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**PRELIMINARY**  
SUBJECT TO REVISION

A PRELIMINARY EVALUATION OF  
HISTORICAL AND PROJECTED WATER DEMAND  
FOR BORREGO VALLEY

by

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This Technical Information Record (TIR) was prepared to document pertinent information developed in the Borrego Valley Investigation. The findings of this TIR have not fully reconciled with all the technical aspects of the total investigation, which will be reviewed when all phases of the investigation have been completed. Review was limited to consideration of technical data by the writer's immediate supervisor. Hence, this TIR is for internal office use only and should be considered preliminary and subject to revision.

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## INTRODUCTION

The purpose of this Technical Information Record (TIR) is to document the findings of the initial phase of the Department of Water Resources (DWR) Borrego Valley Water Resources Management Investigation which is being conducted in cooperation with the County of San Diego. The United States Geological Survey (USGS) is also conducting a cooperative geohydrologic study with the County under a separate agreement. This initial phase consists of gathering data on historical population and water use, and examining available projections of population, irrigated acreage, and water demand. The results are presented in the form of several water demand projections to be used in subsequent phases of the study. The time horizon for this study extends from the present through the year 2000.

## STUDY AREA

The study area comprises the watersheds of the Borrego and Clark Valleys; however, the main focus of this study is on the Borrego Valley ground water basin and it is this area which will be referred to as Borrego Valley hereinafter (Figure 1). The watersheds of Borrego and Clark Valleys are generally bounded by the Santa Rosa Mountains to the north, by a sinuous line extending from Terwilliger Valley to Chariot Mountain in the west, by the Vallecito Mountains to the south, and by Borrego Mountain and the Borrego Badlands to the east.

The study area is located within the seismically active Peninsular Ranges province of Southern California. The Coyote Creek fault, part of the San Jacinto fault zone, transects the area in a northwest-southeast direction. On April 8, 1968, the Coyote Creek fault caused an earthquake with a magnitude of 6.5 on the Richter scale.

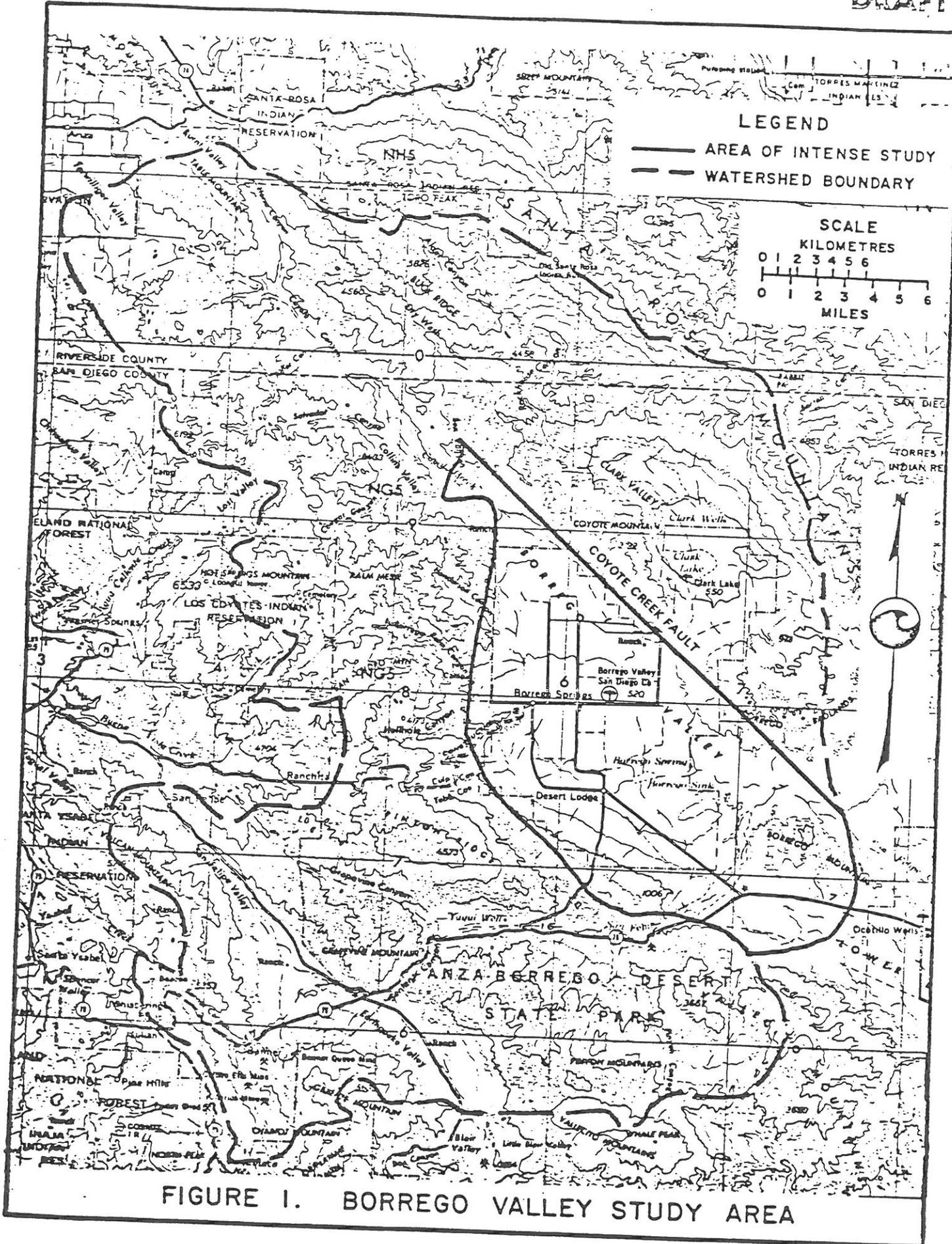


FIGURE I. BORREGO VALLEY STUDY AREA

WATER DEMAND

There are three major components of applied water in the study area: municipal, agricultural, and recreational. Also, water is used by native vegetation. There are no major manufacturers in the area.

Total applied water use is composed of two parts: consumptive use and return water. "Applied water use" is defined to be the total quantity of water delivered to, among others, municipal, agricultural and recreational users. "Consumptive use" is that portion of applied water permanently lost to the study area as a result of evapotranspiration. "Return water" is that portion of applied water that percolates to the ground water table and again becomes available for use; thus, consumptive use is equal to applied water use less return water.

Municipal Water Use

Historically, municipal use has been a minor constituent of total water demand in the study area. The economic development of the valley following World War II has been dominated by agriculture, which remains the major consumer of water in the study area.

The permanent population in the study area is mainly comprised of retirees and those involved in ranching, tourism, and other service occupations. There are substantial seasonal influxes of population, especially during winter. There is also a spillover of tourists visiting the surrounding Anza-Borrego State Park which is renowned for its native Colorado desert scenery.

Historic population data which was obtained from various sources is shown in Table 1.

A reason for the discrepancy between the 1980 population figures obtained by the Census Bureau and USGS is the likelihood that many seasonal residents were absent from the valley during the period the census was

TABLE 1  
HISTORIC POPULATION OF BORREGO VALLEY

<u>Year</u>	<u>USGS</u>	<u>PRC Toups**</u>	<u>U. S. Census</u>
1940	--	36	--
1950	--	350	--
1960	--	780	780
1970	--	838	828
1979	--	1,620	--
1980	2,131*	--	1,405

\*Moyle, W. R., Jr., "Water Resources of Borrego Valley and Vicinity, California," United States Geological Survey, Open-file Report 82-855, p. 21.

\*\*PRC Toups, "Borrego Water District Latent Powers Authorization," Focused Environmental Impact Report, November 1979, p.29.

conducted. The USGS figure was based on an examination of the local telephone directory and a survey of local schools. Considering the fact that domestic water use is less than 10 percent of the total water use of the area and the traditional concept of the reliability of U. S. Census figures, for the purposes of this investigation, it is recommended that the U. S. Census figure of 1,405 in 1980 be used as a basis for projecting future population and water use.

Prior to World War II, the relative isolation of Borrego Valley contributed to the limited influx of population to the area. Since the post-war period, there has been sporadic expansion of local residential developments.

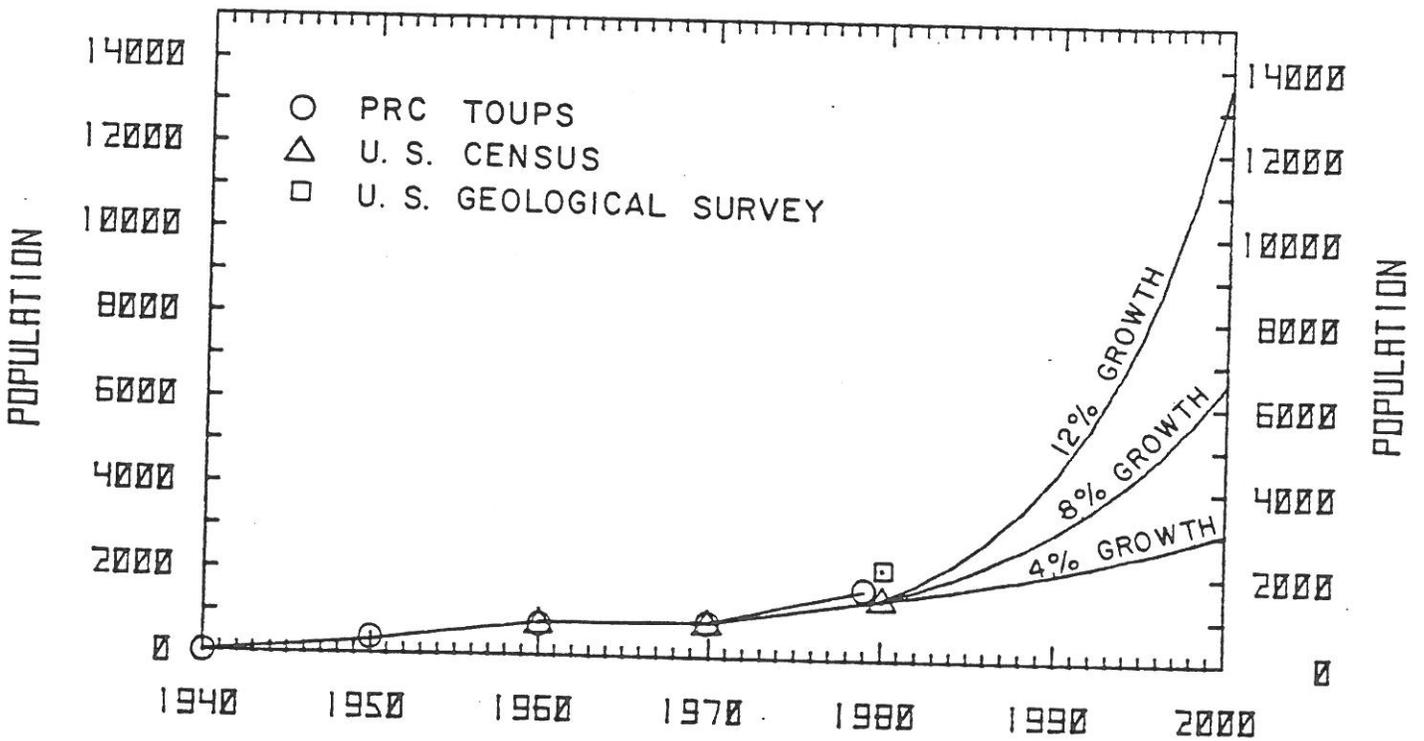
Table 2 and Figure 2 show a series of population projections developed for the area. These projections were made assuming that annual growth rates would range between 4 percent and 12 percent. For the decade 1970-80 using U. S. Census data, the annual growth rate was about 5-1/2 percent. However, caution must be exercised when extrapolating historic trends since future growth need not have any direct relationship to past growth.

TABLE 2  
POPULATION PROJECTIONS

<u>Year</u>	<u>4 percent growth per year</u>	<u>8 percent growth per year</u>	<u>12 percent growth per year</u>
1980	1,405*	1,405*	1,405*
1990	2,100	3,000	4,400
2000	3,100	6,500	13,600

\*U. S. Census.

FIGURE 2  
HISTORIC AND PROJECTED POPULATION  
OF BORREGO VALLEY



USGS has estimated per capita domestic consumptive use to be 125 gallons per day based on water company records. Strictly speaking, this would be the applied water demand. For this investigation, USGS used 125 gallons per capita per day as the domestic consumptive use. DWR has determined that an unit applied water demand of 270 gallons per capita per day is applicable to the Anza-Borrego area.\* Using the population of 1,405 for the year 1980, the applied water demand would be 425 acre-feet for that year. DWR has also determined that consumptive use amounts to about 59 percent of the applied use which for 1980 would mean that 250 acre-feet were consumed, or 159 gallons per capita per day.\*\*

For the purposes of this study, the consumptive use figure of 159 gallons per capita per day used by DWR, which is the higher of the estimates, is used for calculation of return water to the ground water basin.

Table 3 contains estimates of future municipal water use based on the foregoing figures.

TABLE 3  
PROJECTED MUNICIPAL WATER DEMAND IN BORREGO VALLEY<sup>a</sup>

In acre-feet

Year	4% growth per year			8% growth per year			12% growth per year		
	Pop.	Applied use	Consumptive use	Pop.	Applied use	Consumptive use	Pop.	Applied use	Consumptive use
1980	1,405	425	250	1,405	425	250	1,405	425	250
1990	2,100	640	370	3,000	910	530	4,400	1,330	780
2000	3,100	940	550	6,500	1,970	1,160	13,600	4,110	2,420

<sup>a</sup>Applied use = 270 gallons per capita per day.  
Consumptive use = 159 gallons per capita per day.

\*Department of Water Resources. Background data developed for Bulletin 160-82 for the Borrego Valley area.  
\*\*Ibid.

Agricultural Water Use

Farming has been the most important factor in the change in the amount of water use in the Borrego Valley. Major growth of the valley's economy and related water use began following World War II, when electrical lines were extended into the valley permitting the use of efficient deep well turbine pumps for irrigation of the newly introduced table grapes. Citrus has now replaced grapes as the primary crop, and it is generally irrigated with efficient drip systems.

Increasing competition from the Coachella and Imperial Valleys which have access to economical imported water, led to a decline in Borrego Valley agriculture from its peak in the late 1950s. Currently, Colorado River water imported to the Imperial Valley by Imperial Irrigation District by gravity costs farmers \$8 per acre-foot; for Coachella Valley farmers the cost of Colorado River water imported by Coachella Valley Water District is about \$10 per acre-foot. In contrast, for Borrego Valley farmers facing a ground water pumping lift of 250 feet, the power cost alone could exceed \$50 per acre-foot at current rates. Although what has often occurred is that rising agricultural commodity prices have more than compensated for rising pumping costs, this nonetheless illustrates that Borrego Valley farmers are operating at a disadvantage in comparison with their Coachella and Imperial Valley counterparts.

Table 4 shows values of historic use of water by agriculture; PRC Toups' figures are estimates of applied use whereas USGS estimated consumptive use. Table 5 shows two estimates of current agricultural water use. The first set includes estimates using unit applied and consumptive use estimates developed for the Anza-Borrego area by DWR. The total acreage devoted to each crop was determined by a USGS survey. The consumptive use estimates developed by USGS utilized their estimates of unit use by each crop. For the purposes of this study, it is recommended that the estimates using the combination of USGS land use estimates and DWR unit use values be adopted.

TABLE 4  
HISTORIC AGRICULTURAL WATER USE

In acre-feet

Year	PRC Toups*	USGS**	DWR***
1950	11,435	--	--
1958	22,455	--	--
1962	13,830	--	--
1968	7,260	--	--
1972	5,320	--	--
1978	5,705	--	--
1980	--	6,431	7,475

\*Applied water use.  
 \*\*Consumptive use—USGS Open-file Report 82-855, p.21.  
 \*\*\*Consumptive use with DWR unit use values and USGS Open-file Report 82-855, land use data.

TABLE 5  
AGRICULTURAL WATER USE IN 1980

Type of use	No. of irrigated acres*	DWR applied unit use** ft	DWR applied use** ac-ft	DWR con-sumptive unit use** ft	DWR con-sumptive use** ac-ft	USGS con-sumptive unit use* ft	USGS con-sumptive use* ac-ft
Citrus	940	5.4	5,076	3.8	3,572	3.26	3,064
Grass (pasture)	425	7.9	3,358	5.5	2,338	4	1,700
Alfalfa	140	7.3	1,022	5.5	770	6.19	867
Tomatoes (hot house)	10	2.5	25	1.5	15	2	20
Tree farm	390	2.9***	1,131	2.0***	780	2	780
Grapes (dead)	655	0	0	0	0	0	0
Date palm	40	0	0	0	0	0	0
			10,612		7,475		6,431

\*Moyle, W. R., Jr., "Water Resources of Borrego Valley and Vicinity, California," U. S. Geological Survey Open-file Report 82-855, November 1982, p. 21.  
 \*\*Department of Water Resources. Background data developed for Bulletin 160-82 for the Borrego Valley area.  
 \*\*\*Estimate.

Table 6 contains two sets of projections for future agricultural consumptive use: for the first set, it is assumed that agricultural activity will remain level while for the second, it is assumed that there will be a steady decline of agriculture in the valley through the year 2000, due to rising costs of production and urban development.

Recreational Water Use

Several residential developments in the Borrego Valley are centered around golf courses. PRC Toups has attempted to estimate the applied water demand of these golf courses, as well as the demand of landscaped areas which are held in common by the residents of these developments, from water company records. USGS estimated the consumptive demand of only the golf courses in 1980; their estimate of water delivered for landscaping was included as a part of domestic use. Consequently, the two series of figures are not, strictly speaking, comparable. (See Table 7).

TABLE 6  
PROJECTED AGRICULTURAL WATER USE

In acre-feet

Year	Level agriculture		Declining agriculture	
	Applied	Consumptive	Applied	Consumptive
1980	10,612	7,475	10,612	7,475
1990	10,612	7,475	5,306	3,738
2000	10,612	7,475	0	0

TABLE 7  
RECREATIONAL AND LANDSCAPE DEMAND

In acre-feet

Year	PRC Toups* applied	USGS** consumptive	DWR***	
			Applied	Consumptive
1950	190	--	--	--
1958	790	--	--	--
1962	1,725	--	--	--
1968	1,720	--	--	--
1972	2,270	--	--	--
1978	2,050	--	--	--
1980	--	1,890	2,130	1,480

310  
PRC  
land

\*PRC Toups, op. cit., p. 30.  
 \*\*Consumptive use for golf courses alone.  
 270 acres x 7 acre-feet/acre = 1,890 acre-feet.  
 Moyle, W. R. Jr., op. cit., p. 21.  
 \*\*\*Applied use = 270 acres x 7.9 acre-feet/acre.  
 Consumptive use = 270 acres x 5.5 acre-feet/acre.  
 Moyle, W. R. Jr., op. cit., p. 21 and background  
 data for DWR Bulletin 160-82.

Native Vegetational Water Use

Native vegetation, which consists mainly of mesquite and tamarisk around Borrego Sink consumes a substantial amount of water. PRC Toups has estimated that consumptive use totals 3,000 acre-feet per year while USGS has estimated that the figure is about 1,200 acre-feet per year. Since it cannot be ascertained that either number is more reliable, two sets of projections of consumptive water demand will be generated using each estimate.

Historic and Projected Water Use

Table 8 shows total historic water use in Borrego Valley. The values for the years between 1950 and 1978 were developed by PRC Toups while the current 1980 value was developed using USGS and DWR land and water use data. Figure 3 presents the 1980 breakdown as a pie-chart.

TABLE 8  
BORREGO VALLEY APPLIED WATER USE

In acre-feet

<u>Year</u>	<u>Municipal</u>	<u>Agricultural</u>	<u>Golf course and landscape</u>	<u>Total</u>
1950*	170	11,435	190	11,795
1958*	225	22,455	790	23,470
1962*	265	13,830	1,725	15,820
1968*	475	7,260	1,720	9,455
1972*	530	5,320	2,270	8,120
1978*	600	5,705	2,050	8,355
1980**	425	10,612	2,130	13,167

\*Applied water use from PRC Toups, op. cit., p. 30.

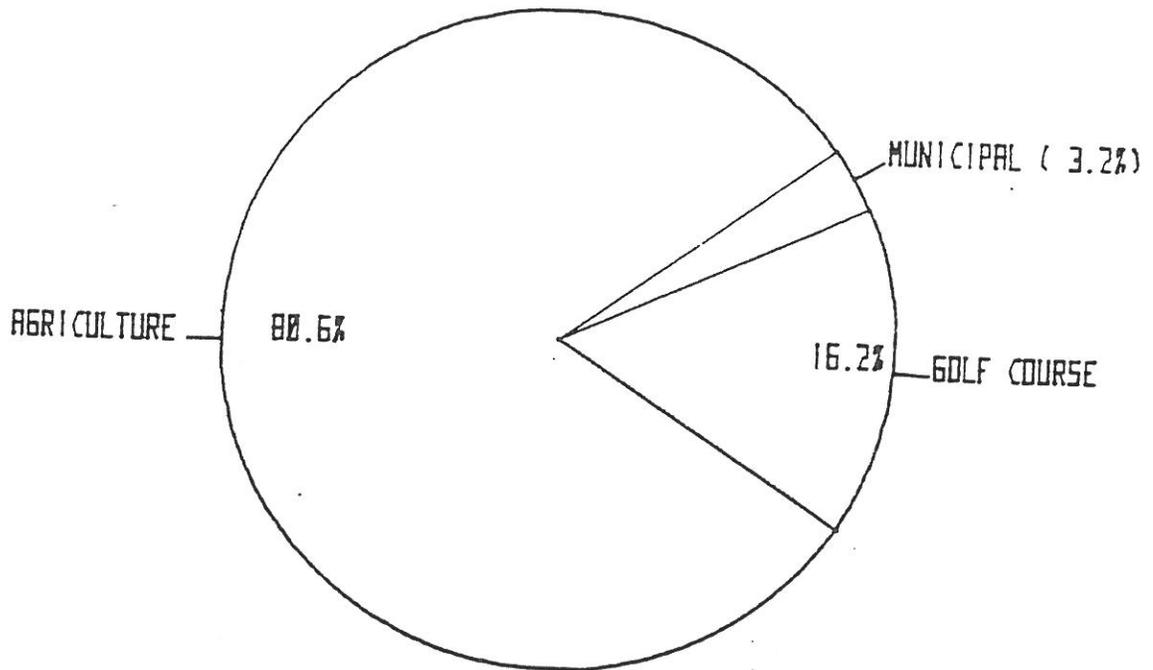
\*\*Applied water use obtained using USGS, U. S. Census, and DWR population, land use, and water use data.

These estimates of historic use are not totally consistent. For the series of values for 1950 through 1980, the municipal, agricultural, and golf course and landscape water use were applied water demands or the amount actually pumped and delivered for these uses.

The seeming inconsistency, for example, of the applied use by agriculture being far higher in 1980 than the corresponding applied use in 1978 can be attributed to the fact that each investigator uses different techniques for making estimates and that a substantial amount of judgment is involved, especially since much of the agricultural, golf course, and landscape use is not metered. The land use in 1980 was determined by USGS. Using these data, unit water use data determined by DWR for each crop were applied to obtain the total water use by agriculture and golf courses. The municipal demand was determined by multiplying the U. S. Census figure of 1,405 for Borrego Valley in 1980 by 270 gallons per capita per day.

FIGURE 3

BORREGO VALLEY WATER USE IN 1980  
TOTAL APPLIED USE OF 13,167 ACRE-FEET



TOTAL APPLIED WATER USE  
IN 1980

Type of use	Water used (acre-feet)
Municipal . . . . .	425
Agricultural irrigation . . . . .	10,612
Golf course irrigation . . . . .	<u>2,130</u>
TOTAL	13,167

Three applied water demand projections are presented in each of Table 9 and Table 10. The individual projections were based on different sets of assumptions regarding the growth or decline of the various types of water use now in the valley. Table 9 presents applied water demands assuming that agricultural and recreational use stays at current levels while domestic use is projected to increase at rates of up to 12 percent annually, through the year 2000. The projections in Table 10 are different in that agricultural use is assumed to decline to zero by the year 2000. Tables 11 and 12 present corresponding projections of consumptive use.

TABLE 9  
BORREGO VALLEY FUTURE APPLIED WATER USE  
(Level agricultural activity)

In acre-feet

<u>Year</u>	<u>4% annual population growth</u>			
	<u>Municipal</u>	<u>Agricultural</u>	<u>Golf course</u>	<u>Total</u>
1980	425	10,612	2,130	13,167
1990	640	10,612	2,130	13,382
2000	940	10,612	2,130	13,682
<u>8% annual population growth</u>				
1980	425	10,612	2,130	13,167
1990	910	10,612	2,130	13,652
2000	1,970	10,612	2,130	14,712
<u>12% annual population growth</u>				
1980	425	10,612	2,130	13,167
1990	1,330	10,612	2,130	14,072
2000	4,110	10,612	2,130	16,852

TABLE 10  
BORREGO VALLEY FUTURE APPLIED WATER USE  
(Declining agriculture)

In acre-feet

<u>4% annual population growth</u>				
<u>Year</u>	<u>Municipal</u>	<u>Agricultural</u>	<u>Golf course</u>	<u>Total</u>
1980	425	10,612	2,130	13,167
1990	640	5,306	2,130	8,076
2000	940	0	2,130	3,070
<u>8% annual population growth</u>				
1980	425	10,612	2,130	13,167
1990	910	5,306	2,130	8,346
2000	1,970	0	2,130	4,100
<u>12% annual population growth</u>				
1980	425	10,612	2,130	13,167
1990	1,330	5,306	2,130	8,766
2000	4,110	0	2,130	6,240

TABLE 11  
BORRERO VALLEY FUTURE CONSUMPTIVE WATER USE  
(Level agricultural activity)

In acre-feet

Year	(1) Municipal	(2) Agricultural	(3) Golf course	Native vegetation (4)USGS/(5)PRC	Total		
					Low native vegetation (6)=(1)+(2)+ (3)+(4)	High native vegetation (7)=(1)+(2)+ (3)+(5)	
<u>4% annual population growth</u>							
1980	250	7,475	1,480	1,218	3,000	10,423	12,205
1990	370	7,475	1,480	1,218	3,000	10,543	12,325
2000	550	7,475	1,480	1,218	3,000	10,723	12,505
<u>8% annual population growth</u>							
1980	250	7,475	1,480	1,218	3,000	10,423	12,205
1990	530	7,475	1,480	1,218	3,000	10,703	12,485
2000	1,160	7,475	1,480	1,218	3,000	11,333	13,115
<u>12% annual population growth</u>							
1980	250	7,475	1,480	1,218	3,000	10,423	12,205
1990	780	7,475	1,480	1,218	3,000	10,953	12,735
2000	2,420	7,475	1,480	1,218	3,000	12,593	14,375

TABLE 12  
 BORLEGO VALLEY FUTURE CONSUMPTIVE WATER USE  
 (Declining agriculture)

In acre-feet

Year	(1) Municipal	(2) Agricultural	(3) Golf course	Native vegetation		Total	
				(4)USGS	(5)PRC	(6)=(1)+(2)+ (3)+(4)	(7)=(1)+(2)+ (3)+(5)
<u>4% annual population growth</u>							
1980	250	7,475	1,480	1,218	3,000	10,423	12,205
1990	370	3,738	1,480	1,218	3,000	6,806	8,588
2000	550	0	1,480	1,218	3,000	3,248	5,030
<u>8% annual population growth</u>							
1980	250	7,475	1,480	1,218	3,000	10,423	12,205
1990	530	3,738	1,480	1,218	3,000	6,966	8,748
2000	1,160	0	1,480	1,218	3,000	3,858	5,640
<u>12% annual population growth</u>							
1980	250	7,475	1,480	1,218	3,000	10,423	12,205
1990	780	3,738	1,480	1,218	3,000	7,216	8,998
2000	2,420	0	1,480	1,218	3,000	5,118	6,900

Table 11 presents consumptive use projections assuming that agricultural, recreational, and phreatophyte consumptive use remains at current levels, while at the same time, domestic use is projected to increase at rates of up to 12 percent annually by the year 2000. Table 12 presents a similar set of projections with the difference being that agricultural consumptive demand is projected to decline from 7,475 acre-feet per year down to zero acre-feet per year by the year 2000. Since there were two estimates of phreatophyte consumptive use available, the total consumptive use was determined using each.

Items of interest include the observation that a significant percentage increase in domestic water use has, relatively speaking, less impact on total water consumption than agricultural water use because agriculture is, by far, the largest consumer of water in the area. The assumption that recreational consumptive use will remain at current levels is likely to be an underestimate since future developments may well include new golf courses.

Although predicting the future of Borrego Valley agriculture is a speculative endeavor, it would seem unlikely that agriculture will expand in the future—more likely, agriculture will experience a significant contraction for the following reasons: the increasing cost of pumping ground water, as electrical rates rise and ground water levels decline, will further reduce the competitiveness of local produce in comparison to that produced in other areas of California which have access to cheaper water; and the increasing value of valley land for retirement residential development. The cost of electricity for pumping within the San Diego Gas and Electric Company service area has risen from slightly under \$0.01 per kilowatthour in 1968 to slightly more than \$0.12 per kilowatthour in 1983. The desirability of valley lands for residential use is illustrated by the recent development of the sizable Rams' Hill residential

project in the southern portion of the valley. The continuing population growth in the major urban centers of Southern California is likely to be reflected, to some extent, in a further expansion of population in the Borrego Valley.

A substantial portion of the population is either retired or in residence only seasonally, raising uncertainty about local growth patterns. Thus, a range of growth rates are presented which were chosen mainly on the basis of past growth rates seen in the valley and also current proposals for residential development.

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