IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics

The drainage area of Brea Creek and its tributaries above Brea Dam is 22.0 square miles. The watershed is 13 miles long and has an average width of 1.8 miles. The area lies entirely in the Puente Hills drainage system. Elevations in the drainage area vary from 205 feet at Brea Dam to about 1,300 feet along the crest of the Puente Hills.

Brea Creek is formed 5 miles above the dam at the confluence of Brea Canyon and Tonner Canyon Creeks, which have tributary areas of 6.5 and 11.8 square miles, respectively. Brea Creek then flows generally southwesterly into Brea Reservoir, through an area of 3.7 square miles immediately tributary to Brea Dam. Below the dam, Brea Creek flows southward through the central business district of the City of Fullerton, where it turns westward to join Coyote Creek, a tributary of San Gabriel River. The longest watercourse in the drainage area, Tonner Canyon Creek, is 14.9 miles long and the overall gradient is about 83 feet per mile.

4-02. Topography

Brea Creek drains a portion of the southern slopes of the Puente Hills in north Orange County as well as a major part of the Coyote Hills in the City of Fullerton. The stream system originates near the border between Los Angeles and San Bernardino Counties. The stream gradients in the foothill and valley areas of Brea Creek are about 100 and 40 feet per mile, respectively. Elevations range from about 1,300 feet in the headwater above Brea Dam to about 70 feet at the confluence with Coyote Creek. Residential and commercial developments exist above and below Brea Dam, but development above the dam represents only about 10 percent impervious cover while development below the dam represents about 30 percent impervious cover. The drainage area above Brea Dam is 22.0 square miles and drainage area at the confluence with Coyote Creek is 33.5 square miles (including drainage area above the dam). Five watersheds contribute to local inflows to the Brea Creek downstream of the dam. Drainage areas of watersheds at concentration points CP-2 (Harbor Boulevard), CP-3 (Bastanchury Road), and CP-4 (Union Pacific Railroad Overcrossing), shown on plate 4-01 are 2.44, 1.94, and 2.08 square miles, respectively.

4-03. Geology and Soils

Brea Dam is located between the Coyote Hills on the upper (northeastern) edge of the Coastal Plain and is about 4 miles southwest of the Whittier fault and the Puente Hills. The left abutment consists of Fernando sediments which are fairly well compacted but practically uncemented sands, silts, clay and gravels in quantities decreasing in the order given. The right abutment contains more silt and clay than the left abutment. The abutments are practically impermeable, and the slight percolation characteristics, revealed by laboratory analyses, are considered to be within reasonable limits.

The Brea Creek drainage area has been divided into two district geological sections by the Whittier fault which traverses the drainage area in a north 65º west direction. The part of the Puente Hills lying on the north raised side of the fault is known as the Puente fault block. About 19 square miles of the Brea Creek drainage area lie on this raised block. The upper structure of this area, known as the Puente formation, is made up of a comparatively impervious indurate series of complexly folded and faulted sediments which have been divided into three classifications: namely, a lower shale, a middle sandstone, and an upper shale. The most important of these, hydrologically, are the lower shale and middle sandstone, as they outcrop over the entire upper portion of the drainage area. The lower shale member consists of laminated white siliceous shales, clayey and silty shales, fine arkosic-sandstone beds, and a considerable thickness of sandstones. The middle member of the Puente formation is a yellow sandstone, which is poorly bedded, rather soft, and made up largely of angular quartz grains.

Following the development of the Puente formation during the upper Miocene era, a period of peneplanation took place, producing great thicknesses of Pliocene and lower Pleistocene sediments. This series comprises the Fernando group which, together with the older alluvium and recent alluvium of subsequent periods, form the present surface materials of 4.4 square miles of the Brea Creek drainage area lying south of the Whittier fault. The recent and older alluviums are the more important, since they are far more in evidence at the surface than the Fernando group. Both of the alluvium groups are of continental origin and consist of unconsolidated, poorly sorted clay, sand, and gravel.

The Puente Hills appear to be a remnant of a once-extensive upland surface, greatly dissected by streams that headed north and east of the hills. The hills are now beheaded; their canyons occupied by small misfit streams, (e.g., Brea and Tonner), that have greatly incised their broad canyon floors. During much of late Pleistocene time, alluvial material accumulated to great thicknesses south of the Puente Hills, overlapping the site of the Coyote Hills onto the central plain to the south. As much as 2,000 feet of these deposits is transected by erosion that breached the Coyote Hills during and after their uplift. This erosion formed an extensive surface of low relief by late Quaternary time, then warped during uplift of the Coyote Hills and dissected by such antecedent streams as Brea and Coyote Creeks. South of Coyote Hills, these creeks have been sharply deflected by westward encroachment of the Santa Ana River alluvial fan and southward encroachment of the San Gabriel River fan; the deflections occur in the area where the two fans merge on the inland margin of the central plain.

Soils in the drainage area are sediments of the late Tertiary period. Sediments comprising the hills are made of sandstone, shales, and conglomerates of the Puente series. Detritus resulting from-erosion is generally sands and fine gravels impregnated with clay in the stream beds. The upper portion of the drainage area has a light to medium cover of chaparral and native grasses.

The portion of the area lying north of the Whittier fault is largely composed of rough, broken, and stony land which is nonagricultural. Small amounts of Yolo loam, Altamont clay loam, and Altamont loam are in evidence in the troughs of Rodeo and La Brea Canyons. In general, the area is highly impervious and capable of producing high rates of runoff. The small portion of the Brea Creek drainage area below the Whittier fault consists of a variety of soils of the Yolo, Ramona, Altamont, and small areas of the Hanford series. These are moderately weathered, medium-textured secondary soils of high agricultural value.

4-04. Sediment

Sediment production within the drainage area above Brea Dam varies considerably according to terrain. In the urbanized valley areas, production is at a minimum. In the steep and largely unurbanized mountain and foothill areas, sediment production is significant, particularly during periods of recurring heavy rains, and is especially great after a severe brush or forest fire.

However, the observed rate of sediment accumulation in Brea Reservoir appears to be relatively minor. Comparison of reservoir capacity at the sedimentation pool elevation of 251 feet indicates that between 1942 and 1964, the sediment trap rate was about 8 ac-ft per year. The original design sedimentation rate was 24 ac-ft per year.

4-05. Climate

The climate of the drainage area above Brea Dam is generally temperate -subtropical and semi-arid, with warm, dry summers and mild, moist winters.

a. Temperature. Average daily minimum/maximum temperatures (degrees Fahrenheit) range from 42/66 in winter to 59/90 in summer. All-time low/high extremes of temperature are about 22/113. The area does not experience significant periods of freezing temperatures.

Plate 4-02, reprinted from the National Weather Service publication Climatography of the United States No, 20 for the nearby Yorba Linda, California weather Station No. 9847, lists among other items the mean daily maximum and minimum temperature and record highest and lowest temperature for each month of the year.

b. Precipitation. Normal annual precipitation in the drainage area above Brea Dam ranges from just under 13 inches at the dam to just over 18 inches in the eastern Tonner Canyon area near the top of the watershed, as is shown on plate 403. The basin average normal annual precipitation above the dam is about 17.3 inches. Based on the Orange County Environmental Management Agency (OCEMA) 1980-1981 Hydrologic Data Report, the 40-year (1941-1980) mean annual precipitation below the dam is about 13.5 inches.

Table 4-01 is a summary of mean, maximum, and minimum observed monthly precipitation for Brea Dam (Sta. No. 1057) for the years 1948-1988, inclusive. Plate 4-02 shows the mean and maximum monthly and annual precipitation, as well as the maximum daily precipitation for each month of the year, for nearby Yorba Linda. Also listed on plate 4-02 are the probabilities (from 5 to 95 percent) for each month of the year that the monthly total precipitation will be equal to or less than the indicated amounts. These tables show that there can be great year-to-year variability in annual, monthly, and daily precipitation.

Table 4-01.

Monthly Mean. Maximum, and Minimum Observed

Precipitation at Brea Dam Station

1948 through 1988

PRECIPITATION (INCHES)

MONTH	MAXIMUM	YEAR	MEAN	MEDIAN	MINIMUM	NO. OF YEARS AT "0"
January	11.05	1969	3.14	2.34	0.00	3
February	8.84	1980	2.50	1.41	0.00	4
March	7.79	1983	2.16	1.39	0.00	3
April	4.11	1958	1.00	0.61	0.00	6
May	2.07	1977	0.15	0.04	0.00	16
June	0.32	1976	0.03	0.00	0.00	32
July	0.30	1968	0.02	0.00	0.00	35
August	2.24	1977	0.09	0.00	0.00	30
September	2.58	1976	0.28	0.00	0.00	22
October	1.77	1983	0.32	0.04	0.00	18
November	6.73	1965	1.62	1.08	0.00	5
December	5.41	1971, 1984	1.67	1.35	0.00	4

Table 4-02 is a precipitation depth-duration-frequency tabulation for Brea Dam. This table shows the computed point-value precipitation depths for durations of from 5 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 almost the same magnitude as those obtained from the National Oceanic and Atmospheric Administration publication, NOAA Atlas 2, for durations from 15 minutes to 6 hours. At durations of 12 and 24 hours, the NOAA Atlas 2 data are higher than the California data, up to 23 percent higher at 24 hours for the 100-year return period.

Table 4-02.
Precipitation Depth-Duration-Frequency Table
for Brea Dam States

Return Period in Years	Maximum Precipitation for Indicated Duration in Inches (M-Minutes; H-Hours) 5M	10M	15M	30M	1H	2H	3H	6H	12H	24H
2	.15	23	.29	.38	.50	.68	.83	1.18	.61	2.07
5	.22	.34	.43	.56	.74	1.00	1.23	1.74	.38	3.06
10	.26	.42	.53	.68	.90	1.21	1.49	2.11	.88	3.71
20	.31	.48	.61	.79	1.04	1.41	1.73	2.46	.35	4.31
25	.32	.51	.64	.82	1.09	1.47	1.81	2.56	.50	4.50
40	.35	.55	.69	.89	1.18	1.60	1.96	2.79	.80	4.89
50	.36	.57	.72	.93	1.23	1.66	2.04	2.89	.94	5.07
100	.40	.63	.80	1.03	1.36	1.84	2.26	3.21	.37	5.63
200	.44	.69	.88	1.13	1.49	2.02	2.48	3.52	.80	6.17
Mean	.16	.25	.32	.42	.55	.75	.91	1.30	1.77	2.28
Record Max.	.34	.49	.60	.73	1.02	1.45	1.70	2.50	3.59	5.40
Record Year	1952	1952	1952	1952	1974	1974	1974	1979	1979	1956

(1) General Winter Storms. Most precipitation in southern California coastal areas occurs during the cool season, primarily from November through early April, as mid-latitude cyclones from the north Pacific Ocean occasionally move across the west coast of the United States to bring precipitation to southern California. Most of these storms are of the general winter type, with hours of light to moderate steady precipitation, but with occasionally heavy showers or thunderstorms embedded. Although these storms frequently produce significant snow above 6,000 feet, snowfall and snowmelt are insignificant in the Brea watershed.

(2)LocalThunderstorms. Local thunderstorms can occur in southern California at any time of the year, but are least common and least intense during the late spring. These types of storms occur fairly frequently in the coastal areas during or just after 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. Local thunderstorms can also occur throughout the fall, as upper-level low-pressure centers sometimes trigger left-over summer moisture. These local thunderstorms can at times result in very heavy rain for short periods of time over small areas, causing very rapid runoff from small drainage areas. The Brea Dam watershed is especially vulnerable to this type of storm.

(3) General Summer Storms. General summer storms in southern California are quite rare; but on occasion 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. The season

in which these storms are the most likely to significantly affect southern California is mid-August through early October, although there have been some effects in southern California from tropical storms as early as late June and as late as early November.

On rare occasions, southern California has received light rain from non-tropical general summer storms, some of which have exhibited some characteristics of general winter storms.

c. Evaporation. Few formal studies of evaporation have been made in Orange County, because Brea Reservoir is normally dry, with any impoundments generally lasting less than a day, evaporation is not a significant consideration at this site. Studies from nearby locations indicate that mean daily evaporation ranges fromabout one-quarter inch in winter to about one-half inch in summer. On days of very strong, dry Santa Ana winds, evaporation can be considerably greater than one inch.

d. Wind. The prevailing wind in northern Orange County is the sea breeze. This gentle onshore wind is normally strongest during late spring and summer afternoons, with speeds in the Fullerton-Yorba Linda area normally 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. It can be especially strong below the Santa Ana River Canyon (where it receives its name), with peak gusts to more than 70 miles per hour (mph) at times. This type of wind, which does not normally occur when water is impounded behind Brea Dam, can create very high fire hazards, but can also be instrumental in drying a saturated watershed, thus reducing the flood potential.

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

All of the major inflowand impoundment events in the history of Brea Dam have been the result of general winter storms.

Prior to the construction of the dam, there were a number of major storms. Information compiled from historical accounts, records of court cases, and statements of witnesses, indicated that large floods occurred in 1811, 1815, 1822, 1825, 1832, 1851, 1852, 1859, 1860, 1862, and 1867 in adjacent basins. Available records since 1880 indicate that mediumto large general floods occurred in February 1891, March 1905, March 1906, January 1910, February 1911, February 1914, January 1916, December 1921, April 1926, February 1927, January 1934, and March 1938. The floods of February-March 1884, December 1889, and March 1938 were outstanding in adjacent basins, and the flood of 1934 was large on some streams in the general area. There was also a significant late summer storm in September 1939; and shortly before Brea Dam was placed into operation, a heavy local thunderstorm struck the watershed in March 1941.

Since the dam was completed, there have been several major storms and inflows, including those of January 1943, January and March 1952, January 1956, January and February 1969, December 1974, February 1978, February-March 1978, January 1979, January-February 1979, January and February 1980, and February-March 1983.

Several of the more significant storms and floods are discussed further in section 8-02.

4-07. Runoff Characteristics

Little streamflow occurs except during and immediately after the heavier rains because drainage area characteristics are not conducive to continuous runoff. Streamflow in the mountain areas above the dams increases rapidly in response to effective rainfall and is characterized by high peaks of short duration carrying considerable debris. Streamflow in the valley subareas below the dam also increases rapidly in response to effective rainfall (due to urbanized areas). Channel flow below the dam is characterized by flows of relatively long duration due to controlled release by Brea Dam with occasional sharp peaks from contributing subareas.

Plate 4-04 lists historic monthly inflows (in ac-ft) to the Brea Reservoir from 1941 to 1985. Plate 4-05 lists the annual maximum of inflows, outflow, storage, and elevation at Brea Dam.

Plate 4-06 shows the historical increase in effective impervious cover over the past 40 years. Effective impervious cover is defined as that impervious cover which contributes to direct overland runoff to a drainage basin outlet. Effective impervious cover for the Brea Creek Basin was obtained from the total impervious cover by using the relationship developed in the report entitled "Los Angeles County Drainage Area (LACDA) Review, Los Angeles County, Part 1, Hydrology Report Base Conditions (Revised March 1989)". Plate 4-07 shows the relationship between total and effective impervious cover.

Plate 4-08 illustrates the 10-year running mean of the historic annual peak flood plotted at the middle of the 10-years. The plot indicates a wet-dry-wet cyclic pattern over the past 40 years. The 10-year average annual peak inflow is plotted against the corresponding percent impervious cover in Plate 4-09. It shows an increase in peak annual discharge with increase of percent impervious cover. Data prior to 1947 does not follow this trend; this might be due to the cyclic behavior of peak discharge mentioned previously.

Plate 4-10 shows plots of running 10-year averages of peak annual inflows to the Brea Dam and annual peak hourly precipitation rates (in/hr) at Brea Dam station, for the available years of record. This plate also shows running 10-year average total precipitation amounts (inches) of the storm during which peak inflow occurred in each year of available record, and the change in percent impervious cover in the watershed during 1947-78. Plate 4-10 shows good correlation between increases in peak inflows and increases in percent impervious cover; however, no consistent trend is evident in the relationship between peak inflows and peak precipitation rates or total storm precipitation at Brea Dam. Observed increases in peak inflows are due to, in addition to increased urbanization in watershed, many other factors not readily quantifiable, e.g., antecedent precipitation, rainfall intensity in the upper drainage areas of the Brea and Tonner Canyon Creeks, upstream channelization (if any), areal extent of storm, rainfall distribution (rather than peak rate or total amount only), soil moisture content and its effect on infiltration rate, change in vegetation cover, etc.

Historical monthly and annual rainfall data at Brea Station are listed on plate 4-11. Plate 4-12 shows a plot of annual inflow to Brea Dam versus annual precipitation at Brea Dam for the period 1949-88. Annual rainfall-runoff relations are plotted separately for the three periods 1949-60, 1961-79 and 1980-88; this comparison indicates a significant change in rainfall-runoff relation after 1960. A given volume of annual precipitation occurring during the period 1961-1979 resulted in 3 to 4 times more runoff than that by the same amount of annual rainfall occurring during the 1949-1960 period. The same volume of annual precipitation resulted in 7 to 13 times more runoff than that occurring during the 1949-1960 period. Although peak annual inflows depend on many additional factors not reflected in annual rainfall-runoff relation, a definite change in watershed characteristics (after 1960) is indicated by this plot (pl. 4-12), and this is in conformity with the trend in peak annual inflows shown on plate 4-08.

Unit hydrograph values for the drainage area upstream of the Brea Dam are given on plate 4-13 and plotted on plate 4-14. This unit hydrograph was obtained by combining three separate unit hydrographs for sub-watershed areas: A (3.7 sq. mi.), B (6.5 sq. mi.), and C (11.8 sq. mi.) upstream of the Brea Dam. These hydrographs were derived using average Fullerton-San Jose S-Graph. Unit hydrographs for subareas B and C were added and routed, and then added with unit hydrograph for subarea A to get the combined unit hydrograph for the total upstream drainage area of 22 square miles. Because of this combination and routing process involved, the combined unit hydrograph shows double peaks as indicated on plate 4-14.

4-08. Water Quality

Because Brea Reservoir is strictly a flood-control project that rarely impounds water for more than 24 hours, it has no appreciable effect on water quality. The nature of urban storm runoff entering the reservoir is generally of poor quality. Routine base flow (usually less than 10 cfs) is typically high in salinity content, whereas storm runoff is generally low in salinity content.

4-09. Channel and Floodway Characteristics

The system diagram which shows the channel capacities and configurations and flood wave travel time is shown on plate 4-01. The channel immediately below Brea Dam is a concrete rectangular channel with a capacity of 2,200 cfs (Photo No. 4-01). (Outflow from Brea Dam is limited to 1,500-cfs). The channel then transitions to a concrete box channel with a capacity of 2,000 cfs before turning into an unlined channel at Hillcrest Park (Photo No. 4-02). The channel transitions from the unlined section to a trapezoidal concrete section and then to rectangular to box to trapezoidal concrete sections with capacity ranging from 2,200 cfs upstream to 3,000 cfs downstream. The channel transitions to a rectangular concrete section with a capacity of 11,000 cfs between the Union Pacific Railroad over-crossing and Dale Street (Photo No. 4-03).

The channel then constricts to an unlined section near Dale Street where the capacity is only 3,500 cfs. Further downstream, the channel transitions to a trapezoidal concrete section with capacity of 4,900 cfs (Photo No. 4-04), then transitions again to an unlined channel with capacity of 4,000 cfs before emptying into Coyote Creek approximately 6 miles below Brea Dam (Photo No. 4-06). The Coyote Creek channel, immediately downstream of the confluence with Brea Creek, is a concrete rectangular channel with a capacity of 21,500 cfs.

The streambed profile of Brea Creek from its confluence with Coyote Creek to downstream of the dam is shown on plate 4-15.

4-10. Upstream Structures

There are no hydraulic structures in the watershed upstream of Brea Dam that affect the operation of Brea Dam.

4-11. Related Structures

a. Fullerton Dam. This dam is constructed on Fullerton Creek, 10 miles above its confluence with Coyote Creek (as shown on pl. 2-01). Fullerton Dam is owned, operated, and maintained by the U.S. Army Corps of Engineers, Los Angeles District.

Fullerton Dam was completed May 1941. The flood storage capacity at spillway crest is 764 acrefeet. It is an earthfill dam, 46 feet high, with a top elevation of 307.0 feet. The spillway is detached with an ogee crest at elevation 290.0 feet and a crest length of 40 feet. The outlet works is through the right abutment and consists of a gated 4-feet wide by 6-feet high conduit, 346 feet long.

b. Carbon Canyon Dam. Carbon Canyon Dam, owned and operated by the U.S. Army Corps of Engineers, Los Angeles District, is a major flood control structure on Carbon Creek 4 miles east of the City of the Brea and approximately 12 miles north of the City of Santa Ana. The dam has 6,114 acft of flood storage capacity at the spillway crest elevation of 475 feet. Numerous flood retarding basins exist along Carbon Creek below Carbon Canyon Dam which have potential to reduce peak floodflows in the main channel. These basins are Miller, Placentia, Raymond, and Gilbert Basins, in downstream order.

c. Whittier Narrows Dam. This unique flood-control facility was built by the U.S. Army Corps of Engineers at the narrows of the San Gabriel River and Rio Hondo in Los Angeles County, just north of Pico Rivera. The facility is owned, operated, and maintained by the Corps of Engineers, Los Angeles District.

This dam has the capability of diverting San Gabriel River inflow westward for discharge into Rio Hondo. During moderate and high reservoir impoundment behind the dam, the waters from the two rivers combine within the reservoir, and can be let out into either of the two downstream channels. Thus a major portion of, and at times the total inflow from the entire upper San Gabriel River drainages can be passed into the lower Rio Hondo, and ultimately into the lower Los Angeles River. During significant flows, however, the outflow from Whittier Narrows Dam is normally discharged into both the Rio Hondo and the San Gabriel River.

4-12. Economic Data

a. Population. Orange County has been one of the fastest growing areas in the country since the end of World War II. The watershed for Brea Dam lies in the Cities of Fullerton and Brea and continues up into the Puente and Chino Hills with the far northern part in Los Angeles County. Most of the downstream area is located in Fullerton with the far western part in the City of Buena Park. The population estimates below are from the State of California, Department of Finance, Population Research Unit, and are as of January 1984:

Fullerton	106,900
Brea	31,850
Buena Park	65,100

b. Agriculture. The watershed above and downstream below the dam was once primarily an agricultural area. The postwar era has brought increasing urbanization to the area which has virtually replaced all agriculture except for a small amount of commercial agriculture in the far downstream area.

c. Industry. The explosive growth in population has been accompanied by corresponding growth in industry and commerce. There are oil fields in the watershed and some light industry in the downstream areas with Hunt-Wesson Foods and Hughes Aircraft as the largest facilities. Both the upstream and downstream areas have numerous residential developments. There are a few business parks in both areas.

d. Flood Damages. Since completion of the project, flood damages prevented through fiscal year 1984 are estimated to be $13,860,000. Stage-damage curves for Brea Creek could not be calculated because the necessary overflow information was not available. Estimated damages on Brea Creek for some of the historic floods are listed in table 4-03. Most of these damages were due to channel erosion in the unlined Brea Creek channel downstream from the dam.

Table 4-03.

Flood Damages on Brea Creek

Flood	Estimated Damage
27 February-3 March, 1938*	$81,000
19-27 January, 1969*	$41,000
21-26 February, 1969*	$84,000
28 February-6 March, 1978**	$13,540
13-18 February, 1980**	$10,580
27 February-3 March, 1983+	$13,790

*Data Source: Reservoir Regulation Manual for Brea Flood-Control Reservoir, U.S. Army Corps of Engineers, Los Angeles District, June 1970.

**Data Source: Federal Disaster Assistance Administration.

+Data Source: Federal Emergency Management Agency.

Photo No. 4-01. Brea Dam rectangular concrete outlet channel (view toward upstream).

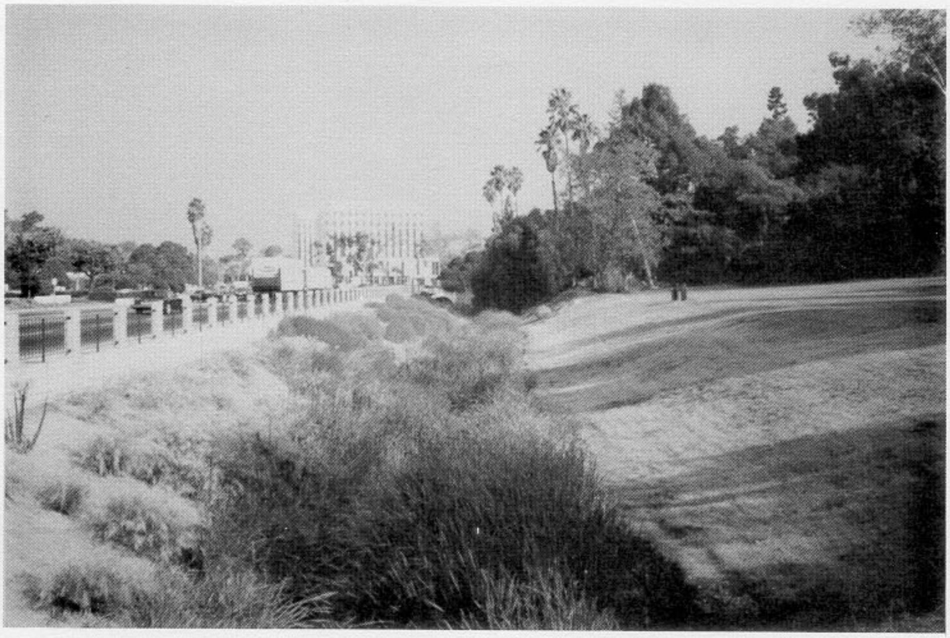

Photo No. 4-02. Unlined earth channel at Hillcrest Park (view toward upstream from Valley View Drive).

Photo No. 4-03. Rectangular concrete channel with 11,000 cfs capacity (view toward upstream from Gilbert Street).

Photo No. 4-04. Trapezoidal concrete channel with 4,900 cfs capacity (view toward downstream from Beach Boulevard).

Photo No. 4-05. An unlined channel with 4,000 cfs capacity (view toward downstream from Western Avenue). Confluence with Coyote Creek is in far background.