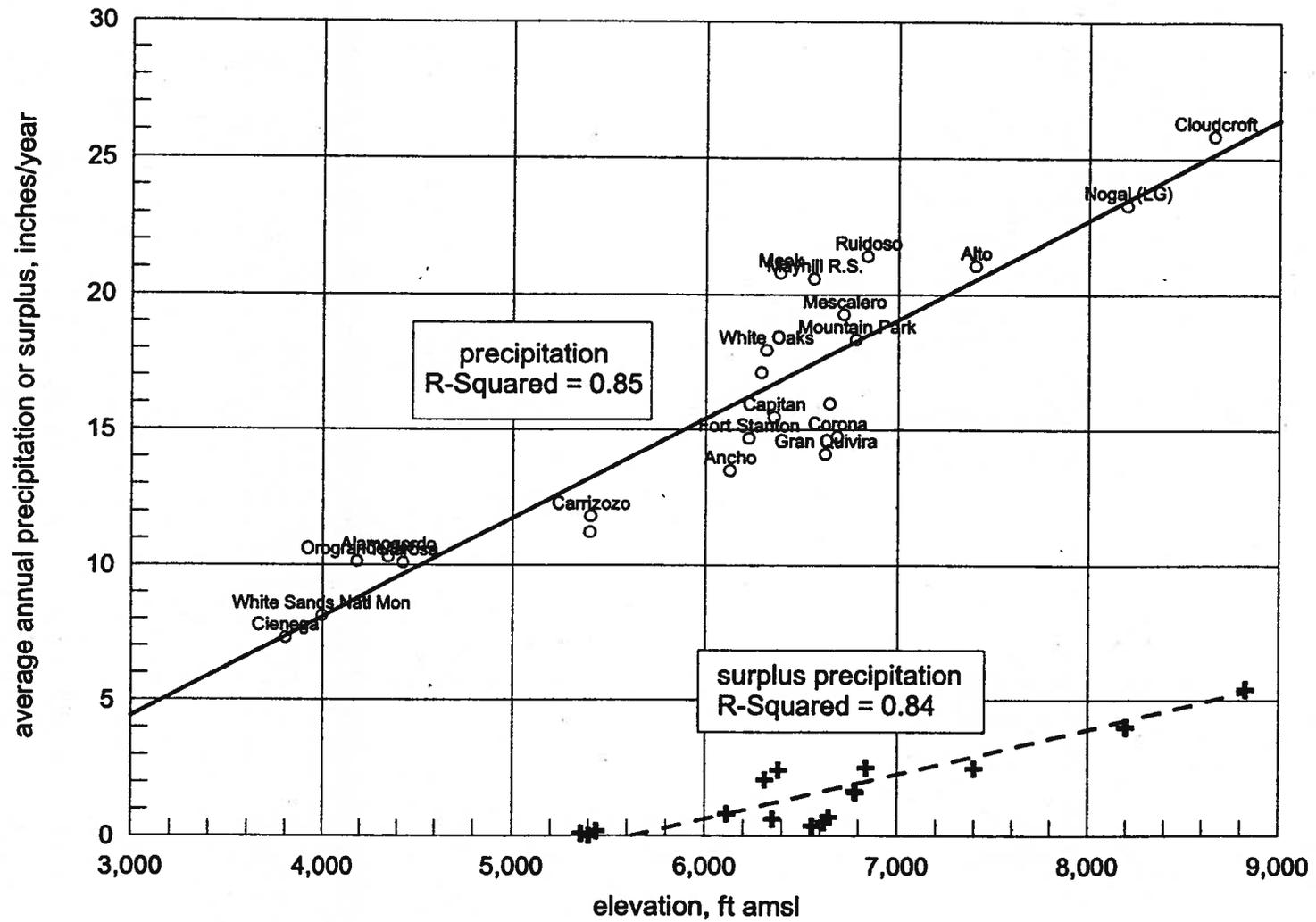


Figure 1.2 Graph of precipitation and surplus versus elevation for the planning region.

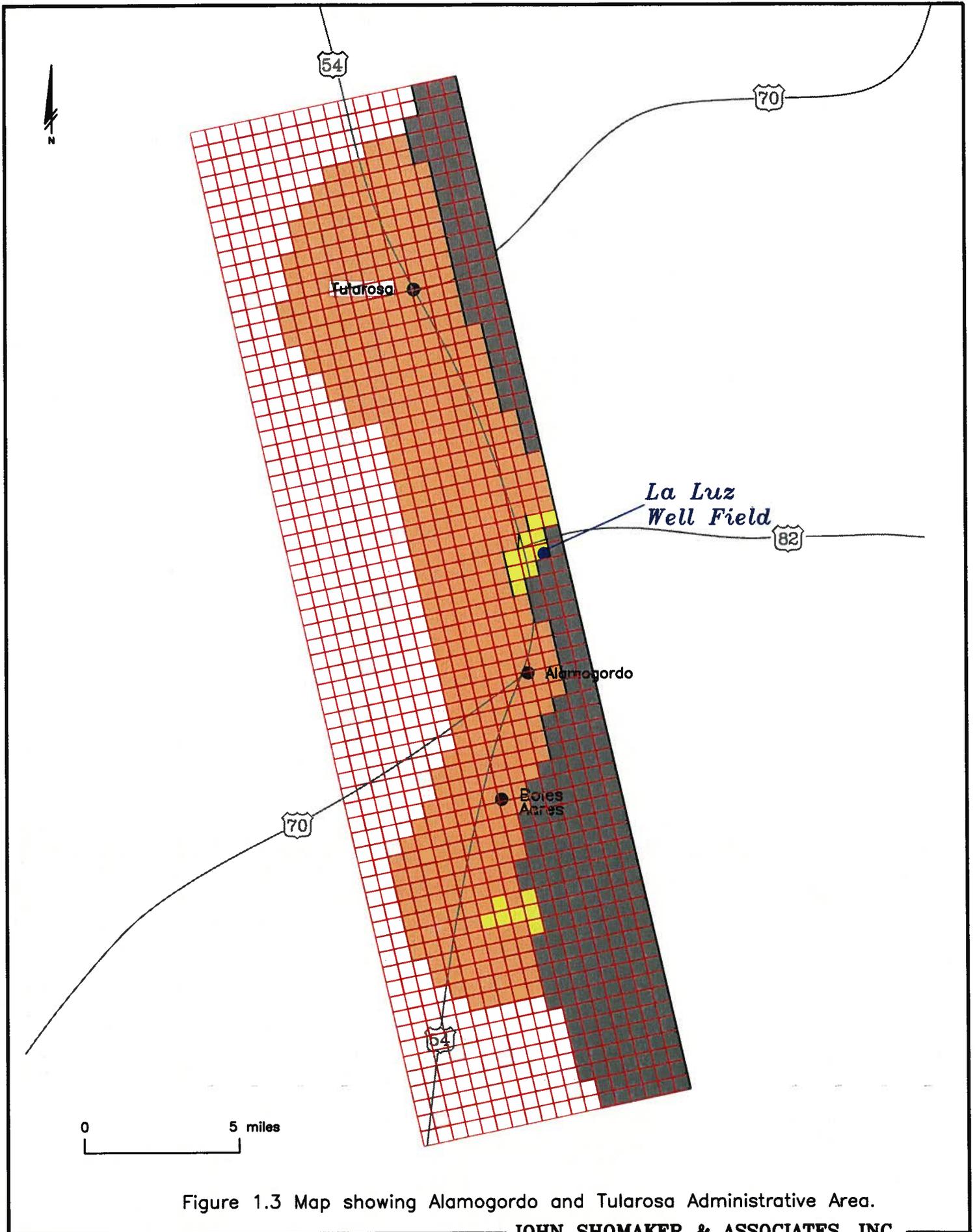


Figure 1.3 Map showing Alamogordo and Tularosa Administrative Area.

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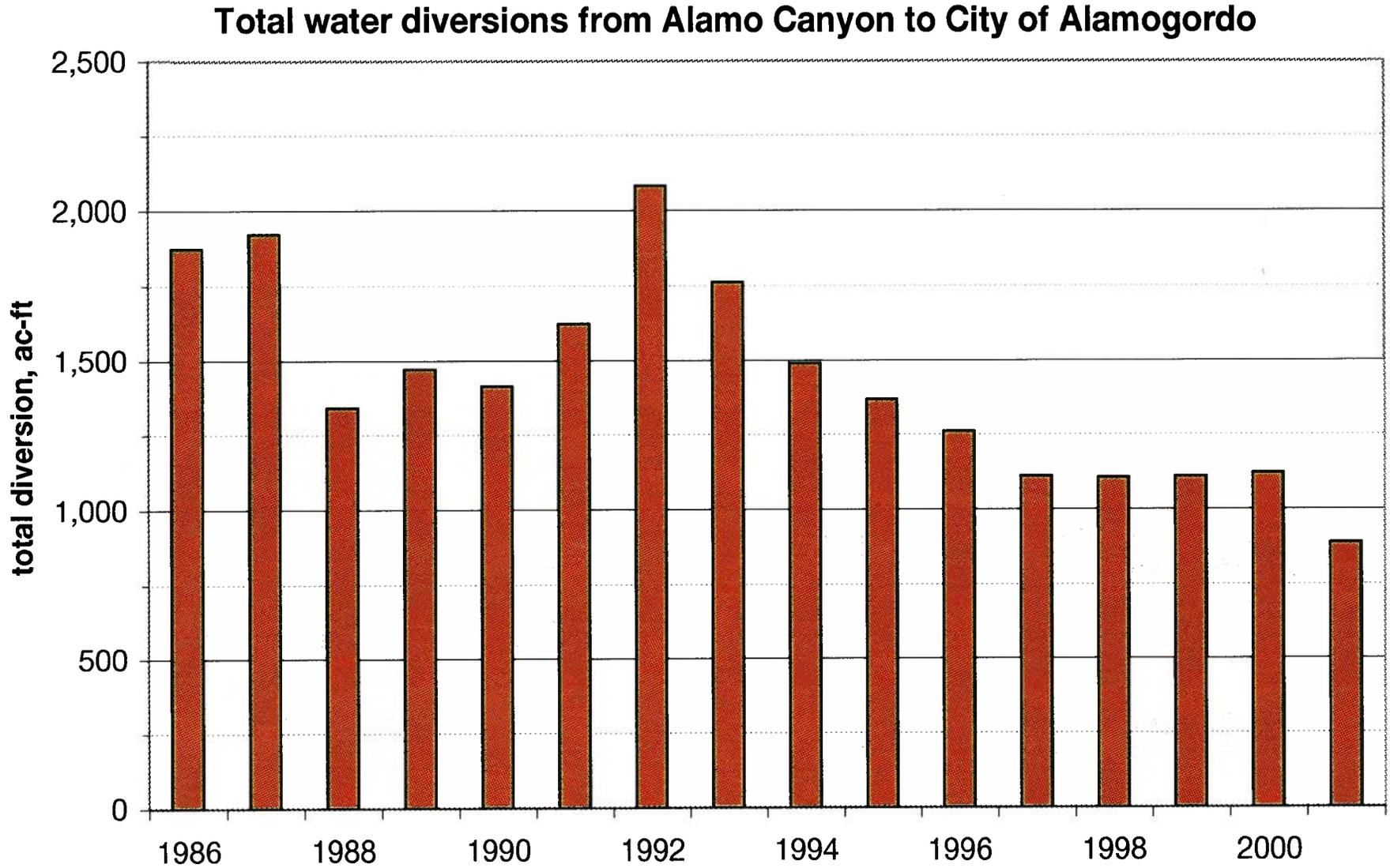


Fig. 2.1 - Alamo Canyon Water Diversions

Total water diversions from La Luz-Fresnal Springs to City of Alamogordo

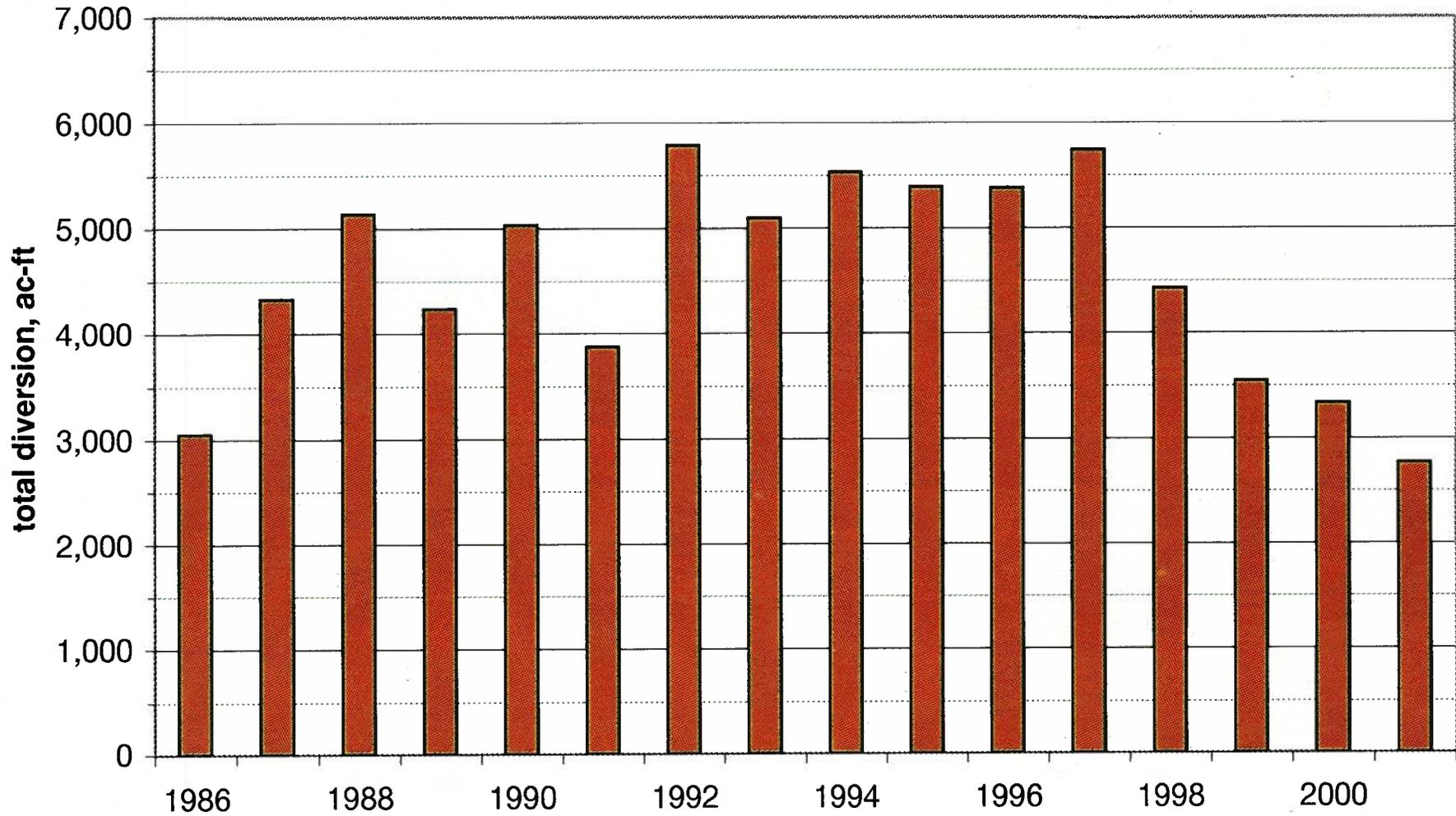


Fig. 2.2 - La Luz-Fresnal Water Diversions

Total water diversions from Bonito Lake to City of Alamogordo

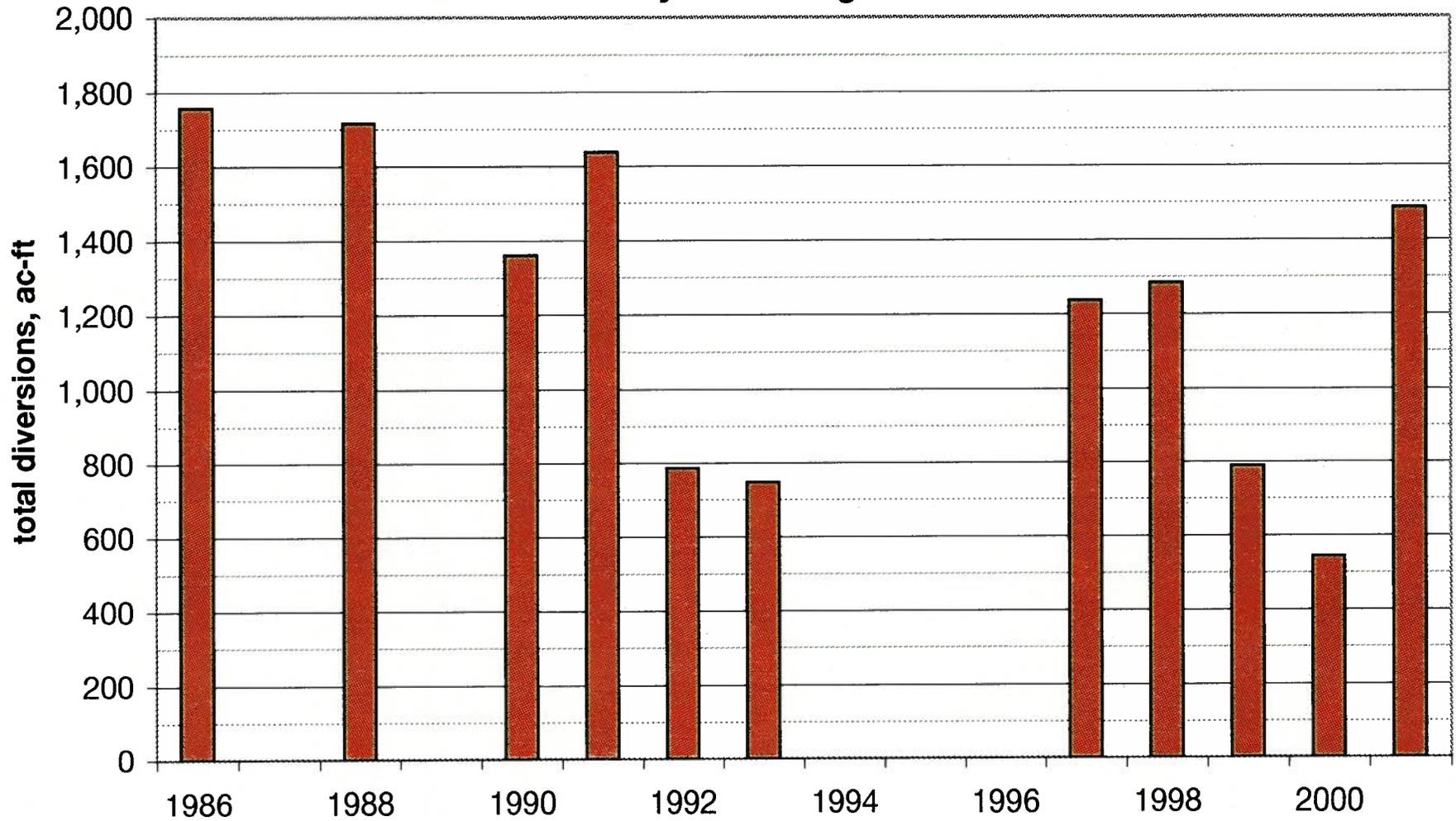


Fig. 2.3 - Bonito Lake Water Diversions

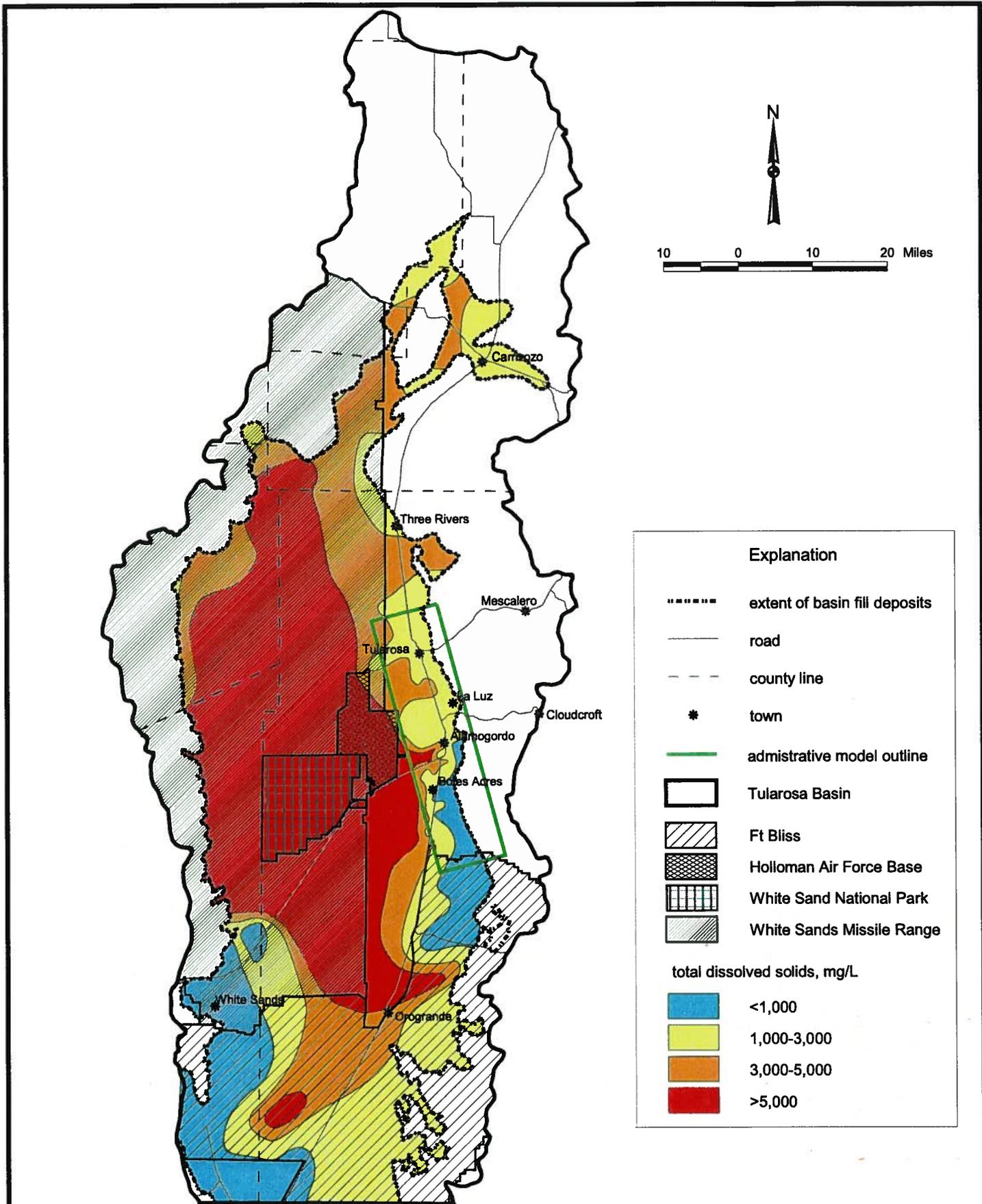


Figure 3.1. Map of Tularosa Basin showing distribution of total dissolved solids in basin-fill aquifer and location of Alamogordo-Tularosa Administrative area and other geographic features.

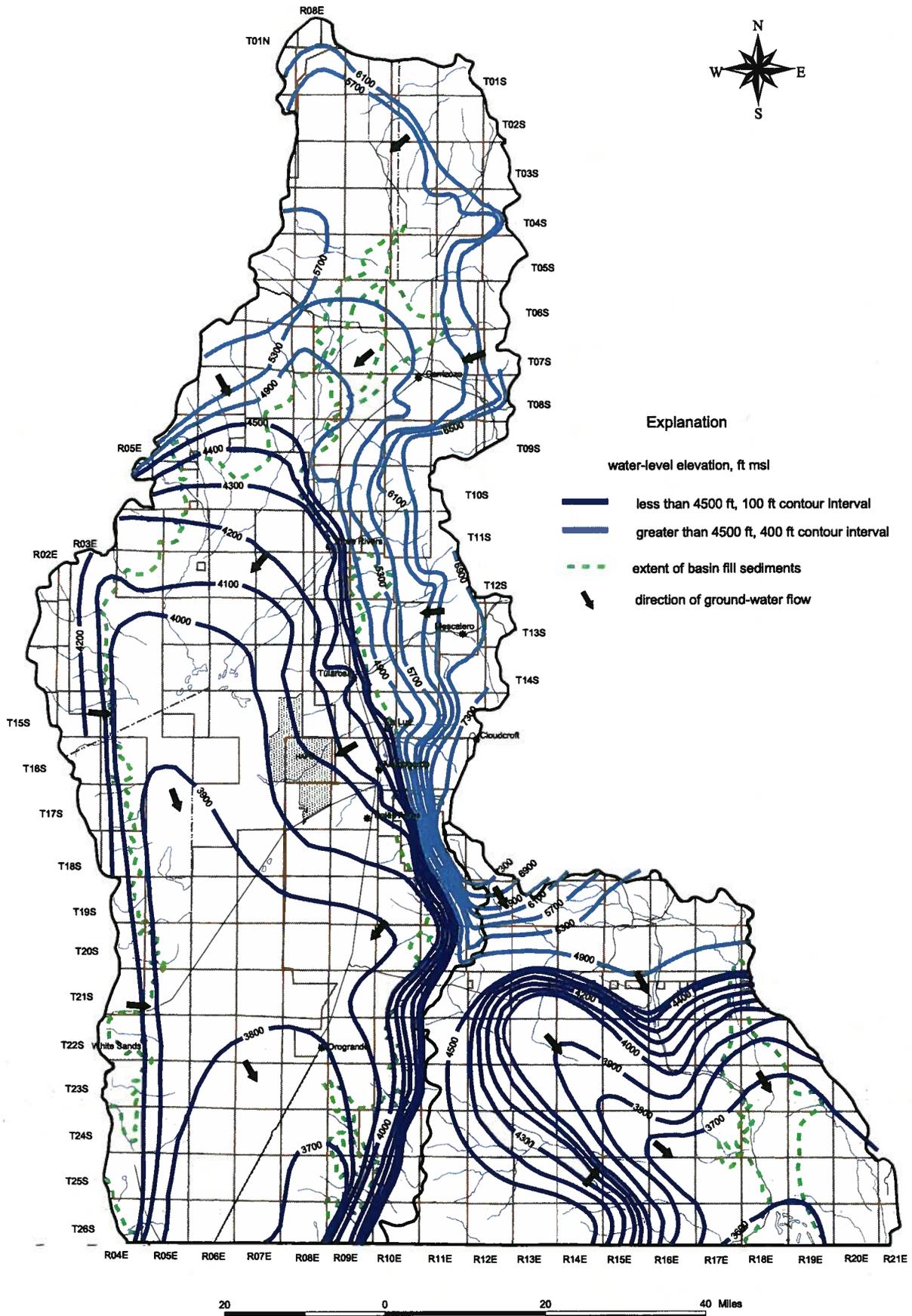


Figure 3.2. Map of the Tularosa and Salt Basins showing water-level elevation contours and ground-water flow direction.

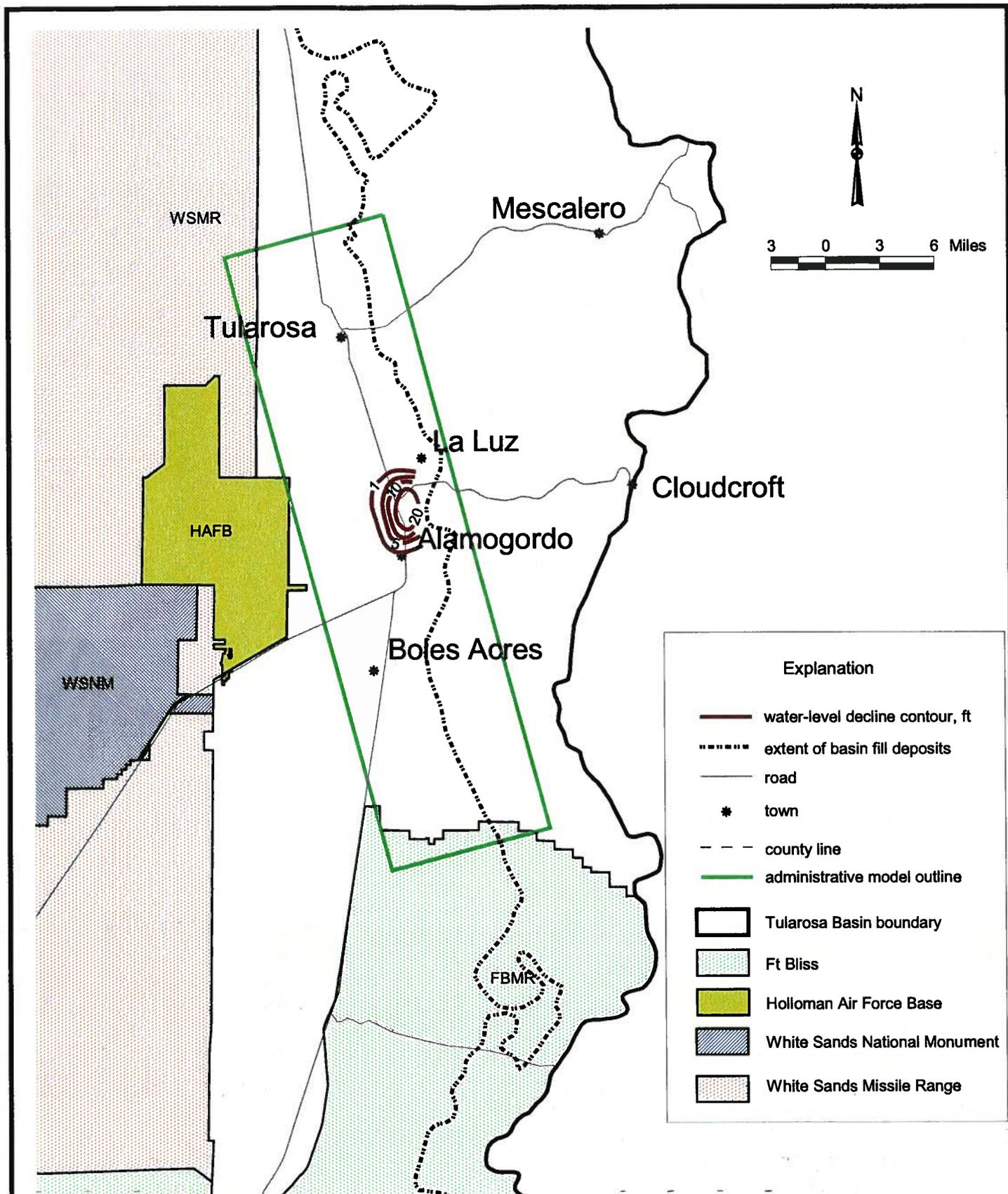


Figure 3.3. Map of the La Luz area within the Tularosa Basin showing historic water-level decline contours, 1900 through 1995.

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City of Alamogordo 40-Year Water Development Plan 2000 – 2040

La Luz wellfield pumping, period of record

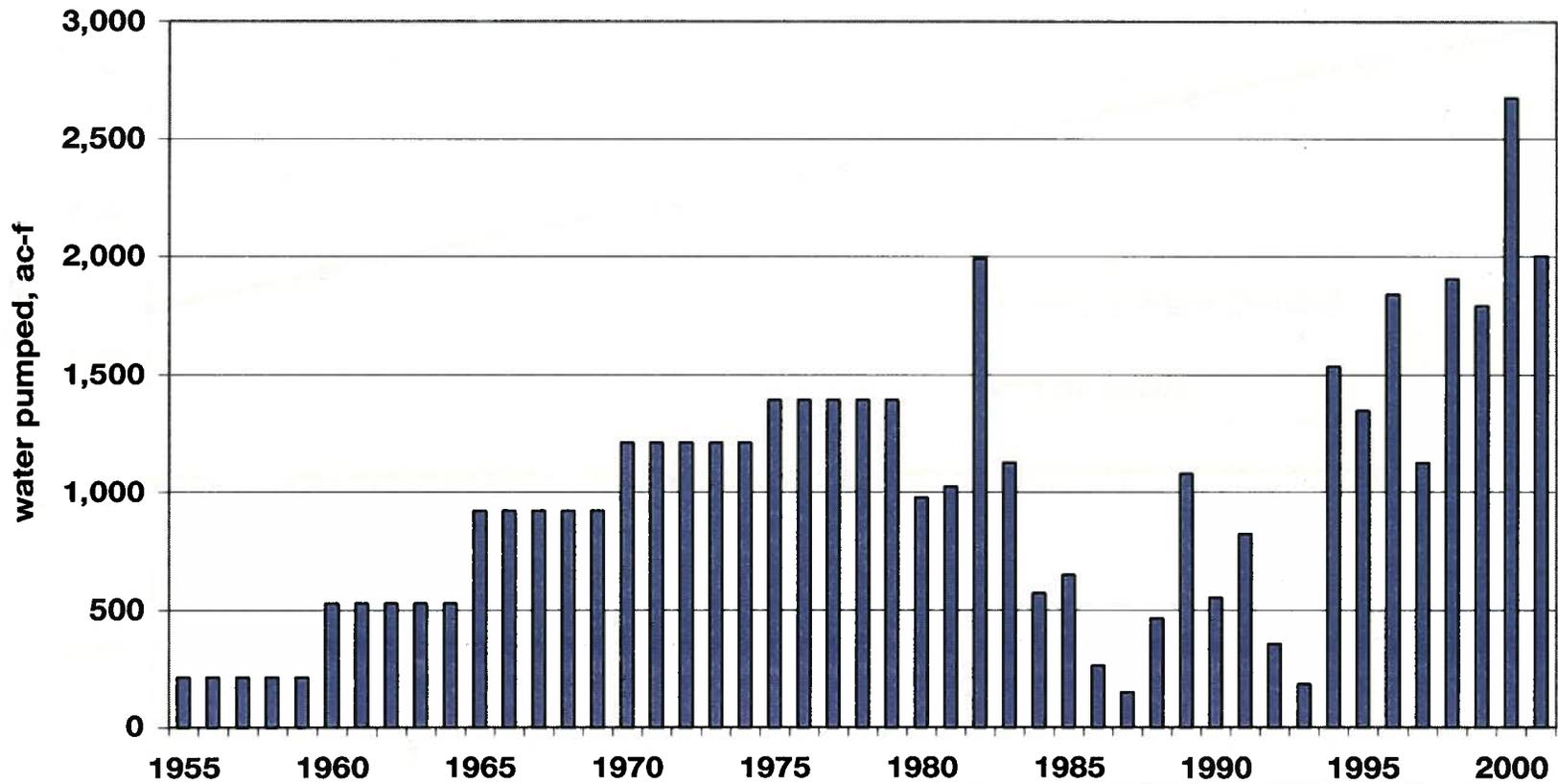


Fig. 3.4 – La Luz Well Field Pumping

City of Alamogordo Peak Day Supply and Demand 2000 - 2040

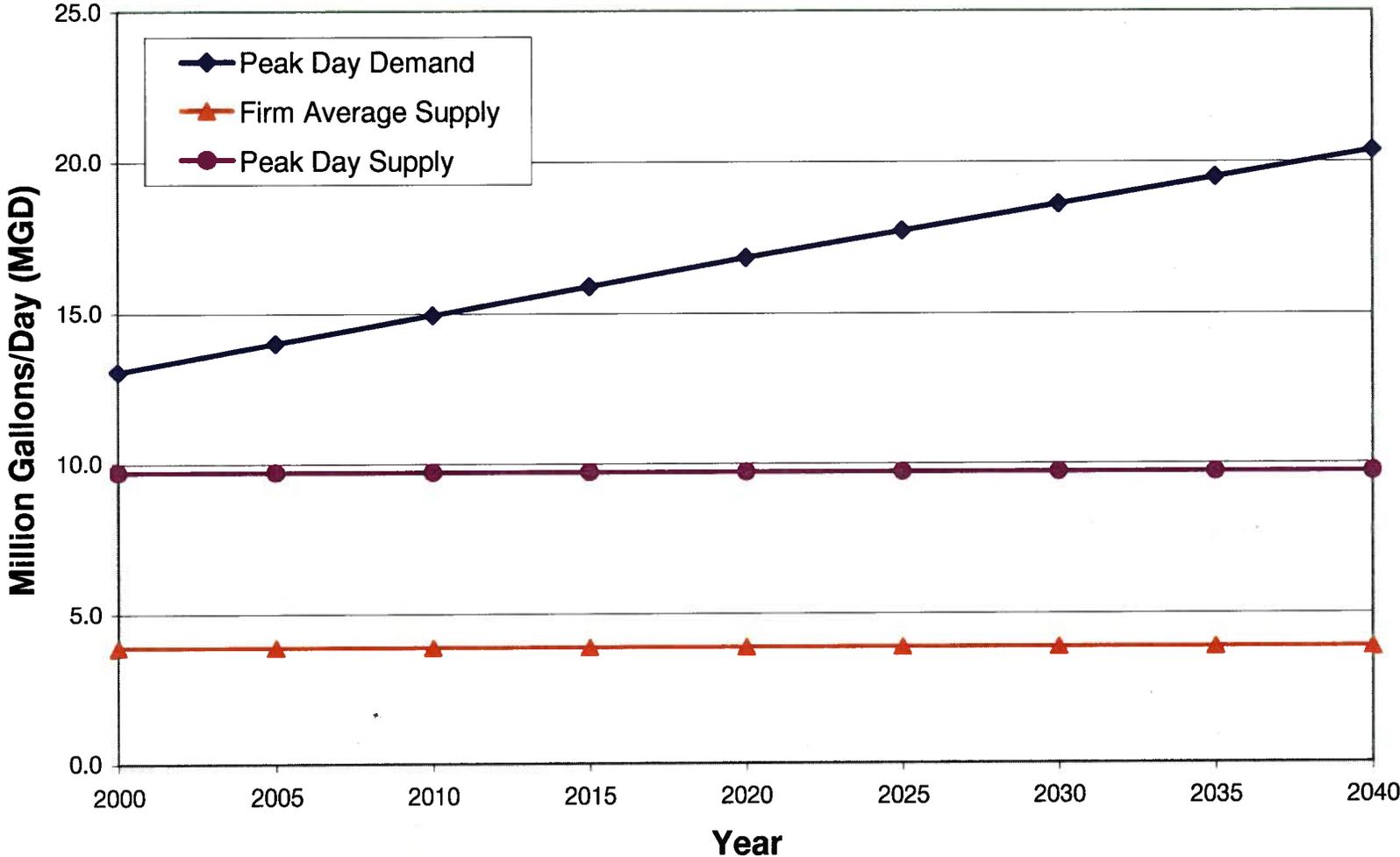


Fig. 6.2 - Projected Peak Day Supply and Demands

City of Alamogordo Water Supply Deficit 2000 -2040

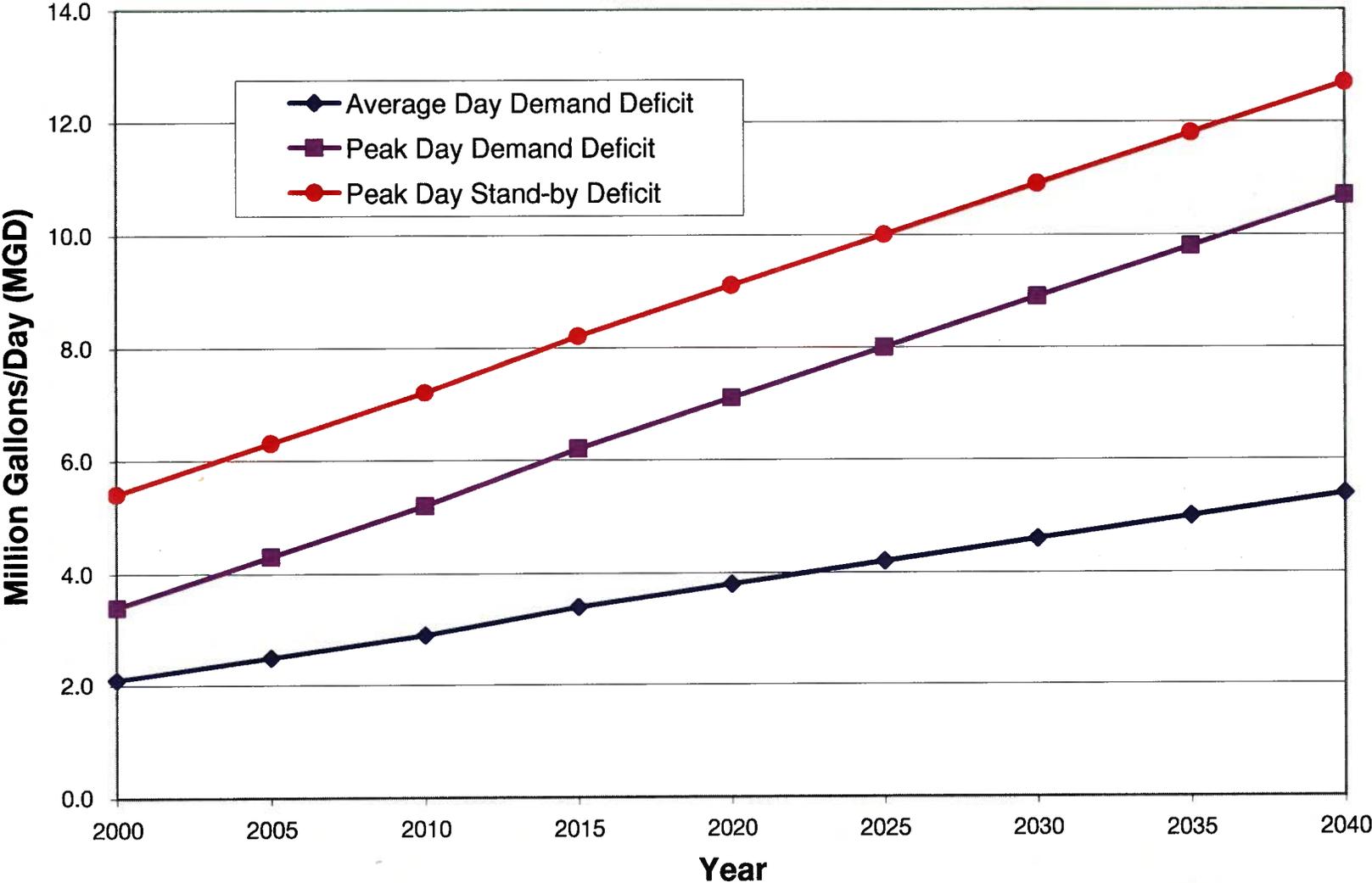


Fig. 6.3 - Projected Water Supply Deficit

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CITY OF ALAMOGORDO

SURFACE WATER RIGHTS					
Type of Right	File No.	Location	Amount of Right	Maximum Amount (AFY) Diverted/Used Since 1990	Comments
Surface	0919 & 01115 Amended; 01110; 01111; 01112; 01113; 01114; 01118; 01119; 01120; 01121; 01342; 01343; 01344; 01345; 01346; 01383 & 01411; 01412; 01455; 01456; 01562 & 2886 Combined	LaLuz & Maruchi, Fresno	891.2 AFY	891.2 AFY	Surface water rights purchased from agricultural users in the Canyons and transferred to City for M&I usage.
Surface	01112	LaLuz, Maruchi, Fresno	16 cfs	4891.68 AFY	City's original surface right, has never flowed constant 16 cfs.
Surface	2176; 0637	Alamo Canyon	3078 AFY	2081.49 AFY	Declared rights from south end of City.
Surface	13-B; Lewis Subfiles: B.2, B.16, B.26, B.61 & B.83 Combined	Rio Bonito	2.3735 cfs	822.32 AFY	Purchased from Railroad during the 1950's, shared with HAFB. Very inconsistent and susceptible to drought.

AFY = acre feet per year
cfs = cubic feet per second

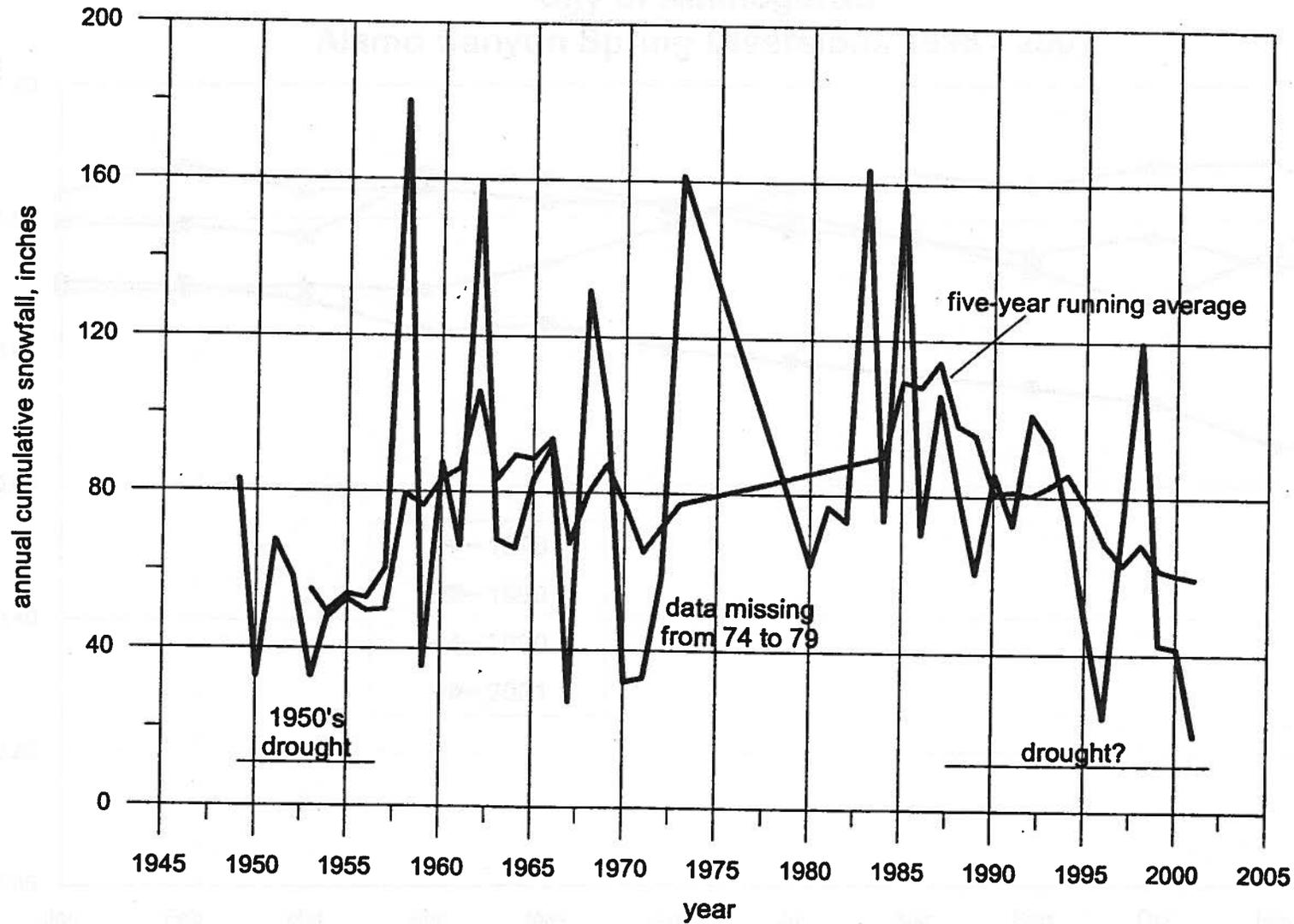
CITY OF ALAMOGORDO

GROUND WATER RIGHTS					
Type of Right	File No.	Location	Amount of Right	Maximum Amount (AFY) Diverted/Used Since 1990	Comments
Ground Water	T-32-S3 - T-32-S9	LaLuz Well field	4572.88 AFY	2673.67 AFY	Declared right northeast of City. Administrative criteria has limited full development of right.
Ground Water	T-33 + T-33-S	Prather, Southwest of Alamogordo	1354 AFY	0 AFY	Old wells southeast of town that City closed to use in the 1960's or 1970's because of costs and other problems. Future unknown.
Ground Water	T-814 & 814-S	Golf Course	269.935 AFY	17.42 AFY	Very saline water from golf course now watered with effluent. Construction use or possible emergency only.

AFY = acre feet per year
 cfs = cubic feet per second

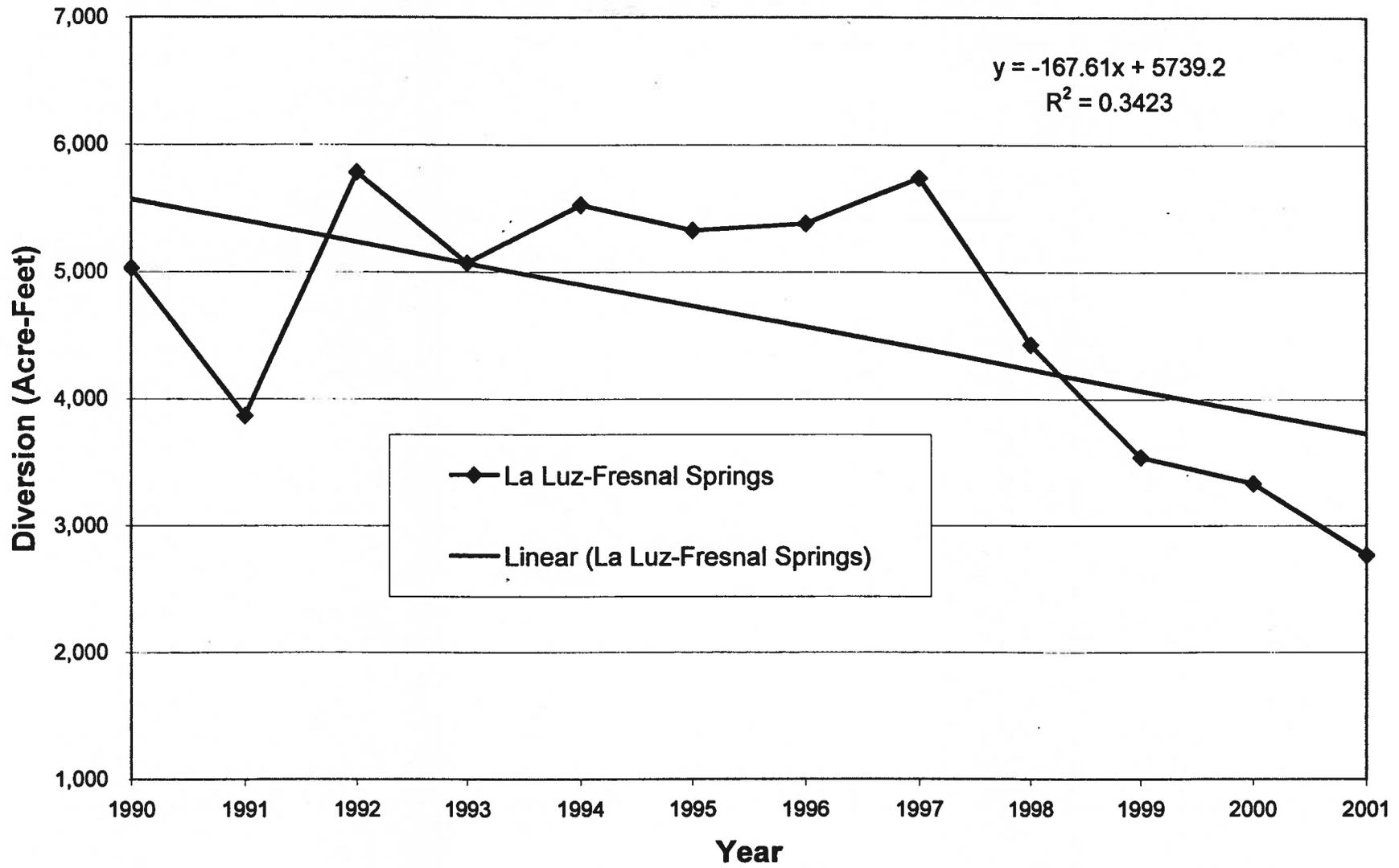
City of Alamogordo 40-Year Water Development Plan 2000 - 2040

**Cumulative Annual Snowfall
Cloudcroft, New Mexico**

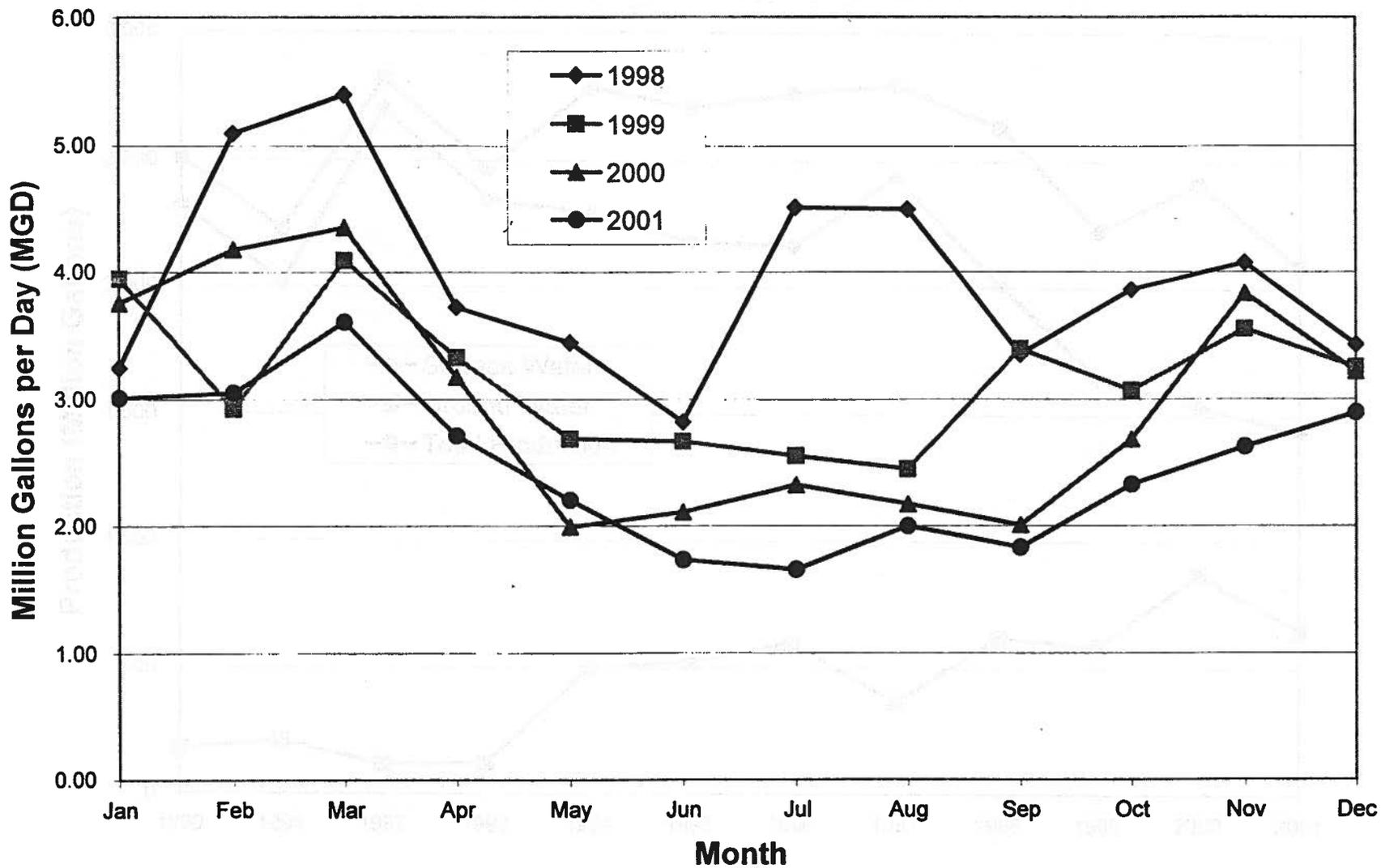


Graph of annual cumulated snowfall, Cloudcroft, New Mexico.

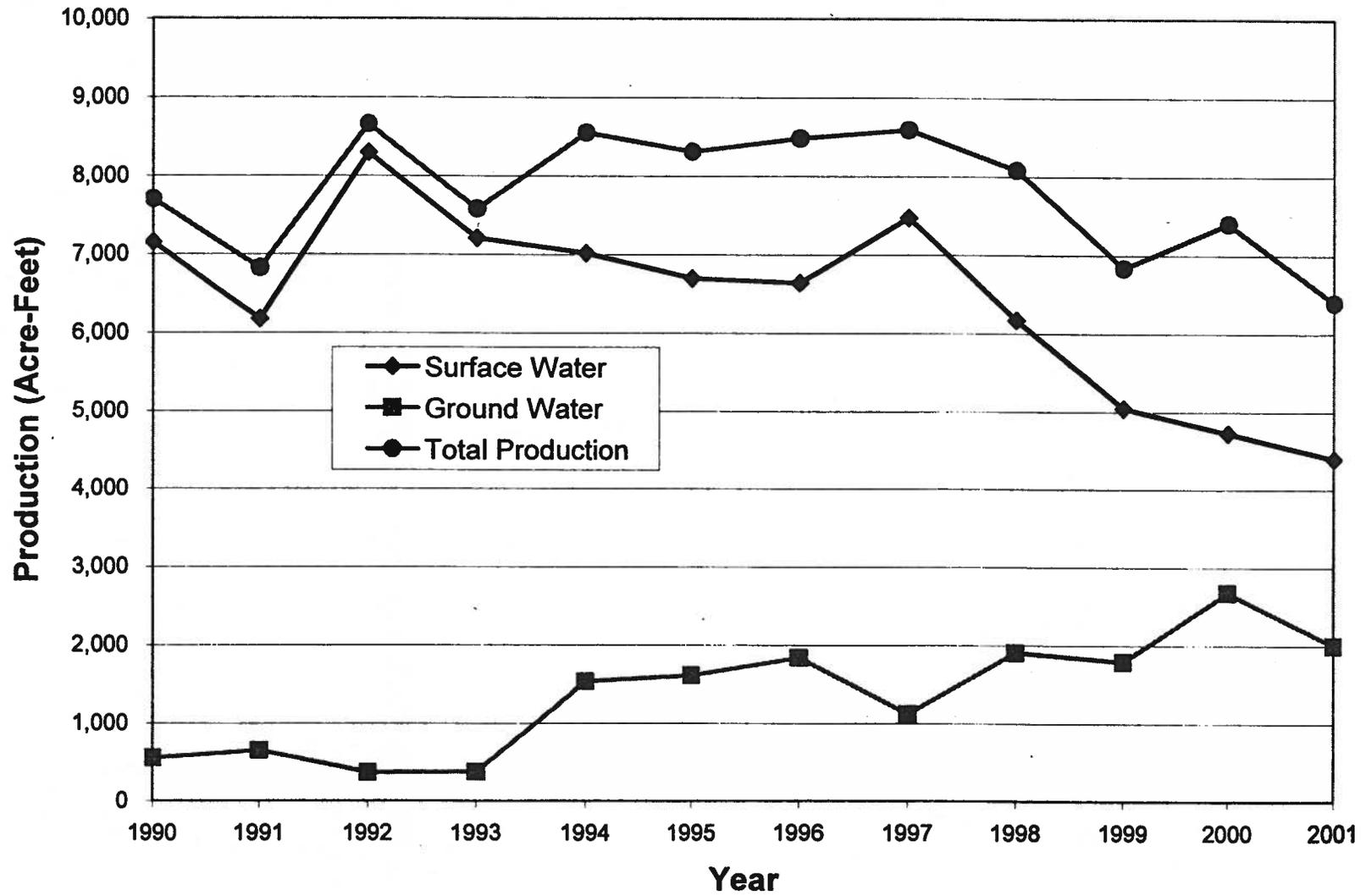
City of Alamogordo La Luz-Fresnal Springs Production 1990 - 2001



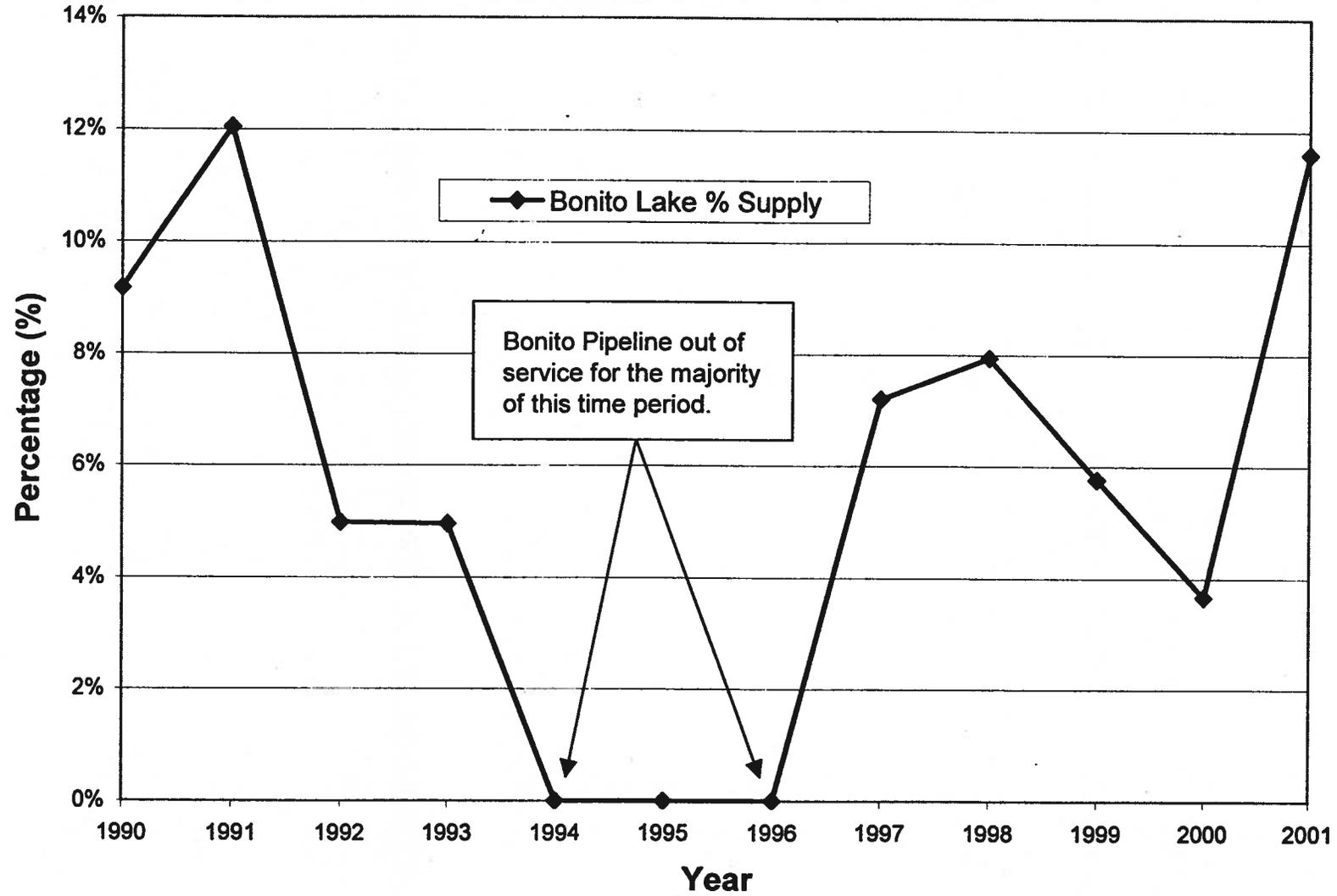
City of Alamogordo La Luz-Fresnal Spring Diversions 1998 - 2001



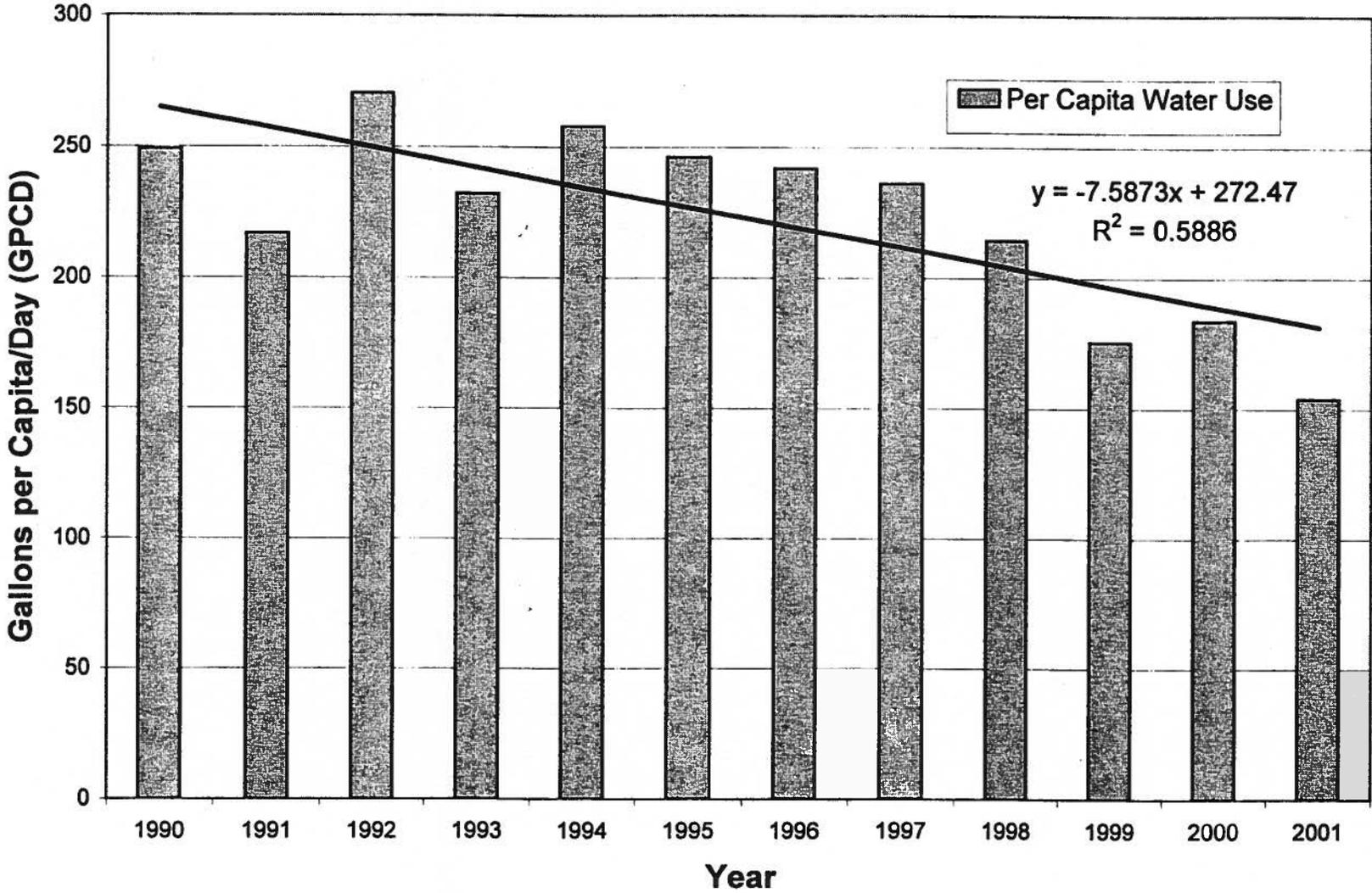
City of Alamogordo Water Production 1990 - 2001



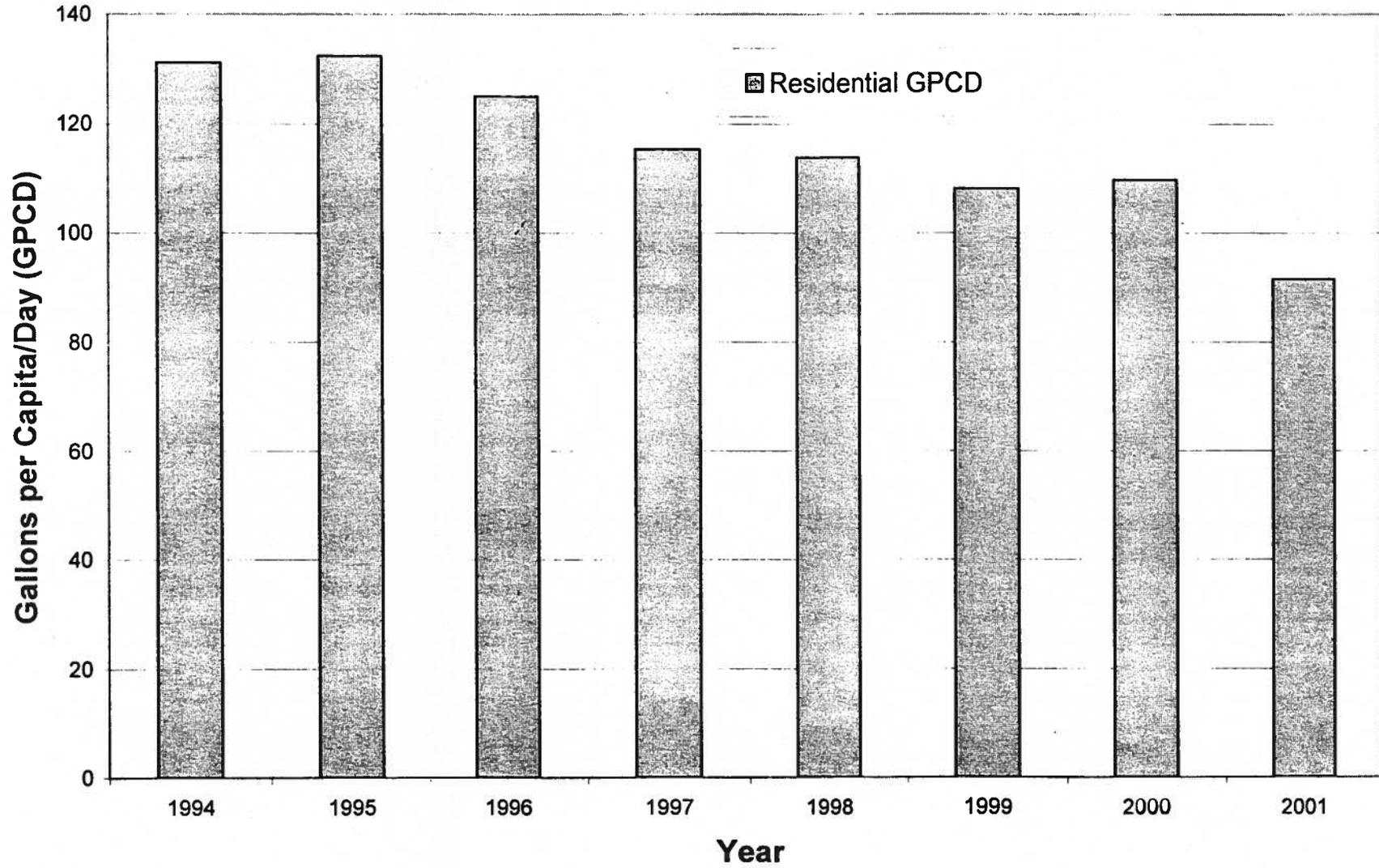
City of Alamogordo Bonito Lake Supply 1990 - 2001



City of Alamogordo Per Capita Water Use 1990 - 2001



City of Alamogordo
Residential Per Capita Water Use 1994 - 2001



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