IV - WATERSHED CHARACTERISTICS

4-01 General Characteristics. San Antonio Creek originates in the San Gabriel Mountains on the south slopes of San Antonio Peak, elevation 10,064 and flows in a southerly direction approximately 11 miles to the site of San Antonio Dam and Reservoir at elevation 2,125. The slopes are very steep average 720 feet/mile (0.136 ft/ft) giving rise to flash floods with very large debris loads. The drainage area (26.7 square miles) is elongated having a length approximately four times the average width. Prior to the completion of San Antonio and Prado Dams, the flow from San Antonio Creek emerged from the canyon mouth across a cone of deposition, joined with Chino Creek and continued southerly to the Santa Ana River.

Vegetal cover is distributed according to elevation and precipitation variation that occur within the watershed. Upper elevation reaches are forested with a heavy growth of coniferous trees, principally fir and spruce. The middle elevations have a growth of conifers and oak with large numbers of sycamores and alders growing adjacent to the streams. The lower elevations of the watershed have a heavy growth of brush consisting primarily of sumac and mountain mahogany, interspersed with sage and grasses. Scrub oak grows in the sheltered areas and on the northern slopes of the tributary canyons. The upper portion of the deposition cone (alluvial fan) has vegetal cover consisting primarily of sage brush and grasses.

4-02 Topography. The watershed area above the San Antonio Dam site is comprised of some of the most rugged mountains and precipitous canyons in southern California. The headwaters are in the San Gabriel mountains and totally within Angeles National Forest. Elevations range from 10,064 (San Antonio Peak also known as Old Mt. Baldy) to 2,125 (at dam site). San Antonio Creek flows southerly and numerous small canyons drain to the creek. Tributary canyon areas range from less than one square mile to approximately 4.5 square miles. Some of the major tributaries, in downstream order, include Icehouse, Bear, Kerkoff, Barrett, Cascade, Dry Lake, Cat, Spruce, Stoddard, and Evey Canyons. San Antonio stream gradients vary from 1,500 feet/mile in the headwaters to 250 feet/mile at the dam site. (pl. 4-01).

4-03 Geology and Soils. San Antonio Creek drains approximately 27 square miles of rough, mountain terrain on the south slope of the San Gabriel Mountains before reaching the north side of the upper Santa Ana River Valley, near the site of the dam. The mountainous area forming the San Antonio Watershed is largely Pre-Cambrian gneisses and schists intruded by granitic rocks. Mountains have been subjected to uplifting since tertiary time and the basins have been supplied with coarse granite and metamorphic materials. The steep mountain slopes are characterized by shallow and rocky soils that are very susceptible to erosional processes. Large areas of decomposed and disintegrated bed rock are exposed.

The dam crosses the canyon mouth about one mile downstream from the apex of an alluvial fan, which extends southward 10 miles across the valley. This fan is the westernmost of a series of fans that coalesce to form a piedmont alluvial slope along the south front of the mountains. Over time, the larger flood events have built up a large fan-shaped detrital cone (alluvial fan) at the mouth of the San Antonio Creek Canyon. The fan, one of the largest in southern California, averages about 2 miles in width and extends about 7 miles in the southerly direction to the vicinity of the City of Pomona. The cone is comprised mostly of large boulders, gravel, and coarse sand at the canyon mouth. The edges and apron areas of the fan are comprised of finer materials primarily sand, silt, and clay. The fan-bay above the dam is characterized by coarse alluvium containing many boulders as much as 3 feet in diameter and occasional ones as much as 10 feet. The maximum known thickness of stream-bed alluvium at the site exceeds 200 feet. Stream-bed alluvium in this vicinity is underlain by a basement complex of crystalline rocks and bordered by terrace deposits of older alluvium.

San Antonio Dam is located in the central Transverse Ranges which are in a seismically active area. The Cucamonga Fault, closest to the dam, trends east-west within a mile southwest of the dam. The San Andreas fault zone which trends northwest-southeast, lies about 12 miles north of the dam on the northern toe of the San Gabriel Mountains. The San Jacinto fault which trends northwest-southeast passing closest to the dam, 16 miles east at Lytle Creek.

The most severe earthquake, since 1932, a Richter Magnitude (Mr) 6.4, occurred in February 1971 at San Fernando, about 44 miles west of the dam. A Mr event of 5.5, with 19 aftershocks, occurred two miles from the dam in February 1990. In April 1990, a series of four other aftershocks, varying from Mr 3.3 to Mr 4.6 occurred in a radius of 2 to 3-1/2 miles from the dam site. There have been 36 other events varying from Mr 4.0 to 5.5 within 25 miles of the dam site since 1932. These events are thought to have occurred on the faults listed above. Plate 4-02 depicts the major faults and earthquakes above a Mr 4.0 within a 100 mile radius of the Dam.

4-04 Sediment. During flood events San Antonio Creek is known to carry a very large sediment/debris load. This is evidenced by the large (relative to drainage area) cones of deposition at the mouth of the canyon. During the larger flood events San Antonio Creek's sediment/debris will range in size from fine silts having diameters less than 0.4 mm to boulders several feet in diameter.

Based on a study of runoff and debris, deposition during the floods of March 1938 and January 1943 (at nearby flood and debris control basins) it was estimated that a flood of reservoir design magnitude would yield 1,350 acre-feet of sediment at the dam site. The study further estimated that during the fifty year period (1895-1944) 3,350 acre-feet would have been deposited had the reservoir been in place. As a consequence of the study an allowance of 2,000 acre-feet for sediment deposition was included in the storage capacity of the San Antonio Reservoir.

Following the January and February storms of 1969, a reservoir survey (July 1969) indicated that the storage of the reservoir had been reduced by some 1,540 acre-feet. More than 75 percent of the volume allowed for deposition was used in the first 14 years of operation. By the summer of 1971, some 2,014 acre-feet of sediment and debris had been deposited in the reservoir and the intake to the outlet works was partially blocked. See sediment survey data summary plate 4-03.

In order to preserve the flood control capacity of the reservoir, the U.S. Army Corps of Engineers, LAD, has undertaken to have sediment removed in order to reestablish the 2,000 acre-feet of deposition storage. In recent years the LAD has issued permits for sand and gravel extraction within the reservoir boundary. It is estimated that approximately 54 acre-feet of sediment have been removed annually for the past several years. There are no sediment monitoring stations either upstream or downstream of the dam. The 1990 survey indicates the reservoir has gained much of its original space and now the storage available at top of dam elevation 2260 is 11,992 ac-ft compared to its original volume of 12,719 ac-ft (see pl. 2-10 and 7-02).

4-05 Climate. The climate of the drainage area above San Antonio Dam is generally temperature-subtropical and semi-arid in the lower elevations, with warm, dry summers and mild, moist winters. In the higher mountains, moderate summers and cold winters, with considerable snowfall, prevail. Nearly all precipitation occurs during the months of December to March. Rainless periods of several months during the summer are common. Most precipitation in the drainage area results from general winter storms that are associated with extratropical cyclones of North Pacific origin.

a. Temperature. Average daily minimum and maximum temperatures (degrees Fahrenheit) in the vicinity of San Antonio Dam range from about 38 and 62 respectively in winter to about 58 and 90 in summer. The corresponding figures near the top of the basin (elevations 8,000 - 10,000 feet) range from about 10 and 22 in winter to about 45 and 60 in summer. All-time low and high extremes of temperature are about 22 and 110 respectively near the dam and about -30 and 75 at the top of the drainage. The lower elevations do not normally experience significant periods of subfreezing temperatures, but above 6,000 feet temperatures below freezing are very common for 4 to 6 months of the year.

Plate 4-04, reprinted from the National Weather Service Climatography of the United States No. 20, consists of a climatic summary for Upland, California, located a few miles southeast of San Antonio Dam. This table lists, among other items, the mean daily maximum and minimum temperature and record highest and lowest temperature for each month of the year at the Upland station.

b. Precipitation. Plate 4-05 shows isohyets of mean seasonal precipitation over the drainage area above San Antonio Dam, as compiled for the designing of San Antonio Dam. Within the drainage area, mean annual precipitation ranges from less than 25 inches near the dam to about 46 inches atop Mt. San Antonio, and averages about 33 inches over the drainage. Summary of precipitation data San Antonio Watershed, plate 4-06.

Plate 4-04 lists the mean and maximum monthly and annual precipitation, as well as the maximum daily precipitation for each month of the year, for Upland, California. Also listed in plate 4-04 are the probabilities (from 5 to 95 percent) for each month of the year that the monthly total precipitation at Upland will be equal to or less than the indicated amounts. This table demonstrates that there can be great year-to-year variability in annual, monthly, and daily precipitation. Not listed in this table are the minimum observed monthly precipitation values, which in the Upland-San Antonio area are at most 0.01 to 0.02 inches for each month of the year.

Plate 4-07 consists of precipitation depth-duration-frequency tabulation for Upland, California. In this table are listed the computed point-value precipitation depths for durations of from 15 minutes to 24 hours, and for return periods from 2 to 200 years. Data for this table were obtained from the State of California Department of Water Resources publication, Rainfall Depth-Duration Frequency for California, revised November 1982. These California Water Resources data are similar to those obtained from the National Oceanic and Atmospheric Administration (NOAA) publication, NOAA Atlas 2.

c. Snow. Snow in southern California is relatively uncommon at elevations below 6,000 feet, but occurs frequently at the higher elevations, and often remains on the ground for many weeks during the winter and spring at elevations above 7,000 to 8,000 feet. The slow melting of this snow normally maintains an inflow of 10-15 cfs at San Antonio Dam for several weeks following each significant storm, and snowmelt can slightly augment the large flows resulting from heavy, warm rains. The drainage area is too small, however, for snowmelt to be a major factor in the production of floodflows on San Antonio Creek.

d. Wind. The prevailing wind in the San Antonio watershed is the sea breeze. This gentle onshore wind is normally strongest during late spring and summer afternoons, with speeds up the canyon typically 10 to 15 miles per hour.

The Santa Ana is a dry desert wind that blows from out of the northeast, most frequently during late fall and winter. The characteristic low humidities and strong gusts of Santa Ana winds usually create very high fire hazards, but can also be instrumental in drying a saturated watershed, thus reducing the flood hazard from later events. Santa Ana winds through the San Antonio Creek Canyon can exceed 60 mph at times.

Rainstorm-related winds are the next most common type in southern California. Winds from the southeast ahead of an approaching storm average 20-30 mph, with occasional gusts to more than 40 mph. West to northwest winds behind storms can sometimes exceed 35 mph, with higher gusts.

4-06 Storms and Floods.

a. Storm Types. General storms consist of one or more cyclonic disturbances, last a total of from one to four or more days, and result in rain or snow over large areas. Local thunderstorms result in intense precipitation over small areas for short periods of time, and may occur independently or in association with general storms. Tropical cyclones are infrequent, but occasionally occur in late summer. A description of storm types which may impact the project area follows:

(1) General Winter Storms. Most precipitation in southern California coastal drainages occurs during the cool season, primarily from November through early April, as mid-latitude cyclones from the northern Pacific Ocean move inland over the area. Most of these storms are the general winter type, characterized by hours of light-to-moderate precipitation, but with occasional heavy showers or thunderstorms embedded within the storm system. Snow is common in these storms above 6,000 feet, but on occasion may fall at 2,000 feet or lower.

(2) Local Thunderstorms. Local thunderstorms can occur in southern California at anytime of the year. They occur fairly frequently in the coastal areas in conjunction with general winter storms. They can also occur between early July and early October, when desert thunderstorms occasionally drift westward across the mountains into coastal areas, sometimes enhanced by moisture drifting northward from tropical storms off the west coast of Mexico. These local thunderstorms can at times result in very heavy rain for periods of one to three hours over small drainages, such as the San Antonio Creek watershed.

(3) General Summer Storms. General summer storms in southern California are quite rare; but on occasion between mid-August and late October, a tropical storm from off the west coast of Mexico can drift far enough northward to bring rain, occasionally heavy, to southern California, sometimes with very heavy thunderstorms embedded. On very rare occasions, southern California has received light rain from general summer storms of non-tropical origin.

b. Floods. Information compiled from historical accounts, records of court cases, and statements of witnesses, indicate that large floods occurred in coastal southern California watersheds in 1811, 1815, 1825, 1832, 1833, 1840, 1851, 1852, 1859, and 1860. Available records since 1860 indicate that medium to large general floods occurred in January 1862, December 1867, February and March 1884, January 1886, December 1889, January 1890, February 1891, April 1903, March 1905, March 1906, January 1910, March 1911, February 1914, January 1916, December 1921, April 1926, February 1927, January 1934, February 1937, March 1938, January 1943, April 1958, November and December 1965, December 1966, January and February 1969, February and March 1978, February 1980, February 1981, and March 1983. Figures 4-01 and 4-02 show water in San Antonio Reservoir in February 1980. There was also a major tropical storm that occurred in September 1939, but no widespread flooding resulted in southern California from this event. Plate 4-08 lists the annual maximum inflow, outflow, and storage of water at San Antonio Dam.

Brief summaries of the major historical storm and flood events in the San Antonio Creek Basin and vicinity follow.

(1) Storm and flood of January 1862. An extreme flood event occurred in January 1862 on the Santa Ana River and in other southern California basins. According to historical accounts, nearly continuous rainfall began on December 24, 1861. An uninterrupted series of cold storms from out of the north brought heavy snow to low elevations in the mountains.

The storm track then changed, and a series of warm storms from east of Hawaii brought very heavy tropical rain to southern California. The combination of this rain, now falling on saturated ground, and massive snowmelt led to a flood with an estimated peak discharge of 317,000 cfs on the Santa Ana River at Riverside Narrows. The San Bernardino County Flood Control District discussed this estimate in their report "Agua Mansa and the Flood of January 22, 1862, Santa Ana River". No data exist for San Antonio Creek, but the heavy rain and snowmelt are likely to have generated one of the largest volumes of runoff in recent centuries, if not the largest, into what is now San Antonio Reservoir.

(2) Storms and floods of January 1916. Two heavy storm series hit southern California in January 1916. The 14-19 January storms dropped southward along the coast, bringing deep snowfalls to the mountains and foothills. The second series dropped southward over water, then moved onshore with very heavy warm rain that melted the previously fallen snow. Heavy flooding resulted 27-28 January in many parts of southern California.

(3) Storms and floods of February 1927. A series of heavy storms moved into southern California from the west during mid-February 1927, resulting in moderate flooding on the Santa Ana River and elsewhere throughout the coastal basins.

(4) Storm and flood of 30 December 1933 - 2 January 1934. This storm caused a disastrous flood in the recently burned Glendale-Montrose-La Crescenta area of the Los Angeles River basin. Precipitation was general over a wide area, and rates for 24 hours were the maximum of record at many stations. This storm was characterized by sharp bursts of rainfall. For San Antonio Creek, runoff was moderate; a peak discharge of 200 cfs was recorded at the Los Angeles County Flood Control District gauge at the mouth of the Canyon.

(5) Storms and floods of February 1937. After record cold and very low snow levels in January 1937, a series of Pacific storms moved into California from the west. The short-duration rainfall of February 6th and 14th, 1937, combining with snowmelt, caused severe flood damage to both agricultural and urban areas of the Inland Empire.

(6) Storm and flood of February-March 1938. The flood of early March 1938 was, and still is, the most destructive of record since 1862 on the Santa Ana River and many other streams in southern California; and its occurrence played a major role in the justification for the construction of San Antonio Dam, Prado Dam, and other flood-control structures. The storm developed out of a series of low-latitude north Pacific disturbances, bringing several bands of intense rainfall to southern California during a 5-day period of 27 February-3 March. Several mountain stations in southern California reported precipitation equaling or exceeding 30 inches during the 5 days. The maximum 12-, 24-, and 48-hour total storm precipitation depths over the drainage area above the dam were estimated at 4.1, 5.8, and 10.5 inches, respectively. The heaviest rain fell on 2 March between 0000 and 1900 hours, during which Camp Baldy reported nearly 8 inches in 6 hours and more than 12 inches in 12 hours. This intense band rain, combined with nearly saturated

ground from above-normal March 1938 precipitation, produced a peak flow of 23,400 cfs, at the Los Angeles County Flood Control District gauge at the mouth of San Antonio Canyon.

(7) Storm and flood of January 1943. The storm of 21-24 January 1943, which in many respects is the most severe storm of record in southern California, resulted when a series of warm Pacific cyclones moving generally eastward from the area north of Hawaii combined with an intense, cold storm moving down the west coast of North America from British Columbia. The deep, low pressure center that consequently developed over Northern California and Oregon generated unusually strong southerly and southwesterly winds over southern California and produced very heavy precipitation over much of the area. Exceptionally large rainfall amounts fell in the mountain areas because of the power orographic uplift of these strong winds. Continuous precipitation, which included two periods of very high intensity rainfall, occurred from about noon on 21 January into the morning of 23 January. This precipitation was caused by two cold fronts, the first of which occurred about midnight on 21 January, and the second, about midnight on 22 January. Rainfall tapered off on 23 and 24 January, although certain mountain stations continued to receive substantial precipitation during these two days. Total rainfall recorded for the storm in the general area ranged from 4.3 inches at Riverside to 29.7 inches at Glenn Ranch in the San Gabriel Mountains. Isohyets of Maximum 24-hour precipitation are shown on plate 4-09. Plate 4-10 shows the hydrograph for the 1943 event. Some snow fell during the storm, mostly above elevations of 8,000 feet. Although the storm was severe over and southwest of the mountains in Los Angeles and San Bernardino Counties, the runoff was moderate because of unusually dry antecedent conditions during the month before the storm occurred.

This storm, transposed on the basis of mean annual precipitation and critically centered over the watershed above the San Antonio Dam location, was used as the standard project storm in the design of San Antonio Reservoir.

(8) Storm and flood of March 1943. The local thunderstorm that occurred between 2200 hours 3 March and 0100 hours 4 March 1943 resulted in short-period precipitation of near record-breaking magnitude for the southern California coastal region. The storm developed out of a moderate general storm, beginning over the southern part of Los Angeles and moving northeast toward the San Gabriel Mountains at about 7 miles per hour. Because many automatic precipitation gages were in operation, the areal distribution of precipitation was well defined. The highest observed intensities were at the Sierra Madre-Carter (7-0-133B) precipitation station located in Sierra Madre, where maximum 15-, 30-, and 60 minute intensities of 5.5, 3.6, and 2.7 inches an hour, respectively, were recorded. Runoff was moderately heavy from local areas where high precipitation intensities occurred. However, as the thunderstorm did not extend appreciably into the San Antonio Basin, no major runoff was recorded there.

Major storms and floods since the construction of San Antonio Reservoir are recorded in Chapter 8.

4-07 Runoff Characteristics. San Antonio Creek is an ephemeral stream. With the exception of some low flows during snowmelt periods flow only occurs during and shortly after a heavy rainfall. Due to the steep slopes and shallow soil complexes, streamflow increases rapidly in response to effective rainfall. As the rainfall diminishes or stops, the streamflow recedes rapidly.

The watershed above the dam site is within the Angeles National Forest and is almost totally undeveloped. Due to the rugged nature of the watershed, it will remain undeveloped in the future; therefore, the runoff characteristics of the watershed will not be altered due to urbanization. The time of concentration at the San Antonio Dam and Reservoir site, under existing conditions, is estimated to be 2.1 hours. Plate 4-11 shows variations in 10-year mean peak discharge for the Los Angeles County region. Plate 4-08 gives annual maximum inflow, outflow and storage of water at San Antonio Dam since its inception in 1956.

Factors that significantly affect the runoff are forest/brush fires and antecedent moisture conditions. The watershed area is susceptible to forest fires that denude the slopes and increase the runoff during storms. The area has been fortunate in that no large fires have occurred in the past 35 years. Larger areas in the lower portion of the watersheds were denuded by fires in 1911, 1927, 1938 and 1953. Dry antecedent conditions in the watershed would be expected to show a significant reduction in the volume of runoff, but may only have a minor affect on the peak runoff ratio. Due to relatively shallow soil complexes, depleted soil moisture storages would fill early during a major storm. When the maximum storm intensity hits, the watershed will respond in much the same manner as the watershed with wet antecedent conditions. Studies performed on rainfall-runoff for large storms were used to estimate watershed loss rates. The average loss rate was found to be 0.4 inches/hour. The maximum and minimum loss rates are 0.8 inches/hour and 0.15 inches/hour, respectively.

4-08 Water Quality. There is no record of water quality measurements for San Antonio Creek runoff. Due to the undeveloped nature of the watershed, the quality of runoff is expected to be similar to that of most forested acres in Southern California. During larger storm events, the runoff has a high suspended sediment concentration. The main impact of San Antonio Dam/ Reservoir is that it serves to settle out some of the finer sands and silts thereby improving water quality. Impoundment durations at San Antonio are generally less than 48 hours. The short duration impoundments do not provide time for changes in water quality due to biological activity. Periodically water is impounded below elevation 2,164 for purposes of conservation (downstream for ground water recharge). Releases made from this pool are variable. The pool is normally emptied within a few days.

4-09 Channel and Floodway Characteristics. In order to protect the highly developed areas in the San Antonio Creek overflow zone downstream of the dam, channel improvements were made a part of the project. A total of 15.7 miles of channel improvements to San Antonio and Chino Creeks were completed in 1960. Detailed hydrologic studies were performed in order to determine the channel capacities required to route the design dam release of 8,000 cfs with provisions for storm drain and tributary inflows. Design flows required a channel with the following capacities:

(1) The channel capacity increases from 8,000 cfs at San Antonio Dam to 17,000 cfs at the Chino Creek confluence.

(2) At the Chino Creek confluence the channel capacity increases from 17,000 cfs to 29,000 cfs at the discharge point to the Prado Reservoir.

The channel improvements are comprised of three different cross sectional segments:

a. San Antonio Dam to Chino Creek Confluence. The first 55,300 feet is a rectangular concrete section. Bottom widths vary from 20 feet at the dam to 35 feet at the Chino Creek confluence. Heights of the channel range from 10 to 15 feet.

b. Chino Greek Confluence to Los Serranos Road. The second section which extends 19,500 feet from the confluence of Chino Creek to Los Serranos Road is a paved trapezoidal section. Bottom widths range from 60 feet to 100 feet with side slopes of 2.25H:1V.

c. Los Serranos Road to Prado Reservoir. The third section extends from Los Serranos Road 8,200 feet to Prado Reservoir. It is an unpaved trapezoidal section. The bottom width is approximately 335 feet with side slopes of 3H:1V This section contains an unpaved pilot channel which is 100 feet wide with depths ranging from 3 to 6 feet.

Plate 4-12 is a schematic of the improved channel depicting information such as bank full time of travel, capacities, distance in miles from the mouth (Prado Reservoir), and major channel crossings.

Incorporated into the planning and design of the channel improvements are provision for storm water drainage structures and tributary confluence structures.

a. Stormwater Drainage Structures. Inlets to the channel were provided for 20 drains that were existing at the time and 71 proposed drains. Eighty-eight of the drains are corrugated metal pipe ranging in size from 8 inches to 48 inches. The three remaining inlets are reinforced concrete box drainage; a 5.25-foot x 10-foot box at Station 764+53, a 4-foot x 9-foot box at station 732+00 and a 8-foot x 10-foot box at Station 743+96.

b. Confluence Structures. Provisions were made for three confluence structures: (1) Soquel Canyon Creek at Station 315+00; (2) An unnamed tributary at Station 426+00; and (3) Chino Creek at Station 560+00. Additionally, the channel improvements provided for 38 road, highway and railroad crossings. Of this total, 30 were new bridges constructed as a part of the project. Plate 4-13 lists the highway bridge crossings and the railroad bridge crossings, respectively.

4-10 Upstream Structures. There are no structures upstream of San Antonio Dam related to flood control. There are several minor diversions for water supply and hydroelectric power generation. The North Palomares Irrigation Company has a small concrete check dam in Evey Canyon which is approximately 2,000 feet upstream of the San Antonio Dam. The San Antonio Water Company operates an infiltration line for water supply which is partly within the reservoir boundary and partly upstream. The Canyon Water Company also operates an infiltration line for water supply. The City of Upland operates a water treatment plant on the east face of San Antonio Dam (fig. 4-03). These minor diversions have no effect on the flood control operation of the San Antonio Dam and Reservoir.

4-11 Downstream Structures. Flood releases from San Antonio Dam plus local downstream runoff are discharged into Prado Reservoir. Prado Dam and Reservoir is regulated for flood control by the Corps. In hydrologic design studies for San Antonio Dam, it was ascertained that flood flows from San Antonio and Chino Creeks present no regulation problems.

Diversion for water conservation were provided in the improved channel to protect the existing water rights of the Pomona Valley Protective Association, Mountain View Water Company, and the San Bernardino Flood Control District. These rights are protected by diverting water to spreading basins for groundwater recharge as follows:

a. PVPA Diversion. At San Antonio Channel Station 1109+00, 600 cfs can be diverted eastward and 300 cfs can be diverted westward. At Station 1030+00, 300 cfs can be diverted eastward. Figures 4-04, a, b, and c show water spreading grounds below San Antonio Dam 21 March 1980.

b. Chino Basin Water Conservation District. At Station 869+00, 100 cfs can be diverted eastward. Figure 4-05 shows water passing through San Antonio Dam outlet works and figure 4-06 shows San Antonio and Chino Creeks Channel with in-channel diversion for water spreading 21 March 1980.

4-12 Economic Data. The San Antonio Dam provides flood protection to agricultural lands and residential, commercial and industrial properties in Pomona, Claremont, Chino, Ontario and Upland, in Los Angeles and San Bernardino Counties.

a. Population.

(1) Los Angeles County. The population of Los Angeles County increased by 71,000 in the second half of 1988, to reach a total of 8,650,337 on January 1, 1989. This six month gain is consistent with the 73,200 gain for the first half of the year, and brings the total growth for all of 1988 to 144,200. With this latest increased, just over 30 percent of the 28,662,000 Californians reside in Los Angeles County. By 2010, the Southern California Association of Governments (SCAG) projects the population to each 10.0 million people, an increase of 1.3 million.

(2) San Bernardino County. The county of San Bernardino is the nation's largest in area. In 1984 the population was approximately 1 million with 75 percent of the population located in 2 percent of the county's land. By January 1989 the population reached 1,324,611, a 32% increase in 4 years.

By 2010, the county is projected to grow by 118 percent (4.5 percent annually) to 2.2 million residents. San Bernardino County is second only to Riverside County as the fastest growing in both population and housing.

(3) Cities.

County	Total Population	
City	1/1/88	1/1/89
Los Angeles		
Pomona	118,000	119,900
Claremont	36,250	36,550
San Bernardino		
Chino	55,700	56,800
Ontario	119,500	124,300
Upland	61,300	63,900

b. Employment.

(1) Several of the top twenty employers in San Bernardino County area located in Ontario; Lockheed Aircraft, General Electric, Dynamark Ltd., and Sunkist Growers Packing House. Ontario International Airport is also located in Ontario. In Upland, San Antonio Community Hospital and Lewis Homes are major employers. Major employers in Chino are Sundance Mfr., Golden West Homes, Inc., Aerojet Ordinance Co., and KSI Disc Products.

(2) In the Claremont area, Los Angeles County, Claremont College is the largest employer with 5,000 employees. Also, the IOLAB manufacturers contact lenses and has 944 employees. Pomona's largest employer is General Dynamics with 5,500 employees. Pomona Unified School District, General Telephone and Cal Poly Pomona are significant employers.

c. Agriculture.

(1) Los Angeles County. In 1982 there were 2,331 farms in Los Angeles County with a total of 317,757 acres. Farms accounted for 12.2 percent of total county land. In 1987 there were 2,035 farms with a total of 280,156 acres. Farms accounted for only 10.8 percent of total county land. Agriculture in Pomona consists of citrus, Chinese vegetables and nursery stock.

(2) San Bernardino County. In 1982 there were 2,074 farms with a total acreage of 2,120,839 in the county. 16.5 percent of total county acreage was in agriculture. By 1987 the number of farms dropped to 1,938 with total acreage of 1,682,364 and 13.1 percent of total county land. In the Chino/Ontario area agricultural preserve, the major uses are diary farming, poultry farming, horse ranches and specialty crops such as strawberries. The Upland area has several Christmas Tree farms.

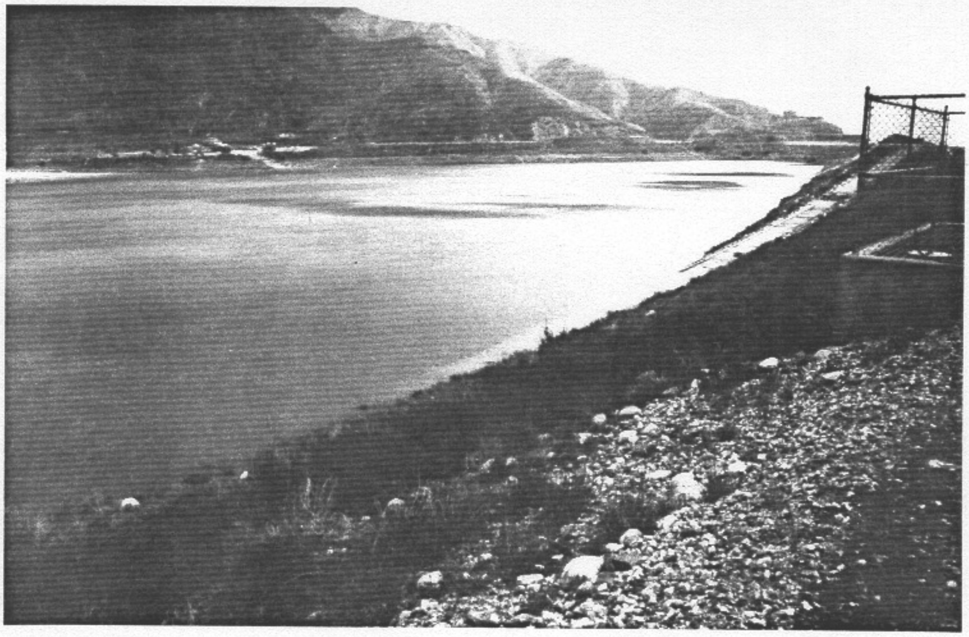


Figure 4-01 Floodwaters In San Antonio Reservoir February 1980.

Figure 4-02 Floodwaters Entering San Antonio Flood Control Basin February 1980.

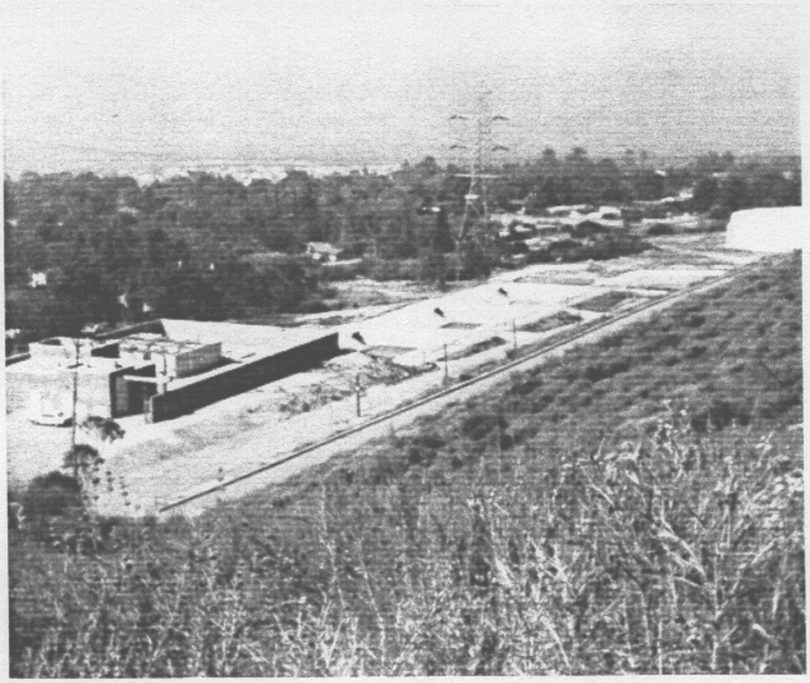
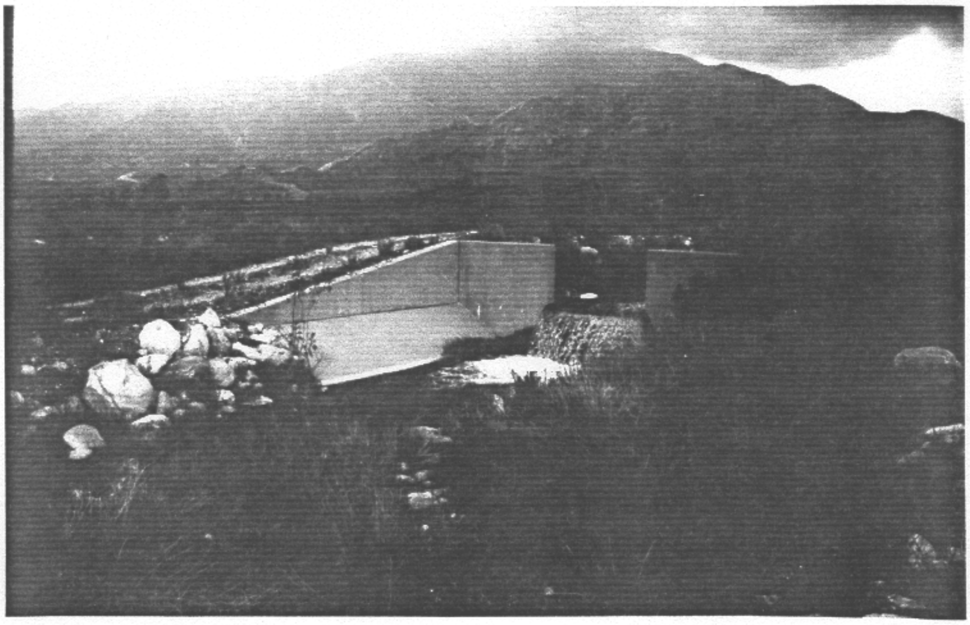


Figure 4-03 City of Upland Water Treatment Plant - East Face Of San Antonio Dam.

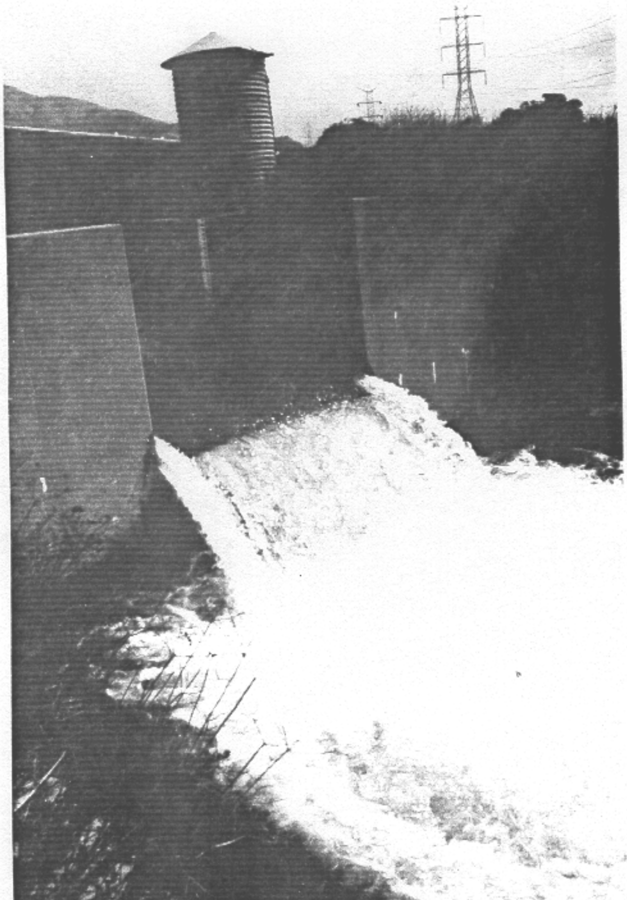
The San Antonio Canyon Water Treatment Plant, located at the base of San Antonio Dam, began operation early in 1990. The $7 million facility, owned solely by the City of Upland, is designed to treat and filter five million gallons of canyon water per day. The canyon water had not previously been used until the construction of the treatment plant.

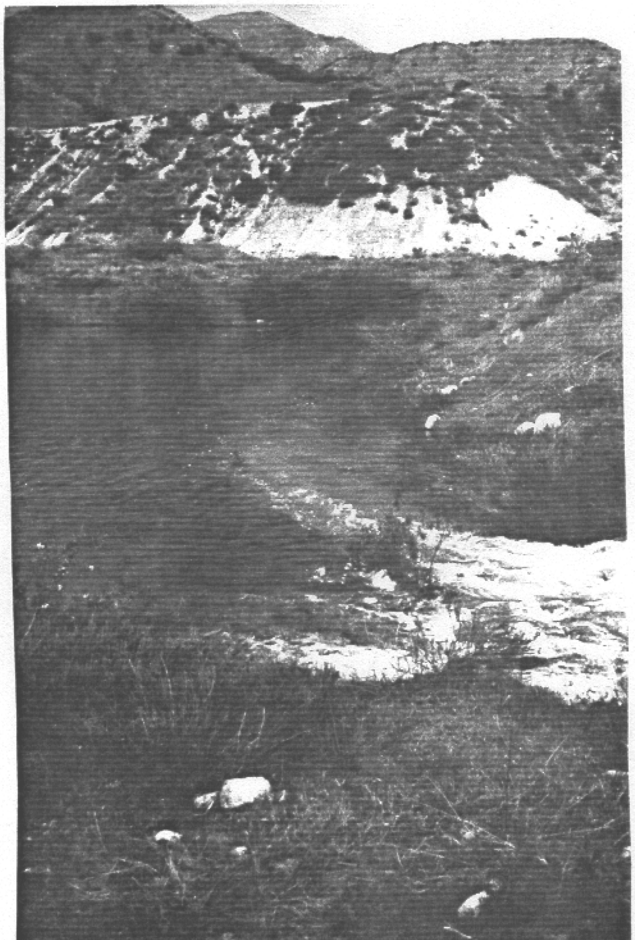
Water Conservation Spreading Below San Antonio Dam



Pomona Valley Protective Association Spreading Grounds 21 March 1980
Looking NW Just Below San Antonio Dam

Figure 4-04 a,b,c





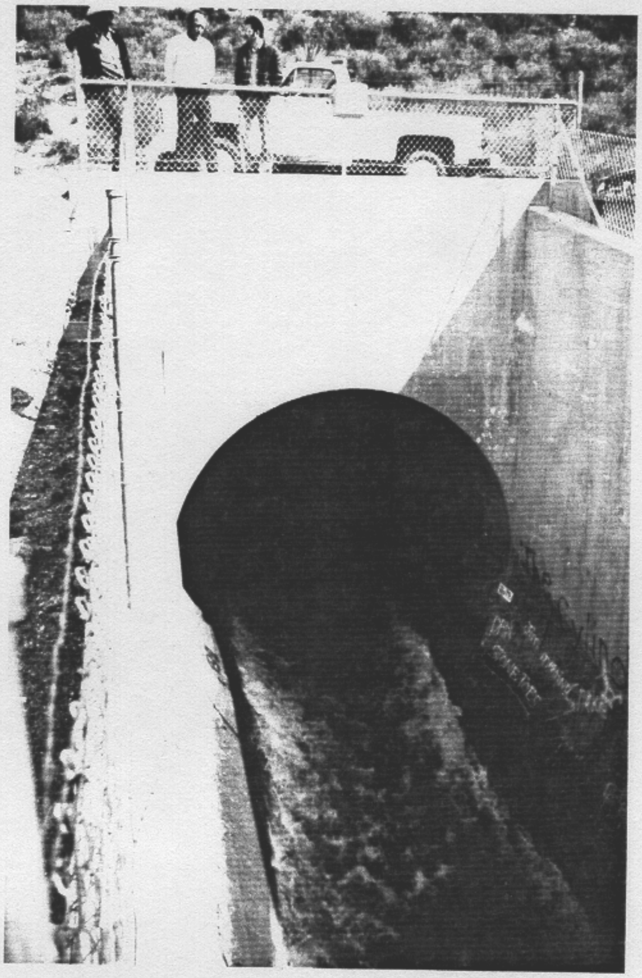


Figure 4-05 Water Passing Through San Antonio Dam Outletworks, 21 March 1980.

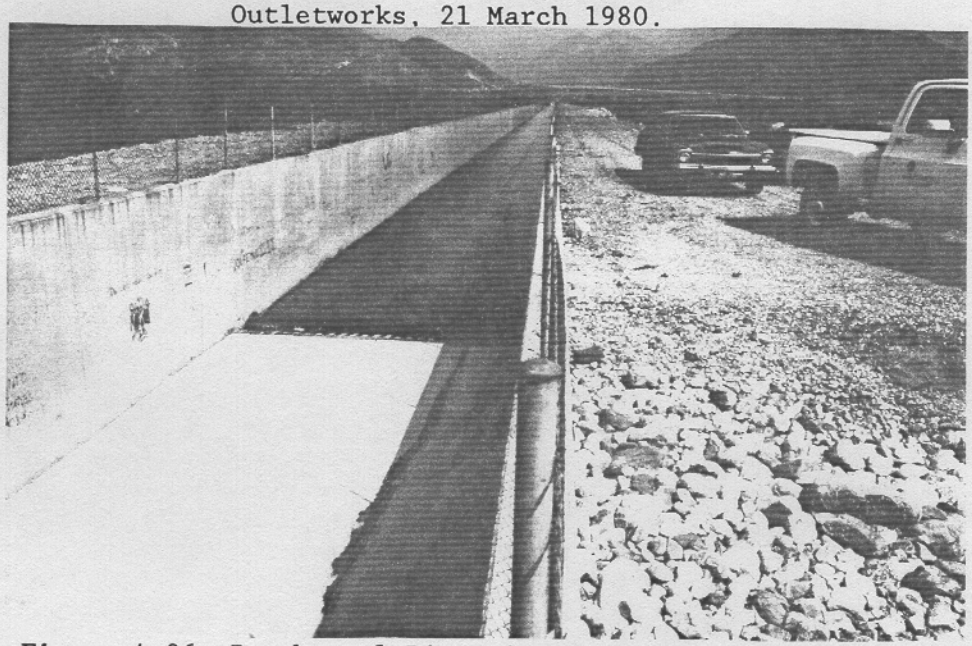


Figure 4-06 In-channel Diversion In San Antonio And Chino Creeks Channel For Water Spreading, 21 March 1980.