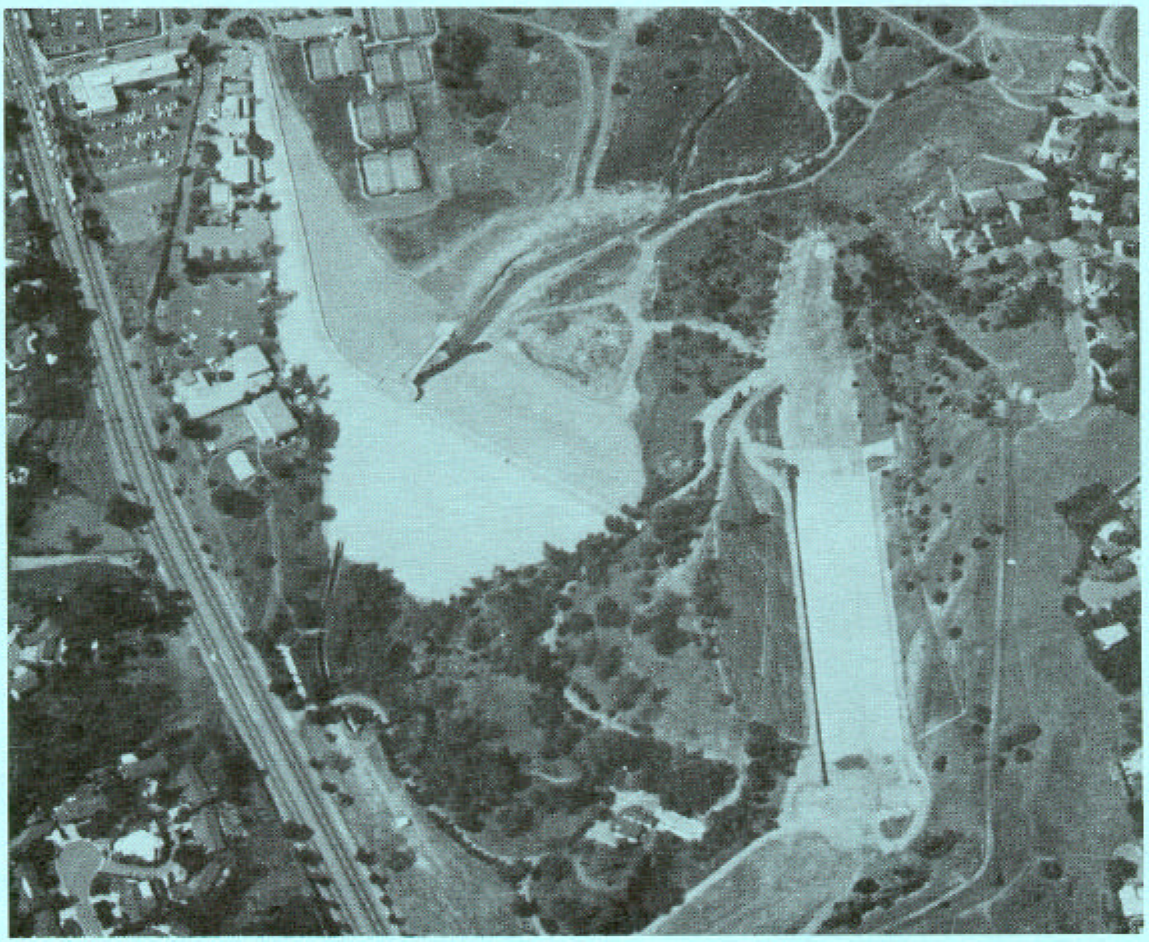
US Army Corps
of Engineers
Los Angeles District

WATER CONTROL MANUAL

BREA DAM
BREA CREEK

California



May 1990

BREA DAM AND RESERVOIR
ORANGE COUNTY, CALIFORNIA

PERTINENT DATA
MAY 1990

Construction Completed	March, 1942
Stream System	Brea Creek
Drainage Area . . . . sq. miles . .	22
Reservoir:	
Elevation	
Streambed at dam. . . . . ft., NGVD . .	208.0
Spillway crest . . . . .ft., NGVD . .	279.0
Spillway design surcharge level . . . . ft., NGVD . .	292.2
Top of dam . . . . .ft., NGVD . .	295.0**
Area	
Spillway crest . . . . .acres . .	162.7
Spillway design surcharge level . . . . . . acres . .	250.2
Top of dam . . . . .acres . .	272.8
Capacity, gross	
Spillway crest . . . . .acre-feet . .	4,008.5 (3.42*)
Spillway design surcharge level . . . . acre-feet . .	6,688.6 (5.70*)
Top of dam . . . . acre-feet . .	7,420.2 (6.32*)
Allowance for sediment (50-year) . . . .acre-feet . .	1,200 (1.02*)
Dam: - Type	Earthfill
Height above original streambed . . . . ft . .	87
Top Length . . . . ft . .	1,765
Top width . . . . ft . .	20
Freeboard . . . . ft . .	5.8+
Spillway: - Type	Ungated, overflow concrete ogee
Crest Length .ft. . .	150
Design surcharge . . . . c.f.s. . .	27,000
Outlets:	
Uncontrolled	
Number and size . . . . .ft . .	2 - 3.0' W x 2.5' H
Entrance invert elevation . . . . . . ft., NGVD . .	251
Controlled	
Gates - type.	Vertical Lift
Number and size. . . . . ft . .	2 - 5' W x 8'H
Entrance invert elevation . . . . . . ft., NGVD . .	208
Conduits	
Number and size. . . . . ft . .	2 - 5' W x 8' H
Length . . . . ft . .	484
Maximum capacity at spillway crest . . . . . .c.f.s . .	3,800
Regulated capacity at spillway crest . . . . c.f.s . .	1,500
Standard Project Flood:	
Duration (inflow) . . . . .days . .	2
Total volume . . . . acre-feet . .	8,260 (7.04*)
Inflow peak . . . . c.f.s . .	8,000
Outflow peak . . . . .c.f.s . .	5,060
Maximum water surface elevation . . . . .ft . .	283.2
Probable Maximum Flood:	
Duration (Inflow) . . . . hours . .	12
Total volume . . . . .acre-feet . .	8,200 (6.99*)
Inflow peak . . . . c.f.s . .	37,000
Outflow peak . . . . .c.f.s . .	27,000
Maximum water surface elevation . . . . .ft . .	292.2
Historic Maximums	
Maximum mean hourly inflow . . . . c.f.s . .	2,625
Date	3-1-83
Maximum release . . . . c.f.s . .	1,440
Date	3-1-83
Maximum storage . . . . acre-feet . .	1,073
Date	3-1-83
Maximum water surface elevation . . . . .ft . .	252.0
Date	3-1-83
Real Estate Taking Line:	
By fee . . . . .acres . .	236.65
By easements . . . . .acres . .	62.08

*Inch of runoff
**Top of parapet watt elevation 298.0 feet

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS
630 Sansome Street, Room 720
San Francisco, California 94111-2206

REPLY TO
ATTENTION OF:

CESPD-ED-W (1110-2-240b)

MAR 20 1991

MEMORANDUM FOR Commander, Los Angeles District
Commander, Sacramento District

SUBJECT: Planned Deviations from Approved Water Control Plans

1. All planned deviations from approved water control plans for reservoir projects within the South Pacific Division must be coordinated with the Coastal Engineering and Water Management Division at CESPD. Approval must be given prior to implementation of the deviation.

2. Emergency deviations do not require prior approval but coordination must still be made as soon as is practical.

ROGER F. YANKOUPE
Brigadier General, U.S. Army
Commanding

WATERCONTROL MANUAL
BREA DAM
BREA CREEK, CALIFORNIA

MAY 1990

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
RESERVOIR REGULATION SECTION

Photo of Brea Dam.

BREA DAM AND WATERSHED AREA

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in looseleaf form; and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made in order to keep the manual current.

EMERGENCY REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise, contact can be made by telephone to the U.S. Army Corps of Engineers, Los Angeles District Office during official business hours (0730-1600, Monday through Friday), plus during non-duty periods of flood operations:

Reservoir Operation Center (213) 452-3623

WATER CONTROL MANUAL
BREA RESERVOIR
ORANGE COUNTY, CALIFORNIA

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ABBREVIATIONS USED

ac-ft	acre-feet
ALERT	Automated Local Evaluation in Real Time (a hydrologic system consisting of automatic telemetry, precipitation and stream gauges that report to a local community computer which is programmed to process data from these gauges in real time and make hydrologic forecasts).
CALTRANS	California Department of Transportation
cfs	cubic feet per second
COE	Corps of Engineers
EM	Engineering Manual
ER	Engineering Regulation
ETL	Engineering Technical Letter
FEMA	Federal Emergency Management Agency
LACDA	Los Angeles County Drainage Area
LAD	Los Angeles District
LATS	Los Angeles Telemetry System

ABBREVIATIONS USED (Continued)

NGVD	National Geodetic Vertical Datum of 1929
NOAA	National Oceanographic and Atmospheric Administration
OCEMA	Orange County Environmental Management Agency
PMF	Probable Maximum Flood
QPF	Quantitative Precipitation Forecast
QPR	Quantitative Precipitation Report
ROC	Reservoir Operations Center
RTU	Remote Terminal Unit
USGS	United States Geological Survey

I - INTRODUCTION

1-01. Authorization

The authority and directives for the preparation of this manual are contained in the following U.S. Army Corp of Engineers' publications:

EM 1110-2-3600, 30 November 1987: Management of Water Control Systems.

ETL 110-2-251, 14 March 1980: Guide for Preparing Water Control Manuals.

ER 1110-2-240, 8 October 1982: Engineering and Design, Water Control Management.

Brea Dam and Reservoir are operated for flood control purposes only. There are no water supply, hydropower, or navigational purposes authorized at this time; therefore, no further mention of them will be made in this manual.

1-02. Purpose and Scope

This water control manual was prepared pursuant to requirements set forth in the Code of Federal Regulations, Title 33, Part 208.11, subparagraph d-4, entitled, "Water Control Plan and Manual". This manual contains (a) descriptive information pertaining to the drainage area and the project; (b) a description of the plan of operation of Brea Dam and its application to various floods; (c) the organization for operations by the U.S. Army Corps of Engineers, Los Angeles District; and (d) sources of hydrologic data and forecasts.

1-03. Related Manuals and Reports

Manuals and reports relevant to Brea Dam, Brea Reservoir, the drainage areas above and below Brea Reservoir, and significant hydraulic structures relating to these drainage areas are listed on plate 1-01.

1-04. Project Owner

Brea Dam and the reservoir lands behind the dam (frequently referred to as the Brea Flood Control Basin) are owned by the Federal Government, or by others with Federal flood easements. (The Federal Government owns 236.65 acres of basin land and has flood easements on 61.99 additional acres). The basin is under the jurisdiction of the U.S. Army Corps of Engineers, Los Angeles District.

1-05. Operating Agencies

a. U.S. Army Corps of Engineers, Los Angeles District is responsible for the operation and maintenance of the dam, reservoir (excluding recreational facilities), and intake and outlet works. The chain of command for reservoir operations decisions is given in table 1-01.

Table 1-01.
Chain of Command for Reservoir Regulation Decisions

Corps of Engineers
Los Angeles District

Title	Office Phone Number
District Engineer	(213) 894-5300

Water Control Decisions		**Operational and Maintenance**	
Title	Phone:	Title	Phone:
Chief, Engineering Division	(213) 452-3629	Chief, Construction-operations Division	(213) 452-3350
Chief, Hydrology & Hydraulics Branch	(213) 452-3525	Chief, Operations Branch	(213) 452-3385
Chief, Reservoir Regulation Section	(213) 452-3527	Chief, Operations & Maintenance Section	(213) 452-3387
Chief, Reservoir Regulation Unit	(213) 452-3530	Dam Tender Foreman	(626) 401-4006
Brea Dam Tender		Call ROC for the last number	

b. The recreational features of Brea Reservoir are managed by the City of Fullerton.

c. The American Hostel Association, Inc. operates a hostel on 2.98 acres of land adjacent to the downstream side of the dam. The land is leased from the Corps.

d. Orange County Environmental Management Agency (OCEMA) is responsible for the operation and maintenance of the Brea Creek channel downstream from Brea Dam.

1-06. Regulating Agencies

a. The U.S. Army Corps of Engineers, Los Angeles - District is responsible for developing the water control plan for Brea Dam and Reservoir.

b. The City of Fullerton is responsible for regulating and administrating recreation programs and facilities at Brea Reservoir. The City has a lease from the Corps for operation and maintenance of recreational development.

II - DESCRIPTION OF PROJECT

2-01. Location

Brea Dam is located across Brea Creek, about 6 miles above the confluence of Brea Creek and Coyote Creek. The dam, which lies within the city limits of Fullerton, is about 1/2 miles north of the intersection of Harbor Boulevard and Brea Boulevard, and about 20 miles southeast of the civic center of Los Angeles. The location of the project is shown on plate 2-01.

2-02. Purpose

The primary purpose for which Brea Dam was constructed is flood control. Other uses and benefits of the dam and reservoir, such as recreation are secondary. Brea Dam regulates flows on Brea Creek, and is designed to provide protection from floods for the City of Fullerton and the adjacent, highly-developed, coastal plain area.

2-03. Physical Components

Brea Dam consists of an earthfilled embankment, with a reinforced concrete spillway and outlet works. The components of Brea Dam and Reservoir include:

a. Dam. The dam is a zoned earthfill embankment with a crest length of 1,765 feet at an elevation of 295 feet, National Geodetic Vertical Datum (NGVD) . The crest width at the top of the dam is 20 feet and the maximum height above the original Brea Creek streambed is 87 feet. The upstream slope (Photo No. 2-01) varies from 1 on 3.3 at the top of the dam to 1 on 4 at the toe. The downstream slope (Photo No. 2-02) varies from 1 on 3 at the top of the dam to 1 on 4 at the toe. The upstream slope is paved with a 2-foot layer of graded rip-rap on a 12-inch gravel blanket (Photo No. 2-03) and the downstream slope is protected with a 2-foot blanket of gravel. The general plan and elevation of the dam is shown on plate 2-02. A 3 foot high parapet wall was added to the dam crest in 1973 to account for a freeboard (wave runup and wind setup) deficiency. The deficiency did not exist at the saddle dike.

b. Outlet Works. The outlet works in the right abutment consist of (1) a lined approach channel, (2) a reinforced concrete intake structure (Photo No. 2-04), (3) outlet gates, (4) ungated outlets, (5) concrete conduits through the dam, (6) a control house with service bridge, and (7) an outlet channel (see pl. 2-03).

(1) The lined approach channel is trapezoidal in cross-section with a bottom width of 25 feet and side slopes of 1 on 2. It is lined with 12 inches of rock paving on a 6-inch gravel blanket for a length of 100 feet, and reinforced concrete for a length of 67 feet, including intake structure wing walls.

(2) The reinforced concrete intake structure includes an inlet channel transition section approximately 31 feet long and an intake tower 87.5 feet high. Trash racks are provided in the base of the intake tower The intake tower provides access to the gate operating cable, sheave blocks and the outlet gates.

(3) The concrete gate control house, located on top of the intake tower, is 22 feet by 28 feet inside, and 17 feet high. The control house contains (i) the gate hoists and electrical controls, (ii) gate position indicators and two Stevens Type F gate-opening recorders, (iii) Stevens A71 and A35 reservoir water stage recorders, (iv) a selsyn indicator connected with the downstream gauging station, (v) a glass-tube rain gauge, and (vi) a remote terminal unit of the Los Angeles Telemetry System.

(4) Two caterpillar- type vertical lift gates, 5 feet wide by 8 feet high, are set in the base of the intake tower at invert elevation 208 feet. The Southern California Edison Company supplies 440-volt power to the motors on the two gate hoist assemblies. In case of commercial power failure, a diesel standby power unit is available to supply 30 KW at 480 volts and 60 Hz. The gates may also be operated by hand crank in case of motor failure. Under normal operating conditions the gates open or close at about one foot per minute.

(5) Two 3 feet wide by 2.5 feet high ungated outlets equipped with trash racks, with entrance crests at elevation 251 feet, are provided to prevent permanent storage above that elevation. A transition section with level invert at elevation 208 feet extends approximately 27 feet downstream and merges the flows from the gated and ungated outlets and directs them into the outlet conduits. Maximum outflow through one gated and one ungated outlet is limited by the capacity of the outlet conduit.

(6) The concrete outlet conduit is double-barreled. Each barrel is 5 feet wide by 8 feet high and is 484 feet long, including an upstream transition section 58 feet long. From the end of the transition section to the outlet portals, the slope is 0.00238. The maximum outlet capacity with the water surface at spillway crest is 3,800 cubic feet per second (cfs). Discharges of gated and ungated outlets against elevation are given on plate 2-04 and plotted on plate 2-05.

(7) The outlet conduit discharges into a rectangular concrete-lined outlet channel 12.5 feet wide and 425 feet long, with channel height ranging from 9 to 12 feet. A trapezoidal section 60 feet long, paved with derrick stone, serves as a transition to Brea Creek Channel.

c. <u>Spillway</u>. The spillway is detached from the embankment and is located through the hill forming the east abutment. It includes (1) a trapezoidal approach channel (Photo No. 2-05), (2) a rectangular control section, and (3) a trapezoidal exit channel (Photo No. 2-06). See plate 2-06. Spillway discharge versus elevation is listed on plate 2-07 and plotted on plate 2-08.

(1) The trapezoidal approach channel is approximately 220 feet long with side slopes of 1 on 2 and a bottom width of 150 feet. The first 180 feet of channel is unlined and the downstream 40 feet is lined with reinforced concrete.

(2) The control section is formed by a concrete ogee 12 feet high and 150 feet long. The spillway channel is 640 feet long and terminates in a flip bucket with lip elevation 240 feet.

(3) The spillway exit channel is approximately 325 feet long and 150 feet wide with side slopes of 1 on 2. Derrick-stone lining protects the first 50 feet of the exit channel.

(4) The spillway channel returns to Brea Creek Channel approximately 800 feet downstream from the outlet works exit.

d. Outlet Works. The outlet works (as shown on pl. 2-03) consist of both controlled and uncontrolled intake conduits. The controlled intake conduit, whose invert elevation is 208 feet, houses two 5 feet wide by 8 feet high vertical lift gates. The uncontrolled intake conduit, whose invert elevation is 251 feet, consists of two 3 feet wide by 2.5 feet high entrances. The uncontrolled and controlled structures join each other just downstream from their entrances and form a 484 feet long, 5 feet high by 8 feet wide conduit. The conduits have a maximum capacity of 3,800 cfs with a reservoir elevation at spillway crest.

e. Saddle Dike. A saddle dike is located about one mile upstream from the dam. The dike, with crest elevation 295 feet, is approximately 640 feet long and 41 feet high. Details and plan views are shown on plate 2-09. The dike was constructed to protect the Union Pacific Railroad right-of-way that is located in the flood control basin.

f. Reservoir. The reservoir formed by Brea Dam has an area and gross capacity at spillway crest (elev. 279 feet) of 162.7 acres and 4,009 acre-feet, respectively. At the top of the dam (elev. 295 feet) the area is 272.8 acres and the capacity is 7,420 acre-feet. The real estate limits for the Brea Reservoir is shown on plate 2-10. The recreational development plan is shown on plate 211. Plate 2-12 shows the storage allocation diagram for Brea Reservoir. Tabulation of areas and capacities is given on plate 2-13. Plate 2-14 shows the area and capacity curves.

2-04. Related Control Facilities

Brea Creek flows enter the San Gabriel River via Coyote Creek channel. The channel of Brea Creek, from outlet of reservoir to the confluence with Coyote Creek, is regulated primarily by Brea Dam.

2-05. Real Estate Acquisition

A total acreage of 298.7 acres was acquired by the Federal Government within the reservoir taking line. The City of Fullerton has acquired 7.75 acres outside the reservoir taking line to supplement the acreage available for recreation development. The boundaries of real estate are depicted on plate 2-11.

2-06. Public Facilities

The public and private facilities within Brea Reservoir are comprised of golf courses, a stadium, picnic areas, and tennis courts. All recreation facilities at Brea Dam recreational areas are operated and maintained by the City of Fullerton. Pertinent elevations are given in table 2-01.

Table 2-01.
Elevations of Recreation and Other Facilities
Brea Reservoir. Fullerton. California

Facility	Lowest Elevation (feet)
Fullerton Municipal Golf Course	239
Bastanchury Road	239
Oil Wells (Union Oil)	275
Tennis Courts	284

Note: Children's Center and Y.M.C.A. are not within the reservoir.

Photo No. 2-01. Upstream slope of dam (view toward southeast).

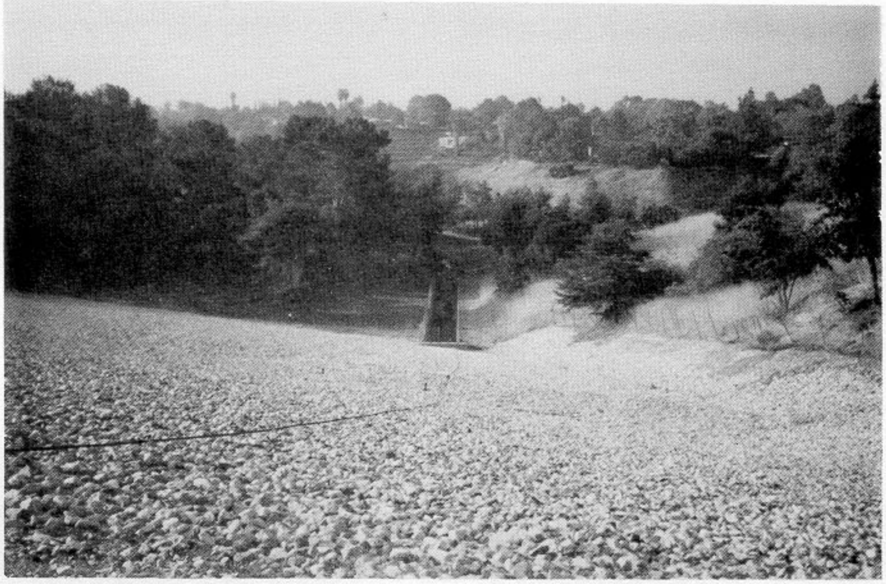

Photo No. 2-02. Downstream slope of dam, with outlet channel in background (view toward south).

Photo No. 2.03. Brea Reservoir (view toward upstream).

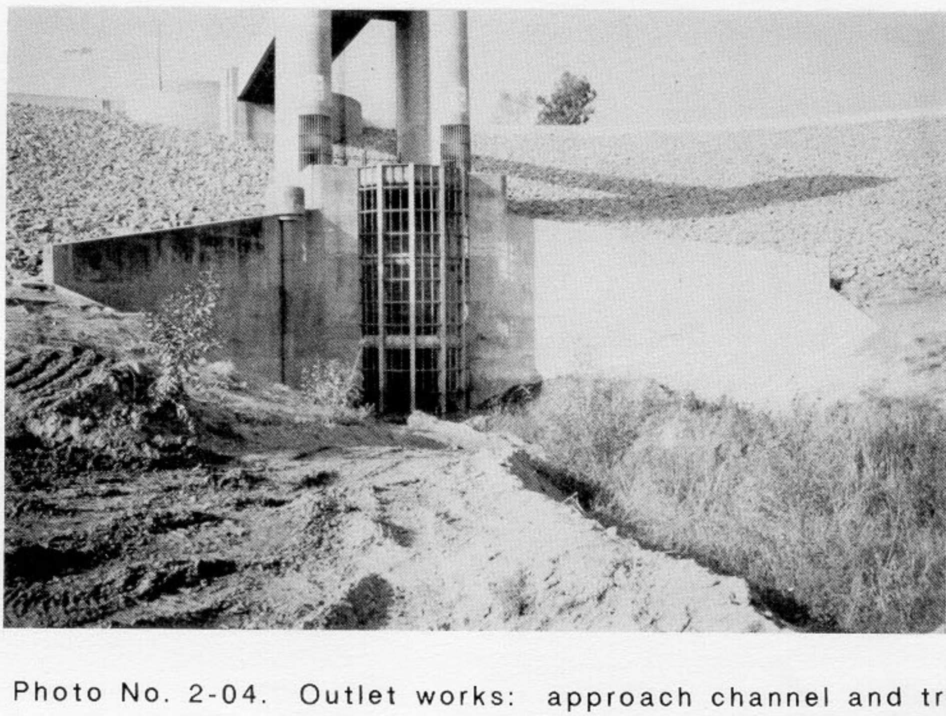

Photo No. 2-04. Outlet works: approach channel and trash rack (view toward downstream).

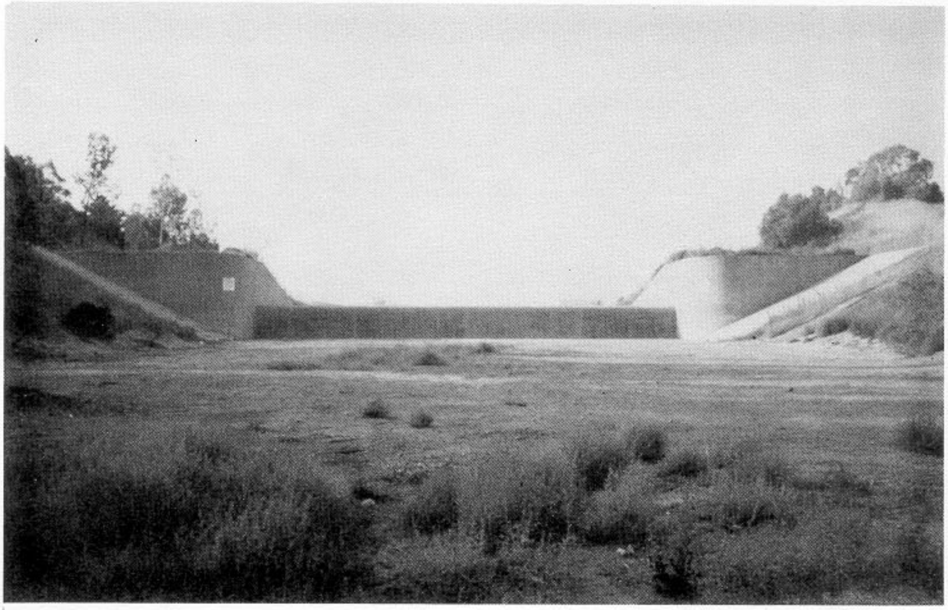

Photo No. 2-05. Approach to spillway (view toward south).

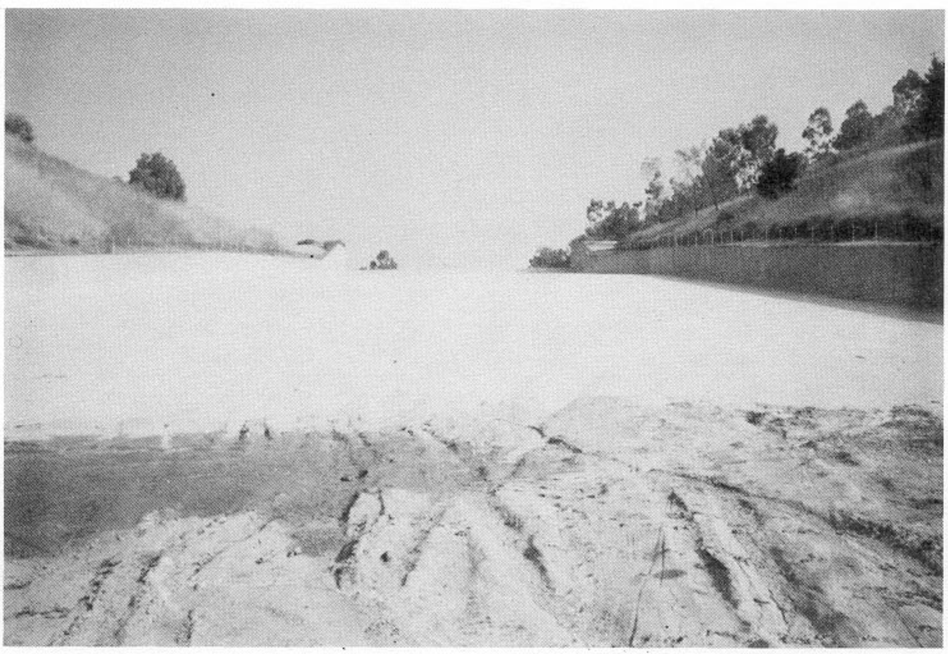

Photo No. 2-06. Spillway outlet channel (view looking upstream)

III - HISTORY OF PROJECT

3-01. Authorization

Brea Dam, one of the units of the flood-control project for the San Gabriel River Basin and Orange County, California, was constructed under authorization of the Flood Control Act of 22 June 1936 (as amended). The Corps of Engineers is responsible for the operation and maintenance of the project. Section 5 of the aforementioned act authorizes construction of Brea Dam under the following paragraphs:

LOS ANGELES AND SAN GABRIEL RIVERS, CALIFORNIA

> Construction of reservoirs and principal flood channels in accordance with plans to be approved by the Chief of Engineers on recommendation of the Board of Engineers for Rivers and Harbors at an estimated construction cost not to exceed $70,000,000; estimated costs of lands and damages, $5,000,000.

SANTA ANA RIVER, CALIFORNIA

> Construction of reservoirs and related flood-control works for protection of metropolitan area in Orange County, California, in accordance with plans to be approved by the Chief of Engineers on recommendation of the Board of Engineers for River and Harbors, at an estimated construction cost not to exceed $13,000,000; estimated costs of lands and damages, $3,500,000.

3-02. Planning and Design

The flood of 1916 and the agricultural growth of Orange County in the 1920's gave rise to the need for improved flood protection on the County's coastal plain, and for development of a system to replenish the groundwater that was being used at an ever increasing rate. The Orange County Flood Control District envisioned a plan that would address both of these issues, and outlined it in their 1929 report, "The Control of Floods and Conservation of Water".

The original plan for the Brea Creek watershed was to construct a storage dam on each of the two forks of Brea Creek. A dam on each of the forks was necessary because a single dam on Brea Creek below the confluence of the forks would have inundated nearby oil fields. Stored water was to have been released downstream and diverted, below the confluence, into the Fullerton Creek watershed and stored behind Fullerton Dam. Releases from Fullerton Dam would then be transmitted to Carbon Canyon Creek via a conduit and subsequently released into the Santa Ana River with the intent of recharging the groundwater aquifer.

It appears that Orange County originally submitted a report on the overall Santa Ana River Basin and

Orange County project and applied for a grant under the Federal Emergency Relief Appropriation Act of 1935. The project was later authorized under the Flood Control Act of 22 June 1936 (as amended).

The Flood Control Act did not authorize any storage for water conservation; therefore Brea Dam was constructed for flood control only. The present dam site was chosen because a greater amount of flood water could be impounded than at the sites proposed by the county. A hydrologic study for Brea Creek was performed in November 1939, and the analysis of design for Brea Dam was accomplished based on the derived hydrologic information in February 1940 (Ref. 1939 Hydrology in the Brea Creek Drainage Area, and 1940 Analysis of Design listed on pl. 1-01). The Dam was named Brea because of its location.

3-03. Construction

Construction of Brea Dam was started in July 1940 and completed in March 1942. The cost of the project, which was financed by Federal funds, was $1,417,815.

3-04. Related Projects

The other components of the flood control system related to Brea Dam are Fullerton Dam and Carbon Canyon Dam. These facilities are discussed in section 4-11 of this manual. All three facilities are operated independently of each other. Their operation only influences flow conditions in their immediate downstream areas.

3-05. Modification To Regulations

At the time of construction of Brea Dam in 1942, a capacity of 1,330 cfs for the downstream channel of Brea Creek was adopted as the regulated outflow from the dam. Modifications to the operating schedule since then have been minor. The original design water control plan for Brea Flood Control Basin is presented in the report, "Brea Creek Improvement, Brea Dam, Analysis of Design," dated February 1940. The plan established a debris pool by keeping both gates closed until the sill; of the ungated outlets was reached at water surface elevation 251.0 feet. Above this elevation, the gates were operated to maintain outflow equal to inflow to a maximum discharge of 1,330 cfs. With increasing flow, the gates were operated to maintain a constant outflow of 1,330 cfs, including discharge through the ungated openings. During falling stages, the maximum outflow of 1,330 cfs was maintained until the water surface receded to elevation 251.0 feet. Below this elevation, water was released at a non-damaging rate. This plan was in effect until 1970.

A water control plan, adopted in 1970, had both gates initially open one foot to pass small flows. The gates were operated to increase the outflow to approximately 1,330 cfs at water surface elevation 232.0 feet, and to maintain this outflow to spillway crest (elev. 279.0 ft.). Above spillway crest, the gates were gradually closed, transferring flow to the spillway. During falling stages, the reverse schedule was followed. In 1970, a maximum discharge of 1,400 cfs was adopted to regulate the outflows, and in 1982, the gate opening for the initial stage was changed from 1.0 to 3.5 feet. This plan will be referred to as the "Previous Plan" in the remainder of this manual.

The current water control plan adopts 1,500 cfs as the limiting release for reservoir elevations up to the spillway crest. This limiting release is consistent with the downstream channel capacities which vary from 1,500 cfs (for the unlined channel near Hillcrest Park) to 11,000 cfs.

3-06. Principal Regulating Problems

There have been no major problems in the regulation of Brea Dam since construction was completed in 1942. The dam has never spilled; there have never been any structural deficiencies or major hydraulic malfunctions.

The trash rack at the entrance to the intake structure occasionally becomes clogged from excess debris accumulation (Photo No. 3-01); periodic maintenance is necessary to remove the accumulated trash and debris. As much as 8 feet of sediment has been deposited at the intake structure as a result of storm runoff. The sediment accumulation occasionally causes the digital recorder float to become stuck. The float eventually becomes dislodged when the buoyant force caused by increasing reservoir head becomes great enough to do so. The result, however, is an erroneous jump in the digital reading.

Photograph 3-02 shows sediment deposition at Basque Avenue in the channel downstream from Brea Dam. Debris and sediment accumulation occurred at Basque Avenue in 1980. Although the accumulation was significant, peak flows were contained within the channel. During the flood of 1983, flows briefly overtopped the channel just upstream of Basque Avenue. Reduced channel capacity due to sediment accumulation was the probable cause of the breakout. Removal of such accumulation is the responsibility of OCEMA.

An oil spill occurred within the Brea Creek basin several miles upstream of the dam in January, 1983. A constant reservoir water surface was maintained to aid in the clean up of the oil from reservoir lands. A minimal amount of oil passed the dam and ultimately reached the ocean. The spill, which was cleaned up shortly thereafter, was considered insignificant by the Regional Water Quality Control Board and the Environmental Protection Agency.

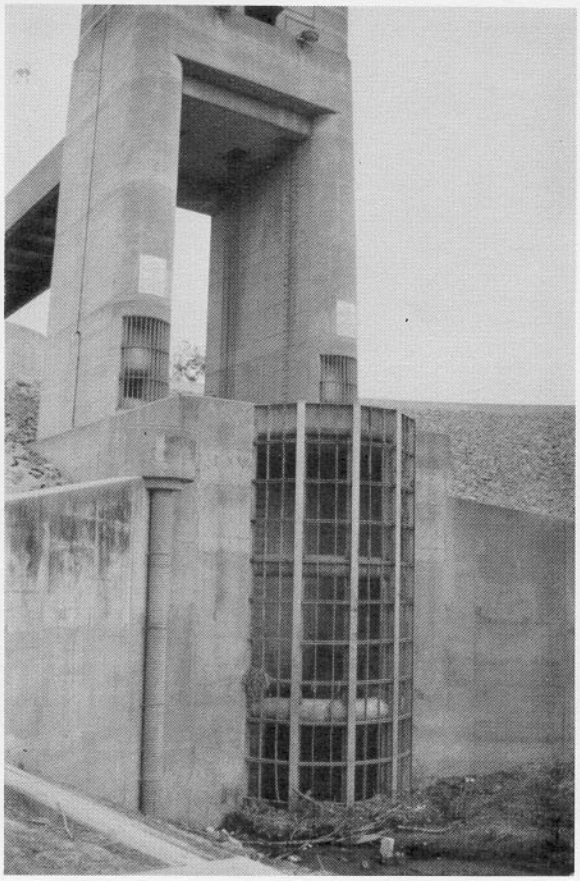

Photo 3-01. Debris intake structure trash rack. Note debris accumulation at base and hanging from structure.

Photo 3-02. Sediment deposition at Basque Avenue (view toward

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 65° 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) Local Thunderstorms. 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).

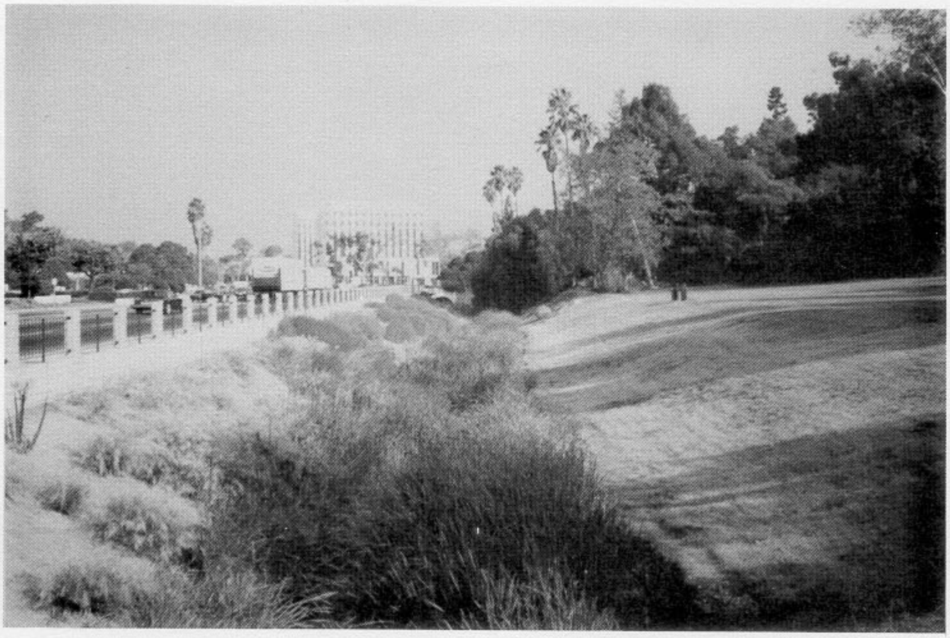

Photo No. 4-02. Unlined earth channel at Hillcrest Park (view toward upstream from Valley View Drive).

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.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometerological Stations

a. Facilities. Hydrologic instrumentation installed at Brea Dam provides data on reservoir water surface elevation, downstream gauge height, precipitation, and the outlet gate openings. A list of the instrumentation and available data is provided on plate 5-01. Data collection facilities of interest in the vicinity of Brea Dam, the Brea Creek gauging station, and nearby precipitation gauges are shown on plate 5-02. These facilities with all pertinent hydrometeorological instrumentation are listed on plate 5-03. The instrumentation located at or near Brea Dam are detailed below.

(1) Reservoir Water Surface Recording System. Two tape-float-pulley assemblies are used within two float wells to measure the water surface elevation. The lower well uses a Stevens A-71 strip-chart recorder and a digital recorder to automatically record the float water surface elevation from elevation 208 to 231. A Stevens A-35 strip-chart recorder and a digital recorder automatically records the float water surface elevation from elevation 231 to the top of the dam.

(2) Reservoir Staff Gauges. A series of staff gauge boards are installed along the upstream face of the dam. The boards are graduated in 0.10 foot increments and are readable from the top of the dam.

(3) Outlet Gate Recorders. Both outlet service gates have a Stevens Type "F" recorder that documents all gate movements. These recorders monitor gate settings and make permanent paper records of them.

(4) Precipitation Measurement. A tipping-bucket rain gauge is installed at the Brea Dam control house. The amount of rainfall is measured by the tips of the bucket. Each tip is equal to 0.01" of rainfall. A magnetic sensor in the gauge sends a signal to a digital recorder after each tip. Rainfall is also measured by a glass rain tube and a Belfort recording gauge. The paper charts from the Belfort gauge are sent to the National Weather Service for publication.

(5) Stream Gauge Stations. Hydrologic facilities for obtaining downstream streamflow data includes U.S. Geological Survey (USGS) gauge #11088500 below the dam and an Orange County Environmental Management Agency (OCEMA) gauge station at Darlington Avenue. The USGS gauge uses a slant manometer with a Stevens digital recorder to measure and record the flow. The OCEMA gauge station houses the COE's Stevens A-71 strip chart recorder with the float-tape and float-tape indicator. Rating tables for both gauges are provided on plates 5-04 and 5-05 and rating curves are shown on plate 5-06.

b. Reporting. Hydrological data from Brea Dam are reported in three separate ways. Readings are made manually by the dam operator, recorded automatically by gauges, and reported in real-time by the telemetry system.

(1) Manual. The dam tender at Brea Dam reports via radio or telephone each morning between 15 November and 15 April to the Reservoir Regulation Unit. The report includes water surface elevation, downstream stage, rainfall and gate settings. This report is made more frequently during periods of rain, as

specified by the Reservoir Regulation Unit. Between 15 April and 15 November, reports are made every Monday morning.

(2) Recording Instrument. Measurements recorded by the Stevens strip-chart recorders or digital recorders are stored on paper strip charts or paper punch tapes. These paper records are retrieved on a -monthly basis in the rainy season, and on a quarterly basis the remainder of the year, and kept on file by the Water Control Data Unit.

(3) Telemetry System. Hydrologic data measured at the dam and other gauges are transmitted to the Los Angeles District Office by the Los Angeles Telemetry System (LATS). The event mode is the primary data transmission mode for the telemetry system. As a gauge registers an event, current data are transmitted by a remote terminal unit (RTU) by a line-of-site radio to a repeater. The data is then relayed via microwave to the LAD office. Each RTU is programmed to trigger whenever 0.04 inches of precipitation, or a 0.25-foot change in water surface elevation, is measured. These RTU's automatically transmit reports at predetermined 24-hour intervals. All RTU's can also be interrogated at any time for current data by the Los Angeles Telemetry System Central Station.

(4) Alert System. There is also an event reporting gauge system throughout southern California sponsored by the National Weather Service. This system is referred to as the ALERT System (Automatic Local Evaluation in Real Time). OCEMA maintains a network of these gauges in Orange County. Included in this network are precipitation station #265 in the City of Brea, and precipitation station #241 located at Miller Basin on Carbon Canyon Creek. Access to this information can be obtained through the REPORT Program on the Water Control Data System computer.

c. Maintenance. The Water Control Data Unit of the Reservoir Regulation Section, Engineering Division, LAD, is responsible for maintaining the hydrometerologic instrumentation owned by the Corps of Engineers.

5-02. Water Quality Station. There are no water quality stations in the watershed above the dam or in the downstream channel.

5-03. Sediment Stations. There are no sediment stations in the watershed above Brea Dam or along the downstream channel of Brea Creek.

5-04. Recording Hydrologic Data. Hydrologic data from Brea Dam is recorded and stored in several forms. A report of daily observations is made by the dam tender at the dam and this record, form SPL-19, Flood Control Basin Operation Report, is stored by the Water Control Data Unit of the Reservoir Regulation Section in the District's base yard office. Using this report and strip charts of reservoir water surface elevation, reservoir computations are made by the Water Control Data Unit on form SPL-30, Reservoir Computations. The same information transmitted by radio or telephone to the Reservoir Regulation Unit is recorded on form SPL-424, Reservoir Operation Report. This information is entered into the RESCAL computer program which stores the record in a computer database and produces a "Daily Reservoir Report" that is issued by the Reservoir Regulation Unit each work day. However, the form SPL-30, is the official hydrologic record of reservoir data for the District. Rainfall records at Brea Dam are kept on form SPL-31 "Rainfall Records" by the dam tender and are stored by the Water Control Data Unit. During the activation of the Reservoir Operation Center in response to a flood situation, radio and telephone calls are logged for permanent record on form SPL-188 "Record of Calls" and are kept on file by the Reservoir Regulation Unit. Examples of these report forms are shown in figures 5-01 through 5-05.

The telemetry system also stores its data in a computer data base file. Paper punch tapes and strip charts retrieved from recording instruments at Brea Dam are stored by the Water Control Data Unit at the District's base yard office.

The USGS publishes daily mean streamflow recorded at the Brea Creek gauge #11088500 in the yearly publication Water Resources Data for California, Volume 1. The paper punch tapes for this gauge are archived by the USGS. The strip chart of precipitation at Brea Dam is sent to the National Climatic Center in Asheville, N.C. for publication in the NOAA monthly report Hourly Precipitation Data.

The State of California, Department of Water Resources, publishes data from the ALERT telemetry gauge network on a monthly basis. The Orange County Environmental Management Agency, the adjacent Ventura County Flood Control District and the Los Angeles County Department of Public Works archive their recording and non-recording data and furnish these data to other agencies upon request.

5-05. Voice Communication Network. The LAD maintains a voice radio communication network connecting all of its operations. This FM radio system uses repeaters on Mount Disappointment or, alternately, Pleasants Peak to communicate between the District Office and Brea Dam.

Power at the District Office, as well at each dam, is backed up by an emergency generator system. If all systems fail at the District Office, there is a complete radio system eleven miles east at the District's Base Yard in El Monte.

5-06. Communication with Project.

a. Regulating Office With Project Office. During the flood season (15 November through 15 April), a routine radio call is made at least once each weekday from the Reservoir Regulation Unit to each dam tender, including Brea Dam. This reservoir operation report ("morning report") is usually made at 0800 hours, Monday through Friday (see fig. 5-05). During flood events the reporting interval is usually reduced to one hour, with the Reservoir Regulation Unit originating the call. Other routine or non-routine radio or telephone calls are made as needed.

In the event that all communications with the District Office, including the Base Yard, should be interrupted, a set of "Standing Instructions to the Project Operator for Water Control" have been compiled for each dam. A copy for Brea Dam is included in Exhibit A of this manual.

b. Between Project Office and Others. No routine communication exists between Brea Dam and other agencies.

c. Between Regulating Office and Others. Before and during the earliest stage of any reservoir releases, the Reservoir Regulation Unit notifies officials of Orange County and the City of Fullerton. A list of agencies to be notified, with applicable office and home telephone numbers, is published annually in the LAD's Instructions for Reservoir Operations Center Personnel (the "Orange Book"). The 1989 notification list is provided in table 5-01.

Table 5-01.

Brea Dam Notification List

Organization	Office Phone No.
Orange County Communications Center (24 hrs.)	714-834-7167
Fullerton Police Department	714-738-6800
California Office of Emergency Services	916-791-4305
City of Fullerton	714-738-6306
Orange County Environmental Management Agency	714-567-6300
Orange County Sheriff	714-647-7000
Maureen Peek Stables	714-441-1370
Corps of Engineers (El Monte)	626-401-4008
Corps of Engineers Emergency Management Branch	213-452-3424

5-07. Project Reporting Instructions. During periods of dam operation, communications between the Reservoir Regulation Unit and each affected dam tender are made on a frequent basis, normally once each hour". If a gate change is required, the Reservoir Regulation Unit (radio call sign WUK 4ROC) broadcasts the gate change instructions to the dam tender. When the gate change is completed, the dam tender calls back with the information of the change. Other special instructions to the dam tenders are conducted in a similar manner. This network of radio communications is also used by the dam tender to report any mechanical failures or other problems at the dam.

5-08. Warnings. The responsibility for issuing all weather watches and warnings and all flood and flash flood watches and warning rests with National Weather Service. Local emergency officials of cities and counties are responsible for issuing any public warnings regarding unusual overflows, evacuations, unsafe roads or bridges, toxic spills, etc. The U.S. Army Corps of Engineers is responsible for providing these officials with current information and when possible, forecasts of water surface elevations and releases at Brea Dam. If an uncontrolled spillway flow or dam break were imminent, the Reservoir Regulation Unit should notify the OCEMA Communication Center so they could initiate evacuations, in addition to the other notification in the "Orange Book".

VI - HYDROLOGIC FORECASTS

6-01. General

The U. S. Army Corps of Engineers does not make any formal hydrologic forecasts for Brea Dam. Brea Creek water quality is also not predicted by the Corps of Engineers or any other agency.

a . Role of Corps of Engineers. Despite the lack of formal hydrologic forecasts, the Corps of Engineers carefully monitors the reservoir water surface elevation in Brea and the adjacent Fullerton and Carbon Canyon Reservoirs, and does notify other agencies of any significant changes or anticipated changes (see sec. 5-06.c.).

The Corps of Engineers, Los Angeles District Meteorologist prepares special quantitative precipitation forecasts (QPF's) for Brea Creek drainages and other watersheds. These are used in determining the potential for significant runoff into Brea and other reservoirs. These QPF's are used only for operation of the project and are not distributed to other agencies. The responsibility of weather forecast dissemination to other agencies belongs to the National Weather Service.

b. Role of Other Agencies. No other agency currently prepares forecasts of water surface elevations in Brea Reservoir or for discharges on Brea Creek, either upstream or downstream of Brea Dam. The closest that any forecast or warning would come to this might be a Flash Flood Watch or Flash Flood Warning issued by the National Weather Service.

The U.S. Army Corps of Engineers, Los Angeles District does receive real-time weather reports and forecasts, as well as historical weather data, from the National Weather Service. This is accomplished by means of weather facsimile pictures and teletype data and forecasts transmitted by the National Weather Service and also by means of direct telephone communication with the National Weather Service Forecast Office, Los Angeles, by the District Meteorologist.

Historical precipitation data are available from Orange County Environmental Management Agency. Historical streamflow data are also available from this agency and from the USGS. These data, while not of use in real-time operations, are important to studies of historical storms and floods which aid in the development and refinement of computerized rainfall-runoff forecast models.

6-02. Flood Condition Forecasts

Forecasts of flood hydrographs are not currently made. However, routine evaluation of inflow, observed precipitation, and forecast precipitation provides for valuable subjective predictions of flood situations. Using such information, the Reservoir Operation Center can evaluate if floodflows will increase or decrease over the next 24 hours. Plate 5-02 and plate 4-01 show the location of precipitation and stream gauges in and near the Brea basin and the key control points downstream of Brea Dam. A unit hydrograph for the watershed upstream of Brea Dam is listed on plate 4-13 and shown on plate 4-14. Forty-two hour upstream excess rainfall, and the corresponding total runoff volume, peak inflow to the reservoir, peak outflow and water surface elevation of the reservoir, and peak discharges at downstream concentration (control) points are given on plate 6-01 for rainfall return periods of 500-, 200-, 100-, 50-, 25-, and 10-years, and for the Standard Project Flood (SPF) event.

6-03. Long-Range Forecasts

Because the watershed above Brea Dam is relatively small, (22 sq. mi.) with no major upstream flood-control facilities, and because water is impounded behind Brea Dam for as short a time as possible, there is little direct need for long-range forecasts in the operation of Brea Dam.

Only in the event of major impoundment at Brea Reservoir, as well as simultaneously at other reservoirs affecting Coyote Creek (see sec. 4-11), would a forecast of more than one day be of immediate significance to the regulation of Brea Dam. In such a case, the forecast of another impending major storm or lack of such storm might influence the release rate of water from Brea Dam in consideration of the release rates from other dams in order to prevent or minimize downstream damages.

Table 6-01.

Excess Rainfall, Runoff, Peak Inflow, Outflow at Dam and Peak Discharges at D/S Control Points for Various Return Periods

Return Period	42-Hour Excess Rainfall (Inch)	Runoff Volume (ac-ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Discharge Max. W.S. Elev. (ft. NGVD)	Peak Discharge (cfs) Control Points Without Dam Release			Peak Discharge (cfs) Control Points With Dam Release		
						CP-2	CP-3	CP-4	CP-2	CP-3	CP-4
500-Year	8.35	9,800	11,758	5,644	283.5	1,126	2,026	3,089	6,594	7,223	7,967
200-Year	6.59	7,700	9,169	1,500	277.9	903	1,625	2,415	1,881	2,452	3,209
100-Year	5.27	6,200	7,302	1,486	268.9	741	1,336	1,986	1,784	2,178	2,798
50-Year	4.06	4,700	5,539	1,500	257.7	589	1,062	1,581	1,861	2,199	2,636
25-Year	2.91	3,400	3,940	1,500	245.07	448	812	1,210	1,818	2,127	2,529
10-Year	1.62	1,900	2,145	1,351	230.5	294	536	801	1,638	1,876	2,133

VII - WATER CONTROL PLAN

7-01. General Objectives

The objective of Brea Dam operations is flood control, specifically, minimization of flood damages along Brea Creek downstream from Brea Dam. For this purpose, water is temporarily stored behind Brea Dam during periods of high inflows and is released slowly through the downstream channel of Brea Creek.

The reduction of inundation damages to the improved reservoir lands by reservoir regulation is not considered. All usage of reservoir land is intended to have a purpose secondary to its role as the bottom of the flood control reservoir. All costs associated with reservoir inundation are intended to be routine maintenance costs associated with a clear understanding of risk and subsequent willingness to locate within the flood control reservoir.

7-02. Major Constraints

Because flood control is the sole purpose of Brea Dam, there are no conflicts between purposes. There are two ungated outlets at elevation 251.0 feet and the spillway crest is at elevation 279.0 feet; flows through the ungated outlet and overtopping the spillway cannot be controlled by gate operation.

Local runoff contributes a significant flow into Brea Creek between Brea Dam and its confluence with Coyote Creek during a storm event. The reservoir release should take into account this uncontrolled local runoff together with the channel capacity. The downstream Brea channel capacity varies along the length of the channel, as described in section 4-09. Considering the local runoff and channel capacity along Brea Creek, maximum reservoir release is limited to 1,500 cfs when spillway flow does not occur.

The trash rack occasionally becomes clogged from excess trash and debris accumulation. Photo 3-01 shows 8 feet of debris was built up during February 1986 and is a typical example of debris accumulation that requires periodic maintenance.

Minor constraints include the following: (i) Heavy vegetation grows inside the earthen channel near Hillcrest Park, which causes a reduction of the channel capacity (see Photo 4-02). (ii) A channel grade break at Basque Avenue, which causes a backwater effect upstream, has caused debris and sedimentation accumulation at this location (see Photo 3-02). (iii) The unlined reach (near Hillcrest Park, between Dale Street and Stanton Avenue, and downstream from Western Avenue to the confluence with Coyote Creek) is highly susceptible to bank erosion. These sites should be monitored by channel patrols during major flows.

7-03. Overall Plan for Water Control

Brea Dam is operated for flood control only. Plate 2-12, which depicts the storage allocations for Brea Reservoir, shows that the entire space of the reservoir below the elevation 279.0 feet (the spillway crest) is devoted to flood control. Between 279.0 and 292.2 feet (the level of Probable Maximum Flood impoundment), the space is allocated to spillway surcharge, with flood control no longer the primary objective in deference to controlling the reservoir to assure the safety of the dam. The space between elevation 292.12 and 298 feet (the top of the parapet wall) is reserved for freeboard.

7-04. Standing Instructions to the Project Operator

A set of Standing Instructions to the Project Operator for Water Control have been compiled for Brea Dam. A copy of these instructions for Brea Dam are included in Exhibit A. This exhibit includes instructions to the Project Operator for normal conditions, during communication outages and unforeseen emergency events requiring deviation from the water control plan.

7-05. Flood Control

a. General. The plan for controlling floods on Brea Creek below Brea Dam is presented in this section.

The objective of the water control plan is to maximize flood control benefits. Project releases will be regulated to protect downstream communities and to avoid spillway flow.

There are two ungated outlets located at elevation 251.0 feet and an emergency spillway with crest elevation at 279.0 feet. Flow through the two ungated outlets is unregulated, although the total downstream release can be regulated by adjusting the gated outlets. Once the spillway overflows occur, the gated outlets are completely closed and the flow cannot be controlled; flood control is no longer the primary objective in reservoir regulation.

b. Current Water Control Plan. Under the current water control plan, real-time precipitation data is utilized to determine gate settings. The project is regulated based on the reservoir water surface elevation and the total precipitation during the past 30 minutes at the dam. This schedule takes into account the downstream channel capacity and the downstream uncontrolled local runoff. The representative rainfall in the basin can be computed using observed measurements of rainfall utilizing either the glass tube rain gauge or the tipping bucket, which are both located inside the control house at Brea Dam, or the Friez dual transverse automatic rain gauges. located at the dam. The reservoir regulation schedule is shown in Exhibit A, Chart A-1. Initially, both gates are open 3.5 feet to pass the flow as rapidly as possible until the outflow reaches approximately 310 cfs at water surface elevation 213.0 feet. Then the gates will be operated to control the outflow according to the reservoir water surface elevation and the rainfall accumulated during the past 30 minutes.

This reservoir regulation schedule specifies the maximum release from Brea Dam that will not exceed the downstream channel capacities along Brea Creek for design inflows to the reservoir of 100-year frequency or less. It takes into account real-time precipitation during the past 30 minutes so that releases from the dam, combined with local inflow from downstream drainage areas, should remain within the channel. For floods larger than 100-year design flow, downstream channel capacities may be exceeded for a relatively short period of time.

7-06. Recreation

As mentioned previously, the sole purpose of Brea Dam is flood control. No water is impounded behind the dam for the purpose of recreation, however several facilities do exist, as described in section 2-06 and shown on plate 2-10 and in table 2-01.

The channel of Brea Creek downstream of Brea Dam is strictly a flood control channel and provides no water-oriented recreational use. Thus, no releases are made for recreational purposes.

7-07. Water Quality

Because Brea Dam is a single purpose flood control dam, it does not impound water for any significant length of time. Therefore, Brea Dam is not operated for water quality objectives. Because Brea Dam has two ungated outlets at elevation 251 feet, it cannot be operated to contain contaminant spills above this elevation.

7-08. Fish and Wildlife

Brea Dam is a single purpose flood control dam. There is no storage allocation for fish and wildlife purposes, nor is there any incidental storage that could be used for fish and wildlife purposes. Therefore, no Brea Dam water control objectives exist for fish and wildlife, either within the reservoir, or within the channel of Brea Creek downstream.

7-09. Channel Maintenance

Maintenance and construction on the downstream channel of Brea Creek normally occur during the dry season of late spring and summer. During such periods, the two Brea Dam gated outlets may be closed in order to reduce releases in support of such downstream activities.

There is a proposal by OCEMA to line the Brea Creek Channel with concrete between Dale Street and the confluence with Coyote Creek. The capacity of the lined channel will be 7,250 cfs between Dale Street and Western Avenue, and 7,600 cfs between Western Avenue and the confleunce with Coyote Creek. The current channel capacities are 3,500-4,900 cfs between Dale Street and Western Avenue, and 4,000 cfs between Western Avenue and the Coyote Creek confluence.

7-10. Rate of Release Change

The gates are designed to open or close at one foot per minute under normal operating conditions. Unlined earthen channels may be subjected to bank erosion or sloughing. Channel observers may identify problems and would notify Reservoir Operations Center (ROC) as necessary. During emergencies, or when downstream inflow has filled the channel of Brea Creek, a gradual increase in gate opening at Brea Dam, based upon downstream reports, may be desired.

7-11. Deviation from Normal Regulation

The normal regulation plan for Brea Dam is prescribed as discussed in sections 7-01 through 7-10 above. At times, however, it may be necessary to deviate from normal regulation. These deviations should be approved (except during emergencies) by management before implementation. The magnitude, duration, and impacts of the deviation should be used to determine the level of management approval required. Following is a discussion of the potential deviations that could be allowed.

a. Emergencies. In the event of a potential drowning, toxic spill, or other accident in which high flows on Brea Creek downstream of Brea Dam could prevent rescue or could cause further injury, the two gated outlets at Brea Dam could be temporarily, partially or totally closed. Such emergency action should be taken immediately, unless such action would likely result in worse conditions such as overtopping the dam. Notifications to all concerned agencies should be made as soon as possible.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation of the dam, although they are not considered emergencies. Construction accounts for the major portion of the incidents and includes utility stream crossings, bridge work, and major construction contracts. Changes in releases are sometimes necessary for maintenance and inspection. Requests for changes of release rates are generally for a few hours to a few days. Each request is analyzed on its own merits. Consideration is given to upstream watershed conditions, potential flood threat, conditions of the reservoir, and possible alternative measures. In the interest of maintaining good public relations, the requests are complied with, provided there are no adverse effects on the overall regulation of the project for the authorized purpose.

c. Planned Deviations. Each condition should be analyzed on its own merits. Sufficient data on flood potential, reservoir and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes will be presented along with recommendations for review and approval.

7-12. Drought Contingency Plan

Brea Dam and Reservoir does not contain any storage allocation for water supply or water conservation. Brea Creek downstream from the dam is mostly concrete lined and does not contain any ground water recharge facilities. However, in the event of a drought, the possibility of impounding water for water conservation would be considered. Any such plan would be evaluated to ensure that the flood control purpose of the project would not be compromised.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General

The sole purpose of Brea Dam is flood control, and by far the greatest effect and benefit of the dam is the protection of life and property downstream of the facility. The major aspects of flood control at Brea Dam for both the reservoir and spillway design floods, as well as several major historical floods, are discussed in section 8-02.

8-02. Flood Control

a. Spillway Design Flood. The spillway of the dam is designed to pass, without danger to the dam or threat of overtopping the dam, the greatest rate of discharge that could be expected from the most severe combination of rainfall and runoff conditions that could reasonably occur.

(1) Original Criteria. The spillway at Brea Dam was designed in 1939 for a peak outflow of 14,500 cfs, having a surcharge of 8.7 feet above the ogee spillway (with crest elev. at 279 feet). An additional 7 feet of freeboard set the top of the dam at elevation 295 feet.

This spillway design resulted from a hypothetical 24-hour storm that produced 10. 14 inches of rain during the 24 hours, as averaged over the drainage area above Brea Dam. Such a storm would result in a peak inflow of 16,800 cfs and a maximum impoundment level of 287.7 feet.

(2) Revised Criteria. In a subsequent 1969 study, the adequacy of the Brea Dam spillway was reviewed under revised criteria. Estimates of Probable Maximum Precipitation (PMP) for the basins in the Los Angeles area were furnished by the Hydrometeorological Section of the U.S. Weather Bureau in October 1968. The report indicated that the highest rate of discharge from the drainage area for the Brea Dam would result from a 6-hour convective-type storm.

The 1/2-, 1-, 3-, and 6-hour precipitation during the Probable Maximum Storm resulted in 3.1, 4.5, 6.4 and 7.5 inches, respectively. A minimum loss rate of 0.10 inch per hour was assumed to prevail throughout the probable maximum storm. In the development of the Probable Maximum Flood (PMF), 40 percent of the area was considered impervious. In this area, base flow would be only a nominal addition to a flood of probable maximum magnitude. The PMF peak inflow for Brea Dam is 37,000 cfs, and the hydrograph is shown on plate 8-01.

The PMF was routed through the spillway assuming the outlet gates were closed and inoperative and the pool level was at spillway crest at the start of the routing. The peak outflow was 27,000 cfs and the maximum pool elevation would be 292.16 feet.

b. Standard Project Flood. The Standard Project Flood (SPF) represents the runoff event that would result from the most severe combination of rainfall and watershed conditions that are considered reasonably characteristic for the region in question. The Corps of Engineers has replaced the Standard Project Flood in favor of the National Economic Development (NED) Criteria for formulating water control plans. Nevertheless, the Standard Project Flood was examined in the development of the Brea Dam Water Control Plan. The resultant level of flood protection was equal to that which would have been developed under NED Criteria.

For the rainfall to be used in the determination of the SPF at a given site, a Standard Project Storm is selected as the most severe reasonably characteristic storm of record within a climatically homogeneous region surrounding the site, and is then transposed to the drainage area upstream of the target site.

The storm of 30 December 1933-1 January 1934, which was centered over the La Cresenta area north of Los Angeles was transposed over the Brea Dam drainage area. The isopercentual lines (expressing precipitation depths in percent of mean seasonal precipitation) were superimposed over the area in such a way as to produce the greatest project storm rainfall amounts that would be consistent with reasonable assumptions concerning the causative meteorological situation. The maximum l-, 6-, 24- And 42-hour (total storm) average precipitation over the area was 0.86, 3.65, 10.00, and 10.95 inches respectively. A variable loss rate with an average of 0.20 inch per hour and a minimum of 0.10 inch per hour was assumed for Tonner and Brea Canyons. An average constant rate of 0.20 inch per hour was considered applicable for the valley areas. In the development of the SPF, 40 percent of the valley areas was considered all impervious. Runoff was computed by a synthetic unit hydrograph determined by the use of the lag curve, using average n-values ranging from 0.02 to 0.03 and the average Fullerton and San Jose S-graph, both of which were derived from data developed in studies of comparable drainage areas in southern California. The SPF peak inflow computed for Brea Dam is 8,000 cfs; the hydrograph is shown on plate 8-02.

c. <u>n-Year Flood</u>. The n-year flood is a flood that has a 1/n probability of being equaled or exceeded in any one given year. The discharge frequency relationship for inflow to Brea Dam was determined by statistical analyses (log Pearson Type III distribution) of historical inflows to the Brea Reservoir. Plate 8-03 shows the inflow frequency curves for 0- (i.e., instantaneous), l-, 3-, 6-, 12-, 24-, and 48-hour durations.

Balanced hydrographs for 500-, 200-, 100-, 50-, 25-, and 10-year floods were derived b using the Standard Project Storm pattern and, by trial and error, matching the n-year peak of the Brea Dam inflow discharge frequency curve for various durations. A constant loss rate of 0.20 in/hr was adopted. The discharge values for 0-, l-, 3-, 6-, 12-, 24-, and 48-hour duration of each frequency of flood are tabulated in table 8-01.

Table 8-01

Inflow Frequency Values for Various Durations

Return Period (Year)	500	200	100	50	25	10	5	2
0-hr	13500	10400	8210	6230	4480	2540	410	380
1-hr	11400	8890	7080	5370	3820	2080	1080	237
3-hr	9080	7090	5660	4300	3070	1680	880	196
6-hr	7510	5870	4680	3560	2540	1390	726	161
12-hr	5610	4390	3520	2680	1920	1060	555	125
24-hr	3910	3060	2440	1860	1330	732	384	86
48-hr	2470	1950	1560	1200	860	479	254	59

Note: 1. All values are in cfs.

2. Values are determined by statistical analyses of historical inflows to the Brea Dam.

3. Values are plotted on plate 8-03.

The 500-, 200-, 100-, 50-, 25-, and 10-year floods are routed through the reservoir using previous (table 7-01) and current operation plans. Inflow and outflow hydrographs at the dam for both plans are shown on plates 8-04 through 809, and the peak outflows and maximum pool elevations are tabulated in table 802. Plates 8-04 through 8-09 also show results of routing using the backup plan. The outflow and water surface elevation frequency curves computed for the current regulation schedule are shown on plate 8-10 and 8-11, respectively.

Table 8-02.

Outflow and Elevation Frequency Values

Return Period Year	500	200	100	50	25	10
Outflow (cfs)	5644	1500	1486	1500	1500	1351
Maximum Elevation (ft., NGVD)	283.5	277.9	268.9	257.7	245.07	230.5

Note: These values were obtained from the reservoir routing using the current operation plan and they are plotted on plates 8-10 and 8-11.

d. Historical Storms and Floods. Most of the major inflow and impoundment events in the history of Brea Dam have been the result of general winter storms, but several local thunderstorms have produced significant peak inflows.

Prior to the construction of the dam, there were a number of major storms and floods on southern California streams, including those of January 1862, February and March 1884, February 1891, January and February 1914, January 1916, December 1921, April 1926, February 1927, December 1933-January 1934, October 1934, February 1937, and February-March 1938. There was also a significant late summer tropical storm in September 1939; and shortly before Brea Dam was placed in 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 below:

(1) Storms of January 1916. Two major series of general winter storms hit southern California during January 1916, as intense cold fronts dropped down the coast from the north, then turned inland. The first series occurred 14-20 January and dropped about 6-7 inches over Fullerton and vicinity. Yorba Linda measured 6.38 inches for the storm period, including 3.52 inches on 17 January. The second storm series occurred 24-30 January and was generally somewhat less heavy; but ground conditions, saturated from the first storm, were more favorable for runoff. About 4 inches fell in the vicinity of Fullerton. Yorba Linda measured 3.98 inches, including 3.01 inches on 27 January. No discharge values or dates are available for Brea Creek.

(2) Storm and Flood of 30 December 1933 - 1 January 1934. A slow-moving low latitude North Pacific storm moved directly into southern California at the end of 1933 and dropped record-setting 24- to 48-hour precipitation from Los Angeles northward through the San Gabriel Mountains. The center of the storm was in La Crescenta and vicinity (see section 8-02.b.). Heavy precipitation also fell in Orange County, with total rainfall in the vicinity of Fullerton generally between 5 and 6 inches. Yorba Linda measured 5.44 inches. More than half of this rain fell within 24 hours between approximately noon of 31 December and noon of 1 January. Very heavy rain fell near midnight at the turn of the year. The peak runoff of the 1933-34 season on Brea Creek occurred on 1 January.

(3) Storm and Flood of 27 February - 3 March 1938. The general winter storm of 27 January - 3 March 1938 resulted when high pressure over California and Nevada pushed northward and allowed a series of low-latitude Pacific storms to move into southern California from the west-southwest. These storms produced an average of about 10 inches of rainfall over the watershed above Brea Dam, with roughly 4.5 inches falling on 2 March, the day of the most intense cold front of the storm series. This 2 March rain, falling on saturated ground, caused severe flooding on most of the larger streams in southern California. On Brea Creek, a peak flow of about 2,000 cfs was measured at the USGS gauge downstream of the site of the reservoir.

(4) Storm and Flood of 14 March 1941. On the af ternoon of 14 March 1941, as part of a moderately heavy general winter storm, an intense local thunderstorm occurred in the vicinity of the City of Fullerton, producing more than two inches of rainfall in less than one hour. With ground saturated from months of heavy rain, the peak discharge from Brea Creek was 3,700 cfs at the USGS gauge downstream of the reservoir site.

(5) Storm and Flood of 16-18 January 1952. As the climax of a long series of winter storms that dropped southeastward from out of the Gulf of Alaska, a deep low and strong cold front moved slowly across southern California during mid January. Stations in the Fullerton-Yorba Linda area all measured totals around 6 inches for the three days. The heaviest rainfall came in bursts of about 1 inch in 2 hours early 16 January, about 0.6 inch in 1 hour mid-afternoon 17 January, and during the 8-hour period ending at 0600 hours 18 January, when 2.42 inches fell at Brea Dam and 1.98 inches at Fullerton Dam. By 18 January, most ground was highly saturated, and the maximum inflow to Brea Reservoir for that storm occurred on 18 January about 0300 hours, with a peak value of approximately 1,000 cfs.

(6) Storms and Floods of 19-27 January 1969. In January 1969 a storm track developed from the equatorial zone southeast of Hawaii all the way to southern California. As the result, four intense storms and several minor rain bands passed through southern California during a 9-day period. Although storm totals of 40- 50 inches in the San Gabriel Mountains resulted in severe flooding in many watersheds, only about 4.5 inches of rain fell on the Brea watershed, including 1.32 inches between 0600 and 1400 hours 25 January. Plate 8-12 depicts the hyetographs of hourly rainfall at Brea Dam and the inflow, outflow, and water surface elevation hydrographs for Brea Reservoir during the 24-26 January 1969 storm period. With ground saturated from a week of antecedent storminess, the 25 January rain generated a peak inflow to the reservoir of about 1,350 cfs (peak hourly 1,192 cfs) just before 1500 hours and a maximum water surface elevation of 245.3 feet at 2000 hours.

(7) Storms and Floods of 3-4 December 1974. A strong, slow-moving cold front passed through southern California during the night of 3-4 December 1974. Rain was especially heavy in the coastal sections of Orange County. A total of 2.75 inches of rain fell at Brea Dam between 1900 hours 3 December and 1200 hours 4 December, including 1.02 inches in 1 hour 0400-0500 4 December. Fullerton Dam and Orange County Reservoir recorded 0.90 and 0.78 inch respectively during the same hour. Relatively dry antecedent conditions limited the peak inflow to Brea Reservoir to approximately 2,150 cfs at 0645 hours 4 December.

(8) Storms and Floods of 28 February - 6 March 1978. In a pattern very similar to that of exactly 40 years earlier, a series of low-latitude Pacific storms moved into southern California at the end of February and beginning of March 1978. There were several major peaks of rainfall and inflow during the storm period (pl. 8-13), including 1 March (most rapid rise of inflow and water surface of the storm period), 4 March (greatest volume of rainfall and runoff), and 5 March (greatest short-term rainfall intensity). A total of about 8.5 inches of rain fell at Brea Dam during these storms, with an estimated 11 inches averaged over the watershed. Of this, 2.05 inches fell on 1 March, with 2.34 inches on 4 March. These rains, on ground saturated by a wet winter, produced peak inflow to the reservoir of approximately 2,200 cfs (peak hourly 1,727 cfs) on 4 March about 1900 hours, and a maximum water surface elevation of 231.4 feet on 4 March about 2030 hours.

(9) Storm and Flood of 5 January 1979. On 5 January 1979 a cold storm dropped rapidly southward from the Gulf of Alaska, spreading general moderate rain over most of southern California. Most of the rain had ended by mid-evening, but an intense post-frontal thunderstorm hit the Fullerton area just before midnight. Brea Dam recorded 1.30 inches between 2200 and 2400 hours, and Fullerton Dam recorded 1.35 inches between 2100 and 2300 hours. The storm totals ending early 6 January were 3.28 and 3.02 inches at the respective dams. This thunderstorm resulted in a very rapid rise in the inflow rate to Brea Reservoir, with a peak of about 2,300 cfs at 0015 hours 6 January and a maximum water surface elevation of 231.5 feet on 6 January at 0200 hours.

(10) Storm and Flood of 30 January - 2 February 1979. Near the end of January 1979 a cold cut-off low pressure center dropped southward off the coast of California and picked up moisture over the water west of southern California. Locally heavy rain developed during the afternoon of 30 January and became heavy during the early evening. Brea Dam measured 1.70 inches between 1900 and 2200 hours, while Fullerton Dam measured 1.61 inches between 1800 and 2100 hours. Brief heavy showers continued on 31 January, with light showers through 2 February. With the ground moderately saturated from preceding rains, the peak inflow to Brea Reservoir that occurred on 30 January at 2145 hours was approximately 1,600 cfs, and the peak water surface elevation of 31 January at 0100 hours-was 232.9 feet.

(11) Storm and Flood of 13-18 February 1980. From 13 through 21 February 1980 a series of intense, warm Pacific storms moved into southern California from out of the west-southwest, dropping a total of 10-13 inches of rain during the 6 days 13-18 February. The Yorba Linda station measured 11.69 inches for the period, including 2.50, 1.65, and 2.05 inches in the 24-hour periods ending at 1800 hours on 14, 16, and 18 February respectively. Although data from several northern Orange County recording rain gauges were not reported for February 1980, the rainfall intensities from stations a few miles away indicate up to 0.6 inch in 1 hour and up to 1.4 inches in 3 hours late 13 February and relatively high rates during other portions of the storm as well. Plate 8-14 shows four periods of rainfall and four corresponding major rises in inflow and water surface elevation at Brea Reservoir during the period. Although the 13 February rainfall was the heaviest, the progressive saturation of the ground led to higher runoff values during the latter two rainfall periods. The peak inflow to Brea Reservoir occurred about 1900 hours 16 February, with approximately 2,500 cfs (peak hourly 2,240 cfs), while the maximum water surface elevation of 246.0 feet occurred 18 February from 0800 to 0900 hours.

(12) Storm and Flood of 27 February - 3 March 1983. A low-latitude Pacific storm reminiscent of those of 5 and 45 years earlier moved into southern California at the end of February and first of March 1983, with 5-8 inches of rain over portions of Orange County. This storm was the climax of a pattern of such storms that had prevailed since mid-January. The heaviest rainfall of the season occurred with the passage of a strong occluded cold front during the late morning of 1 March, with peak intensities well in excess of 1 inch per hour.

The inflow to Brea Reservoir consisted of three broad periods from 27 February to 3 March (pl. 8-15), with the middle period of 1 March by far the most intense. The saturation of the ground by abundant antecedent precipitation helped push the maximum 15-minute peak inflow to 3,610 cfs (peak hourly 2,625 cfs) at 1315 hours 1 March and the maximum water surface elevation of the reservoir to 252.0 feet from 1630 to 1700 hours that day. These values represent the greatest inflow and water surface elevation ever recorded at Brea Dam. For comparison, the 3,700 cfs of 14 March 1941 was measured by the USGS gauge some distance downstream of the reservoir site.

e. Comparison of Floods. The current operation plan was used to route the following historical floods: January 1969, December 1974, March 1978, January 1979, and February 1980. Inflow hydrographs, outflows, and reservoir elevations resulting from these routings are shown on plates 8-16 through 8 - Plate 8-21 is a comparison of these five historical floods, the SPF, the PMF, and the 100-year flood; all of these floods were routed using the current operation plan. Plate 8-22 is a listing of flood magnitudes for the floods shown on plate 8-21. the four diagrams on plate 8-21 depict the maximum values of water surface elevation, reservoir contents, the mean hourly inflows and outflows for the five historical floods, the SPF, the 100-year flood, and the PMF.

8-03. Recreation

None of the recreational facilities in Brea Reservoir depend upon runoff water impounded behind the dam. Thus, there are no direct recreational benefits that result from the dam or its operation. The recreational facilities were constructed because the land within the reservoir could not be used for other purposes. Thus, there is an indirect benefit of the project upon recreation.

The effects of the dam and its operation upon the recreational facilities within the reservoir are by necessity all negative, that is, some of these facilities are occasionally flooded by the impoundment of water behind the dam for flood control. These recreational facilities were constructed and are operated with this understanding.

8-04. Water Quality

There are no benefits of Brea Dam to the water quality of Brea Creek. On the other hand, Brea Creek and its operation should not in any way contribute to the degradation of the water quality of the river. An oil spill has historically occurred; a contingency plan should be prepared jointly by the oil well owner and the U.S. Army Corps of Engineers to reduce the effects of such a spill in the case of its future occurrence.

8-05. Fish and Wildlife

The reservoir lands that constitute the Brea Flood Control Basin provide open space and some natural riparian habitat in the middle of an extensive urban area, thereby providing very important wildlife habitat. About 30 species of birds have been identified in the area. Five of those species being purely migratory, remain for only short periods.

Flooding within the reservoir basin is relatively uncommon (especially May-October) and is usually not prolonged, and therefore does not normally cause serious adverse impact upon biological resources within the basin, although some impacts are inevitable. Wildlife taking refuge in borrows, or slow-moving species might be trapped and killed by flooding.

Flooding within the reservoir basin also has a beneficial impact upon some wildlife. Large numbers of migratory waterfowl utilize low-lying flooded areas within the basin for wintering.

8-06. Frequencies

a. Peak Inflow and Outflow Probabilities. Plates 8-03 and 8-10 are graphs of the inflow and outflow frequencies at Brea Dam. The 0-, l-, 3-, 6-, 12-, 24-, and 48hour peak inflow frequency curves were plotted based on statistical analysis (log Pearson Type III distribution) of historical data.

The outflow curve of plate 8-10, reflects the Brea Dam Water Control Plan. The plate shows the current control plan conditions. A sharp break in the slope of the outflow frequency curve reflects the fact that outflow rate increases rapidly for any additional rise in the reservoir water surface elevation over the spillway crest elevation at 279 feet. A maximum reservoir release of 1,500 cfs is made for floods between the 10-year and 200-year frequencies, while the release is 5,644 cfs for the 500-year flood. Table 8-02 lists the outflow frequency values plotted on plate 8-10.

b. Pool Elevation Frequency. Plate 8-11 shows the reservoir elevation frequency curves for Brea Reservoir based on current water control plan conditions. The values of the curve at specific return periods are listed in table 8-02.

8-07. Other Studies

a. Flood Control Regulation. The "Interim Report on Hydrology and Hydraulic Review of Design Features of Existing Dams for Prado, Brea, Fullerton, and Salinas Dams", dated November 1969, presents the derivation of the Probable Maximum and Standard Project Floods used in this manual. The report entitled "Coyote Creek Tributaries Santa Ana River Basin, Orange County, California, Interim 3, Hydrology Documentation", dated May 1984 was used as the basis for the hydrologic parameters used in this manual.

b. Channel and Floodway Improvements. The downstream channel from Brea Dam is maintained by the Orange County Environmental Management Agency (OCEMA). No floodplain management studies addressing the downstream channel have been conducted by the U.S. Army Corps of Engineers. A Flood Insurance Study has been completed by the Federal Emergency Management Agency (FEMA).

IX - WATER CONTROL MANAGEMENT

9-01.

Responsibilities and Organization

a. Corps of Engineers. Brea Dam is owned by the Federal Government and is operated and maintained by the U.S. Army Corps of Engineers, Los Angeles District, which has complete regulatory responsibility for the dam and the reservoir lands.

Reservoir operations at Brea Dam and other Corps of Engineers facilities are conducted by the Reservoir Regulation Unit of the Reservoir Regulation Section of Los Angeles District. Table 1-01 is an organizational chart depicting the chain of command for the Reservoir Regulation Decisions.

Gate regulation instructions to the Dam Tender are issued by the Reservoir Operations Center (ROC) (see secs. 5-05 and 5-06). In the event that communication between the ROC and Brea Dam are interrupted, a set of Standing Instructions to the Project Operator for Water Control are included in this manual as Exhibit A. Project Operators are part of the Operations Branch under the Constructions-Operations Division of the Corps of Engineers, Los Angeles District.

b. Other Federal Agencies. The U.S. Army Corps of Engineers has complete responsibility for the operation of Brea Dam. Although the Corps of Engineers receives data and information from other Federal and local agencies and informs these agencies of major decisions affecting Brea Dam, no other agency has any responsibility in the operation of Brea Dam. The USGS operates stream gauges within the Orange County drainage area.

c. State and County Agencies. The Orange County Environmental Management Agency (OCEMA) has maintenance responsibility for Brea Creek Channel downstream of Brea Dam.

d. City of Fullerton. A large portion of the Brea Reservoir lands owned by the Federal Government and operated by the Corps of Engineers, is leased to the City of Fullerton for recreational purposes. The Corps of Engineers retains all rights to inundate this land.

e. Private Organizations. There is no involvement of private organizations in the regulations of Brea Dam.

9-02. Interagency Coordination

The U.S. Army Corps of Engineers coordinates with other Federal, State, County, local organizations, and the press, concerning the water control for Brea Reservoir.

a. Local Press and Corps of Engineers Bulletins. The Public Affairs Office of the Corps of Engineers, Los Angeles District, is responsible for interfacing with the press regarding operations at Brea Dam and flow on Brea Creek downstream of the dam. This is accomplished through both interviews and the occasional issuance of press releases. The Corps of Engineers does not publicly issue flood watches or warnings or other status reports or forecasts. These are the responsibility of the National Weather Service.

b. National Weather Service. The Corps of Engineers utilizes National Weather Service data and forecasts in the operation of Brea Dam, including the real-time telemetry data from gauges installed in the watershed and by other County Flood Control Districts in cooperation with the National Weather Service. The Corps shares data with the National Weather Service and other agencies both on a realtime basis and after the fact.

c. U.S. Geological Survey. The Corps of Engineers receives streamflow data in southern California from the USGS, primarily on a historical basis. The Corps coordinates with the USGS in many different ways and shares its data with the Geological Survey.

d. Other Federal, State, or Local Agencies. The Corps of Engineers and Orange County Department of Public Works closely coordinate the operation of their reservoir projects and the maintenance and patrolling of their channels. The Corps keeps the City of Fullerton informed of any anticipated and actual reservoir impoundments. Other interested agencies, such as the California Department of Transportation (CALTRANS), are informed by the Corps of Engineers whenever a major inundation or release at Brea Dam is anticipated.

9-03. Interagency Agreements

The Corps of Engineers has a maintenance agreement with Orange County Department of Public Works for the improved channel of Brea Creek. The Orange County Environmental Management Agency maintains the Brea Creek Channel downstream from Brea Dam.

9-04. Commissions, River Authorities. Compacts and Committees

Brea Dam is not involved in any commissions, compacts, or other such formal multiagency agreements.

9-05. Reports

The U.S. Army Corps of Engineers, Los Angeles District, prepares and files several types of reports.

Each month during the runoff season, November through April, a flood situation and runoff potential report is prepared and sent to the South Pacific Division of the Corps of Engineers.

Five specific forms are also prepared in conjunction with the District's reservoir operations. A copy of each of these forms is included in figures 5-01 through 5-05. These include: Rainfall Record (from manual readings of glass tube rain gauges), Record of Calls (both radio and telephone), Flood Control Basin Operation Report (prepared by each dam tender), Reservoir Computations and Reservoir Operation Report.

The Corps of Engineers also collects and files charts from recording instruments at Brea Dam (and other dams) including precipitation, reservoir water surface elevation, and gate height. Daily precipitation totals and, as needed, other data (such as unusually high intensities) are manually extracted from the precipitation charts, and the charts are sent to the National Climatic Data Center of NOAA. The other charts are maintained on file at the Corps of Engineers, Los Angeles District.

RAINFALL RECORD

STATION	☐ HOURLY ☐ DAILY	DATE

HR	DA	TIME OF READING	GAGE READING	STORM TOTAL	SEASON TOTAL	OBSERVER	REMARKS (SNOW. TEMP., ETC.)
0000	1						
0100	2						
0200	3						
0300	4						
0400	5						
0500	6						
0600	7						
0700	8						
0800	9						
0900	10						
1000	11						
1100	12						
1200	13						
1300	14						
1400	15						
1500	16						
1600	17						
1700	18						
1800	19						
1900	20						
2000	21						
2100	22						
2200	23						
2300	24						
2400	25						
	26						
	27						
	28						
	29						
	30						
	31						
TOTAL							

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PREV. ED. OF THIS FORM MAY BE USED
REPLACES SPL FORM 32 WHICH MAY BE USED

FIGURE 9-01

RECORD OF CALLS ☐ Radio ☐ Telephone

DATE

LOCAL TIME	FROM		TO		CHECK REPTBLE CALLS*	MESSAGE OR REMARKS
	PERSON AND/OR CALL SIGN	TELEPHONE AND CITY	PERSON AND/OR CALL SIGN	TELEPHONE AND CITY		

Reportable telephone calls include collect calls, charge calls and long distance calls that can not be dialed without a code number. Calls are chargeable to MA 3-1311 unless otherwise indicated.

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FIGURE 9-02

FLOOD CONTROL BASIN OPERATION REPORT

Reports Control Symbol
SPLCO – 7

Name | **Month** | **Year**

Day	Reservoir W.S.Elev			Outlet channel		Gate operation																	OPERATOR
						Time	Gate opening in feet																
	Time	Type of Gage	Gage reading in feet	Time	Gage height in feet		NO.1	NO.2	NO.3	NO.4	NO.5	NO.6	NO.7	NO.8	NO.9	NO.10	NO.11	NO.12	NO.13	NO.14	NO.15	NO.16	

REMARKS:

SPL FORM 1 DEC 72 19 EDITION OF 1 MAR 55 MAY BE USED

FIGURE 9-03

RESERVOIR COMPUTATIONS

☐ HOURLY ☐ DAILY

DAM	TIME OF READING (IF DAILY)	DATE

COMPUTED BY	CHECKED BY	DATA SOURCE

HR.	DA.	WATER SURFACE ELEV. FT.	STORAGE AC. FT.	GATE STEP NO.	INST. OUTFLOW			HRS.	STORAGE CHANGE		AV. OUT-FLOW CFS	AV. INFLOW CFS	GATE SETTINGS FT.
					OUT-LETS CFS	DOWNSTREAM G. HT. FT.	DOWNSTREAM FLOW CFS		ACRE-FEET	CFS			
PREVIOUS REPORT													
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	10												
	11												
	12												
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	22												
	23												
	24												
	25												
	26												
	27												
	28												
	29												
	30												
	31												

REMARKS				
	TOTAL			
	MEAN			

SPL FORM 30 MAY 67 PREVIOUS EDITIONS MAY BE USED:
REPLACES SPL FORM 29 WHICH MAY BE USED

FIGURE 9-04

RESERVOIR OPERATION REPORT

DATE | TIME

RADIO CALL SIGN WUK	DAM	WATER SURFACE ELEVATION (FT. MSL)	DIGITAL RECORDER READINGS	RAINFALL: DIGITAL RECORDER	RAINFALL: GLASS TUBE: SINCE LAST REPORT (INCHES)	GLASS TUBE: STORM TOTAL (INCHES)	GLASS TUBE: SEASON TOTAL (INCHES)	GATE SETTINGS (Printed values show initial settings of gates prior to flood runoff)
411	SEPULVEDA		WS GH					GATES OPEN 9.0 FT ☐
412	HANSEN		WS GH					GATES OPEN 8.0 FT. ☐
419	SANTA FE		WS GH					#14 OPEN 0.5 FT. ☐
416	BREA		WS GH					GATES OPEN 2.0 FT. ☐
417	FULLERTON		WS GH					GATES OPEN 1.1 FT. ☐
418	CARBON CANYON		WS GH					#1 OPEN 0.5 FT. ☐
421	PRADO		WS GH					GATES 1 & 6 OPEN 1.0 FT. REM. GATES CLOSED ☐
420	SAN ANTONIO		WS GH					GATES CLOSED ☐
415	WHITTIER NARROWS: RIO HONDO POOL	W. PIT E. PIT COMB.	GH					LACFCD DIVERSION GATE OPEN FT. GATE 1 OPEN FT. GATES 2, 3, & 4 OPEN FT. FT. ☐
	WHITTIER NARROWS: SAN GABRIEL POOL	TELEMARK W. STAFF E. STAFF COMB.	GH		XXXX	XXXX	XXXX	GATE #8 OPEN 0.30 FT. ☐
429	PAINTED ROCK	RES: S T B. PIT	XXXX	XXXX				GATES OPEN 0.5 FT ☐ HOOK: ANEMOMETER: TEMPERATURE:
437	ALAMO	RES: S T	XXXX	XXXX				GATES CLOSED ☐ GATE NO. 3 BYPASS CFS ☐ HOOK: ANEMOMETER: TEMPERATURE:

SPL FORM 1 APR 82 424

REPLACES EDITION JUL 75, WHICH IS OBSOLETE.

FIGURE 9-05

RAINFALL RECORD

STATION	☐ HOURLY ☐ DAILY	DATE

HR	DA	TIME OF READING	GAGE READING	STORM TOTAL	SEASON TOTAL	OBSERVER	REMARKS (SNOW. TEMP., ETC.)
0000	1						
0100	2						
0200	3						
0300	4						
0400	5						
0500	6						
0600	7						
0700	8						
0800	9						
0900	10						
1000	11						
1100	12						
1200	13						
1300	14						
1400	15						
1500	16						
1600	17						
1700	18						
1800	19						
1900	20						
2000	21						
2100	22						
2200	23						
2300	24						
2400	25						
	26						
	27						
	28						
	29						
	30						
	31						
TOTAL							

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REPLACES SPL FORM 32 WHICH MAY BE USED

FIGURE 9-01

RECORD OF CALLS ☐ Radio ☐ Telephone

DATE

LOCAL TIME	FROM		TO		CHECK REPTBLE CALLS*	MESSAGE OR REMARKS
	PERSON AND/OR CALL SIGN	TELEPHONE AND CITY	PERSON AND/OR CALL SIGN	TELEPHONE AND CITY		

Reportable telephone calls include collect calls, charge calls and long distance calls that can not be dialed without a code number. Calls are chargeable to MA 3-1311 unless otherwise indicated.

SPL FORM 29 APR 59 188 PREVIOUS EDITIONS ARE OBSOLETE

FIGURE 9-02

FLOOD CONTROL BASIN OPERATION REPORT

Reports Control Symbol SPLCO – 7

Name | **Month** | **Year**

Day	Reservoir W.S.Elev			Outlet channel		Gate operation																	OPERATOR
							Gate opening in feet																
	Time	Type of Gage	Gage reading in feet	Time	Gage height in feet	Time	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15	No.16	

REMARKS:

SPL FORM 1 DEC 72 19 EDITION OF 1 MAR 55 MAY BE USED

FIGURE 9-03

RESERVOIR COMPUTATIONS

☐ HOURLY ☐ DAILY

DAM	TIME OF READING (IF DAILY)	DATE

COMPUTED BY	CHECKED BY	DATA SOURCE

HR.	DA.	WATER SURFACE ELEV. FT.	STORAGE AC. FT.	GATE STEP NO.	INST. OUTFLOW			HRS.	STORAGE CHANGE		AV. OUT-FLOW CFS	AV. INFLOW CFS	GATE SETTINGS FT.
					OUT-LETS CFS	DOWNSTREAM G. HT. FT.	DOWNSTREAM FLOW CFS		ACRE-FEET	CFS			
PREVIOUS REPORT													
	1												
	2												
	3												
	4												
	5												
	6												
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	27												
	28												
	29												
	30												
	31												

REMARKS				
	TOTAL			
	MEAN			

SPL FORM MAY 67 30 PREVIOUS EDITIONS MAY BE USED: REPLACES SPL FORM 29 WHICH MAY BE USED

FIGURE 9-04

RESERVOIR OPERATION REPORT

DATE | TIME

RADIO CALL SIGN WUK	DAM	WATER SURFACE ELEVATION *(FT. MSL)*	DIGITAL RECORDER READINGS	RAINFALL				GATE SETTINGS *(Printed values show initial settings of gates prior to flood runoff)*
				DIGITAL RECORDER	GLASS TUBE			
					SINCE LAST REPORT *(INCHES)*	STORM TOTAL *(INCHES)*	SEASON TOTAL *(INCHES)*	
411	SEPULVEDA		WS GH					GATES OPEN 9.0 FT ☐
412	HANSEN		WS GH					GATES OPEN 8.0 FT. ☐
419	SANTA FE		WS GH					#14 OPEN 0.5 FT. ☐
416	BREA		WS GH					GATES OPEN 2.0 FT. ☐
417	FULLERTON		WS GH					GATES OPEN 1.1 FT. ☐
418	CARBON CANYON		WS GH					#1 OPEN 0.5 FT. ☐
421	PRADO		WS GH					GATES 1 & 6 OPEN 1.0 FT. REM. GATES CLOSED ☐
420	SAN ANTONIO		WS GH					GATES CLOSED ☐
415	WHITTIER NARROWS — RIO HONDO POOL	W. PIT E. PIT COMB.	GH					LACFCD DIVERSION GATE OPEN FT. GATE 1 OPEN FT. GATES 2, 3, & 4 OPEN FT. FT. ☐
	WHITTIER NARROWS — SAN GABRIEL POOL	TELEMARK W. STAFF E. STAFF COMB.	GH		XXXX	XXXX	XXXX	GATE #8 OPEN 0.30 FT. ☐
429	PAINTED ROCK	RES: S T B. PIT	XXXX	XXXX				GATES OPEN 0.5 FT ☐ HOOK: ANEMOMETER: TEMPERATURE:
437	ALAMO	RES: S T	XXXX	XXXX				GATES CLOSED ☐ GATE NO. 3 BYPASS CFS ☐ HOOK: ANEMOMETER: TEMPERATURE:

SPL FORM 1 APR 82 424

REPLACES EDITION JUL 75, WHICH IS OBSOLETE.

FIGURE 9-05

Related Manuals and Reports

Title	Date
Hydrology in the Brea Creek Drainage Area	November 1939
Analysis of Design, Brea Dam, Brea Creek Improvement	February 1940
Master Plan for Administration and Development Project Land and Water Areas, Brea Flood Control Reservoir	June 1959
Restudy of Brea Dam for Safety and Adequacy of Dams	September 1968
Brea Dam and Reservoir Periodic Inspection and Continuing Evaluation, Report No. 1	May 1969
Interim Report on Hydrology and Hydraulic Review of Design Features of Existing Dams for Prado, Brea, Fullerton, and Salinas Dams	November 1969
Reservoir Regulation Manual for Brea Flood-Control Reservoir	June 1970
Operation and Maintenance Manual for Brea Dam	October 1971
Brea Dam and Reservoir Periodic Inspection and Continuing Evaluation, Report No. 2	February 1974
Brea Dam and Reservoir Periodic Inspection and Continuing Evaluation, Report No. 3	April 1979
Brea Dam Outlet Gate Operation Schedule	July 1982
Brea Dam and Reservoir Periodic Inspection and Continuing Evaluation, Report No. 4	February 1984
Coyote Creek Tributaries, Santa Ana River Basin, Orange County, California, Interim 3, Hydrology Documentation	May 1984
Brea Dam and Reservoir Periodic Inspection and Continuing Evaluation, Report No. 5	March 1989
Los Angeles County Drainage Area (LACDA) Review, Los Angeles County, Part I, Hydrology Report Base Conditions	March 1989

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

RELATED MANUALS
& REPORTS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

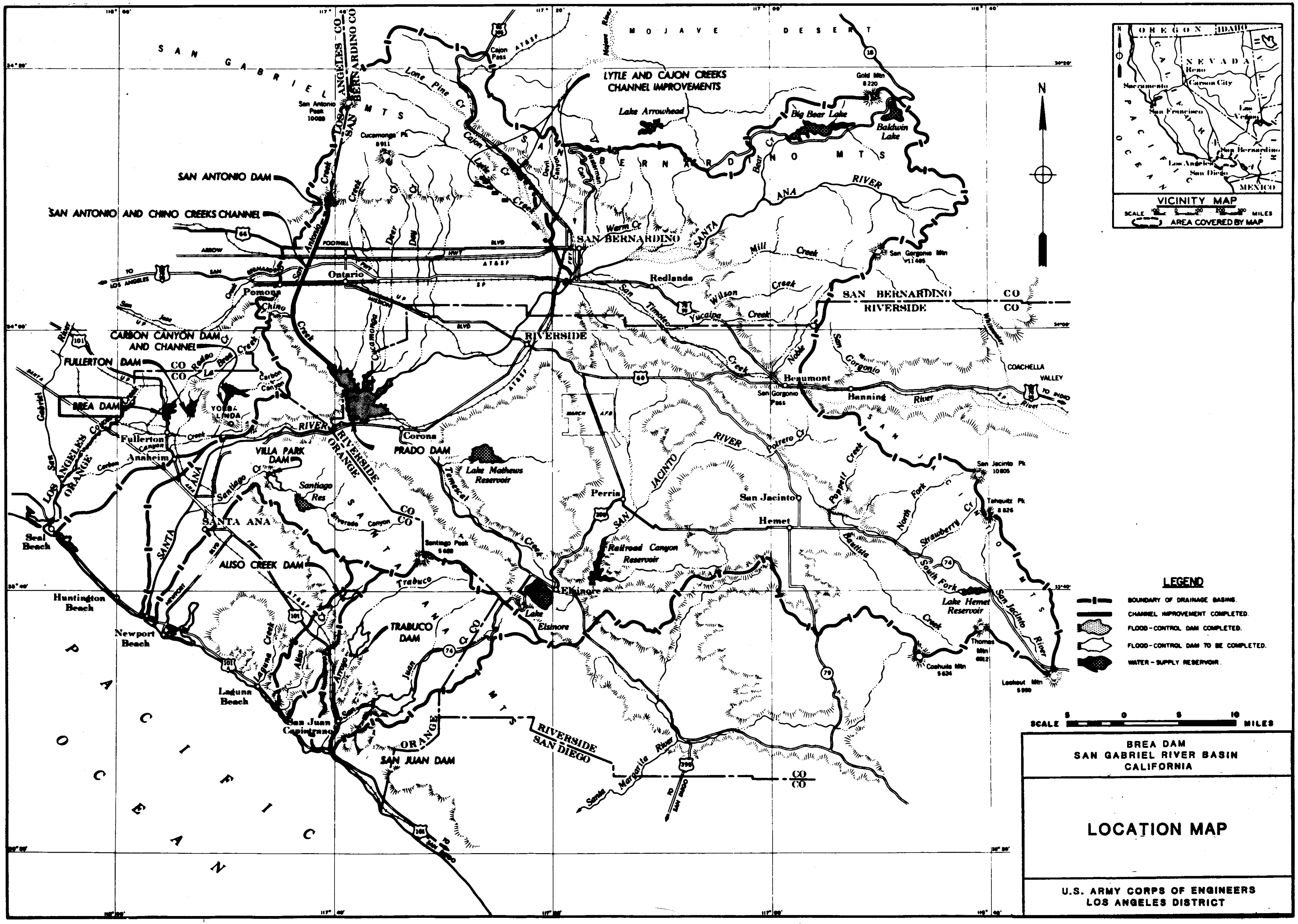
BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA
LOCATION MAP
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
VICINITY MAP
AREA COVERED BY MAP
LEGEND
BOUNDARY OF DRAINAGE BASINS.
CHANNEL IMPROVEMENT COMPLETED.
FLOOD-CONTROL DAM COMPLETED.
FLOOD-CONTROL DAM TO BE COMPLETED.
WATER-SUPPLY RESERVOIR.
SCALE 5 0 5 10 MILES
N
MOJAVE DESERT
SAN GABRIEL MTS
SAN BERNARDINO MTS
LYTLE AND CAJON CREEKS CHANNEL IMPROVEMENTS
Lake Arrowhead
Big Bear Lake
Baldwin Lake
SAN ANTONIO DAM
SAN ANTONIO AND CHINO CREEKS CHANNEL
SAN BERNARDINO
Redlands
Ontario
Pomona
RIVERSIDE
CARBON CANYON DAM AND CHANNEL
FULLERTON DAM
BREA DAM
YORBA LINDA
Fullerton
Anaheim
VILLA PARK DAM
Santiago Res
Corona
PRADO DAM
Lake Mathews Reservoir
Perris
San Jacinto
Hemet
Beaumont
Banning
SAN BERNARDINO CO
RIVERSIDE CO
SANTA ANA
Seal Beach
Huntington Beach
Newport Beach
ALISO CREEK DAM
TRABUCO DAM
Laguna Beach
San Juan Capistrano
SAN JUAN DAM
Railroad Canyon Reservoir
Elsinore
Lake Elsinore
Lake Hemet Reservoir
SAN JACINTO MTS
San Jacinto Pk 10805
Tahquitz Pk 8826
San Gorgonio Mtn 11485
Santiago Peak 5689
COACHELLA VALLEY
RIVERSIDE
SAN DIEGO
ORANGE
PACIFIC OCEAN

PLATE 2-01

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Discharge from Gated and Ungated Outlets, Brea Reservoir
(Discharge in cfs)

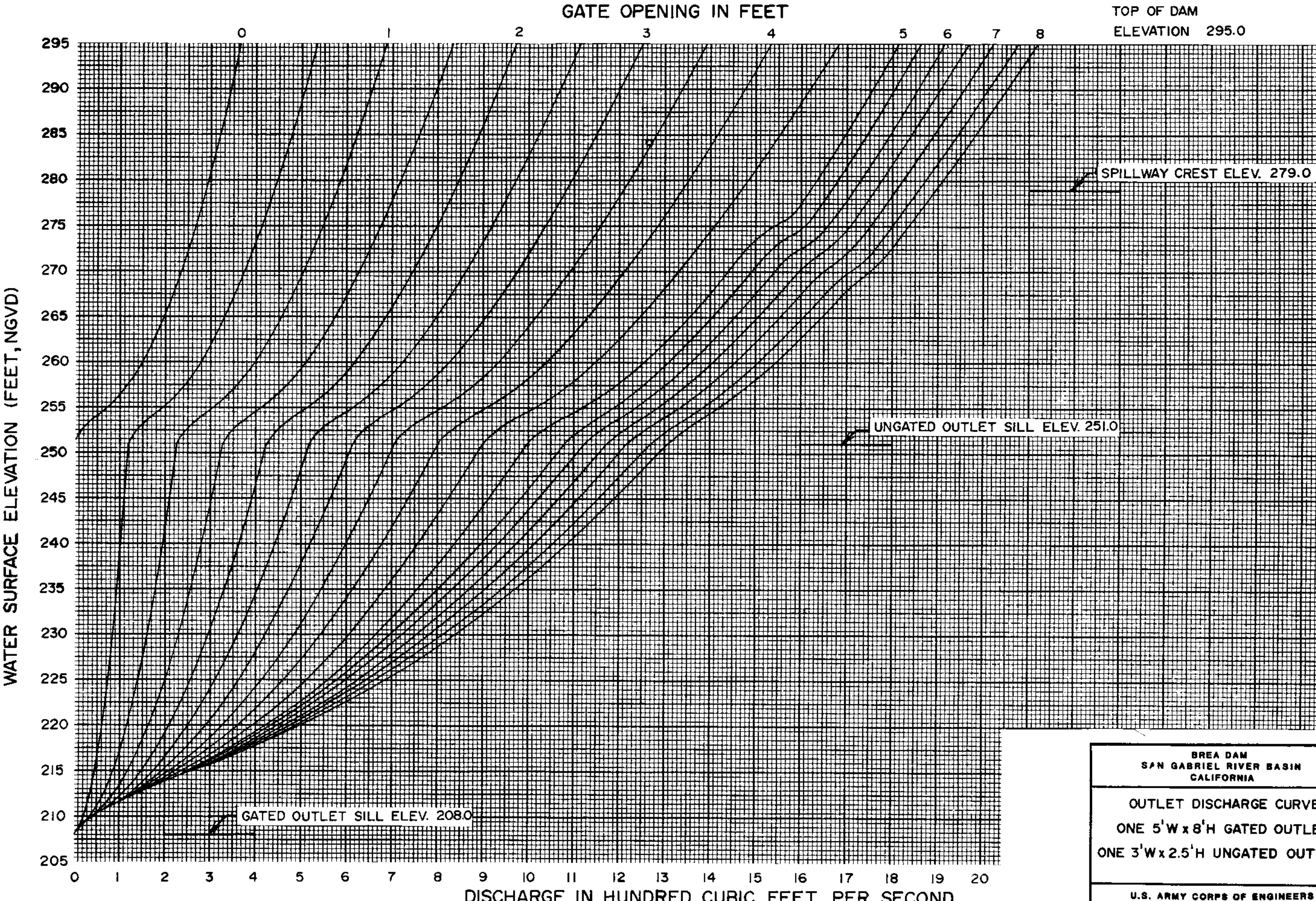
Gate Opening in feet (two gates)

Elev. (ft. NGVD)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	8.0
208.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
209.0	0.0	26.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
210.0	0.0	44.0	70.0	78.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
211.0	0.0	54.0	94.0	122.0	144.0	150.0	150.0	150.0	150.0	150.0	150.0
212.0	0.0	66.0	120.0	156.0	188.0	216.0	220.0	224.0	230.0	230.0	230.0
213.0	0.0	74.0	140.0	190.0	230.0	270.0	284.0	290.0	300.0	320.0	320.0
214.0	0.0	80.0	158.0	210.0	266.0	310.0	340.0	360.0	380.0	400.0	400.0
215.0	0.0	90.0	170.0	234.0	292.0	350.0	388.0	420.0	440.0	500.0	500.0
216.0	0.0	96.0	184.0	256.0	322.0	380.0	430.0	474.0	504.0	580.0	620.0
217.0	0.0	102.0	200.0	274.0	350.0	410.0	470.0	526.0	568.0	650.0	738.0
218.0	0.0	108.0	208.0	290.0	372.0	442.0	506.0	570.0	620.0	712.0	820.0
219.0	0.0	114.0	220.0	308.0	396.0	470.0	544.0	612.0	670.0	780.0	900.0
220.0	0.0	120.0	230.0	326.0	416.0	500.0	580.0	650.0	720.0	840.0	1000.0
221.0	0.0	126.0	240.0	340.0	440.0	526.0	610.0	690.0	762.0	900.0	1080.0
222.0	0.0	132.0	250.0	358.0	460.0	550.0	640.0	724.0	804.0	960.0	1156.0
223.0	0.0	138.0	260.0	370.0	478.0	574.0	670.0	760.0	844.0	1020.0	1230.0
224.0	0.0	144.0	272.0	384.0	496.0	600.0	700.0	792.0	880.0	1070.0	1300.0
225.0	0.0	148.0	280.0	400.0	510.0	620.0	724.0	824.0	920.0	1120.0	1370.0
226.0	0.0	152.0	288.0	412.0	528.0	640.0	750.0	860.0	956.0	1166.0	1440.0
227.0	0.0	156.0	296.0	424.0	544.0	660.0	774.0	886.0	992.0	1208.0	1508.0
228.0	0.0	160.0	304.0	436.0	560.0	680.0	800.0	914.0	1022.0	1250.0	1560.0
229.0	0.0	164.0	312.0	448.0	576.0	700.0	820.0	940.0	1054.0	1290.0	1620.0
230.0	0.0	168.0	320.0	460.0	590.0	720.0	840.0	968.0	1084.0	1330.0	1680.0
231.0	0.0	172.0	328.0	470.0	604.0	740.0	862.0	996.0	1114.0	1370.0	1736.0
232.0	0.0	176.0	336.0	480.0	620.0	760.0	884.0	1020.0	1144.0	1408.0	1786.0
233.0	0.0	180.0	342.0	492.0	634.0	776.0	904.0	1042.0	1170.0	1444.0	1840.0
234.0	0.0	182.0	350.0	502.0	648.0	792.0	924.0	1066.0	1200.0	1480.0	1892.0
235.0	0.0	186.0	358.0	510.0	660.0	808.0	944.0	1088.0	1226.0	1516.0	1940.0
236.0	0.0	190.0	364.0	522.0	676.0	824.0	964.0	1110.0	1252.0	1544.0	1994.0
237.0	0.0	194.0	372.0	534.0	688.0	840.0	982.0	1136.0	1280.0	1580.0	2040.0
238.0	0.0	196.0	378.0	542.0	700.0	856.0	1002.0	1158.0	1304.0	1616.0	2080.0
239.0	0.0	198.0	382.0	552.0	716.0	870.0	1020.0	1178.0	1334.0	1642.0	2126.0
240.0	0.0	200.0	390.0	560.0	724.0	886.0	1040.0	1200.0	1358.0	1678.0	2170.0
241.0	0.0	204.0	398.0	570.0	740.0	900.0	1060.0	1220.0	1380.0	1704.0	2218.0
242.0	0.0	208.0	402.0	580.0	750.0	916.0	1078.0	1240.0	1402.0	1740.0	2260.0
243.0	0.0	212.0	406.0	588.0	760.0	928.0	1096.0	1260.0	1424.0	1766.0	2300.0
244.0	0.0	216.0	414.0	596.0	772.0	940.0	1112.0	1280.0	1450.0	1800.0	2340.0
245.0	0.0	220.0	420.0	602.0	782.0	958.0	1130.0	1300.0	1474.0	1824.0	2380.0
246.0	0.0	222.0	424.0	614.0	796.0	970.0	1144.0	1320.0	1498.0	1856.0	2420.0
247.0	0.0	224.0	430.0	620.0	802.0	982.0	1162.0	1340.0	1520.0	1880.0	2460.0
248.0	0.0	228.0	436.0	628.0	814.0	998.0	1180.0	1358.0	1540.0	1910.0	2500.0
249.0	0.0	232.0	440.0	638.0	824.0	1010.0	1196.0	1376.0	1560.0	1940.0	2538.0
250.0	0.0	236.0	444.0	644.0	836.0	1022.0	1212.0	1392.0	1580.0	1966.0	2576.0
251.0	0.0	238.0	452.0	654.0	850.0	1036.0	1226.0	1408.0	1600.0	1996.0	2618.0
252.0	10.0	260.0	480.0	680.0	880.0	1062.0	1258.0	1440.0	1638.0	2036.0	2660.0
253.0	50.0	298.0	514.0	718.0	916.0	1102.0	1300.0	1482.0	1684.0	2096.0	2714.0
254.0	94.0	340.0	560.0	770.0	960.0	1164.0	1360.0	1550.0	1748.0	2160.0	2778.0
255.0	146.0	392.0	612.0	824.0	1028.0	1230.0	1420.0	1620.0	1810.0	2238.0	2838.0
256.0	184.0	436.0	660.0	874.0	1080.0	1280.0	1480.0	1680.0	1880.0	2300.0	2890.0
257.0	210.0	472.0	700.0	920.0	1126.0	1330.0	1532.0	1740.0	1940.0	2360.0	2940.0
258.0	248.0	502.0	738.0	958.0	1170.0	1374.0	1572.0	1782.0	1984.0	2416.0	2998.0
259.0	280.0	536.0	764.0	990.0	1200.0	1410.0	1618.0	1824.0	2038.0	2460.0	3040.0
260.0	300.0	560.0	800.0	1022.0	1240.0	1446.0	1650.0	1870.0	2080.0	2510.0	3090.0
270.0	470.0	750.0	1010.0	1258.0	1490.0	1722.0	1956.0	2180.0	2420.0	2880.0	3500.0
279.0	580.0	880.0	1160.0	1420.0	1676.0	1922.0	2168.0	2420.0	2680.0	3240.0	3792.0
280.0	592.0	896.0	1176.0	1440.0	1696.0	1940.0	2190.0	2540.0	2700.0	3264.0	3820.0
281.0	600.0	904.0	1184.0	1458.0	1714.0	1964.0	2216.0	2466.0	2730.0	3296.0	3850.0
282.0	612.0	920.0	1200.0	1470.0	1730.0	1984.0	2236.0	2498.0	2760.0	3320.0	3880.0
283.0	620.0	934.0	1220.0	1488.0	1744.0	2002.0	2258.0	2520.0	2780.0	3340.0	3910.0
284.0	632.0	944.0	1230.0	1500.0	1762.0	2024.0	2280.0	2540.0	2810.0	3370.0	3940.0
290.0	686.0	1018.0	1318.0	1600.0	1862.0	2140.0	2400.0	2680.0	2956.0	3516.0	4100.0

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

DISCHARGES FROM GATED & UNGATED OUTLETS, BREA RESERVOIR

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

OUTLET DISCHARGE CURVE
ONE 5'W x 8'H GATED OUTLET
ONE 3'W x 2.5'H UNGATED OUTLET

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

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Spillway Discharge vs. Elevation, Brea Dam

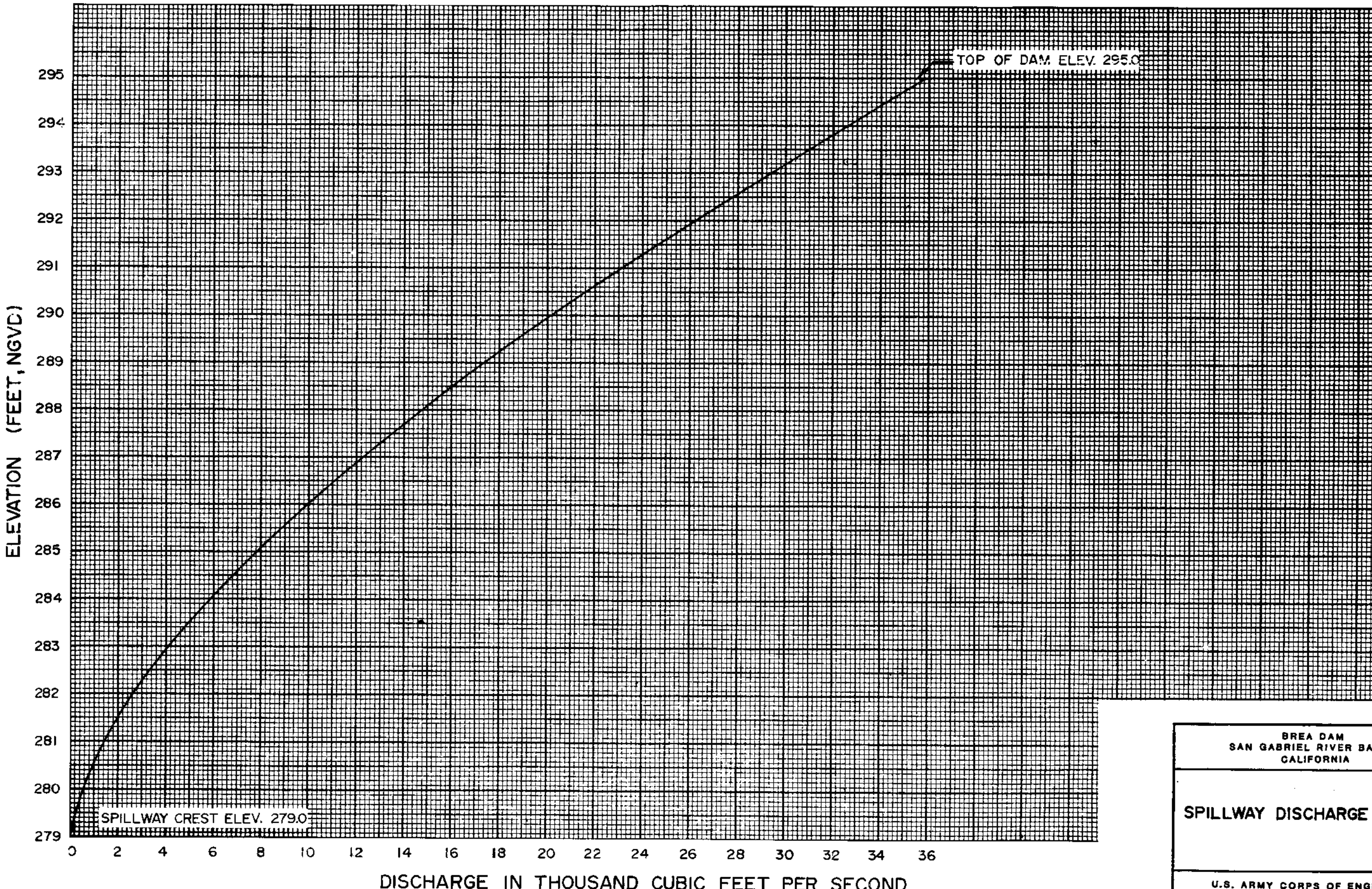
Elevation (feet)	Discharge (cfs)
279	0
280	580
281	1,400
282	2,600
283	4,100
284	5,900
285	7,800
286	10,000
287	12,300
288	14,800
289	17,300
290	20,100
291	23,100
292	26,200
293	29,400
294	32,600
295	35,800

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

SPILLWAY DISCHARGE VS. ELEVATION,

BREA DAM

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

SPILLWAY DISCHARGE CURVE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

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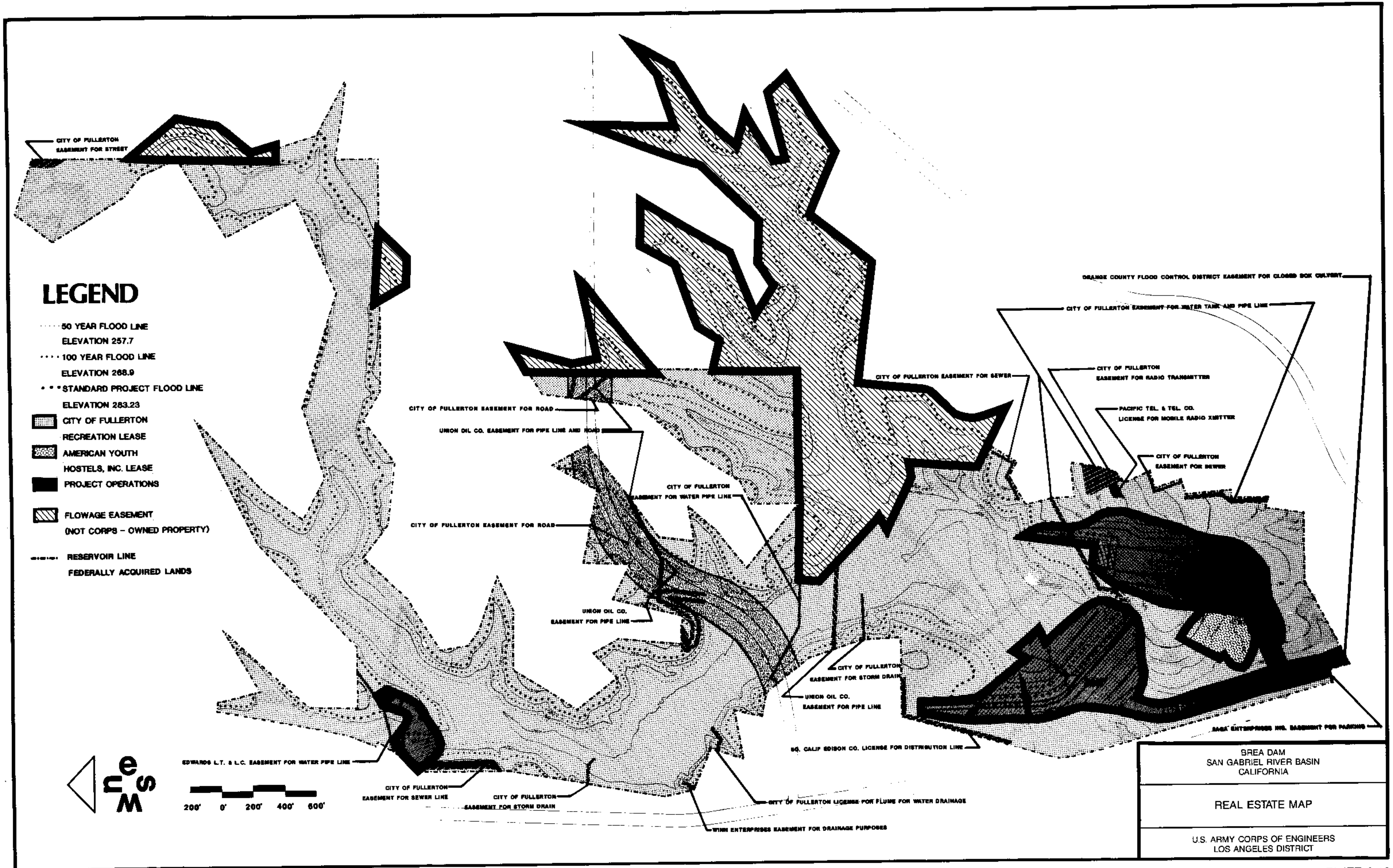
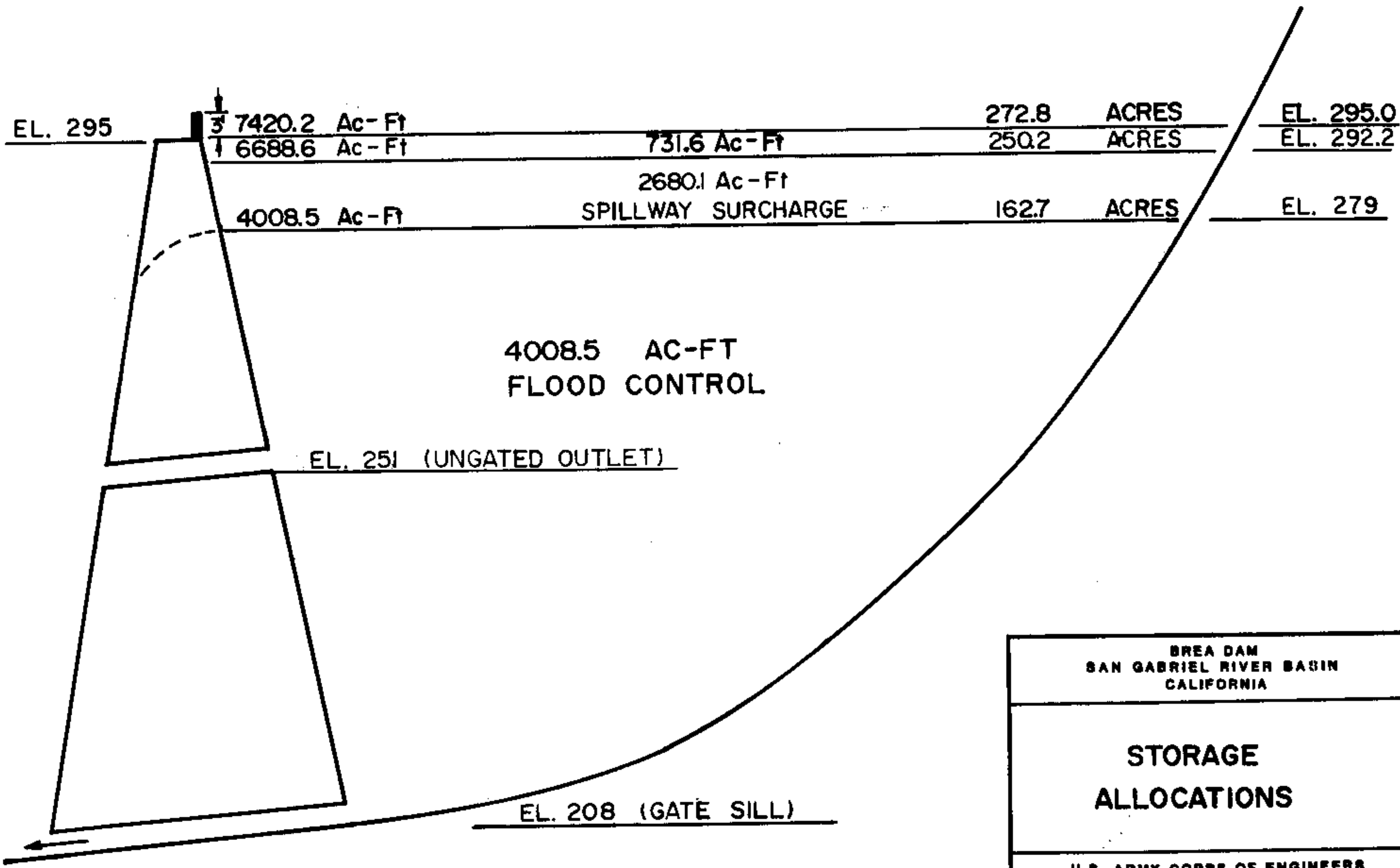

LEGEND
50 YEAR FLOOD LINE
ELEVATION 257.7
100 YEAR FLOOD LINE
ELEVATION 268.9
STANDARD PROJECT FLOOD LINE
ELEVATION 283.23
CITY OF FULLERTON
RECREATION LEASE
AMERICAN YOUTH
HOSTELS, INC. LEASE
PROJECT OPERATIONS
FLOWAGE EASEMENT
(NOT CORPS - OWNED PROPERTY)
RESERVOIR LINE
FEDERALLY ACQUIRED LANDS
CITY OF FULLERTON
EASEMENT FOR STREET
CITY OF FULLERTON EASEMENT FOR ROAD
UNION OIL CO. EASEMENT FOR PIPE LINE AND ROAD
CITY OF FULLERTON
EASEMENT FOR WATER PIPE LINE
CITY OF FULLERTON EASEMENT FOR ROAD
UNION OIL CO.
EASEMENT FOR PIPE LINE
CITY OF FULLERTON EASEMENT FOR SEWER
ORANGE COUNTY FLOOD CONTROL DISTRICT EASEMENT FOR CLOSED BOX CULVERT
CITY OF FULLERTON EASEMENT FOR WATER TANK AND PIPE LINE
CITY OF FULLERTON
EASEMENT FOR RADIO TRANSMITTER
PACIFIC TEL. & TEL. CO.
LICENSE FOR MOBILE RADIO XMITTER
CITY OF FULLERTON
EASEMENT FOR SEWER
CITY OF FULLERTON
EASEMENT FOR STORM DRAIN
UNION OIL CO.
EASEMENT FOR PIPE LINE
SAGA ENTERPRISES INC. EASEMENT FOR PARKING
SO. CALIF EDISON CO. LICENSE FOR DISTRIBUTION LINE
EDWARDS L.T. & L.C. EASEMENT FOR WATER PIPE LINE
CITY OF FULLERTON
EASEMENT FOR SEWER LINE
CITY OF FULLERTON
EASEMENT FOR STORM DRAIN
CITY OF FULLERTON LICENSE FOR FLUME FOR WATER DRAINAGE
WINN ENTERPRISES EASEMENT FOR DRAINAGE PURPOSES
n
e
s
w
200' 0' 200' 400' 600'
BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA
REAL ESTATE MAP
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

RECREATIONAL DEVELOPMENT PLAN

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

STORAGE ALLOCATIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Area and Gross Capacity - Brea Reservoir, Orange County, Fullerton, California

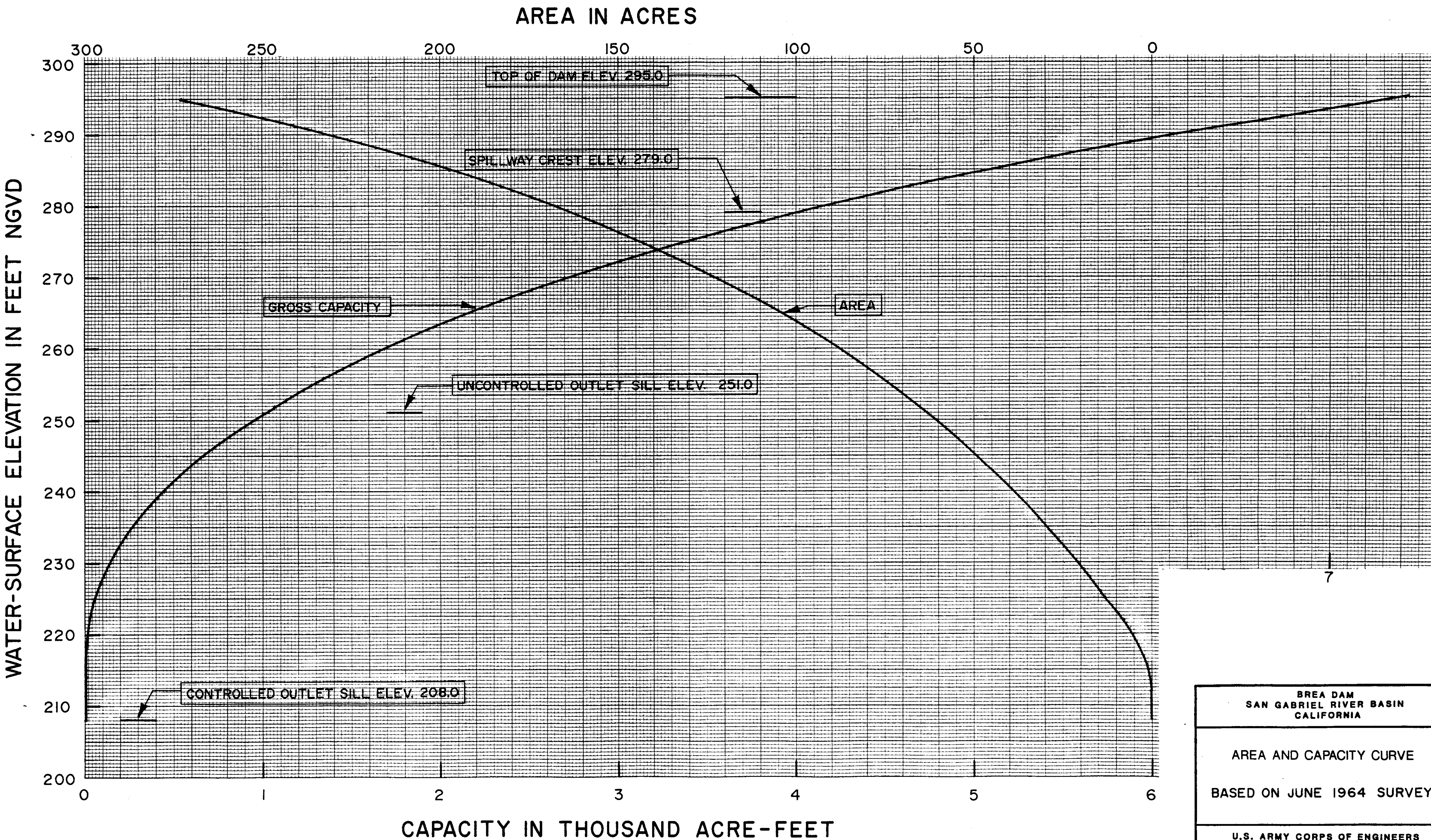
Elevation Feet (NGVD)	Capacity Acre-Feet	Area Acres	Elevation Feet (NGVD)	Capacity Acre-Feet	Area Acres	Elevation Feet (NGVD)	Capacity Acre-Feet	Area Acres
208	0.0	0.0	240	443.4	40.5	272	2,982.8	131.3
209	0.1	0.15	241	484.9	42.4	273	3,116.2	135.5
210	0.3	0.25	242	528.2	44.3	274	3,253.8	139.7
211	0.6	0.4	243	573.4	46.1	275	3,395.5	144.0
212	1.1	0.5	244	620.4	47.9	276	3,541.7	148.6
213	1.6	0.55	245	669.2	49.8	277	3,692.6	153.3
214	2.2	0.65	246	720.0	51.9	278	3,848.2	158.0
215	2.9	0.9	247	773.0	54.0	279	4,008.5	162.7
216	4.0	1.5	248	828.0	56.1	280	4,173.6	167.8
217	5.8	2.1	249	885.2	58.3	281	4,344.0	173.3
218	8.2	2.8	250	944.5	60.5	282	4,520.0	179.2
219	11.3	3.5	251	1,006.2	63.0	283	4,702.4	185.1
220	15.1	4.4	252	1,070.6	65.7	284	4,890.4	191.0
221	20.1	5.9	253	1,137.6	68.3	285	5,084.3	197.2
222	26.9	7.7	254	1,207.2	71.0	286	5,284.7	204.0
223	35.5	9.5	255	1,279.5	73.7	287	5,492.2	211.0
224	45.9	11.3	256	1,354.5	76.5	288	5,706.7	218.1
225	58.0	13.0	257	1,432.5	79.5	289	5,928.4	225.3
226	71.8	14.6	258	1,513.4	82.3	290	6,157.2	232.6
227	87.1	16.1	259	1,597.2	85.3	291	6,393.6	240.5
228	103.9	17.5	260	1,684.0	88.3	292	6,638.1	248.6
229	122.1	19.0	261	1,773.7	91.3	293	6,890.7	256.6
230	141.8	20.6	262	1,866.5	94.3	294	7,151.4	264.8
231	163.2	22.4	263	1,962.3	97.3	295	7,420.2	272.8
232	186.5	24.2	264	2,061.1	100.3			
233	211.6	26.1	265	2,162.9	103.5			
234	267.4	27.9	266	2,268.1	107.3			
235	298.3	29.8	267	2,377.4	111.2			
236	331.3	32.0	268	2,490.5	115.1			
237	311.5	34.1	269	2,607.6	119.1			
238	366.5	36.3	270	2,728.6	123.0			
239	403.9	38.5	271	2,853.6	127.1			

Note: Areas and capacities are based on survey of June, 1964.
Values recomputed from original survey data in September, 1975.

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

AREA & GROSS CAPACITY - BREA RESERVOIR,
ORANGE COUNTY, FULLERTON, CA

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

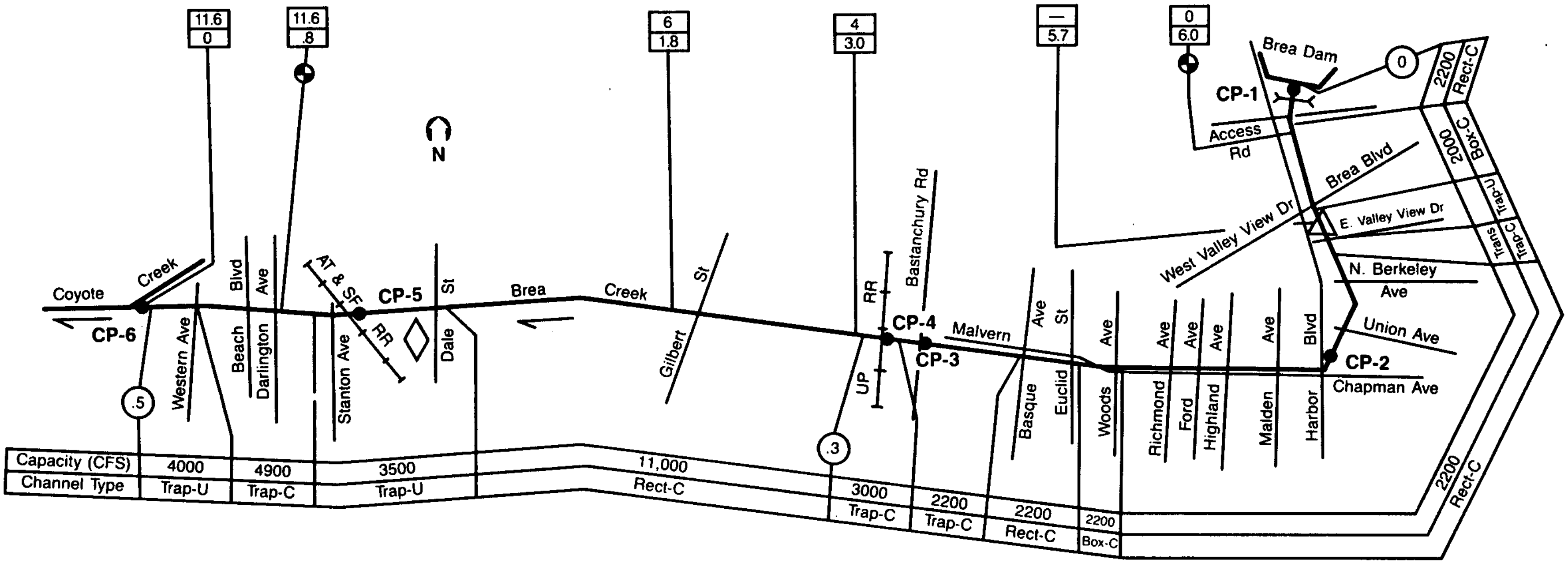


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

AREA AND CAPACITY CURVE

BASED ON JUNE 1964 SURVEY

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



Legend

- Dam
- RD Rubber Dam
- Stream Gage
- Drainage Area
- Miles From Stream Mouth
- Travel Time (Hours)
- Foot Bridge
- U Channel Unlined
- R Rip Rap Side Slopes
- S Soft Bottom
- C Concrete
- G Grouted Stone
- G/C ← Side Slope ← Bottom
- L Levee

	Significant Features	Miles	Remarks
Stream Gage	Brea Creek Below Brea Dam	6.0	
△	Hillcrest Park	5.7	
◇	Brea Creek Retarding Basin	1.4-1.8	
Stream Gage	Brea Creek at Darlington Ave. (OCEMA)	.8	Station No. 211

BREA CREEK, CALIFORNIA

SCHEMATIC SYSTEM DIAGRAM
BREA DAM
TO
COYOTE CREEK

US ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Summary of Climatological Data at Yorba Linda

YORBA LINDA, CA

PERIOD: 1951-80
ELEVATION: 350 FT

CLIMATOLOGICAL SUMMARY

TEMPERATURE (F)

	MEANS			EXTREMES						MEAN NUMBER OF DAYS				DEGREE DAYS	
	* DAILY MAXIMUM	* DAILY MINIMUM	* MONTHLY	RECORD HIGHEST	YEAR	DAY	RECORD LOWEST	YEAR	DAY	MAX 90 AND ABOVE	MAX 32 AND BELOW	MIN 32 AND BELOW	MIN 0 AND BELOW	* HEATING BASE 65	* COOLING BASE 65
JAN	67.3	42.4	54.9	91+	76	17	23	60	2	0	0	2	0	320	7
FEB	69.3	43.1	56.2	92+	77	15	27+	56	17	0	0	1	0	253	7
MAR	70.4	43.6	57.0	93+	59	12	29	51	2	0	0	1	0	256	8
APR	73.7	46.0	59.9	99	66	15	32+	56	2	1	0	0	0	179	26
MAY	76.7	50.9	63.8	104+	79	13	38+	60	5	2	0	0	0	84	47
JUN	81.8	54.5	68.2	111+	73	20	41+	53	3	5	0	0	0	26	122
JUL	88.8	58.2	73.5	110+	57	4	46+	53	2	13	0	0	0	0	264
AUG	89.2	59.0	74.1	108+	56	23	46	51	7	14	0	0	0	0	282
SEP	87.4	56.7	72.0	114+	55	1	43+	54	21	11	0	0	0	0	215
OCT	81.4	52.0	66.7	109+	58	16	30+	71	29	6	0	0	0	55	108
NOV	74.2	46.1	60.1	100+	76	4	29+	79	21	1	0	0	0	172	25
DEC	68.9	42.3	55.6	99+	58	3	22+	68	21	0	0	1	0	299	7
YEAR	77.4	49.6	63.5	114	SEP 55	1	22	DEC 68	21	53	0	5	0	1644	1118

PRECIPITATION TOTALS (INCHES)

	* MEAN	* GREATEST MONTHLY	YEAR	GREATEST DAILY	YEAR	DAY	SNOW MEAN	SNOW MAXIMUM MONTHLY	SNOW YEAR	MEAN NUMBER OF DAYS .10 OR MORE	.50 OR MORE	1.00 OR MORE
JAN	3.58	12.58	69	5.20	56	26	.0	.0		5	2	1
FEB	2.78	11.69	80	3.01	69	24	.0	.0		4	2	1
MAR	2.30	6.98	78	2.90	68	08	.0	.0		4	1	1
APR	1.15	5.21	58	1.64	58	01	.0	.0		3	1	0
MAY	.27	2.42	77	1.38	77	08	.0	.0		1	0	0
JUN	.05	.51	76	.51	76	10	.0	.0		0	0	0
JUL	.02	.29	68	.22	68	27	.0	.0		0	0	0
AUG	.15	2.61	77	2.41	77	17	.0	.0		0	0	0
SEP	.29	2.37	76	1.40	76	10	.0	.0		1	0	0
OCT	.23	1.96	57	.94	79	20	.0	.0		1	0	0
NOV	1.57	7.33	65	2.40	67	19	.0	.0		2	1	1
DEC	2.07	6.91	66	3.15	51	29	.0	.0		3	1	1
YEAR	14.46	12.58	JAN 69	5.20	JAN 56	26	.0	.0		24	8	5

*FROM 1951-80 NORMALS

ESTIMATED VALUE BASED ON DATA FROM SURROUNDING STATIONS

+ ALSO ON EARLIER DATES.

DEGREE DAYS TO SELECTED BASE TEMPERATURES (F)

HEATING DEGREE DAYS

BASE BELOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
65	320	253	256	179	84	26	0	0	0	55	172	299	1644
60	107	138	132	86	19	0	0	0	0	12	80	168	822
57	126	88	79	46	6	0	0	0	0	0	41	110	496
55	92	60	51	27	0	0	0	0	0	0	23	78	331
50	30	16	11	6	0	0	0	0	0	0	0	22	85

COOLING DEGREE DAYS

BASE ABOVE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
55	89	94	113	174	273	396	574	592	510	363	176	96	3450
57	61	66	79	133	216	336	512	530	450	305	134	66	2888
60	29	31	39	83	137	250	419	437	360	220	83	31	2119
65	7	7	8	26	47	122	264	282	215	108	25	7	1119
70	0	0	0	6	7	41	118	145	93	36	5	0	451

DERIVED FROM THE 1951-80 MONTHLY NORMALS

PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT

MONTHLY PRECIPITATION (INCHES)

PROBABILITY LEVELS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.05	.00	.00	.00	.00	.00	.00	**	.00	.00	.00	.00	.00
.10	.22	.04	.00	.00	.00	.00	**	.00	.00	.00	.02	.00
.20	.77	.29	.49	.06	.00	.00	**	.00	.00	.00	.15	.17
.30	1.31	.62	.88	.25	.01	.00	**	.00	.00	.00	.34	.47
.40	1.91	1.06	1.28	.46	.05	.00	**	.00	.00	.00	.59	.83
.50	2.59	1.61	1.73	.72	.10	.00	**	.00	.00	.03	.90	1.27
.60	3.41	2.32	2.25	1.02	.18	.01	**	.00	.01	.12	1.30	1.80
.70	4.42	3.26	2.89	1.42	.29	.03	**	.00	.12	.24	1.83	2.51
.80	5.83	4.64	3.75	1.97	.46	.07	**	.01	.38	.42	2.62	3.51
.90	8.20	7.08	5.19	2.90	.78	.16	**	.35	.98	.72	4.02	5.21
.95	10.53	9.58	6.60	3.84	1.11	.25	**	.86	1.67	1.03	5.45	6.93

THESE VALUES WERE DETERMINED FROM THE INCOMPLETE GAMMA DISTRIBUTION.

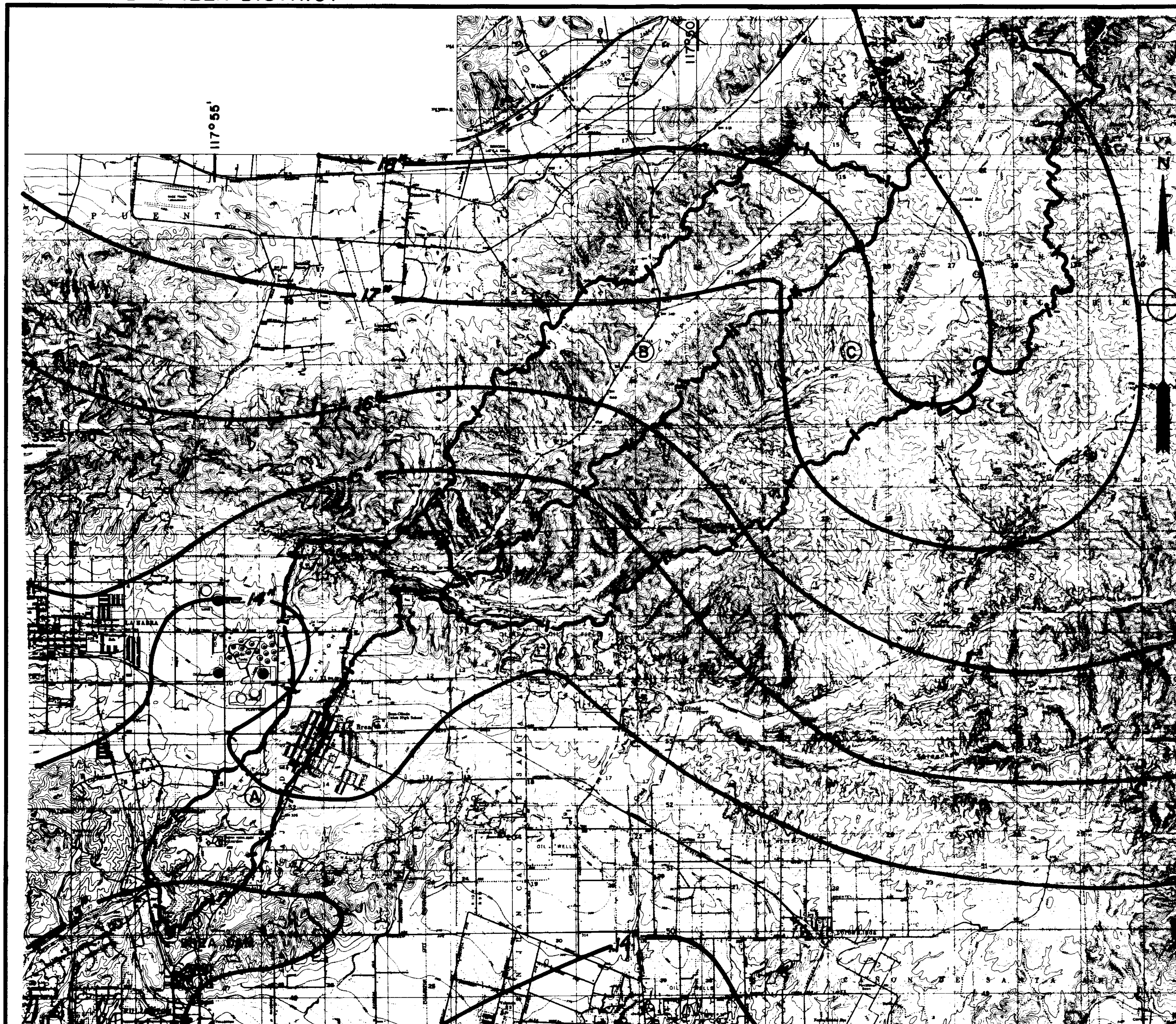
** STATISTICS NOT COMPUTED BECAUSE LESS THAN SIX YEARS OUT OF THIRTY HAD MEASUREABLE PRECIPITATION

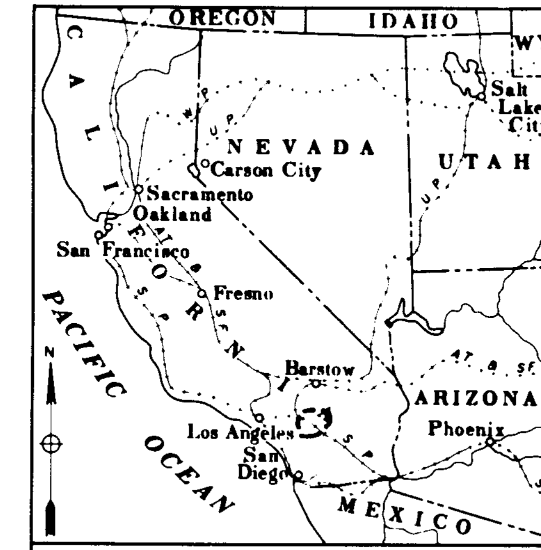
BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

SUMMARY OF CLIMATOLOGICAL DATA AT YORBA LINDA

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 4-02





VICINITY MAP

SCALE 100 0 100 200 300 400 MILES

AREA COVERED BY MAP

LEGEND

DRAINAGE AREA

DRAINAGE SUBAREA

(A) SUBAREA DESIGNATION

SCALE 1 0 1 MILES

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

NORMAL ANNUAL PRECIPITATION (INCHES)

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Historical Annual and Monthly Runoff Data at Brea Dam
(All Values in Acre-Feet)

Flow Per Month

Year	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	Water Year Total
1941-42	0.	0.	0.	11.70	16.46	19.10	12.40	0.	0.	0.	0.	0.	59.66
1942-43	0.	0.	0.	859.44	347.11	883.83	72.20	5.16	0.20	1.39	2.58	8.33	2180.24
1943-44	24.99	21.82	171.17	14.88	518.08	230.68	16.66	0.	0.	0.	0.	0.	998.28
1944-45	9.32	48.00	58.12	8.53	70.81	128.33	14.08	10.12	5.95	6.74	9.72	11.70	381.42
1945-46	1.19	5.95	141.42	12.30	11.11	15.37	37.50	12.30	5.95	6.15	6.15	5.95	261.34
1946-47	8.17	54.66	48.20	6.55	5.95	16.66	10.51	8.33	7.93	3.33	2.06	3.57	175.92
1947-48	0.	0.	0.	0.	3.37	0.	0.	0.	0.	0.	0.	0.	3.37
1948-49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1949-50	0.	0.	0.	0.	67.44	0.	0.	0.	0.	0.	0.	0.	67.44
1950-51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1951-52	0.	0.	187.15	1134.09	0.	703.5	0.	0.	0.	0.	0.	0.	2024.74
1952-53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1953-54	0.	0.	0.	0.	113.34	0.	0.	0.	0.	0.	0.	0.	113.34
1954-55	0.	0.20	0.	25.98	3.97	4.56	1.19	16.46	0.60	0.	0.	0.	52.96
1955-56	0.	0.	0.	527.80	0.	0.	20.03	3.97	0.	0.	0.	0.	551.80
1956-57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1957-58	0.	0.	0.	0.	444.75	323.70	576.56	0.60	0.	0.	0.	0.	1345.61
1958-59	0.	0.	0.	24.79	62.26	0.	0.	0.	0.	0.	0.	0.	87.05
1959-60	0.	0.	0.99	29.45	40.86	0.	5.95	0.	0.	0.	0.	0.	77.25
1960-61	0.	0.	0.	3.49	0.	0.	0.	0.	0.	0.	0.	0.	3.49
1961-62	0.	1.59	75.57	103.14	741.62	11.11	0.	0.	0.	0.	0.	0.	933.03
1962-63	0.	0.	0.	0.20	200.93	35.40	22.41	0.	0.	0.	0.	7.74	266.68
1963-64	4.76	144.00	0.	19.24	0.	48.6	14.68	0.	0.	0.	0.	0.	231.28
1964-65	0.	9.92	5.95	0.	5.95	92.83	283.83	0.	0.	0.	0.	0.	398.48
1965-66	0.	405.62	337.19	42.64	138.25	6.94	0.	0.	0.	0.	0.	0.	930.64
1966-67	0.	97.79	878.88	560.33	0.	17.65	136.25	0.	0.	0.	0.	0.	1690.90
1967-68	0.	338.34	284.23	22.02	16.86	623.21	27.37	0.	0.	0.	0.	0.	1312.03
1968-69	6.35	8.73	84.10	1783.78	2913.92	309.42	105.12	10.71	13.88	16.26	11.70	12.75	5276.72
1969-70	4.24	107.25	11.80	48.42	148.17	277.09	11.92	8.53	9.10	11.68	9.10	7.48	654.78
1970-71	12.77	365.81	265.79	52.96	74.78	34.31	21.40	36.83	17.53	17.36	16.54	9.76	925.84
1971-72	18.45	9.38	690.25	6.15	5.72	16.50	21.20	12.95	11.07	5.61	16.94	27.17	841.39
1972-73	24.36	123.37	260.67	343.34	1019.50	315.37	20.21	28.48	33.02	18.49	26.64	17.49	2230.94
1973-74	16.03	58.91	16.07	1215.07	15.07	334.02	24.50	0.	0.	0.	0.	0.	1679.67
1974-75	61.59	13.67	326.88	14.48	239.78	341.16	85.69	0.	0.	0.	0.	0.	1083.25
1975-76	16.07	21.22	11.50	12.89	378.84	163.44	119.50	0.	0.	0.	0.	0.	723.46
1976-77	12.75	29.55	59.50	166.81	56.33	91.64	17.85	0.	0.	0.	0.	0.	434.43
1977-78	9.30	11.64	660.10	1549.09	2632.07	5521.98	353.06	0.	0.	0.	0.	0.	10,737.24
1978-79	6.15	557.32	368.01	2632.26	928.26	961.79	5.95	0.	0.	0.	26.78	24.00	5510.52
1979-80	116.63	117.02	72.00	2416.07	7844.03	3004.96	5.95	6.15	5.95	6.15	6.15	5.95	13,607.01
1980-81	6.15	5.95	6.15	447.27	5.55	1313.26	6.35	5.95	5.95	6.15	6.15	5.95	1820.83
1981-82	23.60	335.21	515.90	168.00	6.15	2421.42	786.17	6.15	0.	0.	0.	0.	4262.60
1982-83	12.30	934.21	11.90	885.82	3076.52	4554.90	1282.71	12.30	11.90	12.30	12.30	11.90	10,819.06
1983-84	1329.45	11.90	11.90	12.30	11.50	11.90	12.30	12.30	11.90	12.30	12.30	11.90	1461.95
1984-85	68.13	322.79	2603.11	424.66	477.22	287.40	45.98	54.13	36.46	37.07	43.44	30.64	4431.03
Mean	40.7	94.6	185.6	354.2	514.6	525.6	94.9	5.7	4.0	3.7	4.7	4.6	1832.9
High	1329.45	934.21	2603.11	2632.26	7844.03	5521.98	1282.71	54.13	36.46	37.07	43.44	30.64	10,819.06
Low	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Computed values from Corps records

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

HISTORICAL ANNUAL & MONTHLY
RUNOFF DATA AT BREA DAM

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Annual Maximum Inflow, Outflow, Elevation, and Storage of Water at Brea Dam, Fullerton, California

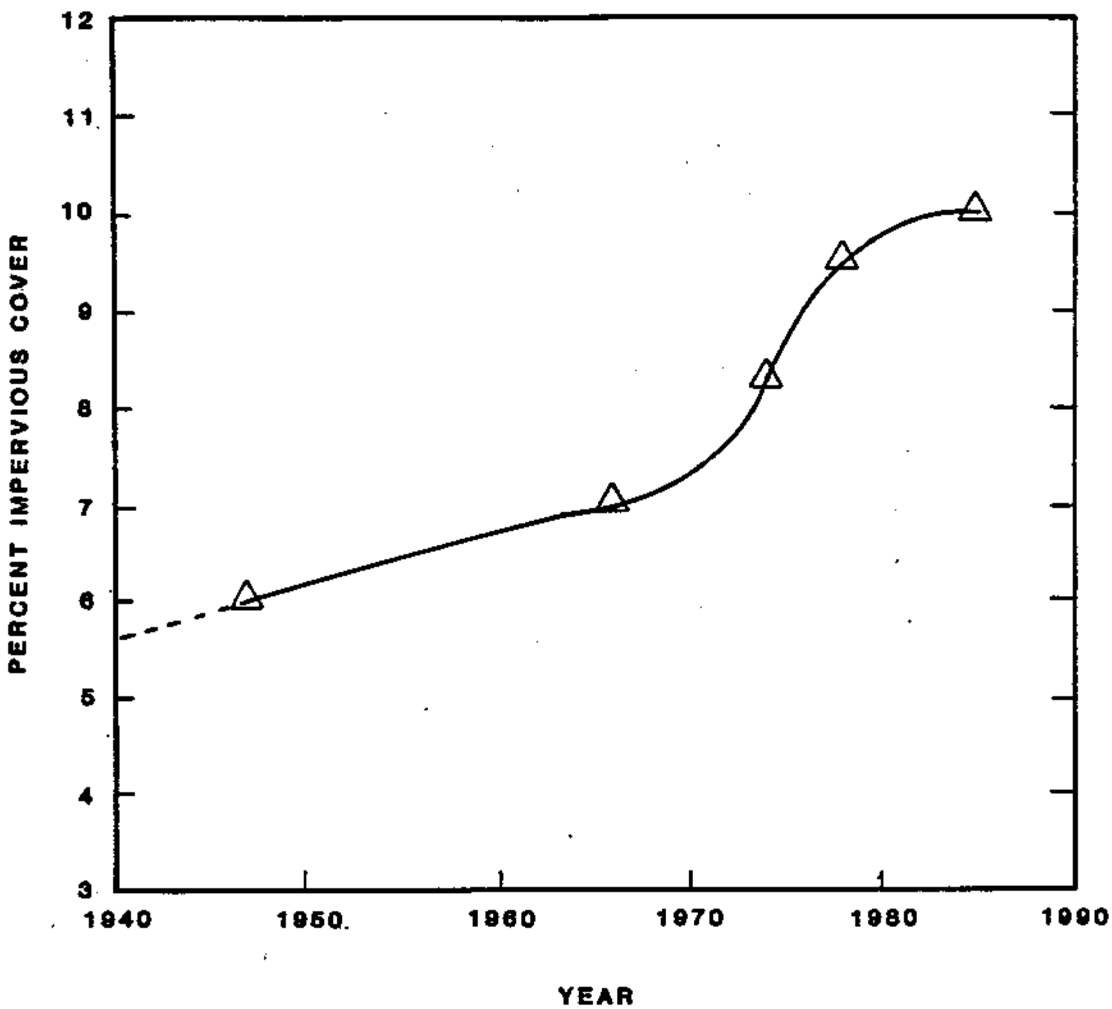
Water Year	Peak Inflow (cfs)	Date	Peak Outflow (cfs)	Date	Maximum Water Surface Elevation (ft., NGVD)	Date	Maximum Storage (ac-ft)	Date
1941-42	42	15 Mar	4.3	15 Mar	209.00	15 Mar	0.2	15 Mar
1942-43	702	23 Jan	203	25 Jan	240.77	23 Jan	458.0	23 Jan
1943-44	354	22 Feb	652	29 Feb	239.77	23 Feb	490.2	23 Feb
1944-45	48	2 Feb	13	23 Mar	223.22	3 Feb	54.3	3 Feb
1945-46	146	23 Dec	166	23 Dec	213.73	23 Dec	2.0	23 Dec
1946-47	28	25 Dec	6.5	12 Nov	221.95	26 Dec	30.4	26 Dec
1947-48	4	4 Feb	0.5	4 Feb	208.0		0	
1948-49	20		0		208.0		0	
1949-50	64	6 Feb	87	6 Feb	215.21	6 Feb	3.2	6 Feb
1950-51	1		0		208.0		0	
1951-52	907	18 Jan	250	3 Mar	237.92	18 Jan	403.6	18 Jan
1952-53	6		0		208.0		0	
1953-54	141	13 Feb	137	13 Feb	213.25	13 Feb	1.8	13 Feb
1954-55	8.5	18 Jan	7.4	18 Jan	209.42	18 Jan	0.2	18 Jan
1955-56	388	26 Jan	223	26 Jan	225.11	26 Jan	69.0	26 Jan
1956-57	1		0		208.0		0	
1957-58	392	7 Apr	270	7 Apr	224.34	7 Apr	57.9	7 Apr
1958-59	11	16 Feb	11	16 Feb	208.53	16 Feb	0.1	16 Feb
1959-60	80	1 Feb	82	1 Feb	210.70	1 Feb	0.6	1 Feb
1960-61	7.2	26 Jan	10	26 Jan	208.30	26 Jan	0.1	26 Jan
1961-62	282	11 Feb	226	11 Feb	224.35	19 Feb	58.0	19 Feb
1962-63	211	10 Feb	190	10 Feb	217.00	10 Feb	5.7	10 Feb
1963-64	129	20 Nov	150	20 Nov	213.73	20 Nov	2.1	20 Nov
1964-65	256	9 Apr	194	9 Apr	217.80	9 Apr	8.1	9 Apr
1965-66	371	29 Dec	327	29 Dec	223.20	29 Dec	37.5	29 Dec
1966-67	784	24 Jan	250	3 Dec	233.57	24 Jan	225.4	24 Jan
1967-68	778	18 Dec	344	8 Mar	233.00	8 Mar	210.1	8 Mar
1968-69	1192	25 Jan	636	25 Feb	248.70	25 Feb	862.0	25 Feb
1969-70	240	4 Mar	225	5 Mar	218.30	5 Mar	9.5	5 Mar
1970-71	341	29 Nov	230	29 Nov	220.00	29 Nov	15.0	29 Nov
1971-72	644	27 Dec	234	24 Dec	226.20	27 Dec	73.4	27 Dec
1972-73	775	11 Feb	286	11 Feb	229.07	11 Feb	136.0	11 Feb
1973-74	663	7 Jan	236	7 Jan	232.02	7 Jan	186.1	7 Jan
1974-75	1451	4 Dec	574	4 Dec	229.12	4 Dec	123.0	4 Dec
1975-76	255	1 Mar	340	1 Mar	217.97	9 Feb	8.2	9 Feb
1976-77	296	3 Jan	224	3 Jan	219.32	3 Jan	12.5	3 Jan
1977-78	1727	4 Mar	1007	4 Mar	231.41	4 Mar	172.5	4 Mar
1978-79	1585	6 Jan	1172	31 Jan	232.90	31 Jan	209.0	31 Jan
1979-80	2240	16 Feb	1220	16 Feb	246.00	18 Feb	720.0	18 Feb
1980-81	827	1 Mar	1000	1 Mar	223.75	1 Mar	43.1	1 Mar
1981-82	1015	17 Mar	1020	18 Mar	223.60	17 Mar	41.5	17 Mar
1982-83	2641	1 Mar	1440	1 Mar	252.00	1 Mar	1073	1 Mar
1983-84	1239	1 Oct	820	1 Oct	224.80	1 Oct	55.5	1 Oct
1984-85	1049	18 Dec	699	18 Dec	233.90	18 Dec	44.8	18 Dec
1985-86	1876	15 Feb	1281	15 Feb	228.95	15 Feb	121.0	15 Feb
1986-87	928	4 Jan	928	4 Jan	230.85	4 Jan	159.0	4 Jan
1987-88	1147	4 Dec	1018.1	17 Jan	232.80	17 Jan	206.0	17 Jan
Mean	602		391		223.52		136	
Maximum	2641	1 Mar 83	1440	1 Mar 83	252.00	1 Mar 83	1073	1 Mar 83
Minimum	1		0		208.00		0	

Notes: Computed values from Corps records
Gate Sill Elevation at 208.0 feet
Peak inflows are peak hourly mean values

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

ANNUAL MAXIMUM INFLOW, OUTFLOW, ELEVATION, & STORAGE OF WATER AT BREA DAM, FULLERTON, CA

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

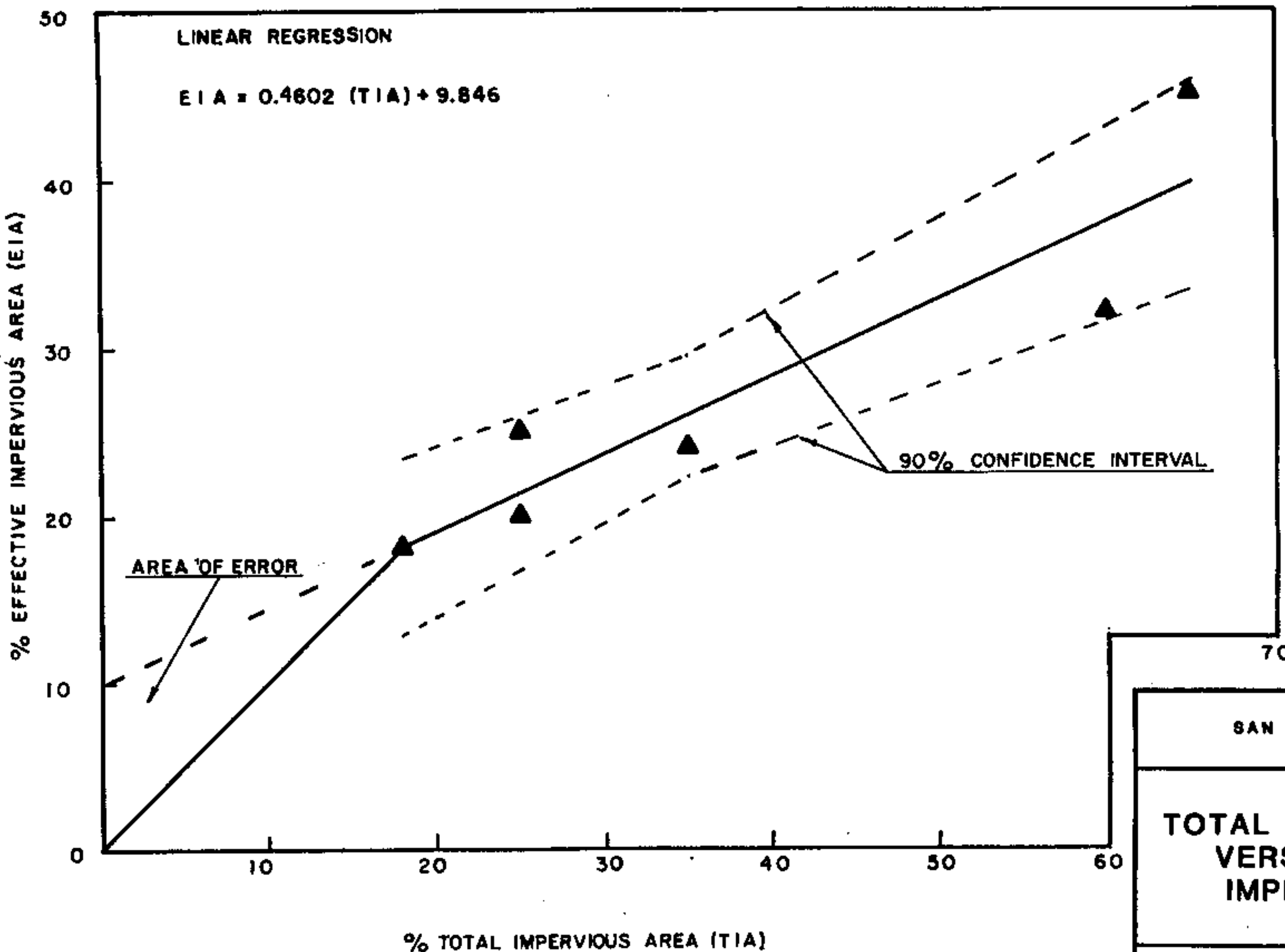


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

EFFECTIVE PERCENT OF IMPERVIOUS COVER IN DRAINAGE BASIN

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

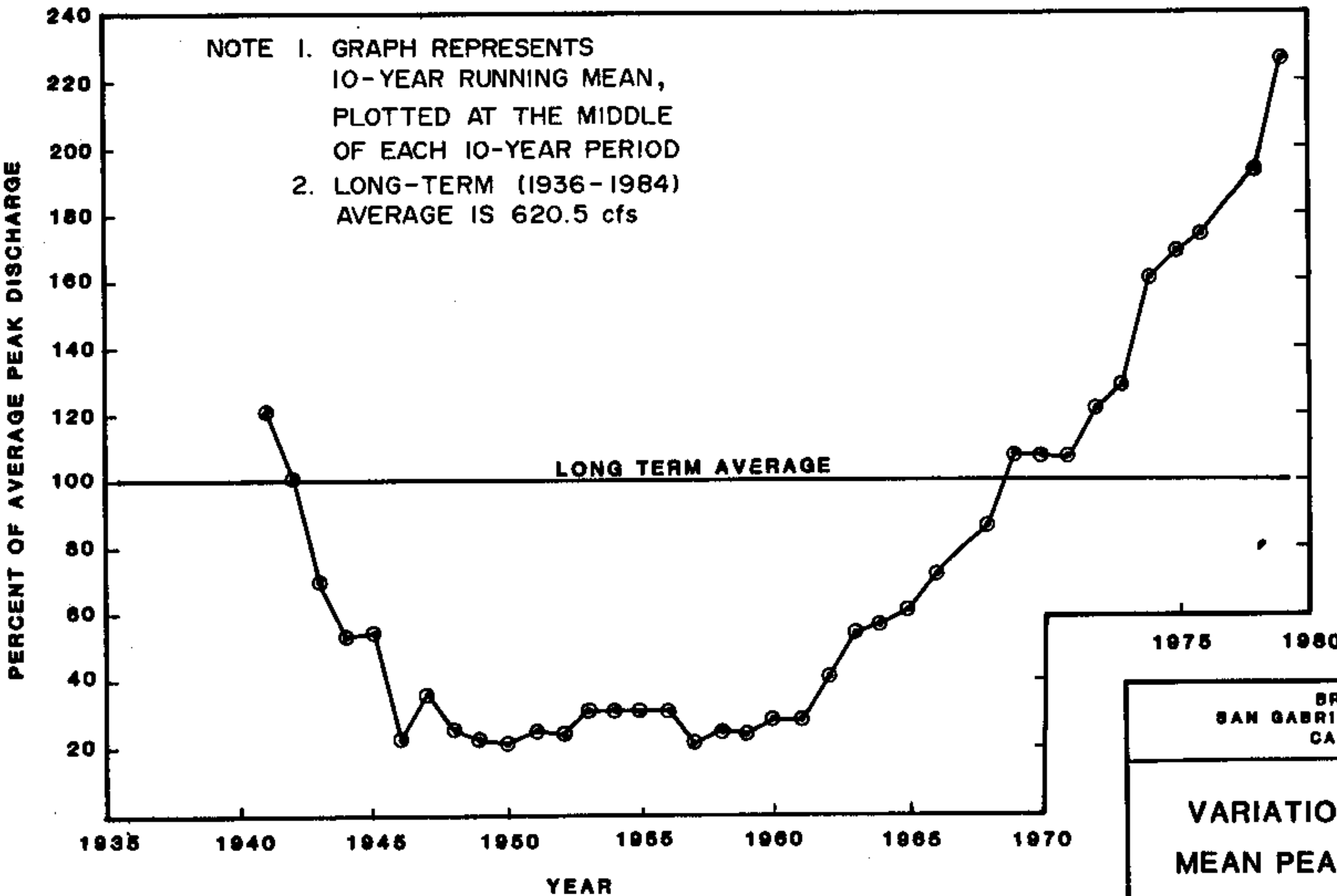
Total Basin Drainage Area: 22 mi.²



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

TOTAL IMPERVIOUS AREA VERSUS EFFECTIVE IMPERVIOUS AREA

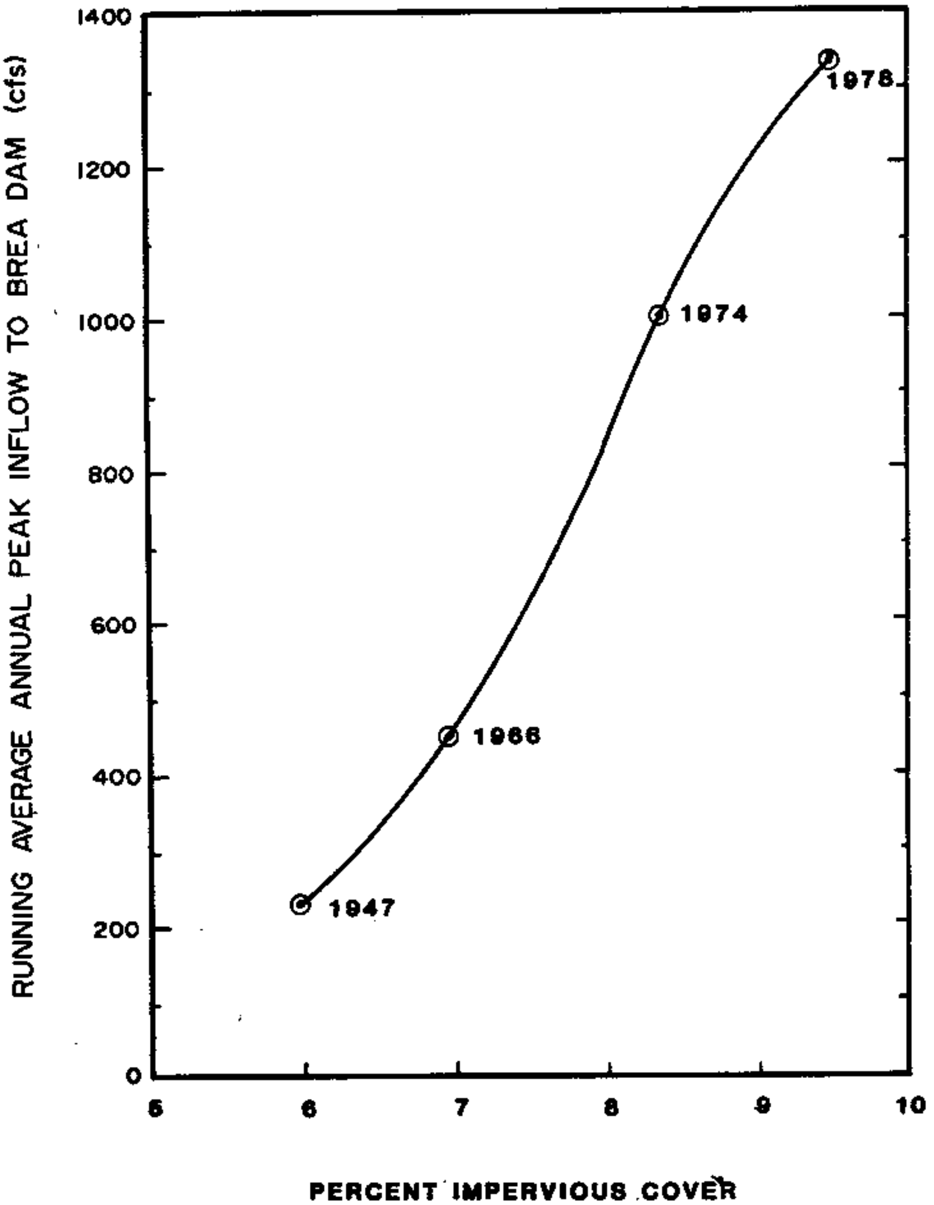
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

VARIATION IN 10-YEAR MEAN PEAK DISCHARGE

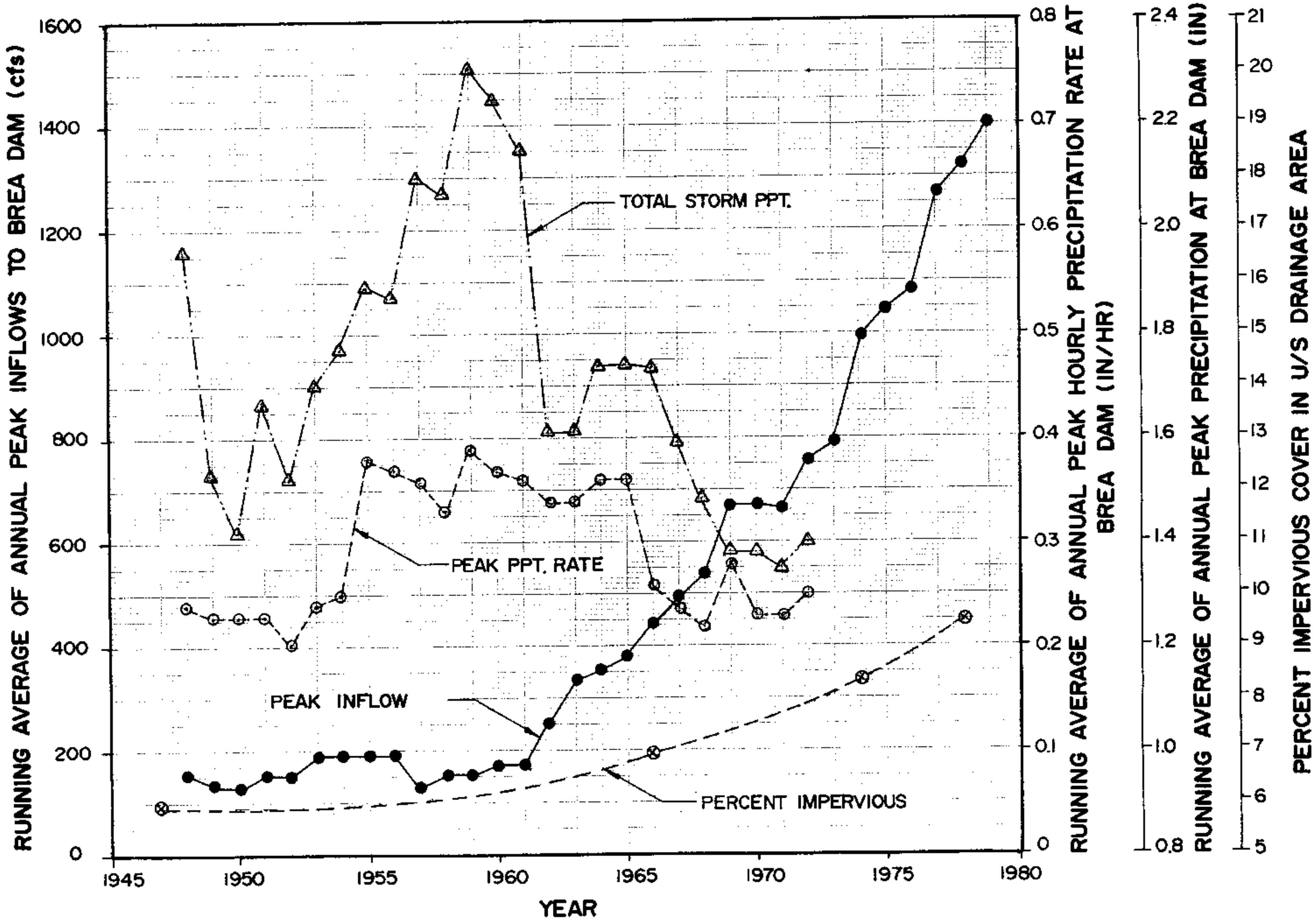
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

INFLOW VERSUS URBANIZATION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

RUNNING AVERAGE OF ANNUAL PEAK INFLOWS AND PRECIPITATION RATES

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

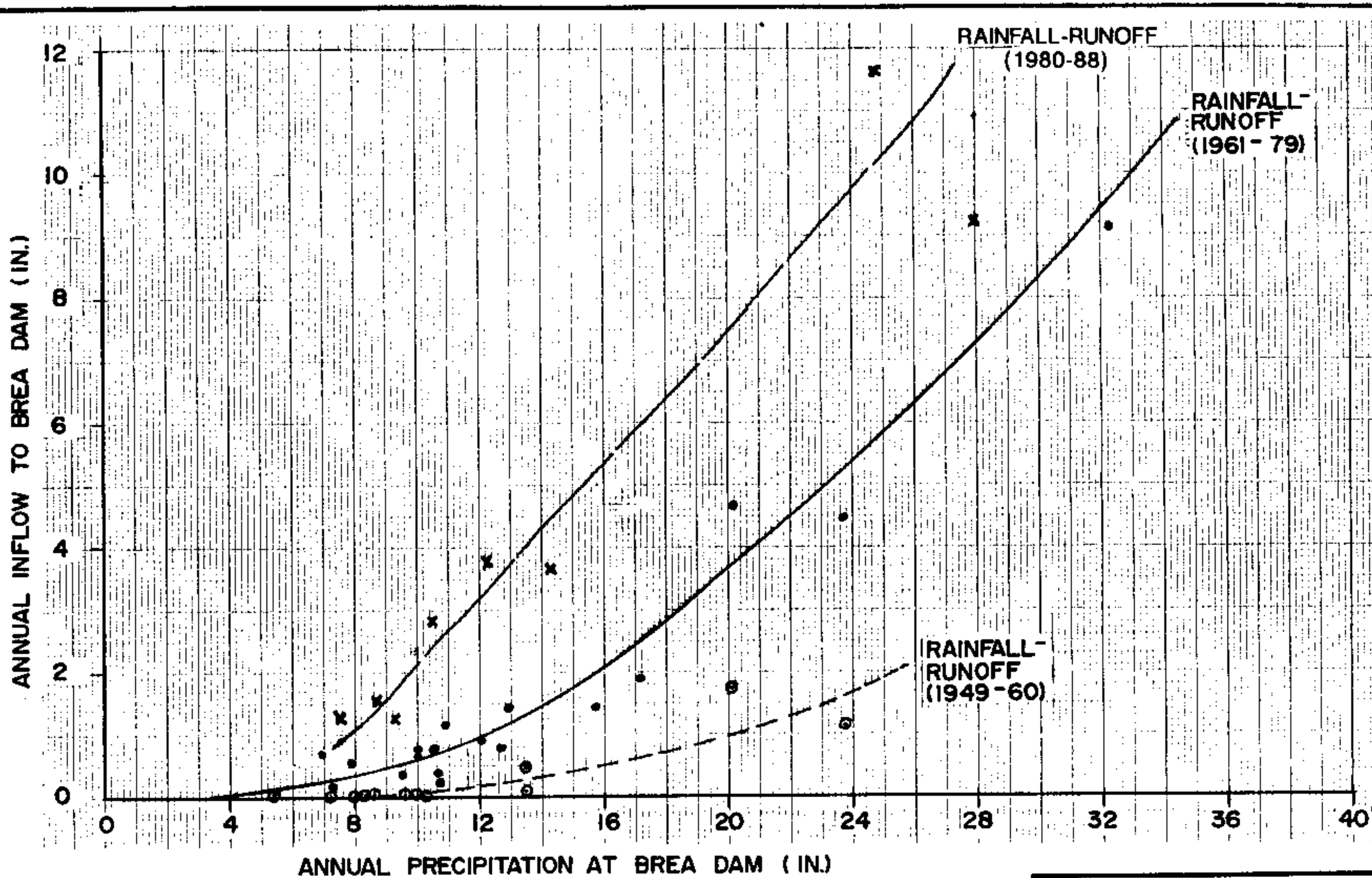
Historical Monthly and Annual Rainfall at Brea Dam Station
(all values in inch)

Year	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	ANNUAL
1948-49	0	0	2.81	1.94	2.24	1.08	0	.24	0	0	0	0	8.31
1949-50	0	.83	2.58	2.55	2.33	.85	.79	.09	0	0	0	0	10.02
1950-51	0	2.63	0	2.36	.84	.35	1.59	.09	0	0	.11	.12	8.09
1951-52	.41	.91	1.95	8.53	.14	6.35	1.80	0	0	0	0	.13	20.22
1952-53	0	3.64	2.62	1.30	.76	.81	1.07	0	0	0	0	0	10.20
1953-54	0	1.19	.24	5.67	2.29	4.16	.10	0	0	0	0	0	13.65
1954-55	0	1.26	.73	4.32	.99	.21	1.42	.70	0	0	0	0	9.63
1955-56	0	1.49	.55	8.11	.39	0	2.25	.69	0	0	0	0	13.48
1956-57	.25	0	.28	3.20	1.01	.54	.97	.79	.18	0	0	0	7.22
1957-58	1.77	.97	3.18	1.90	6.57	4.36	4.11	0	.03	0	.37	.53	23.79
1958-59	.02	.28	0	1.59	3.01	0	.68	0	0	0	0	0	5.58
1959-60	0	.09	1.46	2.76	1.95	1.35	.96	.08	0	0	0	0	8.65
1960-61	.63	1.87	.09	1.05	0	.58	.04	0	0	0	.02	0	4.28
1961-62	0	.50	.55	1.87	8.70	.89	0	.23	0	0	0	0	12.74
1962-63	.09	.02	0	0	4.89	2.00	1.43	0	.09	0	.09	2.04	10.65
1963-64	.59	3.36	0	1.04	.09	1.64	.30	.09	.16	0	0	0	7.27
1964-65	.25	1.37	1.24	.55	.15	2.20	3.96	.04	0	.02	0	1.06	10.84
1965-66	0	6.73	3.24	.95	1.27	.34	0	0	0	0	0	.05	12.58
1966-67	.02	2.11	4.74	3.69	0	1.60	2.84	.01	.06	0	0	.60	15.67
1967-68	0	3.91	1.47	1.14	.54	2.92	.57	.04	0	.30	0	0	10.89
1968-69	.16	.28	1.57	11.05	8.75	1.17	.61	.05	0	.10	0	0	23.74
1969-70	0	2.03	.10	1.99	2.22	1.52	.05	0	0	0	0	0	7.91
1970-71	0	3.95	3.89	.60	.72	.40	.45	.13	0	0	0	0	10.14
1971-72	.30	.20	5.41	0	0	0	.30	.10	.27	0	.30	.11	6.99
1972-73	.59	3.55	1.58	2.98	5.20	3.25	0	0	0	0	0	0	17.15
1973-74	0	1.71	.55	6.83	.25	3.33	.20	.08	0	0	0	0	12.95
1974-75	.68	0	3.72	.13	2.42	3.66	1.55	0	0	0	0	0	12.16
1975-76	.39	.30	.17	0	3.43	1.42	1.42	0	.32	0	0	2.58	10.03
1976-77	0	.50	.80	2.44	.60	.91	0	2.07	0	0	2.24	0	9.56
1977-78	0	0	5.32	7.67	8.84	7.79	1.54	0	0	0	0	1.10	32.26
1978-79	0	.60	2.58	10.07	2.77	4.11	0	0	0	0	0	0	20.13
1979-80	.61	.25	.36	8.59	10.55	3.93	.34	.13	0	0	0	0	24.76
1980-81	0	0	.79	2.55	1.55	3.24	.41	.06	0	0	0	.01	8.61
1981-82	.83	3.60	.58	2.68	.44	4.85	1.02	.07	0	0	0	.19	14.26
1982-83	.22	3.40	1.72	3.87	5.39	8.37	3.25	.16	0	0	.35	1.26	27.99
1983-84	2.62	3.39	1.84	0.26	0	.20	.65	0	0	0	.02	.25	9.23
1984-85	.07	2.21	5.41	1.23	1.63	1.20	.02	.12	0	0	0	.32	12.21
1985-86	.23	4.07	.28	2.20	4.96	3.51	.61	0	0	.21	0	1.73	17.80
1986-87	.30	.90	.24	3.57	.93	1.12	.19	.01	.02	.01	.09	.09	7.47
1987-88	1.84	.55	2.04	2.31	1.19	.10	2.36	.01	0	0	.01	.08	10.49
Mean	0.32	1.62	1.67	3.14	2.50	2.16	1.00	0.15	0.03	0.02	0.09	0.31	12.99

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

HISTORICAL MONTHLY & ANNUAL RAINFALL AT BREA DAM STATION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



⊙ 1949 - 60
• 1961 - 79
x 1980 - 88

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

ANNUAL RAINFALL - RUNOFF RELATIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Unit Hydrograph Ordinates for Watershed Above Brea Dam

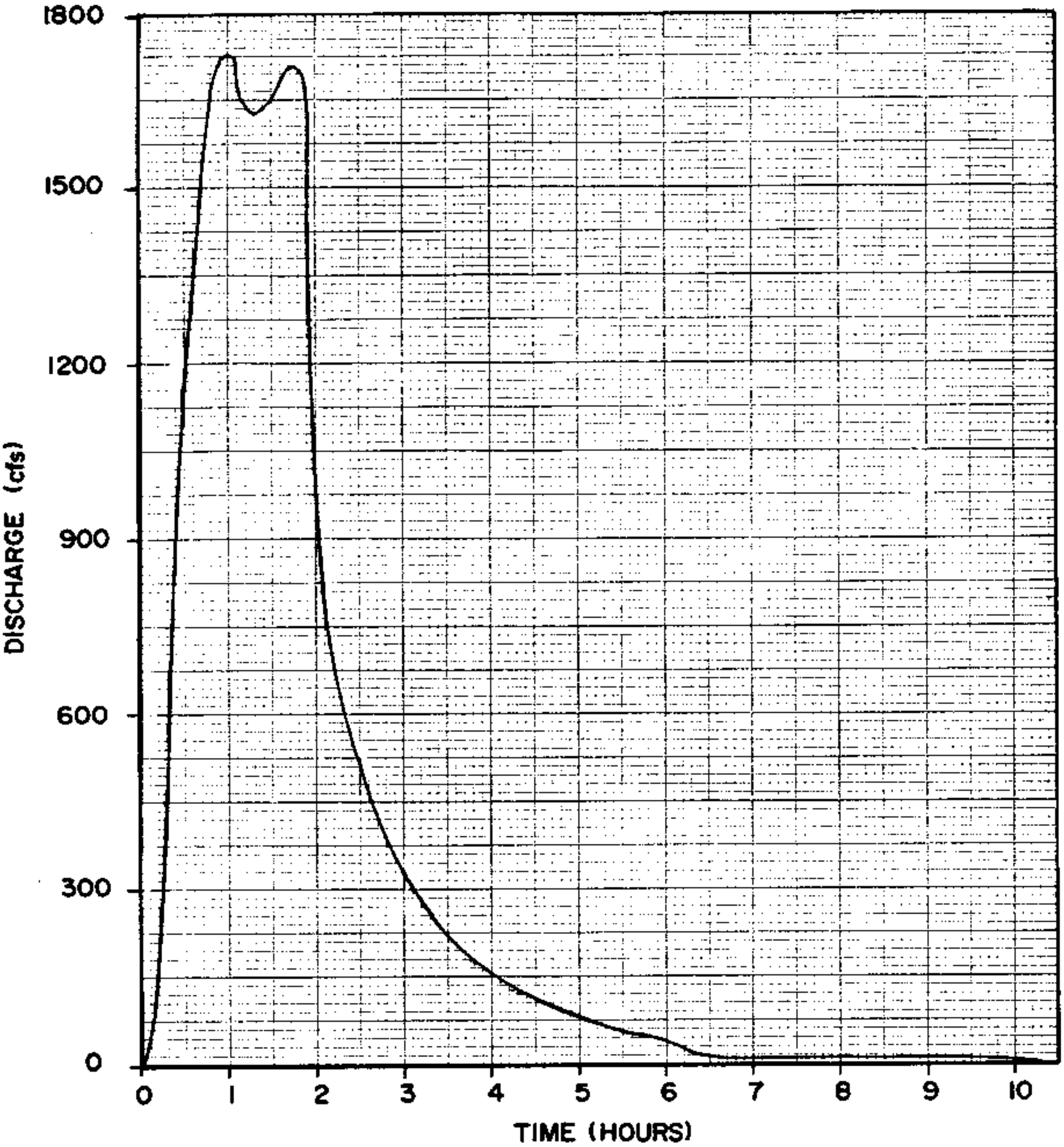
15-Minute Time Period	Discharge (cfs)	15-Minute Time Period	Discharge (cfs)
1	0	23	55
2	288	24	50
3	1,079	25	39
4	1,552	26	17
5	1,728	27	10
6	1,623	28	9
7	1,646	29	9
8	1,715	30	9
9	1,032	31	9
10	660	32	9
11	514	33	9
12	404	34	9
13	326	35	9
14	271	36	9
15	228	37	9
16	179	38	9
17	146	39	9
18	130	40	9
19	111	41	8
20	96	42	4
21	82	43	1
22	70	44	0

Note: Unit hydrograph derived on the basis of 1 inch/hour for each 15 minute period of 1 hour. Unit hydrographs for three sub-drainage areas upstream of Brea Dam were combined to obtain the above unit hydrograph.

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

UNIT HYDROGRAPH ORDINATES FOR
WATERSHED ABOVE BREA DAM

US ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

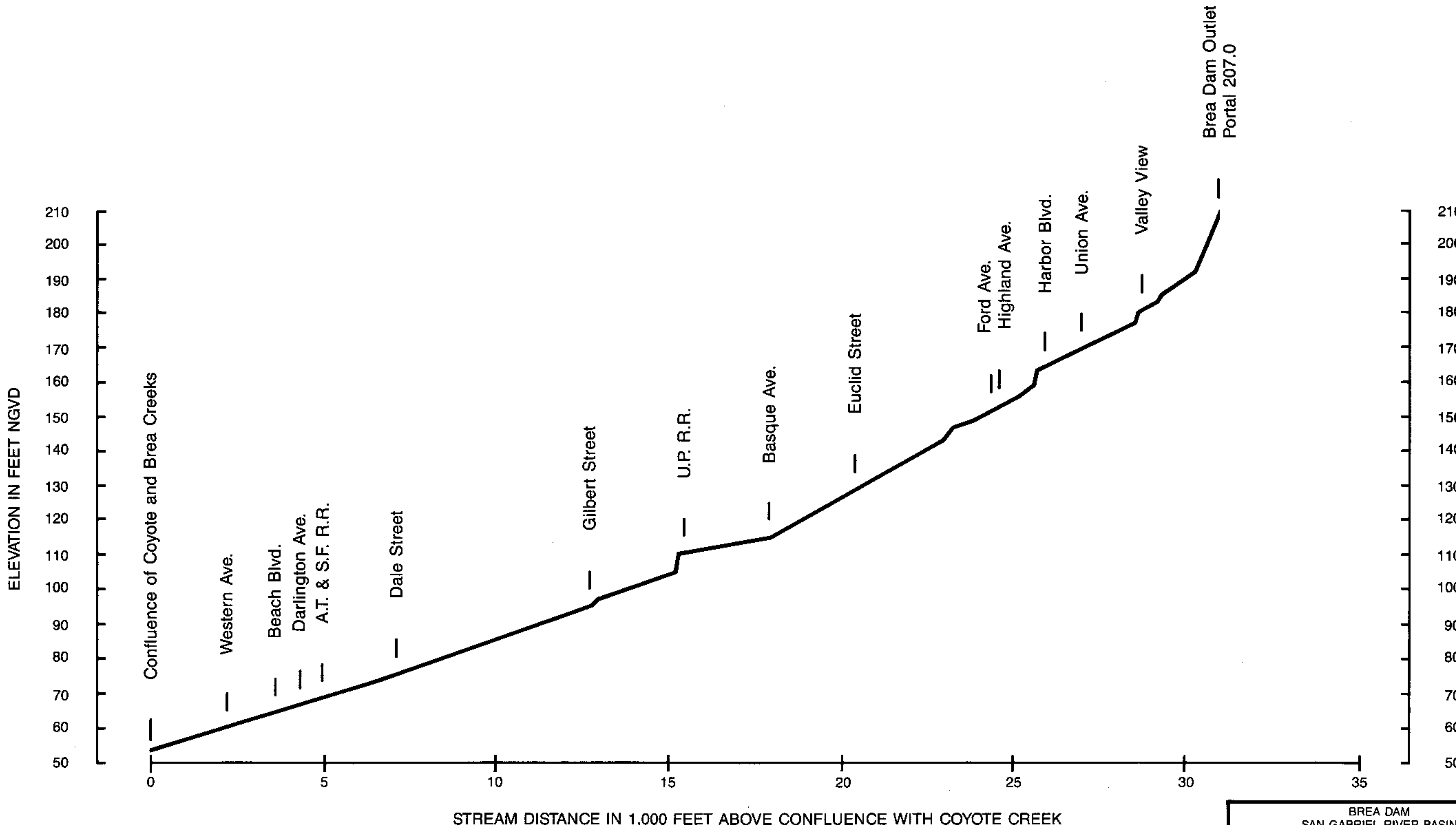


NOTE: 15-MINUTE PERIOD UNIT HYDROGRAPH IS DERIVED ON THE BASIS OF 1 INCH/HOUR RAINFALL EXCESS FOR EACH 15-MINUTE PERIOD BY COMBINING UNIT HYDROGRAPHS FOR THREE SUBDRAINAGE AREAS UPSTREAM OF BREA DAM. VALUES PLOTTED HERE ARE LISTED IN TABLE 4-07

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

UNIT HYDROGRAPH
DRAINAGE BASIN ABOVE BREA DAM

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

BREA CREEK
STEAMBED PROFILE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

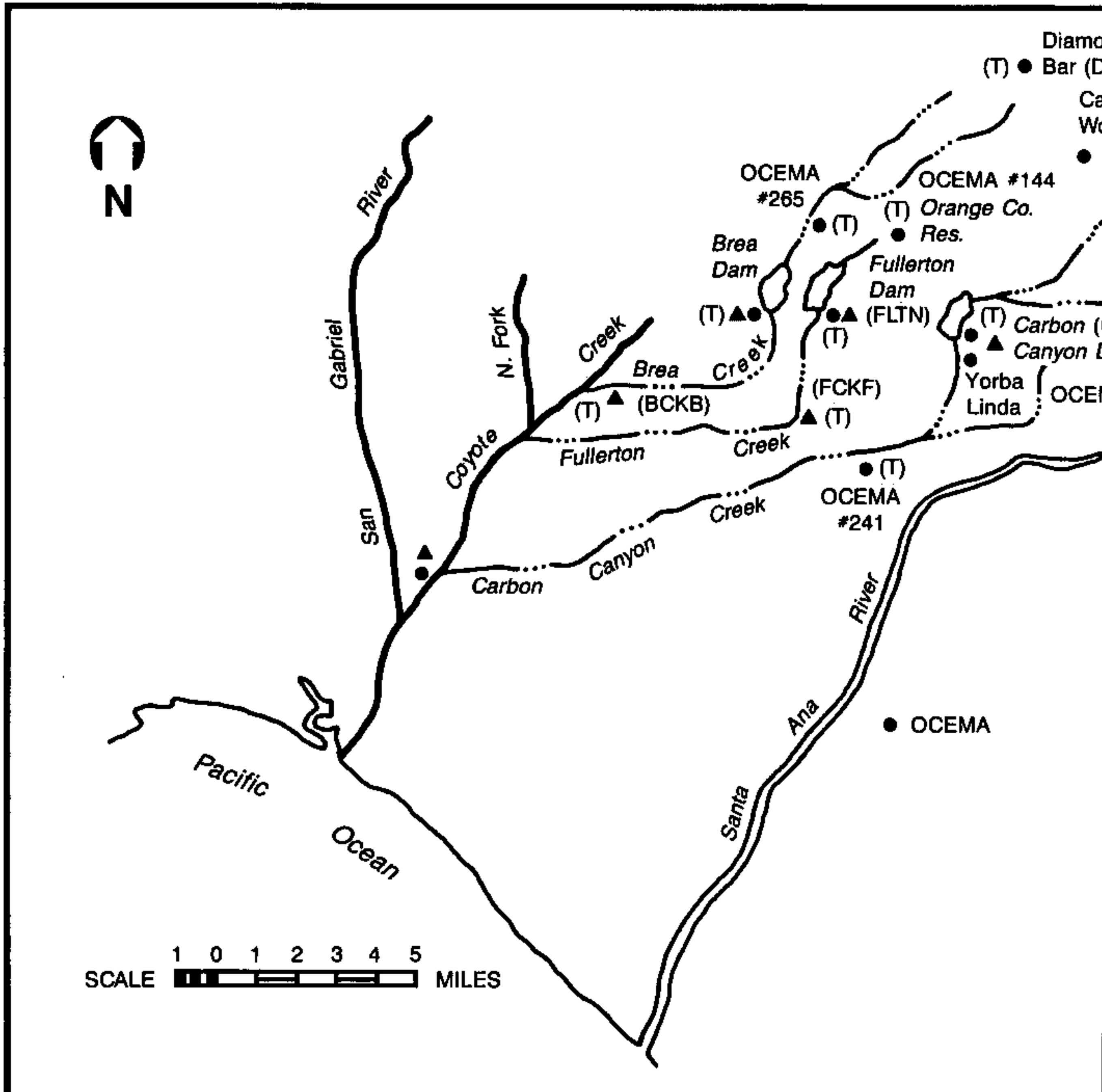
Hydrologic Instrumentation at Brea Dam

Parameters	Gauge Type	Automatic Recorders	Report Mode	Stored Record (Period Available)	Comments
Water Surface Elevation	Staff Boards	None	Visual	Flood Control Basin Operation Report SPL 19 (1942-present).	
	Upper Float Well Lower Float Well	Stevens A-35 Stevens A-71	Visual Visual	Paper strip charts (1941-present).	The lower well paper strip chart is operated at 9.6"/day during the rainy season for better definition and 2.4"/day in other periods. The upper well is operated 2.4"/day all the time.
	Upper and Lower Float Well	Digital recorder with quartz clock	Telemetry	Punch tape (1974-present). Telemetry data file.	
Downstream Gauge Height	Slant Manometer	Digital recorder	Visual Telemetry	Flood Control Basin Operation Report SPL 19 (1942-present). Punch tape (1974-present). Telemetry data file.	U.S.G.S. operates the gauge, publishes the daily record and stores the paper punch tape for U.S.G.S. station ID #11088500.
Outlet Gate Opening	Gate Opening Indicator	Stevens type F	Visual	Flood Control Basin Operation Report SPL 19 (1942-present). Paper strip charts (1941- present).	
Precipitation	Tipping Bucket	Digital recorder	Telemetry	Punch tape (1941-present). Telemetry data file.	
	Belfort Recording	Gauge	None	Paper chart (1941-present).	Data on the paper charts are evaluated for daily rainfall amounts and the charts are than sent to the NWS for publication.
	Glass Raintube	None	Visual	Rainfall Record SPL 31 (1941-present). Reservoir Operation Report SPL 424 (1941-present).	

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

HYDROLOGIC INSTRUMENTATION AT BREA DAM

US ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

PRECIPITATION AND
STREAM GAUGES

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 5-02

Precipitation, Reservoir, and Stream Gauges In and Near the Brea Dam Watershed

Station Identification	Station Name	Latitude (N) (deg-min-sec)	Longitude (W) (deg-min-sec)	Elevation (ft)	Type of Gauge(s)*
BREA	Brea Dam	33-53-26	117-55-26	340	RR, CR, RW, CW
BCKB	Brea Creek blw Brea Dam	33-53-16	117-55-32	208	RS, CS
CCYN	Carbon Canyon Dam	33-54-55	117-50-24	500	RR, CR, RW, CW
CCKC	Carbon Creek blw Carbon Canyon Dam	33-54-40	117-50-29	403	RS, CS
CCYG	Carbon Canyon Gilman	33-55-26	117-46-34	1624	RR
CCYW	Carbon Canyon Workman	33-57-29	117-46-42	1180	RR
DBAR	Diamond Bar	34-00-06	117-48-48	920	RR, CR
FLTN	Fullerton Dam	33-53-50	117-53-08	310	RR, CR, RW, CW
FCKF	Fullerton Creek blw Fullerton Dam	33-53-45	117-53-07	261	RS, CS
OCEMA #265	City of Brea	33-54-53	117-54-04	110	AR
OCEMA #241	Miller Basin	33-51-54	117-51-10	219	AR
OCEMA #144	Orange County Reservoir	33-56-07	117-52-58	660	AR
OCEMA #163	Yorba Linda	33-52-19	117-48-37	299	RR, **

*Legend:	Rain (Precipitation)	Reservoir Water Surface Elevation	Streamflow Water Surface Elevation	Outlet Gate Height
Non-Standard, Non-Recording (Staff)	NR	NW	NS	NG
Standard, Non-Recording	SR			
Recording (at site)	RR	RW	RS	RG
Corps Event Reporting Telemetry	CR	CW	CS	CG
Alert Event Reporting Telemetry	AR	AW	AS	

** Will be replaced with AR in the near future.

For location of these gauges, see Plate 5-01.

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

PRECIPITATION, RESERVOIR, & STREAM GAUGES IN & NEAR THE BREA DAM WATERSHED

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Rating Table for Brea Creek Below Brea Dam (BCKB)

Gauge Height (ft)	Channel Flow (cfs)	Gauge Height (ft)	Channel Flow (cfs)
1.0	0.2	5.2	1110
1.2	2.0	5.4	1180
1.4	18.6	5.6	1240
1.6	59.6	5.8	1310
1.8	110	6.0	1380
2.0	160	6.2	1450
2.2	208	6.4	1530
2.4	261	6.6	1600
2.6	315	6.8	1680
2.8	371	7.0	1750
3.0	427	7.2	1830
3.2	484	7.4	1900
3.4	541	7.6	1980
3.6	600	7.8	2060
3.8	660	8.0	2140
4.0	721	8.2	2220
4.2	784	8.4	2290
4.4	848	8.6	2370
4.6	912	8.8	2450
4.8	976	9.0	2530
5.0	1040	9.2	2630

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

RATING TABLE FOR BREA CREEK
BELOW BREA DAM (BCKB)

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Rating Table for Brea Creek at Darlington (BCKD)

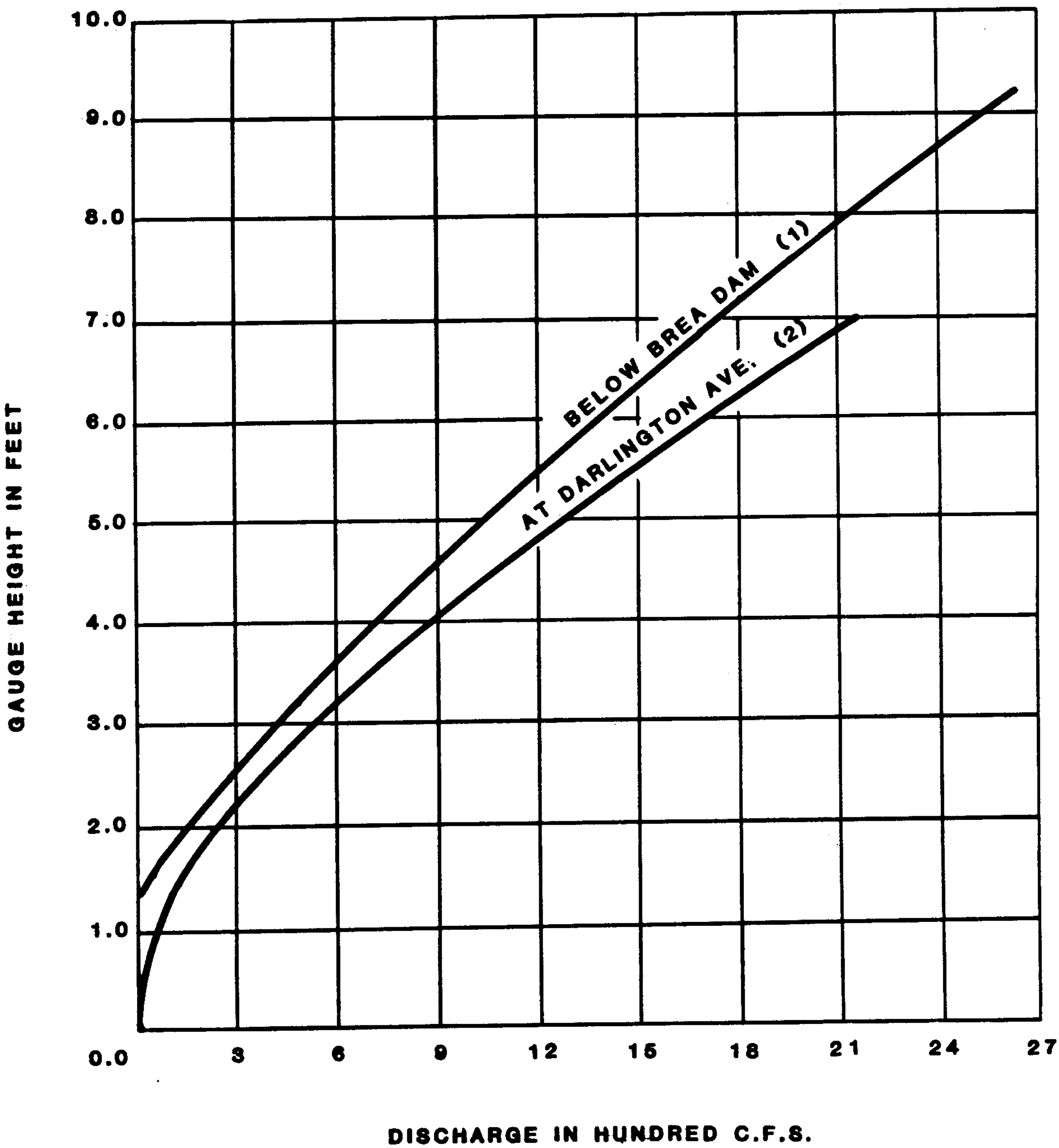
Gauge Height (ft)	Channel Flow (cfs)	Gauge Height (ft)	Channel Flow (cfs)
0.0	0.0	4.6	1118
0.2	1.1	4.8	1198
0.4	6.8	5.0	1280
0.6	18.2	5.2	1363
0.8	35.0	5.4	1447
1.0	58.0	5.6	1533
1.2	85.0	5.8	1621
1.4	118	6.0	1710
1.6	155	6.2	1800
1.8	189	6.4	1890
2.0	245	6.6	1980
2.2	295	6.8	2070
2.4	348	7.0	2160
2.6	404	7.2	2258
2.8	463	7.4	2356
3.0	525	7.6	2454
3.2	590	7.8	2552
3.4	657	8.0	2650
3.6	728	8.2	2748
3.8	803	8.4	2846
4.0	880	8.6	2944
4.2	958	8.8	3042
4.4	1038	9.0	3140

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

RATING TABLE FOR BREA CREEK

AT DARLINGTON (BCKD)

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



(1) U.S.G.S. GAUGING STATION

(2) O.C.E.M.A. GAUGING STATION

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

BREA CREEK
STREAM GAUGE
RATING CURVES

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Excess Rainfall, Runoff, Peak Inflow, Outflow at Dam and Peak Discharges at D/S Control Points for Different Return Periods

Return Period	42-Hour Excess Rainfall (Inch)	Runoff Volume (ac-ft)	Peak Inflow (cfs)	Peak Outflow (cfs)	Max. W.S. Elev. (ft. NGVD)	Peak Discharge (cfs) @ Control Points Without Dam Release			Peak Discharge (cfs) @ Control Points With Dam Release		
						CP-2	CP-3	CP-4	CP-2	CP-3	CP-4
SPF	7.04	8,260	8,000	5,060	283.23	N/A	N/A	N/A	5,632	6,068	6,520
500-Year	8.35	9,800	11,758	5,644	283.5	1,126	2,026	3,009	6,594	7,233	7,967
200-Year	6.59	7,700	9,169	1,500	277.9	903	1,625	2,415	1,881	2,452	3,209
100-Year	5.27	6,200	7,302	1,486	268.9	741	1,336	1,986	1,784	2,178	2,798
50-Year	4.06	4,700	5,539	1,500	257.7	589	1,062	1,581	1,861	2,199	2,636
25-Year	2.91	3,400	3,940	1,500	245.07	448	812	1,210	1,818	2,127	2,529
10-Year	1.62	1,900	2,145	1,351	230.5	294	536	801	1,638	1,876	2,133

Locations
CP-2 at Harbor Boulevard
CP-3 at Bastanchury Road
CP-4 at Union Pacific Railroad

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

EXCESS RAINFALL, RUNOFF, PEAK INFLOW, OUTFLOW, AT DAM & PEAK DISCHARGES AT D/S CONTROL POINTS FOR DIFFERENT RETURN PERIODS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Previous Gate Operation Schedule for Brea Dam
Fullerton, California*

Step No.	When reservoir water surface is between elevations	Gate setting for gates as indicated No. 1	No. 2	Computed Discharge
	Feet, NGVD	Feet of opening	Feet of opening	Cubic feet per second
1....	208.0 - 212.0	1.0	1.0	0 - 120
2....	212.0 - 216.0	2.0	2.0	185 - 325
3....	216.0 - 222.0	3.5	3.5	475 - 730
4....	222.0 - 232.0	5.0	5.0	970 - 1,410
5....	232.0 - 236.0	4.5	4.5	1,280 - 1,400
6....	236.0 - 240.0	4.1	4.1	1,285 - 1,390
7....	240.0 - 244.0	3.8	3.8	1,290 - 1,380
8....	244.0 - 248.0	3.6	3.6	1,310 - 1,390
9....	248.0 - 251.0	3.4	3.4	1,330 - 1,375
10....	251.0 - 254.0	3.1	3.1	1,260 - 1,400
11....	254.0 - 256.0	2.8	2.8	1,280 - 1,410
12....	256.0 - 258.0	2.6	2.6	1,330 - 1,430
13....	258.0 - 261.0	2.3	2.3	1,290 - 1,390
14....	261.0 -266.0	2.0	2.0	1,265 - 1,400
15....	266.0 - 270.0	1.8	1.8	1,310 - 1,400
16....	270.0 - 277.0	1.5	1.5	1,260 - 1,385
17....	277.0 - 279.2	1.25	1.25	1,260 - 1,385
18....	279.2 - 279.5	1.0	1.0	1,260 - 1,410
19....	279.5 - 279.8	.75	.75	1,270 - 1,410
20....	279.8 - 280.0	.50	.50	1,275 - 1,365
21....	280.0 - 280.2	.50	0	1,210 - 1,405
22....	Above 280.2	0	0	Spillway flow only

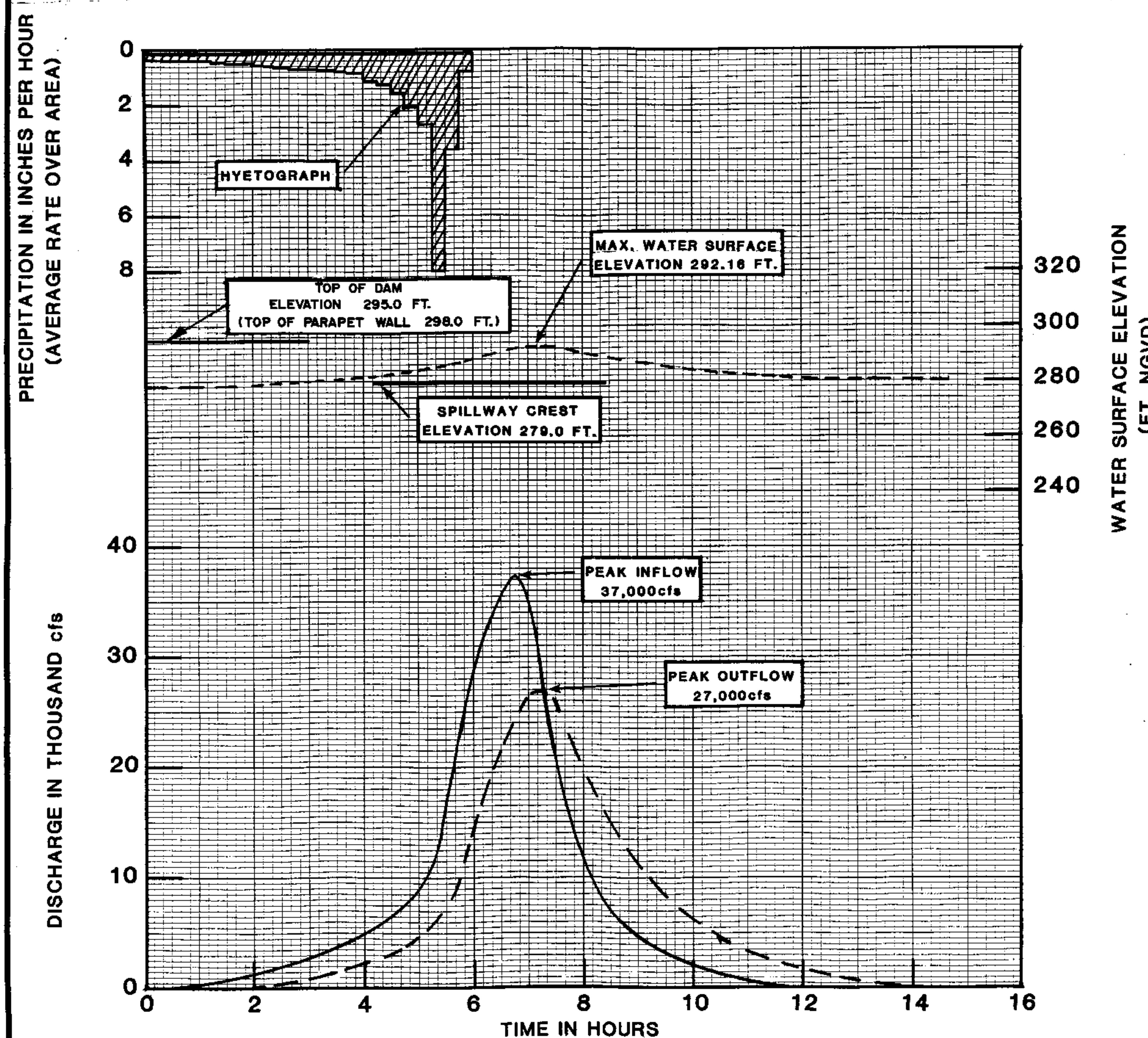
*Schedule applicable for rising or falling stages

Notes: Ungated sill elevation 251.0
Spillway crest elevation 279.0

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

PREVIOUS GATE OPERATION
SCHEDULE FOR BREA DAM

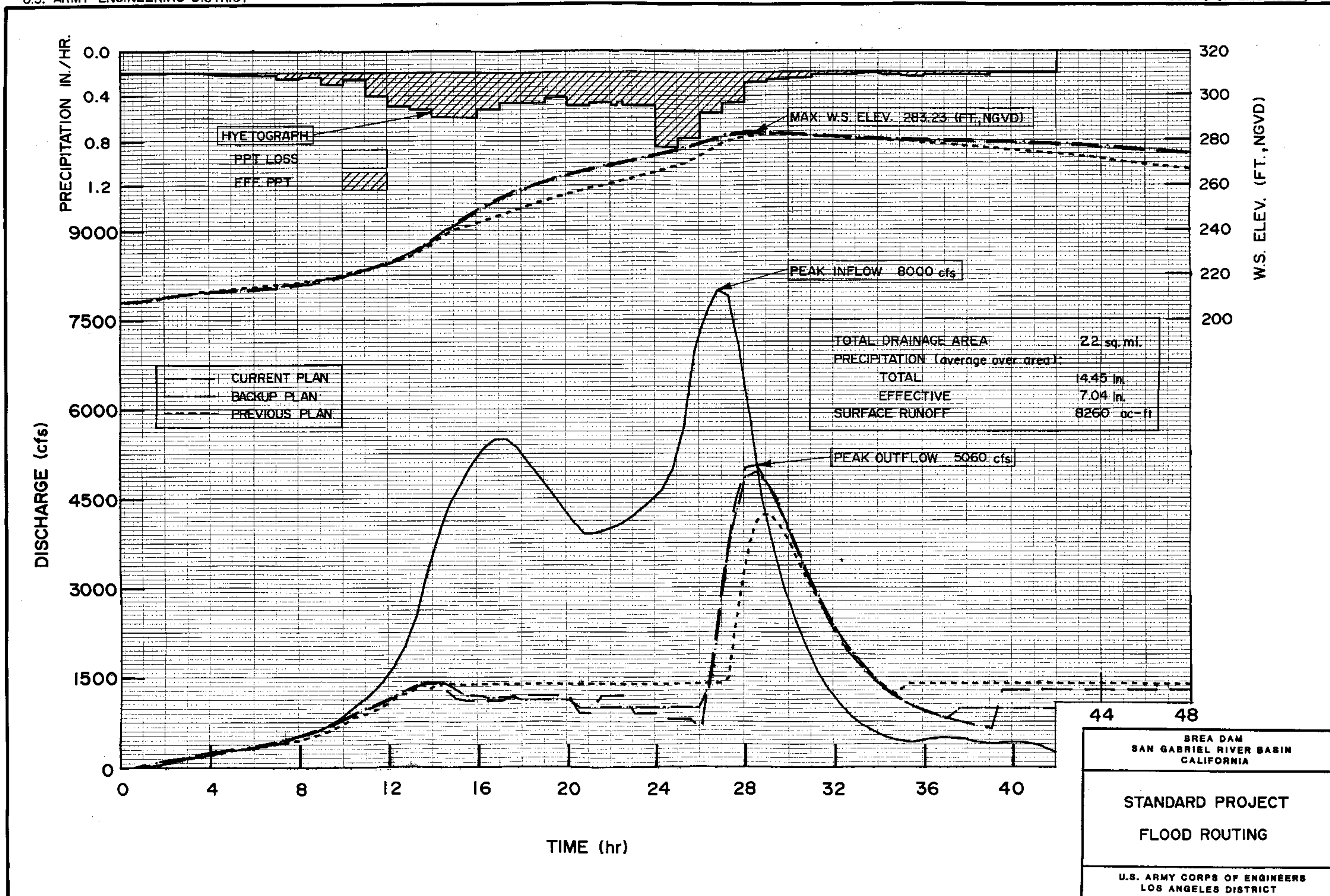
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

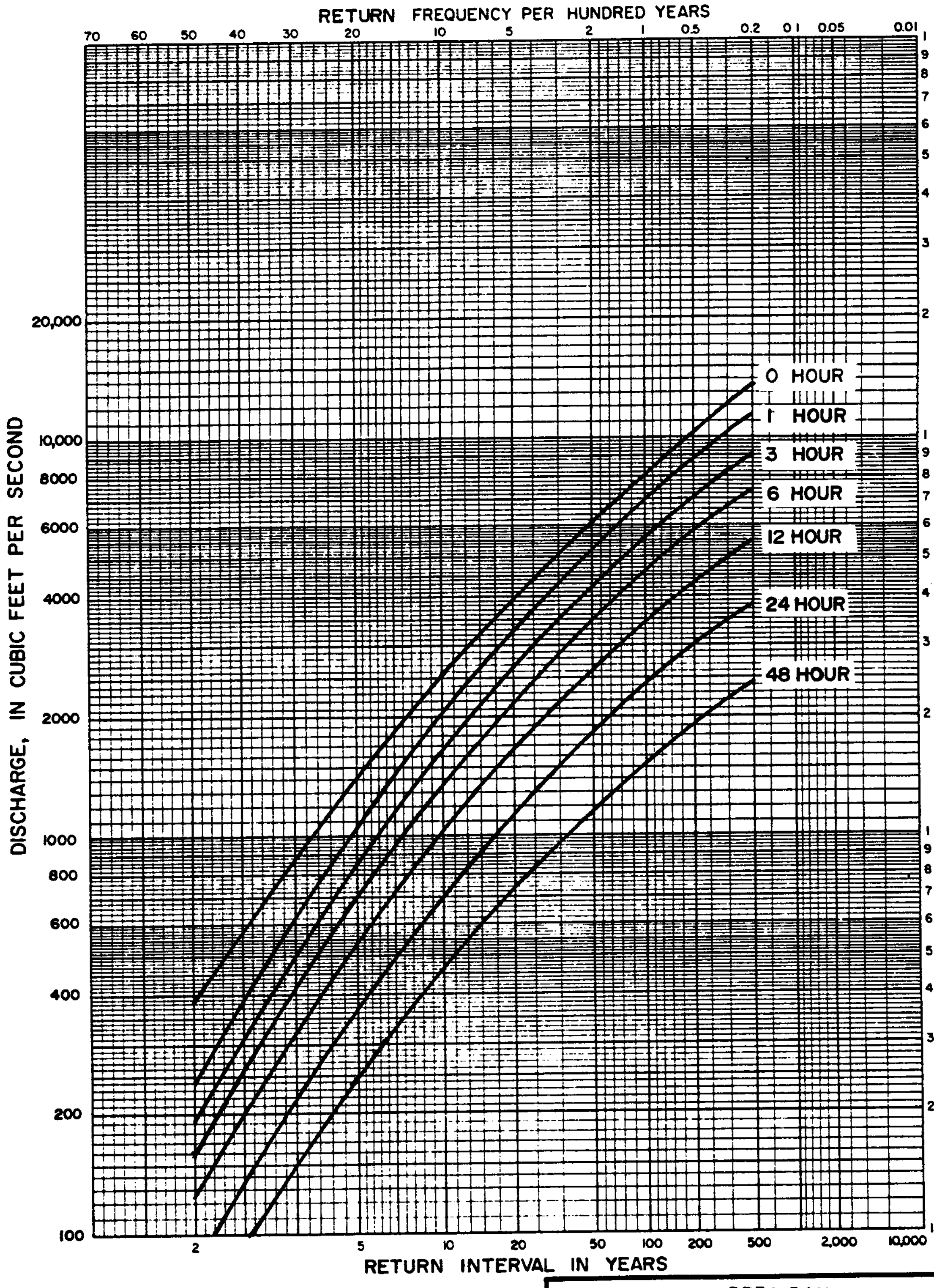


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

PROBABLE MAXIMUM FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT


PRECIPITATION IN./HR.
0.0
0.4
0.8
1.2
W.S. ELEV. (FT.,NGVD)
320
300
280
260
240
220
200
HYETOGRAPH
PPT LOSS
EFF. PPT
MAX. W.S. ELEV. 283.23 (FT.,NGVD)
PEAK INFLOW 8000 cfs
TOTAL DRAINAGE AREA 22 sq. mi.
PRECIPITATION (average over area):
TOTAL 14.45 in.
EFFECTIVE 7.04 in.
SURFACE RUNOFF 8260 ac-ft
CURRENT PLAN
BACKUP PLAN
PREVIOUS PLAN
PEAK OUTFLOW 5060 cfs
DISCHARGE (cfs)
9000
7500
6000
4500
3000
1500
0
0
4
8
12
16
20
24
28
32
36
40
44
48
TIME (hr)
BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA
STANDARD PROJECT
FLOOD ROUTING
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



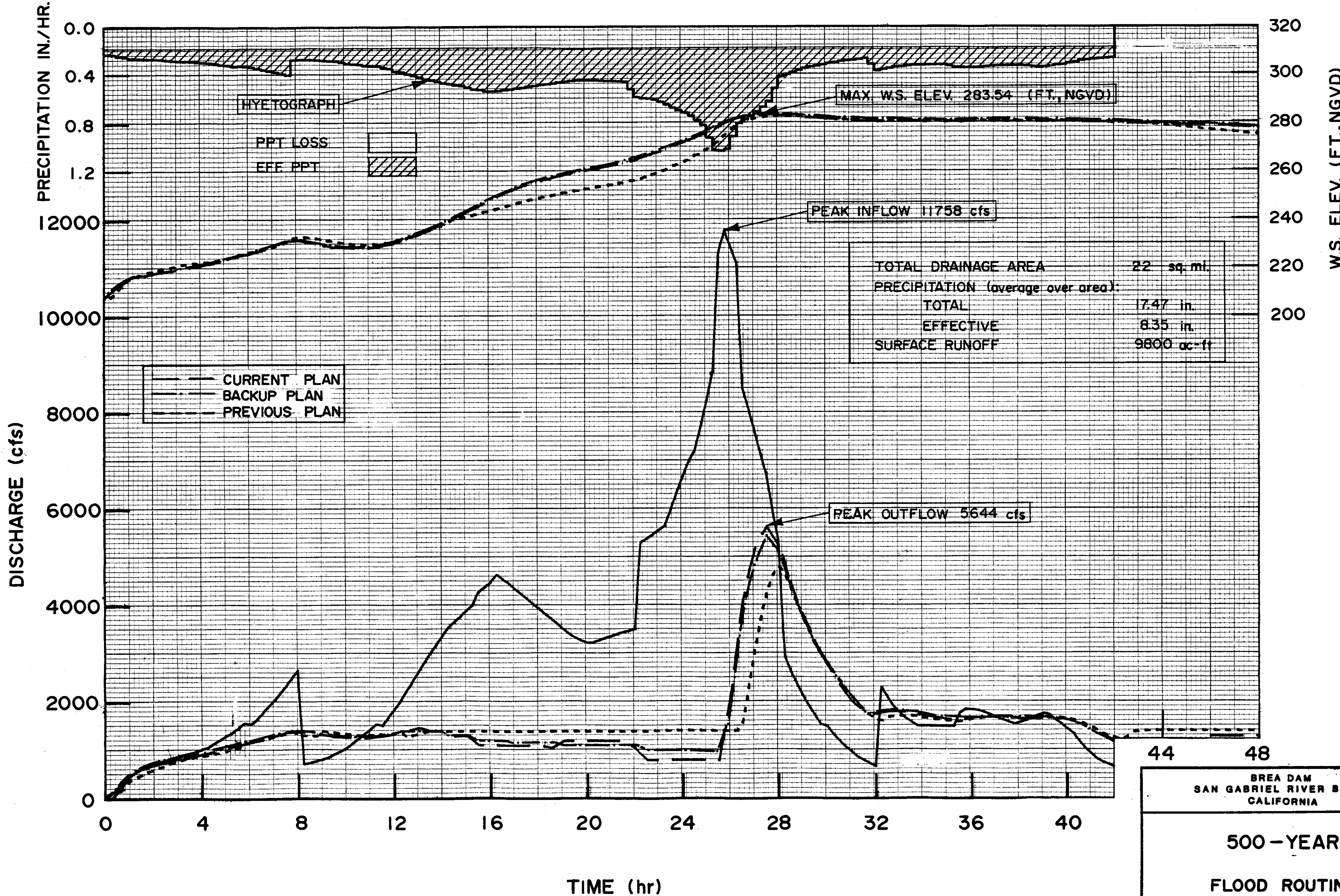
DA = 22 Sq. Mi.
INSTANTANEOUS : G = -0.65, N = 54
OTHERS : G = -0.80, N = 44
MEDIAN PLOTTING POSITIONS

NOTE: FREQUENCY VALUES FROM THE CURVES OF THIS PLATE ARE LISTED IN TABLE 8-01

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

INFLOW FREQUENCY CURVES

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

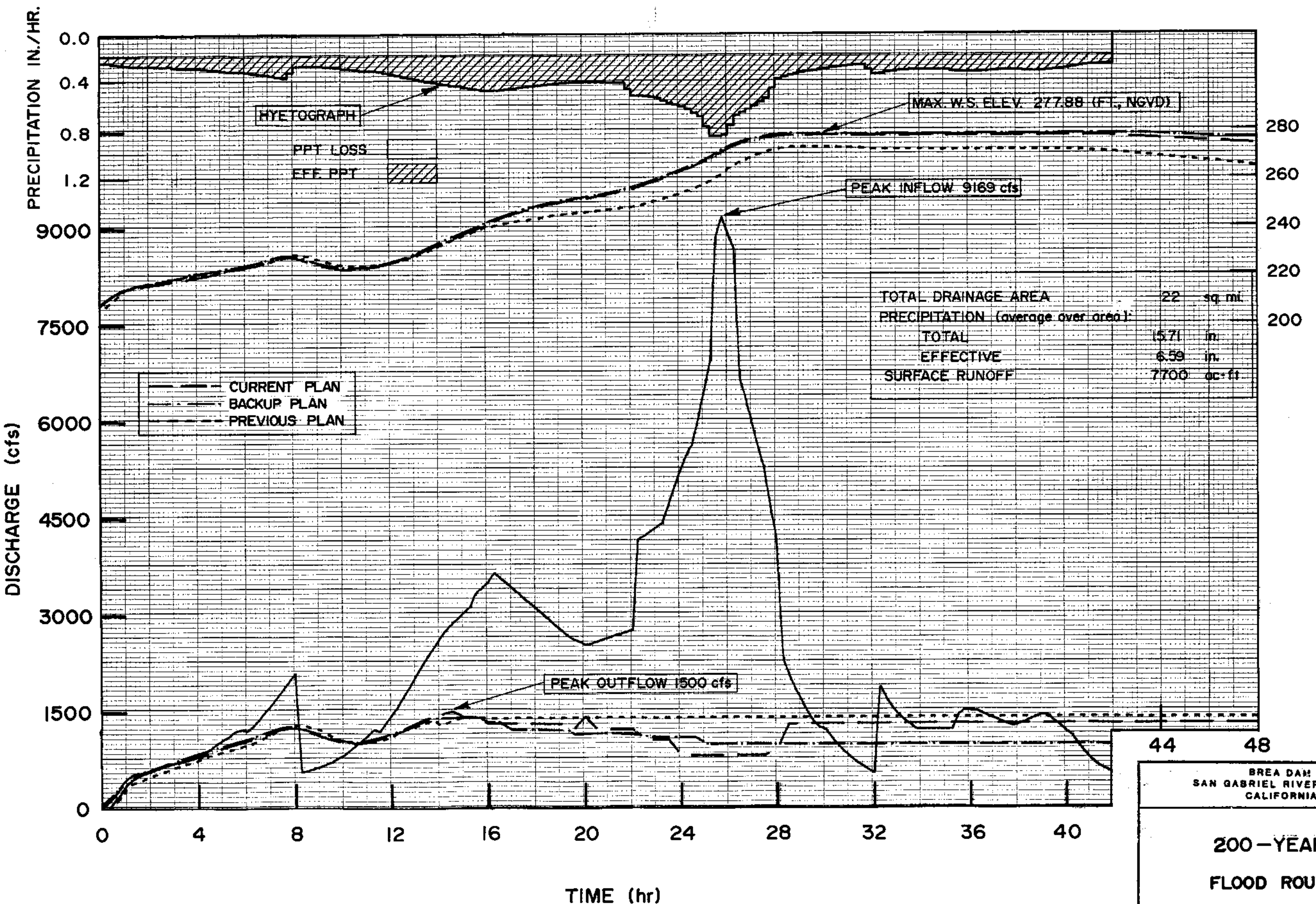


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

500-YEAR

FLOOD ROUTING

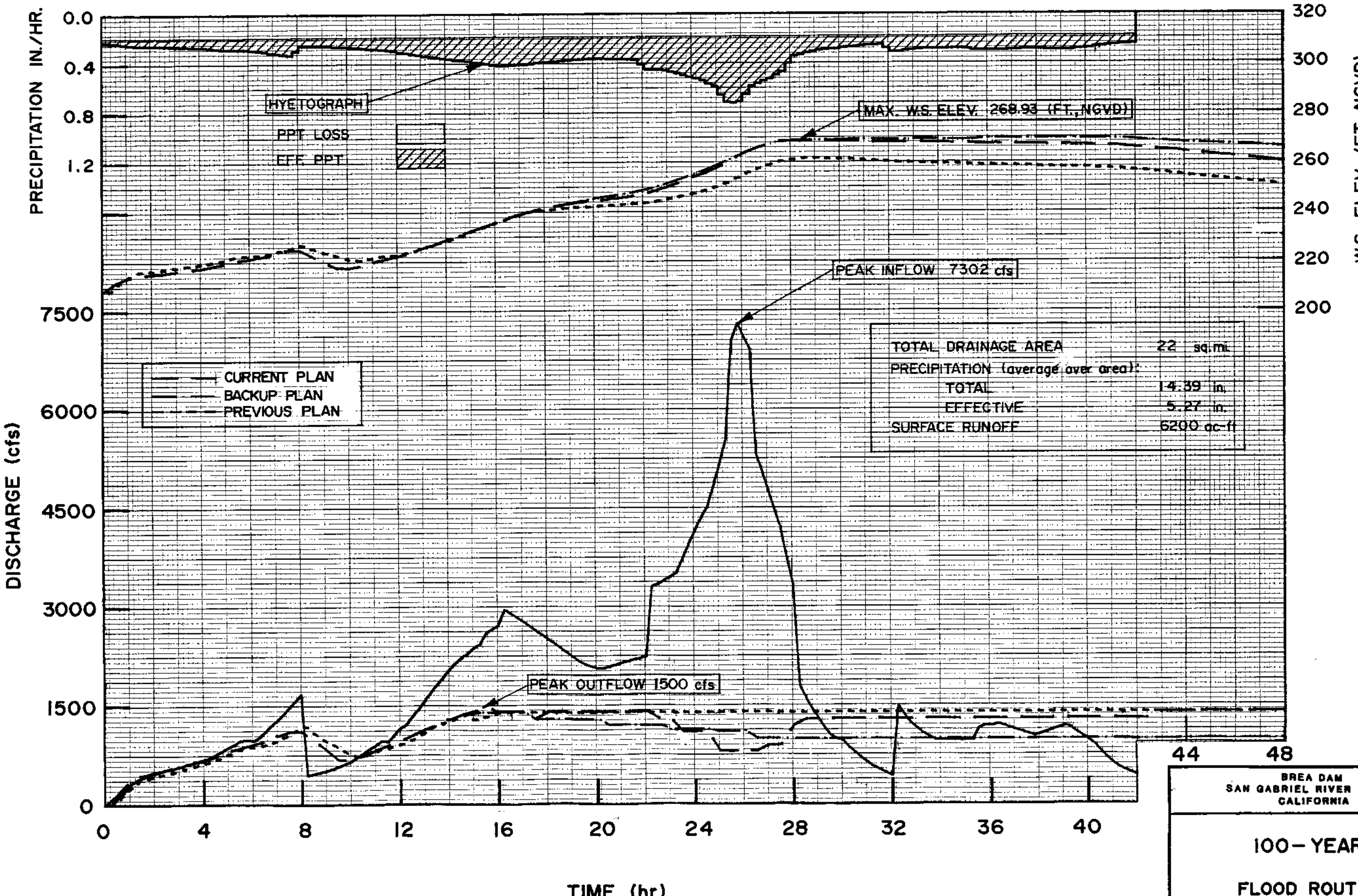
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

200-YEAR
FLOOD ROUTING

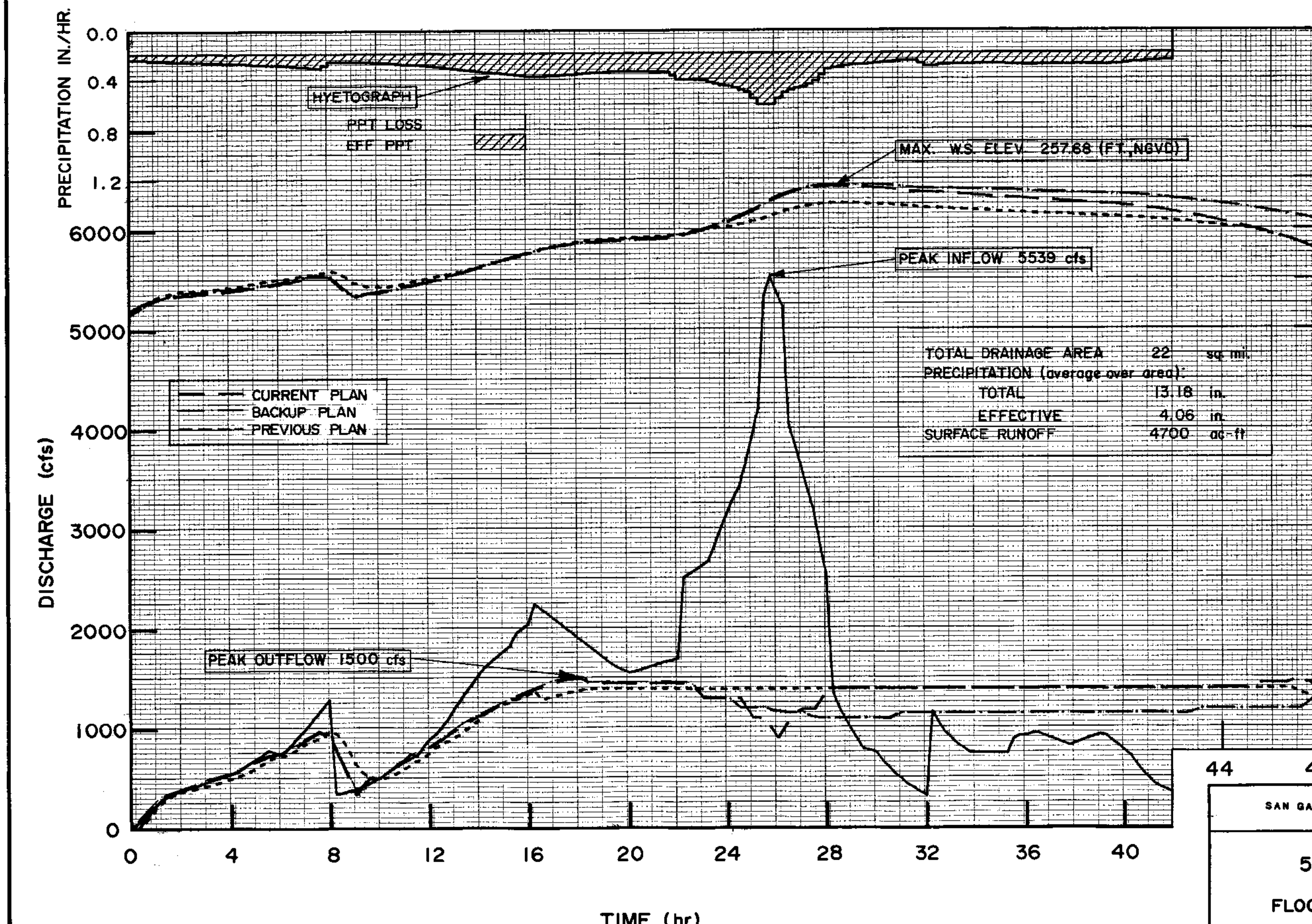
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

100-YEAR
FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

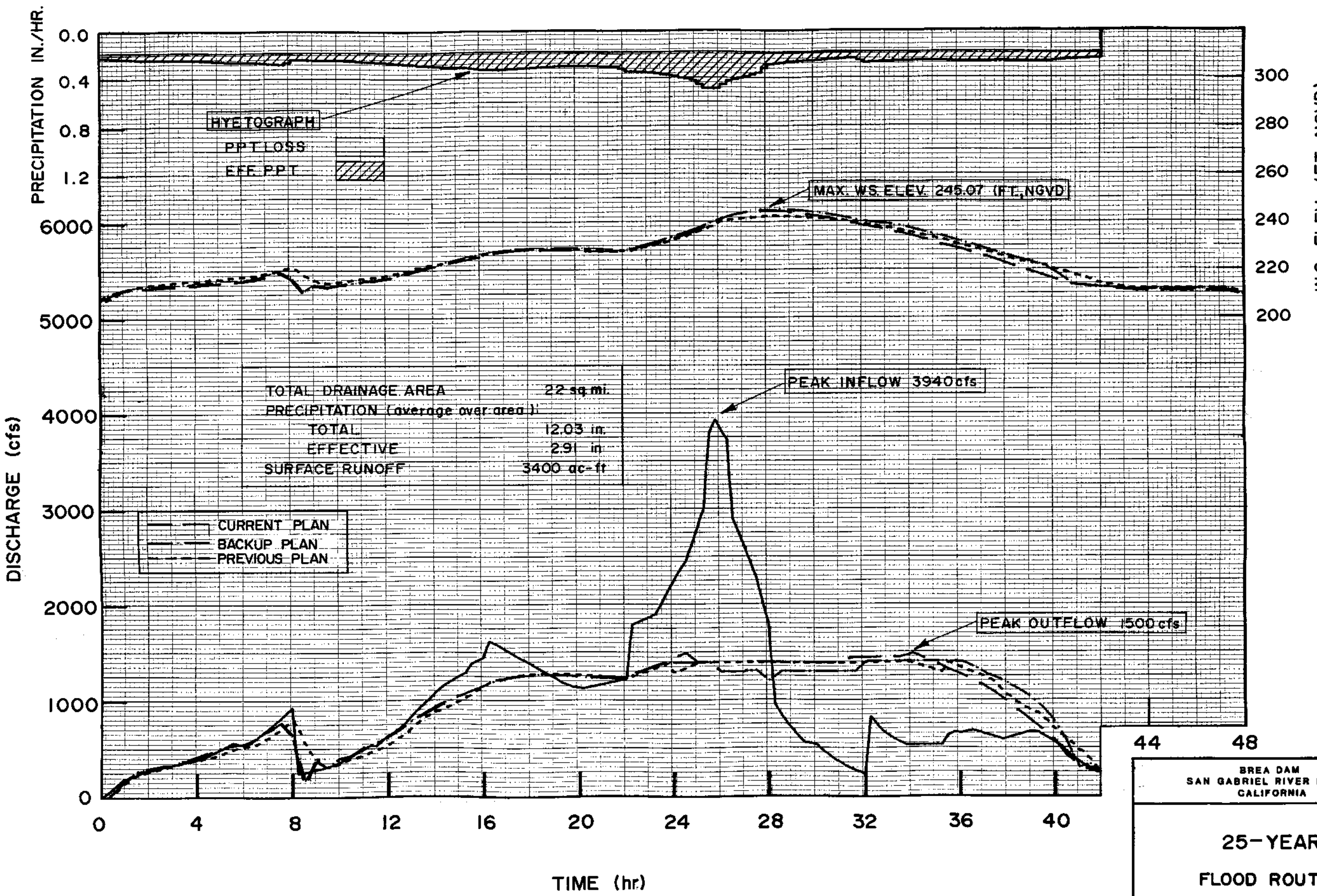


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

50-YEAR

FLOOD ROUTING

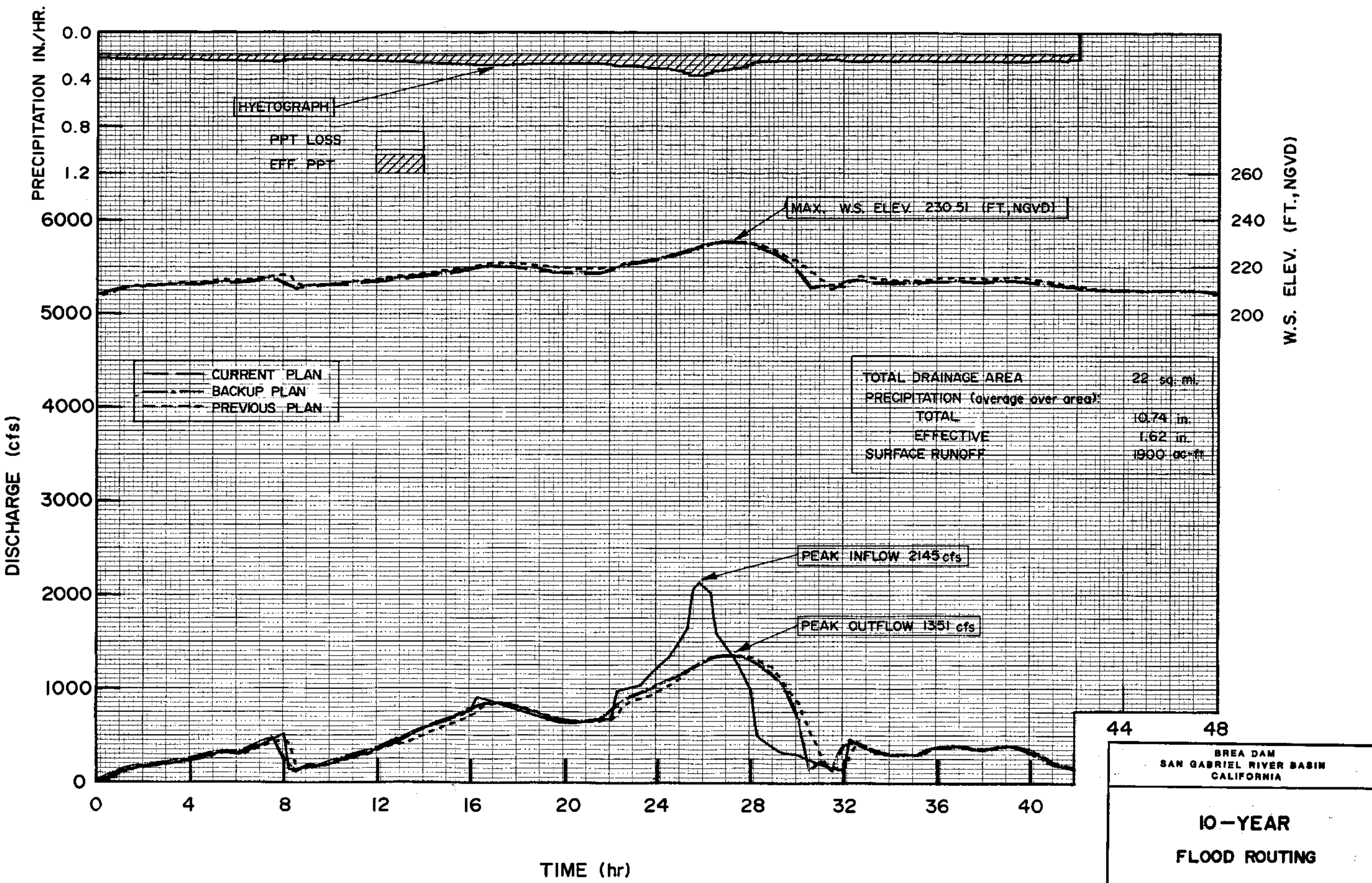
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

25-YEAR
FLOOD ROUTING

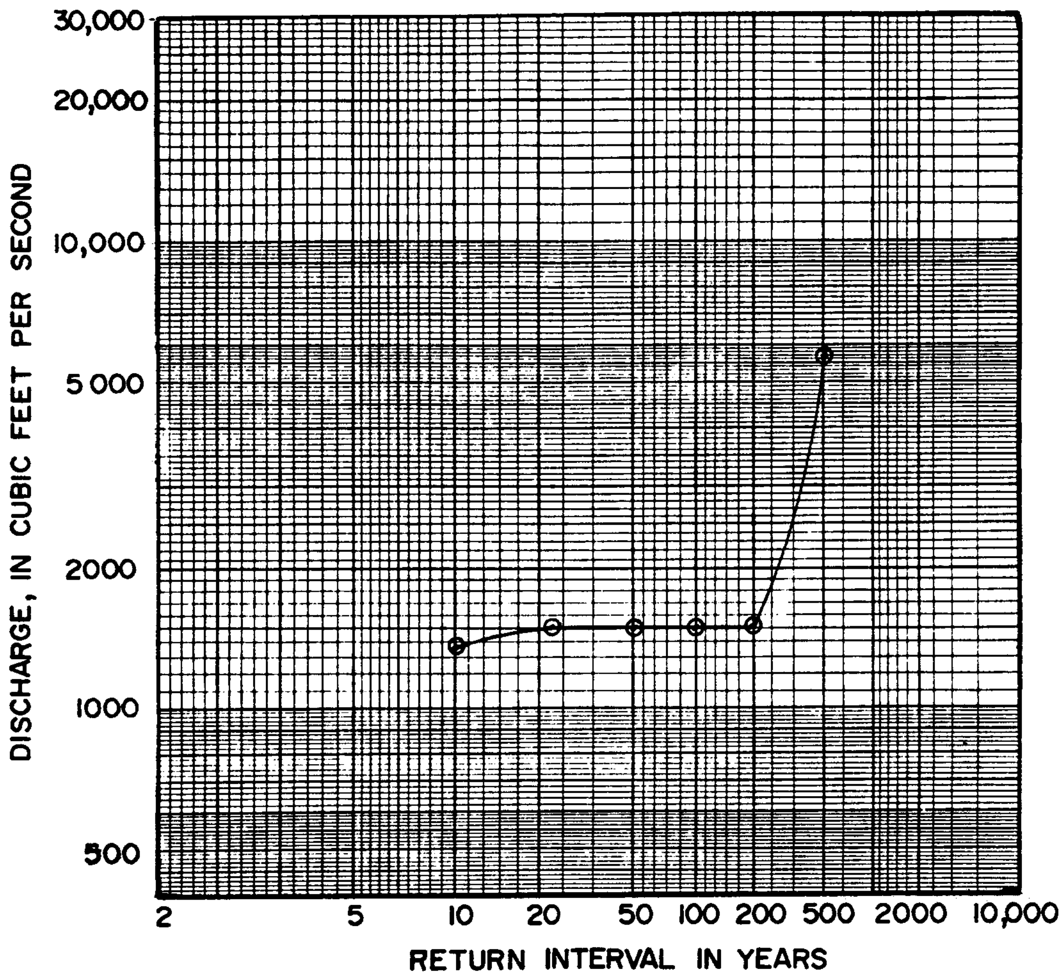
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

10-YEAR
FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

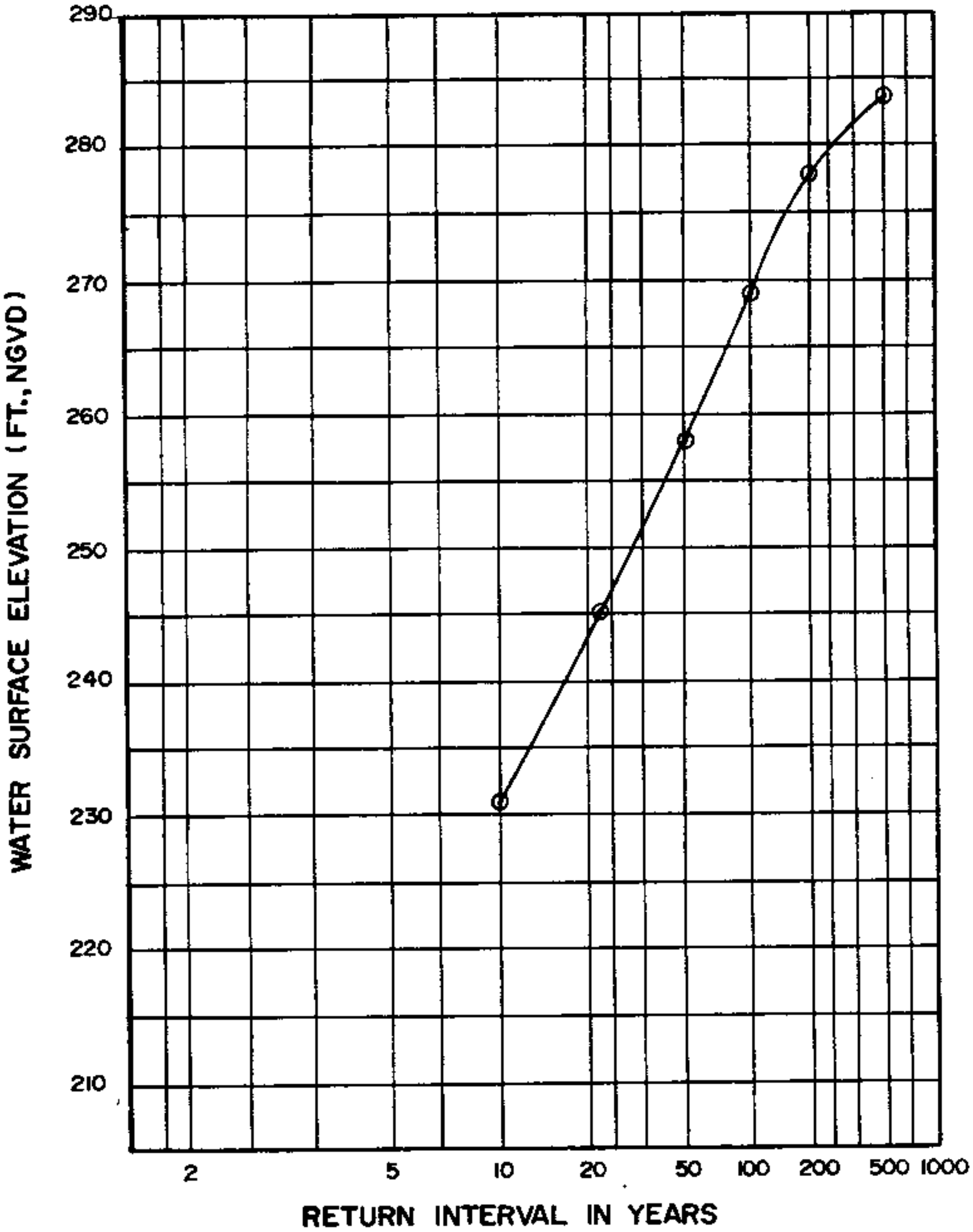


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

OUTFLOW FREQUENCY CURVE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

NOTE: FREQUENCY VALUES PLOTTED IN THIS PLATE
ARE LISTED IN TABLE 8-02

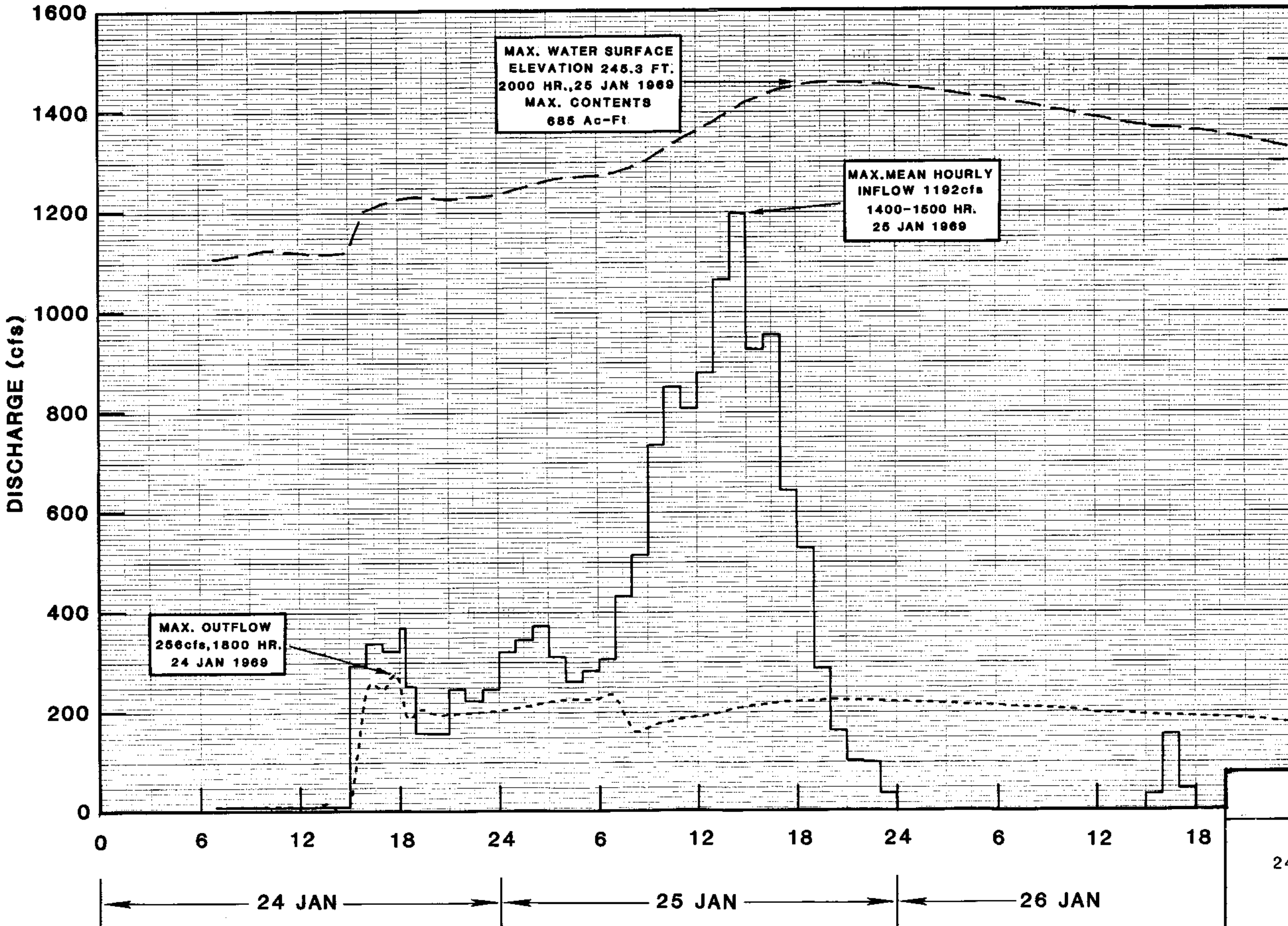


NOTE: FREQUENCY VALUES PLOTTED IN THIS PLATE ARE LISTED IN TABLE 8-02

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

ELEVATION FREQUENCY CURVE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

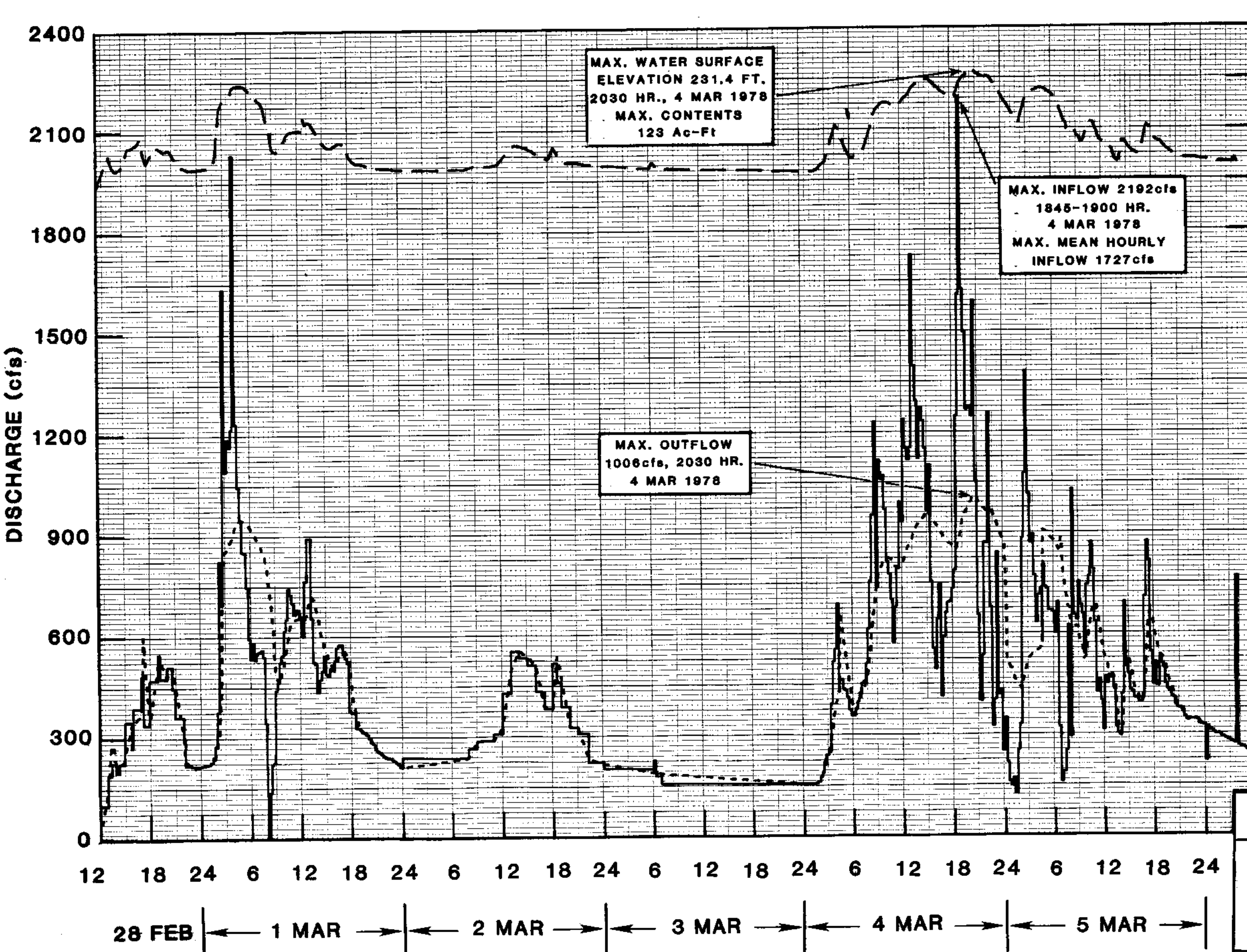


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

24-26 JANUARY 1969

FLOOD ROUTING

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

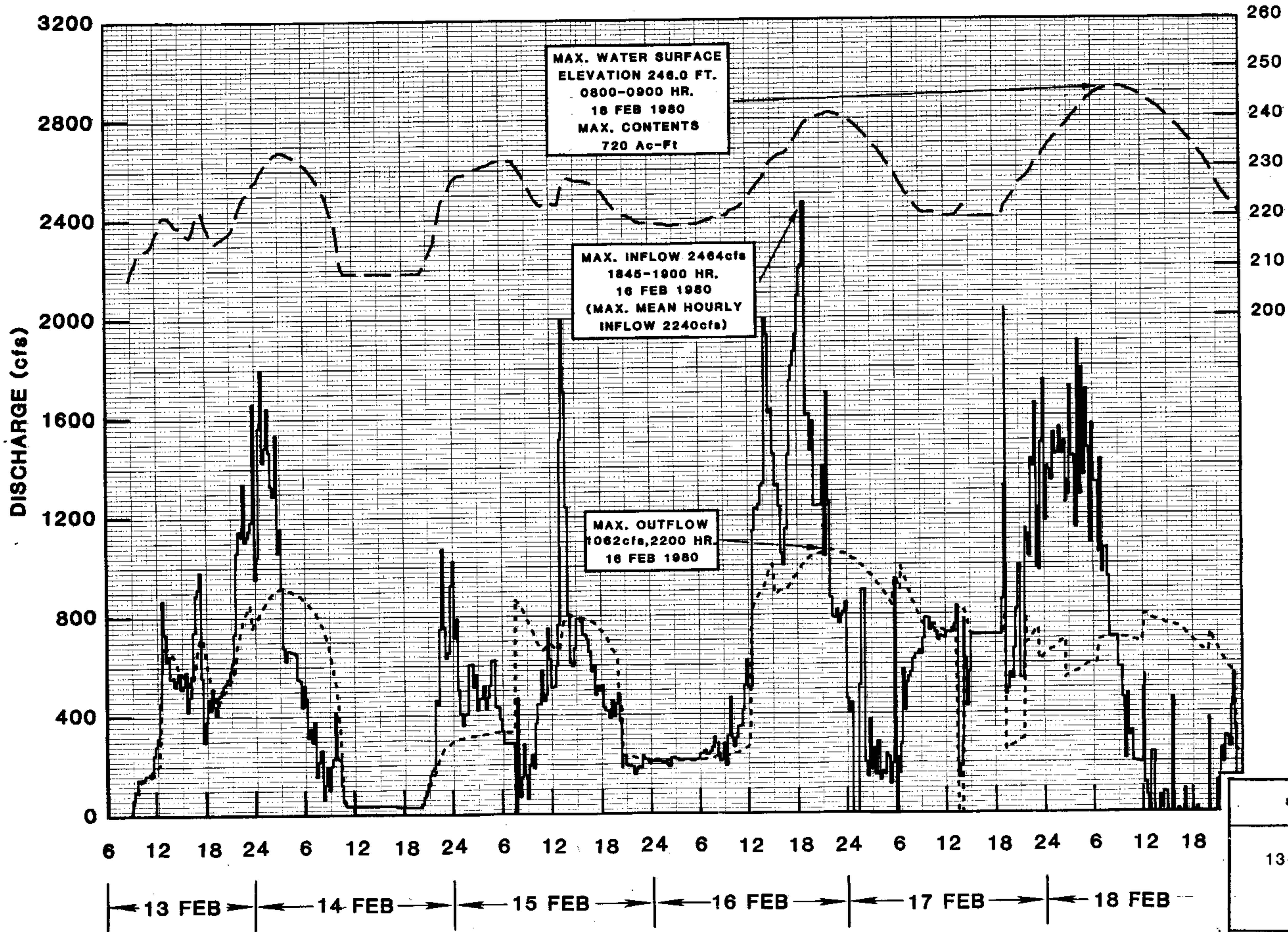


BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

28 FEB - 6 MAR 1978

FLOOD ROUTING

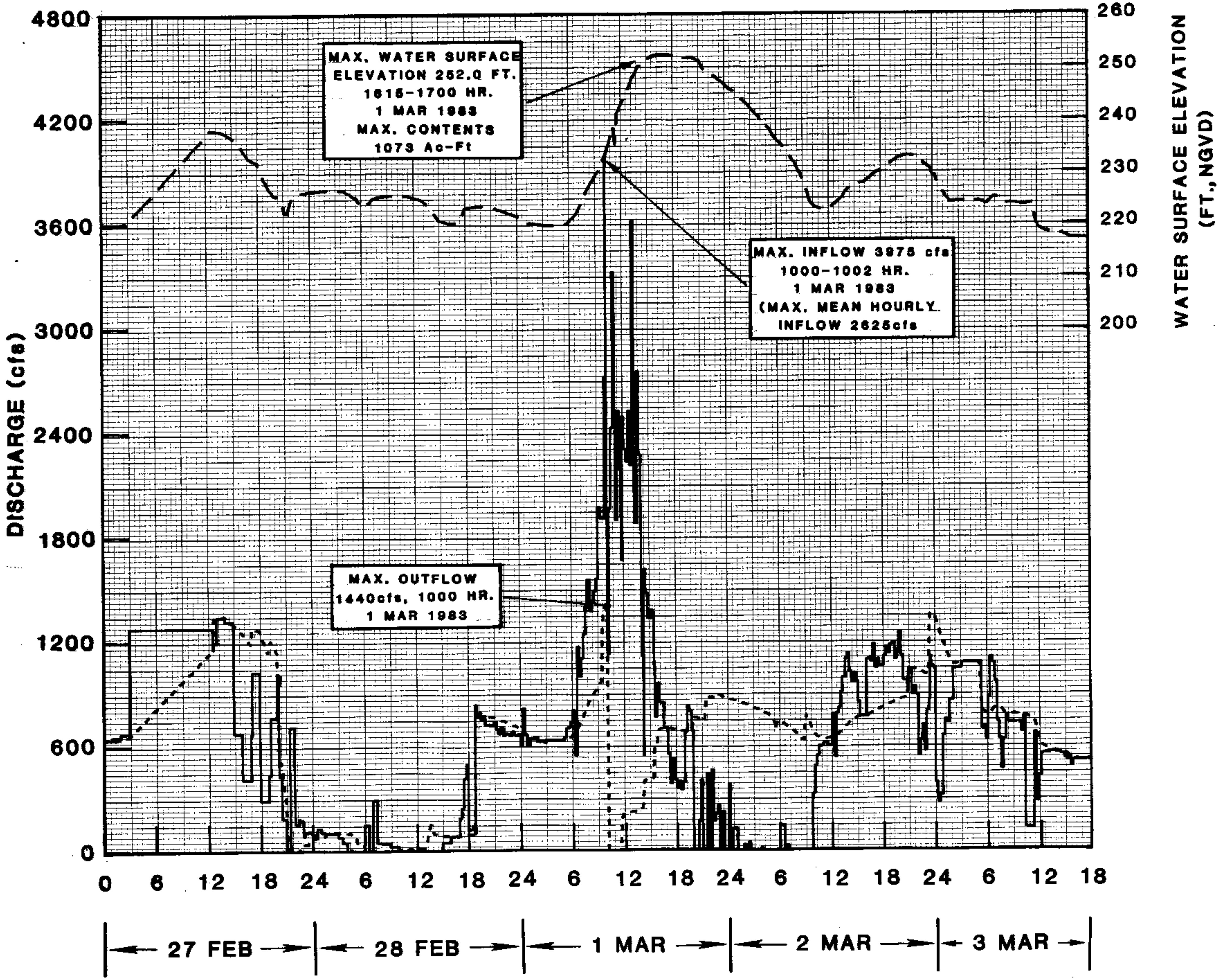
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

13-18 FEBRUARY 1980
FLOOD ROUTING

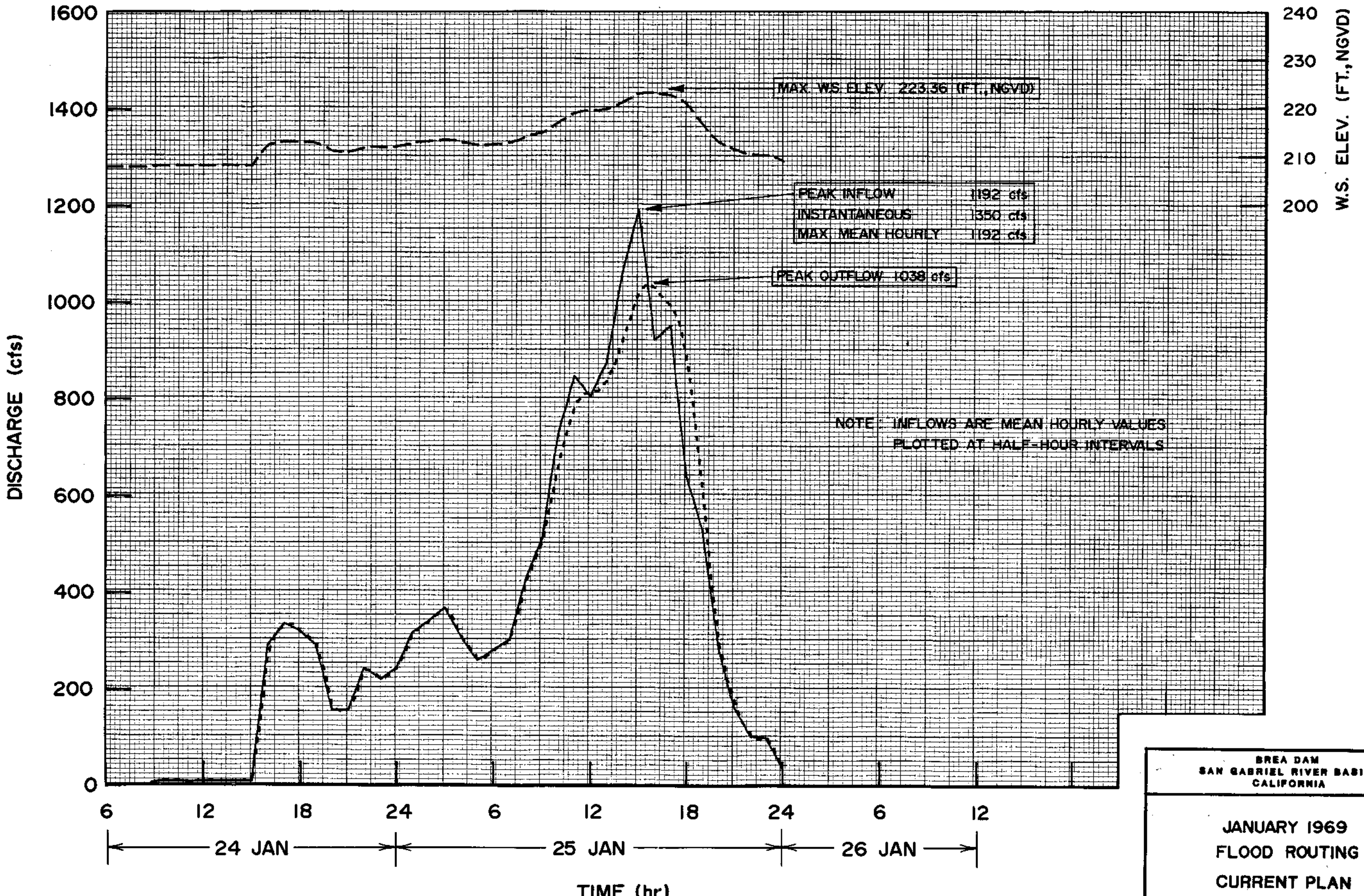
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

27 FEB - 3 MAR 1983
FLOOD ROUTING

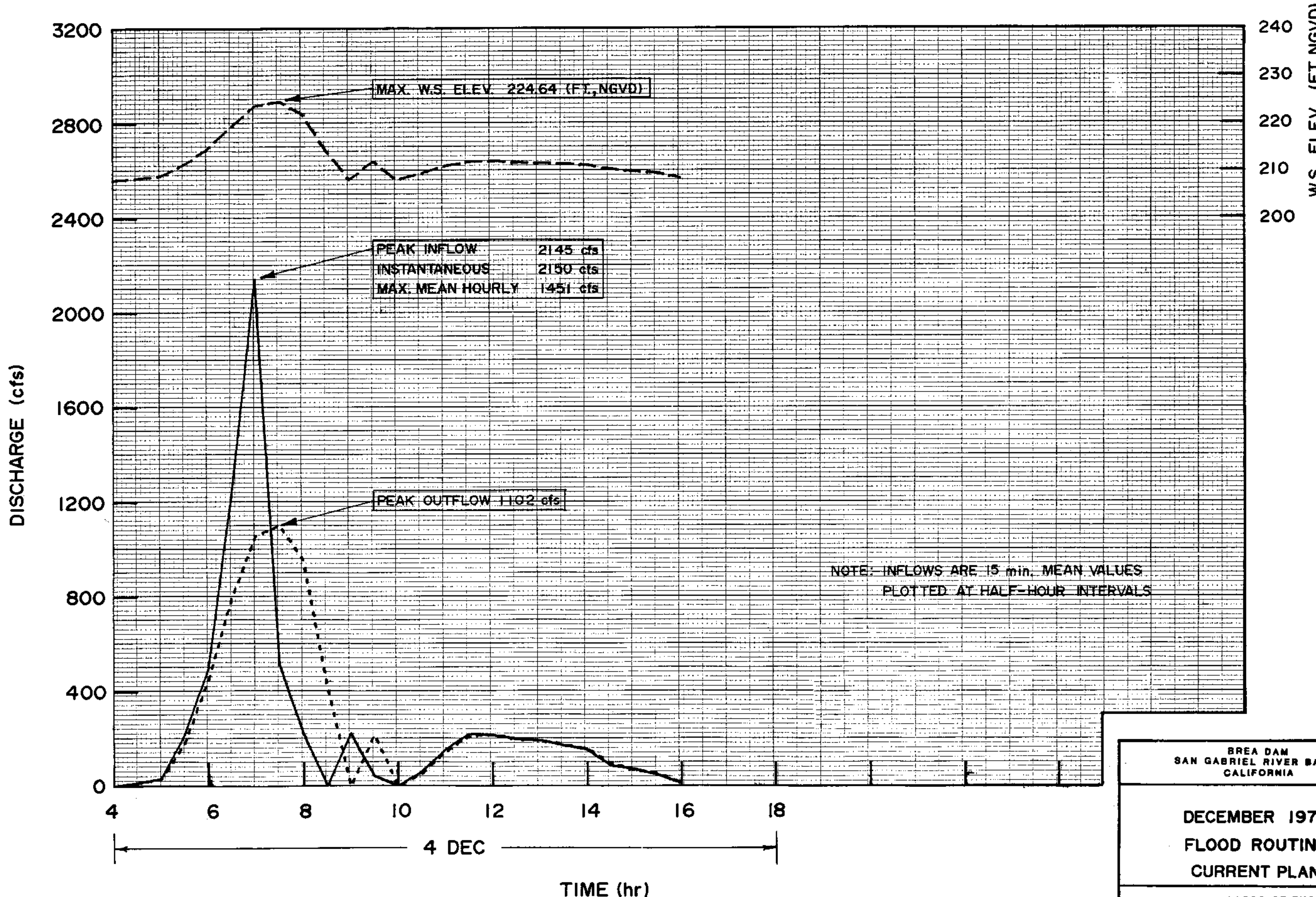
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

JANUARY 1969
FLOOD ROUTING
CURRENT PLAN

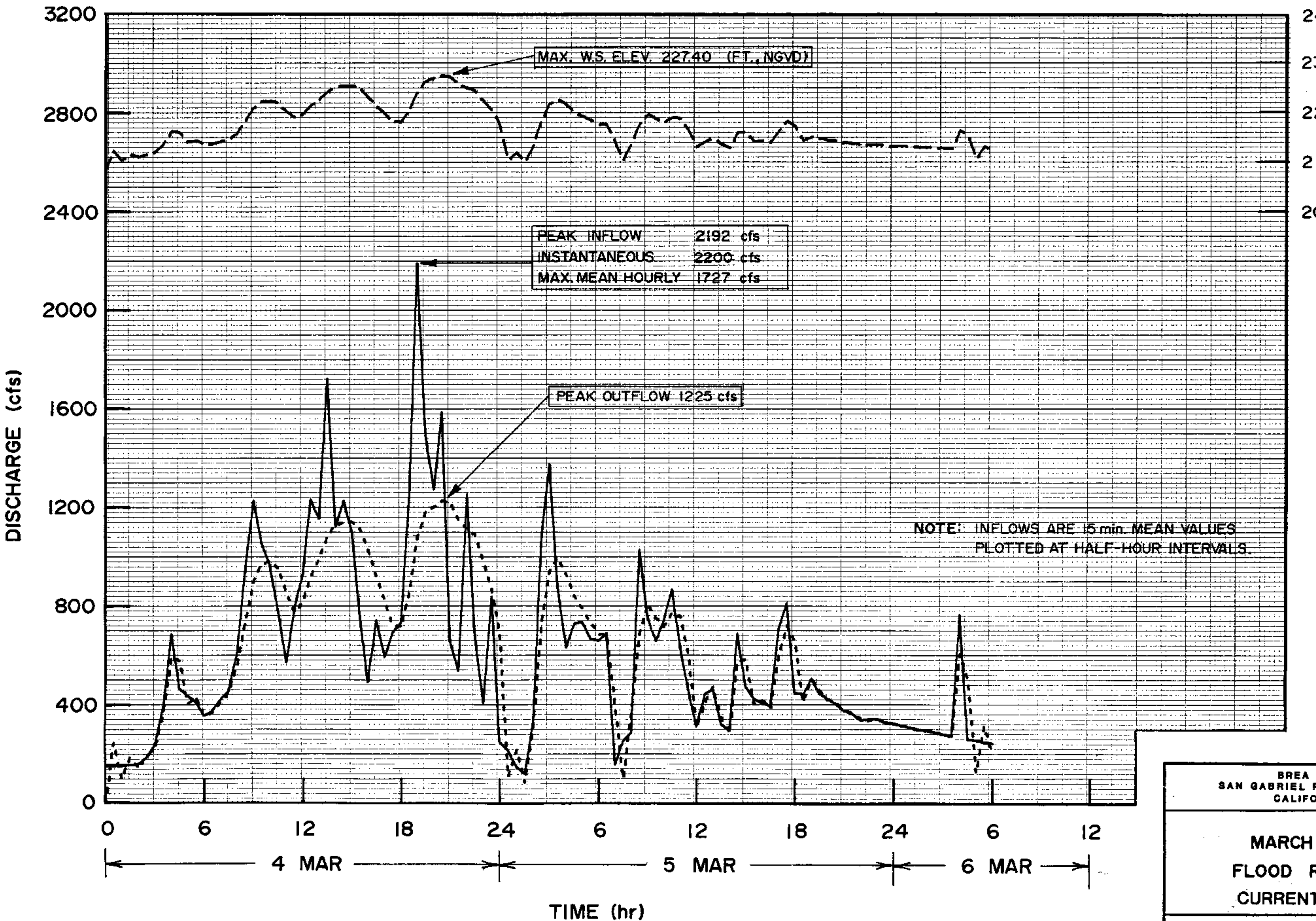
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

DECEMBER 1974
FLOOD ROUTING
CURRENT PLAN

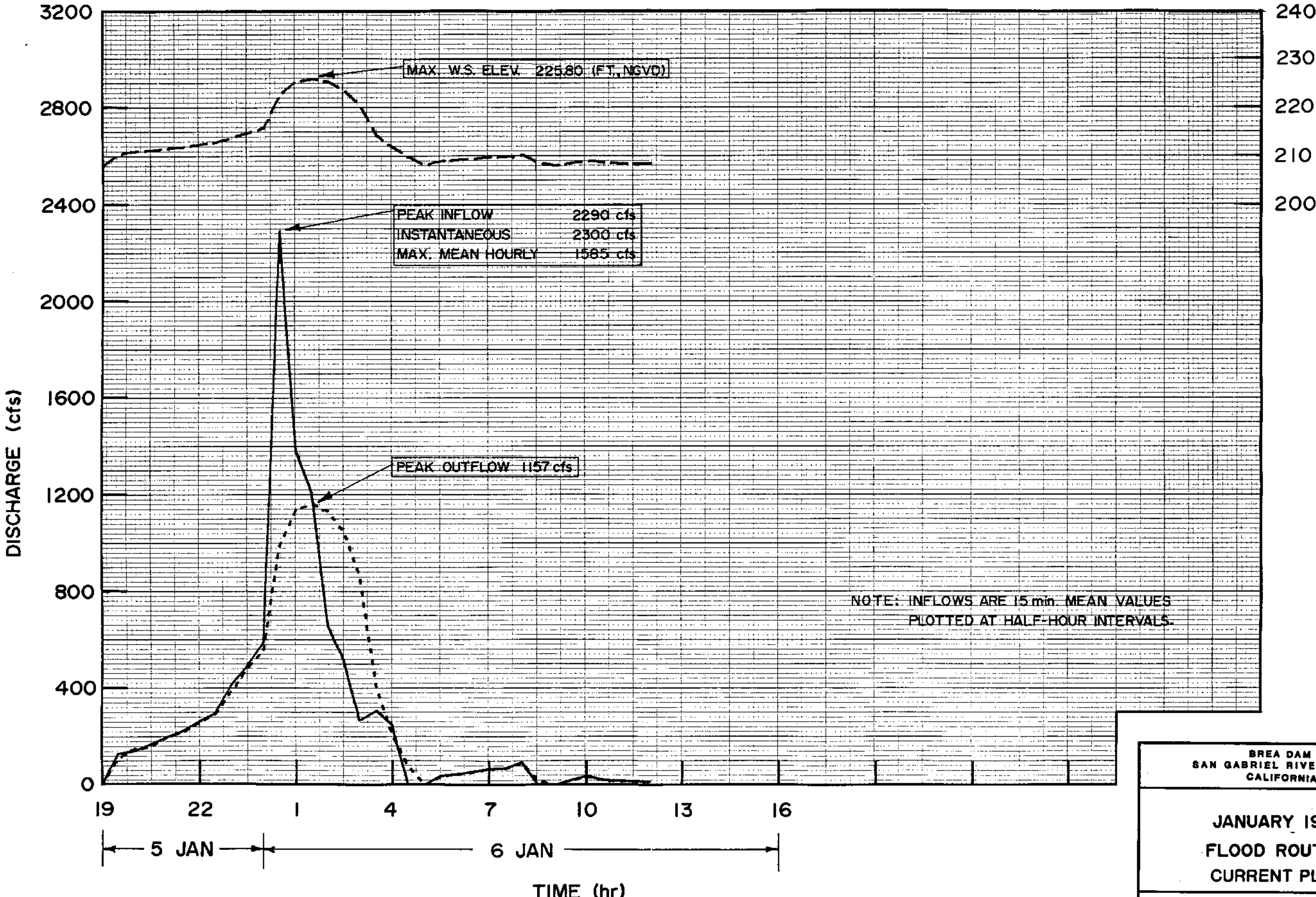
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

MARCH 1978
FLOOD ROUTING
CURRENT PLAN

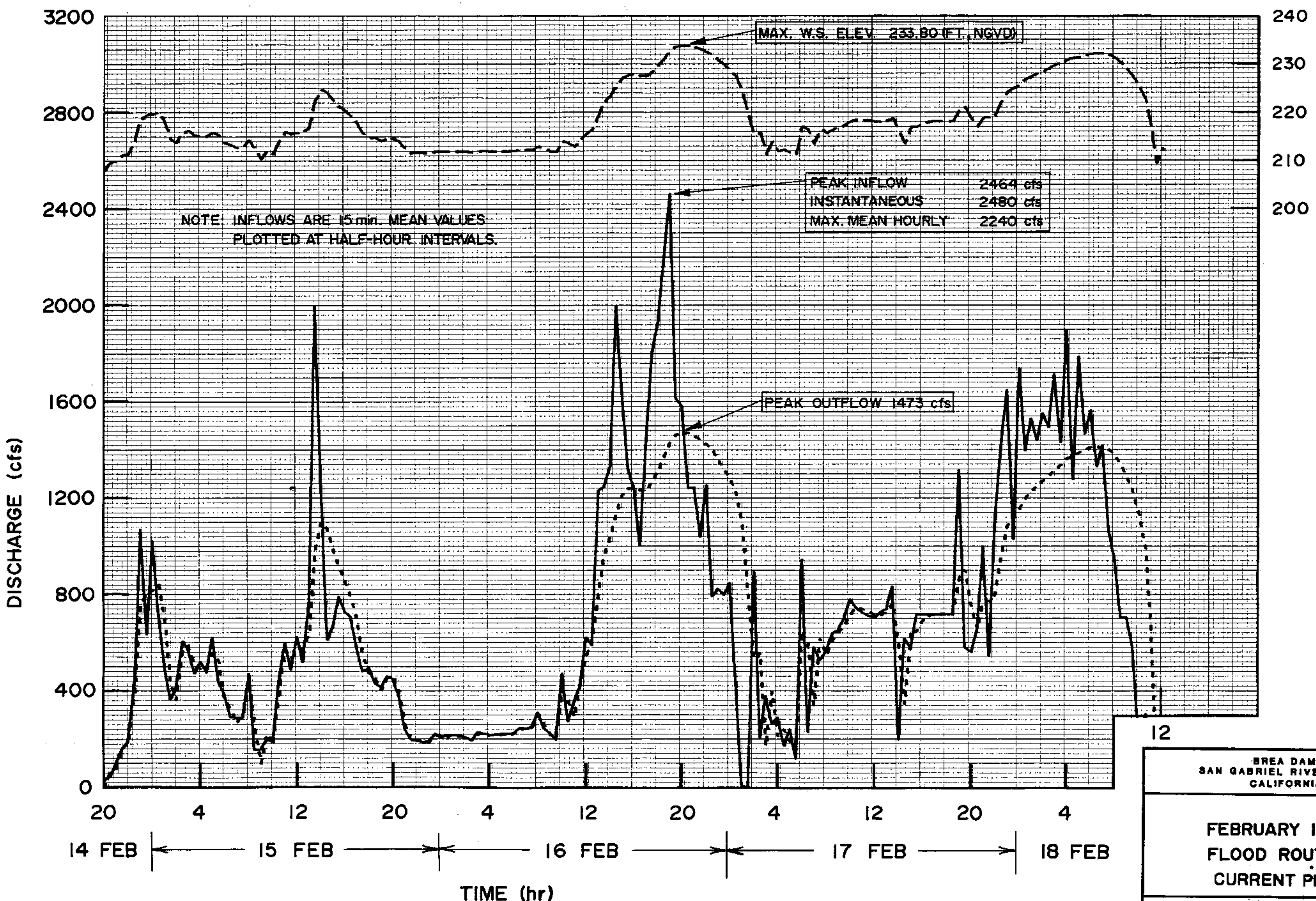
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

JANUARY 1979
FLOOD ROUTING
CURRENT PLAN

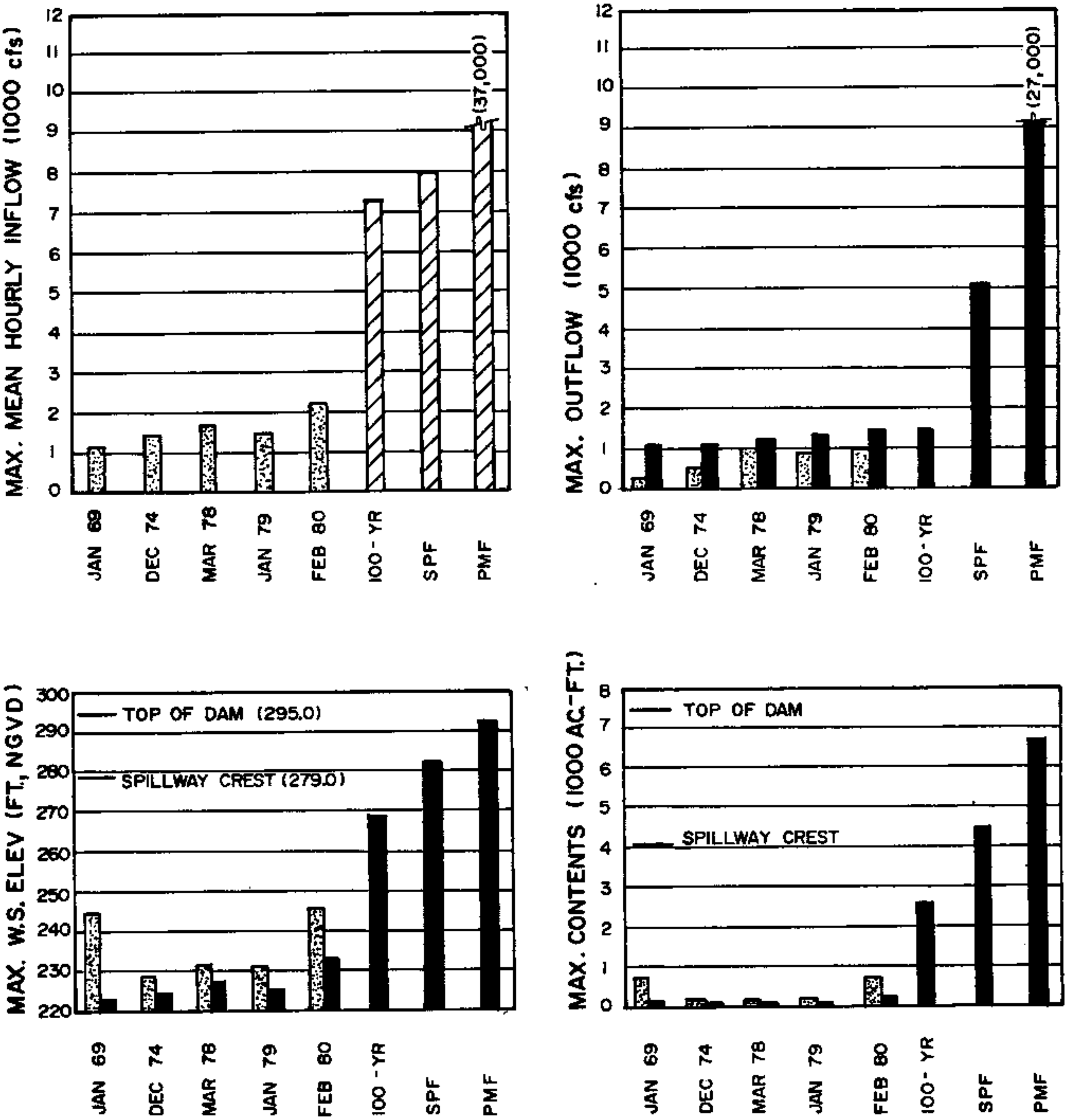
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

FEBRUARY 1980
FLOOD ROUTING
CURRENT PLAN

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT



RECORDED
DESIGN VALUE
REGULATION PLAN
SPF STANDARD PROJECT FLOOD
100-YR 100-YR FLOOD
PMF PROBABLE MAX FLOOD

NOTE: A LISTING OF THE QUANTITIES DEPICTED HERE CAN BE FOUND IN TABLE 8-03.

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

COMPARISON OF HISTORICAL AND DESIGN FLOODS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

TABLE

Comparison of Historical and Design Floods
(Peak values for all quantities)

	OPERATION RECORDS				REGULATION CONTROL PLAN		
	INFLOW* (CFS)	**OUTFLOW** (CFS)	**W.S.E.** (FEET, NGVD)	**CONTENTS** (AC-FT)	**OUTFLOW** (CFS)	**W.S.E.** (FEET, NGVD)	**CONTENTS** (AC-FT)
Prob. Max. Flood	37,000	N/A	N/A	N/A	27,000	292.16	6,678
Standard Proj. Flood	8,000	N/A	N/A	N/A	5,060	283.23	4,561
100-year Flood	7,302	N/A	N/A	N/A	1,486	268.93	2,599
25 January 1969	1,192	256	245.30	684	1,038	223.18	37
4 December 1974	1,451	567	229.12	124	1,102	224.64	53
4 March 1978	1,727	1,007	231.40	172	1,224	227.40	94
6 January 1979	1,585	872	231.50	175	1,157	225.80	69
16 February 1980	2,240	1,061	246.00	720	1,473	233.80	233
1 March 1983	2,625	1,440	252.00	1,073	1,400	237.89	467

* Maximum mean hourly values for historical floods.

Note: See Plate 8-50 for graphical comparison of the values listed here. All floods routed using current operation plan.

BREA DAM
SAN GABRIEL RIVER BASIN
CALIFORNIA

(TABLE) COMPARISON OF HISTORICAL & DESIGN FLOODS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

STANDING INSTRUCTIONS TO THE PROJECT OPERATOR

FOR WATER CONTROL

BREA DAM

BREA CREEK

FULLERTON, CALIFORNIA

Exhibit A

to the

Water Control Manual

for

Brea Dam

Los Angeles District Office

U.S. Army Corps of Engineers

January 1990

STANDING INSTRUCTIONS TO THE PROJECT OPERATOR FOR WATER CONTROL

BREA DAM WATER CONTROL MANUAL

TABLE OF CONTENTS FOR EXHIBIT A

LIST OF CHARTS FOR EXHIBIT A

1. BACKGROUND AND RESPONSIBILITIES

1.01 General Information.

(1) This exhibit is prepared in accordance with instructions contained in EM 1110-2-3600, paragraph 9-2, (Standing Instructions to Project Operators for Water Control), and EP 1110-2-240 and pertains to duties and responsibilities of the Project Operator in connection with the operation of Brea Dam and the reporting of required hydrologic data.

Operational instructions to the project operator are outlined with specific emphasis on flood emergencies when communication facilities between the project operator and the Reservoir Operation Center (ROC) have been disrupted. The exhibit is designed to be used independently as a flood control guide or in conjunction with the rest of the water control manual. To facilitate independent use of this exhibit, charts required for normal and emergency flood control operation of Brea Dam are included. They are designated as Charts A-1 and A-3.

The project operator is required to have available at the dam site, this exhibit and other manuals that complement these standing instructions. These manuals are: The current year's Orange Book - "Instructions for Reservoir Operations Center Personnel"; and the "Operation and Maintenance Manual for Brea Dam". Any deviation from the standing instructions will require the approval of the District Commander.

(2) The purpose of Brea Dam and Brea Reservoir is for flood control. Other uses and benefits of the dam and reservoir, such as recreation, are secondary. Brea Dam regulates flows on Brea Creek, and is designed to provide protection from floods for the City of Fullerton and the adjacent, highly developed, coastal plain area.

(3) Reservoir operations at Brea Dam and other Corps of Engineers facilities are conducted by the Reservoir Regulation Unit of the Reservoir Regulation Section of the Los Angeles District. Table 1-01 is an organizational chart depicting the chain of command for the reservoir operation decisions.

(4) Brea Dam is located across Brea Creek, about 6 miles above the confluence of Brea Creek and Coyote Creek. The dam, which lies within the city limits of Fullerton, is about 1/2 mile north of the intersection of Harbor Boulevard and Brea Boulevard, and about 20 miles southeast of the civic center of Los Angeles. The local project area is shown on plate 2-01.

Brea Dam consists of an earth filled embankment, with a reinforced concrete spillway and controlled outlet works. The general plan and elevation of the Dam is shown on plates 2-07 and 2-08.

(5) The physical constraints of Brea Dam are two ungated outlets at elevation 251.0 feet and the spillway crest which is at elevation 279.0 feet; flows through the ungated outlet and overtopping the spillway cannot be controlled by gate operations. The table and curves of discharge versus elevation for gated and ungated outlets are shown on plates 2-04 and 2-05. The spillway general plan and profile is shown on plate 2-06. The spillway's rating

table and curve are shown on plates 2-07 and 2-08.

The reservoir capacity below the spillway crest is 4008.5 acre-ft, which is used totally for flood control. The area and gross capacity of Brea Dam is shown on plate 2-13.

Local runoff contributes a significant flow into Brea Creek between Brea Dam and its confluence with Coyote Creek during a storm event. The reservoir releases should take into account these uncontrolled local runoff flows together with the channel capacity. The downstream Brea channel capacity varies along the length of the channel, as shown on plate 4-01. Considering the local runoff and channel capacity along Brea Creek, maximum reservoir releases are limited to 1500 cfs when spillway flow does not occur.

The trash rack occasionally becomes clogged from excess trash and debris accumulation. During the February 1986 storm, 8 feet of debris was built up, as shown in Photo 3-01. Periodic maintenance of the trash rack is required, especially after major inflows in the reservoir.

The minor constraints in the downstream channel include the following: (i) Heavy vegetation grows inside the earthen channel near Hillcrest Park, which causes a reduction in the channel capacity (see Photo 4-2); (ii) A Channel grade break at Basque Avenue, which causes backwater effect upstream, has caused debris and sedimentation accumulation at this location (see Photo 3-02); (iii) The unlined channel reach (near Hillcrest Park, between Dale Street and Stanton Avenue, and downstream from Western Avenue to the confluence with Coyote Creek) is highly susceptible to bank erosion. These sites should be monitored by channel patrols during major flows.

(6) Brea Dam is owned, operated, and maintained by the U.S. Army Corps of Engineers, Los Angeles District, which has complete regulatory responsibility.

1.02 Role of the Project Operator.

(1) Normal Conditions (dependent on day-to-day instruction).

The Project Operator (dam tender) will be instructed by the Reservoir Operations Center (ROC), as necessary, for water control actions under normal hydrometeorological conditions.

The Project Operator is responsible for the project works to insure that all the equipment is in good operating condition, and that the gates and electrical facilities in the control house are periodically inspected and tested according to the preestablished schedule.

(2) Emergency Conditions (flood or drought).

The Project Operator will be instructed by the ROC for water control actions during flood events and other emergency conditions.

The Project Operator responsibilities are:

(1) Be present at the Dam when rainfall or runoff occurs, as instructed by the Operations Branch.

(2) Operate the gates in accordance with instructions from the ROC.

(3) Notify the ROC when a gate change will be required according to Chart A-1, Brea Dam Outlet Gate Operation Schedule.

(4) Notify the ROC if unable to set the gates as instructed.

(5) Follow the Water Control Diagram provided in Charts A-1 and A-2 in this exhibit during periods of communication disruption.

2. DATA COLLECTION AND REPORTING.

2.01 Normal Conditions.

During normal operations, from 15 November and 15 April, measurements are made daily by the Project Operator to determine the water surface elevation (staff and "tape" reading), downstream stage, incremental precipitation since last report, total accumulated precipitation, the setting of each outlet gate and the times of these measurements. For normal conditions, between 15 April and 15 November, measurements are made once a week (every Monday morning).

The Project Operator maintains the record of measurements and logs all radio and telephone communication on the following forms: Rainfall Record, SPL 31 (from manual glass readings of glass tube rain gauges), (see fig. 5-01); Record of Calls, SPL 188 (both radio and telephone, (see fig. 5-02); Flood Control Basin Operation Report, SPL 19 (prepared by each Project Operator), (See fig. 5-03); and the Record of Data from Digital Recorder, SPL 648, (see fig. A-01).

2.02 Emergency Conditions.

During flood operations or emergency operations, the Project Operator should follow instructions, as issued by the ROC. These measurements may require the staff, gauge, and instruments readings at a specified interval.

When reporting to the ROC, the Project Operator should clearly describe the silt and debris situation at the trash racks, gates and downstream gauges. When instruments are not working, or are stuck in silt, the Project Operator should not report the erroneous reading, but should rather state the instrument or staff problem. Care should be taken to avoid issuing misleading reports due to siltation at the reservoir staff boards. When debris or silt causes the flow to be deceptively perched above the invert, or cause a loss of contact with the staff board, the Project Operator should report a descriptive message identifying the limitations, and quantifying the estimated reservoir depth.

If the radio systems fail, the Project Operator should try to reestablish communication via telephone.

2.03 Regional Hydrometeorological Conditions.

The Project Operator will be informed by the ROC of regional hydrometeorological conditions that may impact the project.

3. WATER CONTROL ACTION AND REPORTING.

3.01 Normal Conditions.

During normal hydrometeorological conditions, the Project Operator will be instructed by the ROC for the appropriate water control action. The Project Operator should:

(1) Establish communication with the ROC.

(2) Implement instructions.

(3) Notify the ROC on the status of the water control action.

The Project Operator cannot implement a gate change regardless if the change will have no effect on the reservoir operation. Gate setting changes may be requested by the Project Operator for maintenance, etc., but they will have to be approved by the ROC.

3.02 Emergency Conditions.

During the emergency conditions, the Project Operator will be instructed by the ROC to take the necessary water control action. During flood conditions, the Project Operator will be instructed according to Chart A-1 and will be required to notify the ROC for upcoming gate changes. The Project Operator should:

(1) Establish communication with the ROC.

(2) Implement the instructions.

(3) Notify the ROC on the status of the water control action.

3.03 Inquiries.

All significant inquires received by the Project Operator from citizens, constituents or interested groups regarding water control procedures or actions must be referred directly to the ROC.

3.04 Water Control Problems.

The ROC must be contacted immediately by the most rapid means available in the event that an operational malfunction, erosion, or other incident occurs that could impact project integrity in general or water control capability, in particular.

Emergency departures from the regulation instructions issued by the ROC may be required, because of water control equipment failures, accidents, or other emergencies requiring immediate action. Under these situations, the Project Operator should contact the ROC via radio for instructions. When communications are broken, or the situation demands immediate action, the Project Operator may proceed independently. The ROC should be notified of such action as soon as possible. All other non-emergency deviations from normal procedure should be approved in advance by the ROC. The District Engineer, Los Angeles District, U.S. Army Corps of Engineers, may make temporary modifications to the water control regulations. Permanent changes are subject to approval by the Division Engineer, South Pacific Division, U.S. Army Corps of Engineers.

The Project Operator should immediately alert the ROC via radio channel WUK 4ROC, whenever the requested gate change cannot be fully implemented due to mechanical or physical problems. For example, debris occasionally prevents total gate closure. The ROC will evaluate the problem and provide further instructions to the Project Operator.

3.05 Communication Outage.

The ROC maintains a close contact with the Project Operator at Brea Dam. During flood periods, communication between the Project Operator and ROC may be broken. The Project Operator should try to reestablish communication through the Los Angeles County Flood Control District (WUK 4470).

During the rising stages of the flood, the Project Operator should allow a period of one hour to reestablish communication with the ROC. If after one hour of attempting to reestablish communication, the Project Operator should operate the dam according to observed precipitation and reservoir water surface elevation, utilizing Chart A-1. A summary of the Project Operator instruction is shown on Chart A-2.

Emergency notifications are normally made by the ROC. However, if the Project Operator loses communication with the ROC and an emergency notification situation arises, such as an imminent dam failure or uncontrolled spillway flow (water surface elevation above 279.0 feet), the Project Operator should make the necessary notifications. The emergency evacuation notification list is shown in table 5-01.

The notifications should include: (a) description of the type and extent of existing or impending emergency; (b) advisement for evacuation from the flood plain; (c) information on the time of initial release of hazardous amounts of water; (d) the depth of water behind the dam; and (e) the Project Operator's name and telephone number.

Upon completing the above notifications, attempt to reestablish communications with the ROC. Document all notifications made, and refer to the Orange Book (Instructions for Reservoir Operations Center Personnel) for more information on additional emergency notifications. The Project Operator should not leave the dam unless his safety is in jeopardy.

Chart A-1. Brea Dam Reservoir Regulation Schedule.

Brea Reservoir W.S. Elevation (ft., NGVD)	Precipitation at Brea Dam Station (Inches) During Preceding 30-Minute Period													
	0-0.2		0.2-0.24		0.24-0.29		0.29-0.34		0.34-0.40		0.40-0.50		0.50+	
	Gate* Opening (feet)	Release (cfs)	Gate* Opening (feet)	Release (cfs)	Gate* Opening (feet)	Release (cfs)	Gate* Opening (feet)	Release (cfs)	Gate* Opening (feet)	Release (cfs)	Gate* Opening (feet)	Release (cfs)	Gate* Opening (feet)	Release (cfs)
208 213	3.5 4.0	0 310	3.5 4.0	0 310	3.5 4.0	0 310	3.5 4.0	0 310	3.5 4.0	0 310	3.5 4.0	0 310	3.5 4.0	0 310
213- 215	4.0 6.3	310 500	4.0 6.3	310 500	4.0 6.3	310 500	4.0 6.3	310 500	4.0 6.3	310 500	4.0 6.3	310 500	4.0 6.3	310 500
215- 235	6.3 5.0	500 1,500	6.3 5.0	500 1,500	6.3 4.6	500 1,400	6.3 4.6	500 1,400	6.3 4.6	500 1,400	6.3 4.6	500 1,400	6.3 4.6	500 1,400
235- 240	4.8 4.3	1,450 1,450	4.6 4.2	1,400 1,400	4.6 4.2	1,400 1,400	4.3 3.8	1,300 1,300	4.3 3.8	1,300 1,300	4.3 3.8	1,300 1,300	3.9 3.5	1,200 1,200
240- 245	4.2 3.8	1,400 1,400	3.8 3.5	1,300 1,300	3.8 3.5	1,300 1,300	3.4 3.1	1,150 1,150	2.9 2.6	1,000 1,000	2.9 2.6	1,000 1,000	2.6 2.3	900 900
245- 251	3.8 3.5	1,400 1,400	3.5 3.2	1,300 1,300	2.9 2.7	1,100 1,100	2.9 2.7	1,100 1,100	2.6 2.4	1,000 1,000	2.5 2.3	950 950	2.3 2.1	900 900
251- 257	3.5 2.4	1,400 1,400	2.9 1.9	1,200 1,200	2.7 1.6	1,100 1,100	2.1 1.2	900 900	2.1 1.2	900 900	2.0 1.1	850 850	1.9 0.9	800 800
257- 265	2.4 2.0	1,400 1,400	1.9 1.6	1,200 1,200	1.5 1.3	1,050 1,050	0.9 0.8	800 800	0.9 0.8	800 800	0.9 0.8	800 800	0.9 0.8	800 800
265- 279	1.8 1.3	1,300 1,300	1.6 1.1	1,200 1,200	1.0 0.5	900 900	0.8 0.4	800 800	0.8 0.4	800 800	0.8 0.4	800 800	0.8 0.4	800 800
279+	0	578+	0	578+	0	578+	0	578+	0	578+	0	578+	0	578+

Note: Above schedule is based on rainfall loss rate of 0.2 in./hr. For a different loss rate, adjust the observed precipitation during preceding 30-minute period from the relation:

* Both Gates

$$P_a = P_o + 0.10 - \text{Loss Rate (in./hr.)} / 2 \qquad (\text{minimum value of } P_a = 0)$$

and use the above table utilizing P_a instead of P_o (P_a = adjusted precipitation during preceding 30-minute period; P_o = observed precipitation during preceding 30-minute period)

Chart A-2. Project Operator Instructions.

1. <u>Communication with the District Office is Available</u>.

   a. Notify the Reservoir Operations Center when a gate change will be required according to the schedule.

   b. Notify the Reservoir Operations Center if unable to set the gates as instructed.

2. <u>Communication with the District Office is not Available</u>.

   a. Try to reestablish communication through the Los Angeles County Flood Control District (WUK 4470).

   b. (i) Rising Stages. Allow a period of one hour to pass to reestablish communication with the District Office. If after one hour communication is not reestablished follow Chart A-1, utilizing observed precipitation and reservoir elevation.

      (ii) Falling Stages. Maintain current downstream gauge height until communication is reestablished.

   c. If one or more of the gates cannot be operated, adjust the remaining gates gradually and uniformly until the downstream gauge height agrees with scheduled values. Keep a close check on gauge height and change the gate opening as often as required. If the downstream gauge height is not obtainable, adjust the gates that are functioning so that the sum of the gate openings will equal the sum of the openings shown in the schedule

OUTLETS
(Looking Downstream)

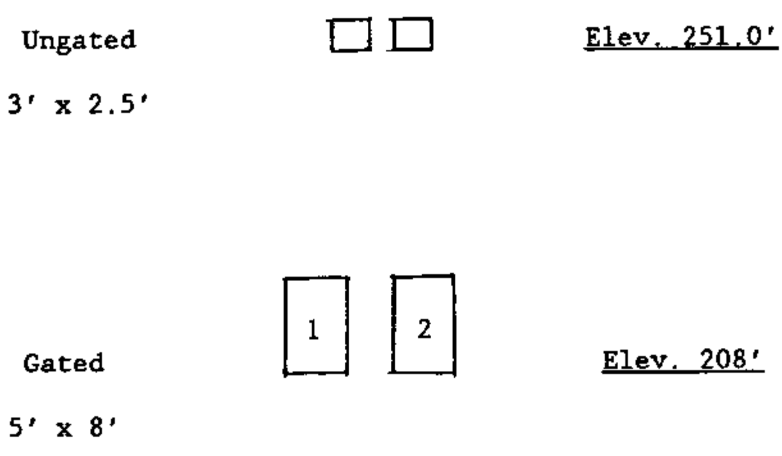


EXHIBIT B

Pertinent Data for Other Reservoirs in the Vicinity of Brea Dam

CARBON CANYON DAM AND RESERVOIR
CARBON CANYON CREEK, ORANGE COUNTY, CALIFORNIA
PERTINENT DATA
MAY 1989

Completion date..	May 1961
Stream system...	Carbon Canyon Creek
Drainage area...mi^2	19.3
Reservoir:	
Elevation	
Streambed at dam...............................ft, NGVD	400
Debris pool.......................................ft, NGVD	419
Flood control pool (spillway crest)...........ft, NGVD	475
Original Spillway design surcharge level......ft, NGVD	493.7
Revised Spillway design surcharge level (PMF).ft, NGVD	491.9
Top of dam...ft, NGVD	499
Area (based on original survey**)	
Debris pool...ac	40.5
Spillway crest..ac	223.5
Spillway design surcharge level......................ac	308.5
Top of dam...ac	343.0
Capacity, gross (based on original survey**)	
Debris pool..ac-ft	298 (0.29*)
Spillway crest.......................................ac-ft	7033 (6.83*)
Spillway design surcharge level..................ac-ft	12,063 (11.72*)
Top of dam..ac-ft	13,781 (13.39*)
Allowance for sediment (50-year).................ac-ft	1500 (1.46*)
Area (based on 1969 survey***)	
Debris pool...ac	33.8
Spillway crest..ac	222.0
Spillway design surcharge level......................ac	287.2
Top of dam...ac	305.6
Capacity (based on 1969 survey***)	
Debris pool..ac-ft	228 (0.23*)
Spillway crest.......................................ac-ft	6615 (6.43*)
Spillway design surcharge level..................ac-ft	11,324 (11.0*)
Top of dam..ac-ft	12,899 (12.53*)
Dam:	
Type...	Earthfill
Height above original streambed.....................ft	99
Top length...ft	2610
Top width..ft	20
Freeboard..ft	7.1
Spillway:	
Type...	Ungated broad-crested weir
Crest width..ft	125
Design discharge at surcharge elevation (493.7)....ft^3/s	36,800
PMF discharge at surcharge elevation (491.9).......ft^3/s	31,200
Outlets:	
Gates - type..	Hydraulic slide
Number and size..	2 - 5'W x 6.5'H
Entrance invert elevation....................ft, NGVD	403
Conduits - type..	Rectangular
Number and size..	1 - 4.75'W x 7'H
Length (including transition section)...............ft	549
Entrance invert elevation....................ft, NGVD	403
Discharge at spillway crest elevation..............ft^3/s	1270
Discharge at top of dam elevation..................ft^3/s	1480
Reservoir design flood:	
Total inflow volume.(2-day).........................ac-ft	8030 (7.80*)
Inflow peak...ft^3/s	9300
Spillway design flood:	
Design total inflow volume (1-day).................ac-ft	10,600 (10.30*)
Design inflow peak.......................................ft^3/s	56,000
PMF total inflow volume (15-hour)..................ac-ft	11,800 (11.46*)
PMF inflow peak..ft^3/s	52,000
Historic maximums:	
Maximum release...ft^3/s	446
Date...	2-26-69
Maximum water surface elevation.................ft, NGVD	430.9
Date...	3-1-83
Maximum storage (2-26-69).........................ac-ft	891.7
Maximum peak inflow (1-hour).........................ft^3/s	1702

* inches of runoff
** based on surveys of October 1937, August 1941, August 1949, and bottom resurvey of March 1961.
*** based on resurvey of September 1969.

FULLERTON DAM AND RESERVOIR
ORANGE COUNTY, CALIFORNIA

PERTINENT DATA
MARCH 1989

Construction Completed	May 1941
Stream System	Fullerton Creek
Drainage Area ... sq. miles	5.0
Reservoir:	
Elevation	
Streambed at dam ... ft., NGVD	260
Spillway crest ... ft., NGVD	290
Spillway design surcharge level ... ft., NGVD	298.4
Top of dam ... ft., NGVD	307
Area	
Spillway crest ... acres	62
Spillway design surcharge level ... acres	92
Top of dam ... acres	130
Capacity, gross	
Spillway crest ... acre-feet	764 (2.84*)
Spillway design surcharge level ... acre-feet	1394 (5.18*)
Top of dam ... acre-feet	2306 (8.56*)
Original allowance for sediment ... acre-feet	230
Dam: - Type	Earthfill
Height above original streambed ... ft.	46
Top length ... ft.	575
Top width ... ft.	15
Freeboard (PMF) ... ft.	8.5
Spillway: - Type	Ungated ogee
Crest length ... ft.	40
Crest elevation ... ft.	290
Design surcharge (modified Rational Method) ... ft.	8.4
Design discharge (modified Rational Method) ... ft.	3380
Outlets:	
Uncontrolled	
Number and size	1 - 3'W x 2'H
Entrance invert elevation ... ft., NGVD	275
Controlled	
Gate type	Vertical lift
Size ... ft.	2 - 3'W x 5'H
Entrance invert elevation ... ft., NGVD	261
Conduits	
Number and size	1 - 4'W x 6'H
Length ... ft.	346
Maximum capacity at spillway crest ... cfs	590
Regulated capacity at spillway crest ... cfs	500
Standard project flood:	
Duration (inflow) ... days	1.75
Total volume ... acre-feet	1750 (6.50*)
Inflow peak ... cfs	2100
Outflow peak ... cfs	1250
Maximum water surface elevation	
1969 reservoir regulation schedule ... ft.	293.75
Current reservoir regulation schedule ... ft.	292.50
Probable maximum flood	
Duration (inflow) ... days	0.25
Total volume ... acre-feet	1820 (6.76*)
Inflow peak ... cfs	16000
Outflow peak ... cfs	5650
Spillway outflow peak ... cfs	5650
Maximum water surface elevation ... ft.	301.44
Historic maximums:	
Maximum inflow ... cfs	3800
Date	3-14-41
Maximum outflow ... cfs	444
Date	3-1-83
Maximum water surface elevation ... ft., NGVD	285.6
Maximum storage ... acre-feet	522.5 (68% full)
Date	1-31-79

*Inches of runoff

EXHIBIT C

Finding of No Significant Impact (FONSI)

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS
FINDING OF NO SIGNIFICANT IMPACT
BREA DAM WATER CONTROL
ORANGE COUNTY, CALIFORNIA

I have reviewed the attached Environmental Assessment for the Brea Dam Water Control plan (ie. modification to operational schedule). The proposed operational schedule would accommodate expected incoming flows into the reservoir while not exceeding the capacity of the downstream channel. No significant biological resources, cultural resources, water quality, or land use would be potentially affected by the proposed plan. The environmental assessment covers the proposed operational schedule which would go into effect upon approval of the South Pacific Division office of the U. S. Army Corps of Engineers, expected January 1989.

I have considered possible impacts on environmentally significant resources as discussed in the EA and find that there are no significant impacts resulting from the project. Therefore, an Environmental Impact Statement need not be prepared for the modification to the operational schedule.

28 Oct 88
DATE

Tadahiko Ono
TADAHIKO ONO
Colonel, Corps of Engineers
District Engineer

EXHIBIT D

Chain of Correspondence For Approval of Water Control Manual

CESPD-ED-W (CESPL-ED-HR/29 Jan 90) (1110-2-240b) 1st End Krhoun/dh
705-1433
SUBJECT: Brea Dam Water Control Manual

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street, Room 720, San Francisco, Calif 94111-2206 25 APR 1990

FOR Commander, Los Angeles District, ATTN: CESPL-ED-HR

1. Subject manual is approved subject to the following paragraph.

2. On Chart A-2, Project Operator Instructions, subparagraph 2bi, modify instructions to follow the backup plan as the project does not have a backup plan. Suggest the project operator operate the dam according to observed precipitation and reservoir water surface elevation utilizing Chart A-1. This would be consistent with paragraph 3.05 on page A3-2.

3. Please furnish this office four copies of the final printing of the manual.

FOR THE COMMANDER:

wd all encls

Walter C. Day
JAY K. SOPER
Director of Engineering

DEPARTMENT OF THE ARMY

LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2711
LOS ANGELES, CALIFORNIA 90053-2325

REPLY TO
ATTENTION OF

29 January 1990

CESPL-ED-HR (1110-2-240b)

MEMORANDUM FOR Commander, South Pacific Division, Attn: CESPD-ED-W (Krhoun)

SUBJECT: Brea Dam Water Control Manual

1. Stated herein are your comments received informally and our responses as discussed between our offices by telephone:

a. "Page 5-02, Paragraph 5-04- The District should reevaluate the need for maintaining as many hard copies of the hydrologic and hydraulic data indicated in this paragraph. It appears much of this data is also stored in the water control data system which would appear to be the preferred approach. This comment would refer to recording hydrologic data for other District projects as well."

We have reevaluated this comment according to EM 1110-2-3600 (Management of Water Control Systems), Chapter 5, Section 5-2e. We feel that, for the present, retention and maintenance of hard copies of hydrologic and hydraulic data is necessary, if the computer system were to crash and data were lost.

b. "Page 6-1, paragraph 6-01a- Delete the second paragraph as it describes future operations for the project. The manual should only contain information on procedures currently in place. In the third paragraph specifically indicate that the forecasts are used only for operating the project and are not distributed to other agencies since weather forecasting is the function of the NWS. Delete the last sentence of the third paragraph as this shows future operation procedures."

Concur. The sections cited for deletion have been deleted. The requested statement, regarding limitations on the use of weather forecasts, has been inserted.

c. "Page 7-02, Paragraph 7-05 b&c- Delete descriptions to original and previous water control plans. This manual should be restricted to only describing the current water control plan."

Concur. These descriptions have been deleted and incorporated into Chapter 3 (History of Project).

d. "Page 7-03, Paragraph 7-05d- The current water control plan presented in the manual contains a primary plan and an alternative plan, should real-time precipitation not be available. In the primary plan the dam releases are based on precipitation and reservoir levels while in the alternative plan the releases are only based on reservoir levels. Since there are two rain gauges at the control house the dam tender could manually read the precipitation at half hour

e. "Page 7-6, Table 7-01- Delete comparisons to the previous operating plan. Any information comparing the plan in the manual with the previous plan should also be deleted." Table 7-01 has been deleted.

f. "Page 8-2, Paragraph 8-02b- delete the last paragraph in this section (see comment 5)." The last paragraph has been deleted.

g. "Page 8-7, paragraph 8-02e- Delete this paragraph in its entirety (See comment 5)." The sections of this paragraph that dealt with comparison of the current and previous operating plan have been deleted.

3. Three copies of the Water Control Manual, as revised are enclosed for your review.

4. If you have any questions, please contact Robert Stuart of the Reservoir Regulation Section at (213) 894-3001 (FTS 798-3001).

ROBERT E. KOPLIN, PE
Acting Chief, Engineering Division

CESPD-ED-W (CESPL-ED-HR/20 Oct 89) (1110-2-240b) 1st End
Krhoun/6-2033
SUBJECT: Brea Dam Water Control Manual

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street, Room 720, San Francisco CA 94111-2206 03 JAN 1990

FOR Commander, Los Angeles District, ATTN: CESPL-ED-HR

1. Subject final draft manual has been reviewed and comments are enclosed. These comments are furnished to assist the District in finalizing the manual. Approval will be given after review by this office of the final manual.

2. District is requested to furnish its compliance with the comments along with the submission of the final manual.

FOR THE COMMANDER:

2 Encl
wd encl 1
Added 1 encl
2. Comments

JAY K. SOPER
Chief, Engineering Division

CESPD-ED-W

21 Nov 1989

SOUTH PACIFIC DIVISION
COMMENTS ON
DRAFT WATER CONTROL MANUAL
FOR
BREA DAM

1. Page 5-02, Paragraph 5-04- The District should reevaluate the need for maintaining as many hard copies of the hydrologic and hydraulic data indicated in this paragraph. It appears much of this data is also stored in the water control data system which would appear to be the preferred approach. This comment would refer to recording hydrologic data for other District projects as well.

2. Page 6-1, paragraph 6-01a- Delete the second paragraph as it describes future operations for the project. The manual should only contain information on procedures currently in place. In the third paragraph specifically indicate that the forecasts are used only for operating the project and are not distributed to other agencies since weather forecasting is the function of the NWS. Delete the last sentence of the third paragraph as this shows future operation procedures.

3. Page 7-02, Paragraph 7-05 b&c- Delete descriptions to the original and previous water control plans. This manual should be restricted to only describing the current water control plan.

4. Page 7-03, Paragraph 7-05d- The current water control plan presented in the manual contains a primary plan and an alternative plan should real-time precipitation not be available. In the primary plan the dam releases are based on precipitation and reservoir levels while in the alternative plan the releases are only based on reservoir levels. Since there are two rain gauges at the control house the dam tender could manually read the precipitation at half hour intervals. This would preclude the need for the alternative plan. If this is not appropriate suggest the alternative plan be one of the release schedules shown in the primary plan. The release schedule in the alternative plan only differs slightly from several in the primary plan.

5. Page 7-6, Table 7-01- Delete comparisons to the previous operating plan. Any information comparing the plan in the manual with the previous plan should also be deleted.

6. Page 8-2, Paragraph 8-02b- Delete the last paragraph in this section (see comment 5).

7. Page 8-7, Paragraph 8-02e- Delete this paragraph in its entirety (see comment 5).

8. Suggest a statement be added in the Introduction Section referencing the current Environmental Documentation. For Brea Dam this would be the October 1988 EA and FONSI.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS

October 20, 1989

REPLY TO
ATTENTION OF

CESPL-ED-HR (1110-2-240B)

MEMORANDUM FOR Commander, South Pacific Division, Attn: CESPL-ED-W

SUBJECT: Brea Dam Water Control Manual

1. Enclosed are three copies of the Brea Dam Water Control Manual prepared in accordance with ETL 1110-2-251.

2. Also enclosed are three copies of the October 1988 Finding of No Significant (FONSI) and Environmental Assessment package for your review.

3. If there are any questions, please contact Robert Stuart of the Reservoir Regulation Unit at (213) 894-3001.

FOR THE COMMANDER:

for ROBERT E. KOPLIN, PE
Acting Chief, Engineering Division

Enclosure