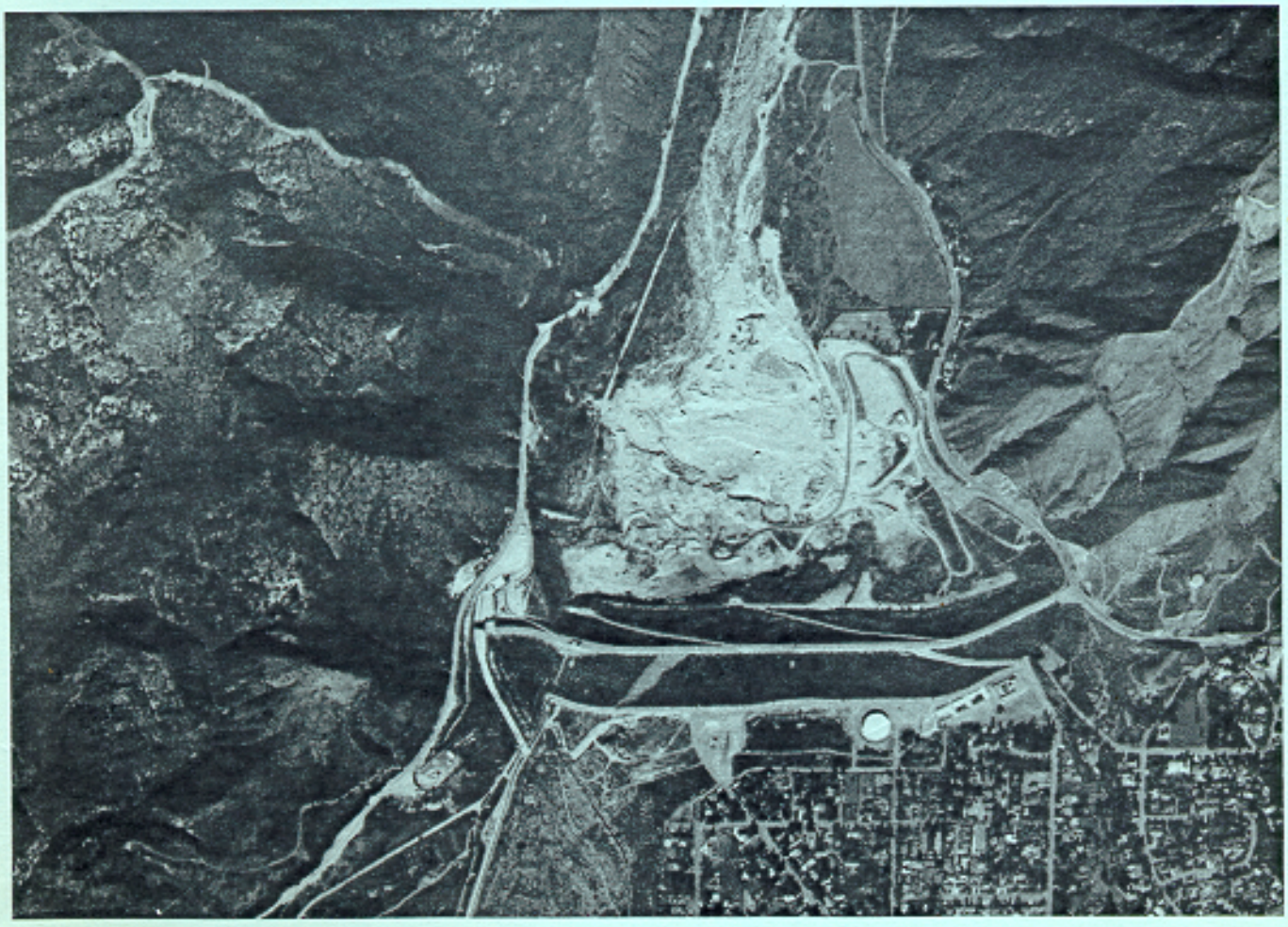
US Army Corps
of Engineers
Los Angeles District

WATER CONTROL MANUAL

SAN ANTONIO DAM
LOS ANGELES COUNTY AND SAN BERNARDINO COUNTY
SAN ANTONIO CREEK, CALIFORNIA



YEAR OF PHOTO: 1990

MAY 1991

SAN ANTONIO DAM AND RESERVOIR
LOS ANGELES COUNTY AND SAN BERNARDINO COUNTY, CALIFORNIA

PERTINENT DATA
JULY 1990

Stream System		San Antonio Creek
Drainage Area	sq. mi.	26.7
Elevation		
Streambed at upstream toe of dam	ft, NGVD	2,125
Debris Pool	ft, NGVD	2,164
Flood control pool (spillway crest)	ft, NGVD	2,238
Spillway design surcharge level	ft, NGVD	2,254.4
Top of dam	ft, NGVD	2,260
Area		
Debris pool	acres	59
Spillway crest	acres	145
Spillway design surcharge level	acres	163
Top of dam	acres	168
Capacity, gross		
Debris pool	acre-ft	953(0.67*)
Spillway crest	acre-ft	8,535(6.02*)
Spillway design surcharge level	acre-ft	11,063(7.83*)
Top of dam	acre-ft	11,992(8.46*)
Allowance for sediment		
50-year	acre-ft	2,000
Reservoir design flood	acre-ft	1,350
Dam: - Type		Earth
Height above original streambed	ft	160
Top length	ft	3,850
Top width	ft	30
Freeboard	ft	5.1
Spillway: - Type		Ungated overflow concrete ogee
Crest length	ft	200
Design surcharge	ft	16.4
Design discharge	c.f.s.	51,160
Outlets:		
Gates - type		Vertical lift
Number and size		3 - 5'-8"W x 10'H
Gate sill elevation	ft, NGVD	2,125
Conduits		
Number and size - diameter	ft	1 - 14.5
Length	ft	508
Maximum capacity at spillway crest	c.f.s.	11,800
Regulated capacity at spillway crest	c.f.s.	8,000
Reservoir design flood:		
Duration (inflow)	days	2
Total volume	acre-ft	22,500(15.81*)
Inflow peak	c.f.s.	19,000
Spillway design flood:		
Duration (inflow)	days	1
Total volume	acre-ft	18,200(11.90*)
Inflow peak	c.f.s.	60,000
Historic maximums:		
Maximum release	c.f.s.	8,420
Date		1-25-69
Maximum water surface elevation	ft, NGVD	2225.6
Date		2-19-80

WATER CONTROL MANUAL

SAN ANTONIO DAM

SAN ANTONIO CREEK, LOS ANGELES COUNTY AND
SAN BERNARDINO COUNTY, CALIFORNIA

JULY 1991

Prepared

by

U.S. Army Corps of Engineers

Los Angeles District

Reservoir Regulation Section

SAN ANTONIO DAM

NOTICE TO USERS OF MANUAL

Regulations specify that this Water Control Manual be published in loose leaf 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 to keep the manual current.

EMERGENCY REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise, the Reservoir Regulation Section, Los Angeles District Office can be contacted by telephone at 213-894-6916. See plate 9-01 for other important telephone numbers for reservoir regulation assistance.

ORGANIZATION OF MANUAL

Indicated by Roman Numerals, this manual is divided into chapters. Within each chapter are numbered paragraphs, which are major topics discussed in the chapter. Figures cited in the text of each chapter are presented at the end of that chapter. Plates cited are located in the back of the manual. Exhibits are included in the back as appendices.

WATER CONTROL MANUAL

SAN ANTONIO DAM
SAN ANTONIO CREEK, LOS ANGELES COUNTY, CALIFORNIA

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LIST OF EXHIBITS

ABBREVIATIONS USED

ac-ft	acre-feet
ALERT	Automatic Local Evaluation in Real-Time
CBWCD	Chino Basin Water Conservation District
CFR	Code of Federal Regulation
cfs	cubic feet per second
COE	U.S. Army Corps of Engineers
CON-OPS	Construction Operations Division USACOE, LAD
DWP	Department of Water and Power, City of Los Angeles
EM	Engineering Manual
ER	Engineering Regulation
ETL	Engineering Technical Letter
FAA	Federal Aeronotics Administration
ft^3/s	cubic feet per second

ABBREVIATIONS USED (Continued)

ft.	feet
FONSI	Finding of No Significant Impact
GDM	General Design Memorandum
HEC	Hydrologic Engineering Center, U.S. Army Corps of Engineers
LACDA	Los Angeles County Drainage Area
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LAD	Los Angeles District, U.S. Army Corps of Engineers
LATS	Los Angeles Telemetry System
mph	miles per hour
MTBY	Call Letters for Mt. Baldy Precipitation Station within Los Angeles Telemetry System
MWD	Metropolitan Water District
NGVD	National Geodetic Vertical Datum of 1929
NOAA	National Oceanographic and Atmospheric Administration
NWS	National Weather Service
OCEMA	Orange County Emergency Management Agency
P.L.	Public Law
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
ppm	parts per million
PVPA	Pomona Valley Protective Association
QPF	Quantitative Precipitation Forecast
RDF	Reservoir Design Flood
ROC	Reservoir Operations Center
RRS	Reservoir Regulation Section
RTU	Remote Terminal Unit
SARRT	Santa Ana River Real-Time Water Control System
SBCFCD	San Bernardino County Flood Control District
SCAG	Southern California Association of Governments
SNTO	Call Letters for San Antonio Dam within Los Angeles Telemetry System
SPF	Standard Project Flood
SPS	Standard Project Storm
USGS	U.S. Geological Survey
VHF	Very High Frequency
WSE	Water Surface Elevation
WY	Water Year

I - INTRODUCTION

1-01 Authorization. This Water Control Manual was prepared in accordance with regulations and guidelines set forth in the following documents and U.S. Army Corps of Engineers Publications:

Engineering Regulation (ER) 1110-2-240, 8 October 1982, "Engineering and Design, Water Control Management" has been published by the Federal Register as 33 CFR 222.7.

Engineering Manual (EM) 1110-2-3600, 30 November 1987, "Engineering and Design, Management of Water Control Systems";

Engineering Technical Letter (ETL) 1110-2-251, 14 March 1980, "Engineering and Design, Guide for Preparing Water Control Manuals".

1-02 Purpose and Scope. The purpose of this manual is to provide current information regarding San Antonio Dam and Reservoir regulation policies and the organizational structure of the regulating agency (U.S. Army Corps of Engineers). The manual contains:

(1) Descriptive information of the project, drainage area, and watershed characteristics;

(2) A description of the plan of operation and management of the Dam and appurtenant facilities;

(3) A description of hydrometerologic data collection and utilization of communication networks; and

(4) A section on hydrologic forecasts.

San Antonio Dam was authorized and constructed for the purpose of flood control with incidental water conservation. The project does not provide recreation, hydroelectric power, or navigation. Therefore, these activities are not discussed in the manual.

1-03 Related Manuals and Reports. Manuals and reports relevant to San Antonio Dam and Reservoir and the upstream and downstream drainage areas are listed in plate 1-01.

1-04 Project Owners. San Antonio Dam and Reservoir are owned by the Federal Government. The U.S. Army Corps of Engineers, Los Angeles District (LAD) has jurisdiction regarding all aspects of the project.

1-05 Operating Agency. The U.S. Army Corps of Engineers, LAD, is responsible for the operation and maintenance of San Antonio Dam and Reservoir in order to insure the flood control objectives of the project are met. San Antonio Dam is staffed by one dam tender on a year-round basis. During normal working hours (0700 to 1500 hours Pacific Standard Time) the dam tender works at or around the dam. The dam tender does not reside at the project. In case the dam tender is unavailable, an alternate dam tender is assigned to the dam.

Dam tenders are under the supervision of the Operations Branch, LAD, but receive reservoir regulation instructions from the Reservoir Regulation Section, LAD San Antonio Dam's telephone number is (714) 982-5494.

The U.S. Army Corps of Engineers, LAD, is also responsible for the operation and maintenance of the downstream channel beginning at the outlet works of San Antonio Dam to Prado Reservoir. The Pomona Valley Protective Association (PVPA) and San Bernardino County Flood Control District (SBCFCD) are responsible for the operation and maintenance of the diversion works located downstream of the San Antonio Dam outlet works.

1-06 Regulating Agencies. The U.S. Army Corps of Engineers, LAD, is solely responsible for the regulation of San Antonio Dam and Reservoir.

The Pomona Valley Protective Association (PVPA) and the Chino Basin Water Conservation District (CBWCD) are responsible for the regulation of the diversion works downstream of the San Antonio Dam outlet works.

II - DESCRIPTION OF PROJECT

2-01 Location. San Antonio Dam is located in the Santa Ana River Watershed on San Antonio Creek approximately 10.5 miles upstream from its confluence with Chino Creek. The Dam is located about 30 miles east of Los Angeles and 22 miles west of San Bernardino. The majority of the Dam is in San Bernardino County. A small portion of the Dam is in Los Angeles County. The Dam is sited at the mouth of the canyon where San Antonio Creek emerges from the San Gabriel Mountains. It is approximately 5 miles north of the communities of Claremont and Upland. Plate 2-01 shows the San Antonio Dam location and local project area.

2-02 Purpose. The purpose of San Antonio Dam and Reservoir is to regulate floodflows and debris on San Antonio Creek. Although water conservation was not formally authorized as a project purpose at San Antonio Dam, it is the policy of the U.S. Army Corps of Engineers to assist local agencies in the conservation of water to the maximum extent possible without interfering with flood-control functions. The project, including the reservoir basin, dam and channel improvements to San Antonio and Chino Creeks, provides protection to a large area of agricultural, residential, commercial, and industrial properties in which are located the communities of Claremont, Upland, Pomona, Ontario, and Chino. Protection is also provided to major federal, state, and county highways as well as several major railways. Channel improvements extend some 15.7 miles downstream to Prado Dam and Reservoir.

2-03 Physical Components. San Antonio Dam is a zoned earth (rolled-fill) embankment with outlet works and detached reinforced concrete ogee spillway. (figs. 2-02 and 2-07). The components of the dam are shown on plate 2-02. They include:

a. Dam. The dam is a zoned earthfill embankment (fig. 2-03). It has a crest length of 3,850 feet and a crest width of 30 feet. The top of the dam (El. 2,260 ft. NGVD) is 160 feet above the original streambed at the centerline of the dam. Both the upstream and downstream slopes of the embankment are 2H:1V between elevations 2,260 NGVD and 2,220 NGVD. Below elevation 2,220 NGVD, the slopes are 2.5H:1V. The dam consists of four zones: an upstream pervious zone; an impervious central zone; a downstream random pervious zone; and a downstream select pervious zone. Both the upstream and downstream faces of the dam are protected by a three foot stone blanket. Details of the embankment sections are shown on plate 2-03.

b. Outlet Works. The outlet works (figs. 2-02 and 2-03) are benched into rock at the toe of the right abutment. They consist of an approach channel, a trash rack, an intake structure, three gates, a conduit transition and an outlet conduit (figs. 2-04 and 2-05). The flow is from north to south. A plan of the outlet works is shown on plate 2-04.

(1) Approach channel. The approach channel is 88.5 feet in length. It is an open reinforced concrete channel with a base width of 27 feet 8 inches. Wall heights vary from 3 feet 6 inches to 47 feet 9 inches.

(2) Trash rack. The trash rack (fig. 2-02) is installed in the approach channel just upstream of the intake structure. It consists of inclined 16 inch iron beams spaced to provide 4-foot clear openings. A clear opening of 3 feet 6 inches is also provided above the approach channel invert which allows passage of small debris during low stages.

(3) Intake structure. The intake structure is 70 feet in length and consists of three 5 foot 8 inch by 10 foot intakes which have bellmouth shape entrances.

(4) Slide gates. Three slide gates, each 5 feet 8 inches wide by 10 feet high, are used to regulate the outflow through the dam. Two 10 hp motors are connected to the gates to provide hydraulic pressure for operating the gates. Southern California Edison supplies 480-volt power to the two motors. A 50-kw diesel generator is maintained operational for emergency use. Gates are operated from a control house on the crest of the dam. The speed at which the gates are operated is approximately one foot per minute. If more than one gate is operated simultaneously, the rate of gate movement is reduced proportionately.

(5) Conduit transition. The conduit provides a smooth transition from the three 5 foot 8 inch by 10 foot rectangular intakes to a single 14 foot 6 inch diameter circular section. The transition length is 86.5 feet.

(6) Outlet conduit. The outlet conduit is circular in section with a diameter of 14 feet 6 inches, a length of 508 feet and a slope of 0.0521 foot/foot. With the gates fully open, the conduit discharges 11,800 cfs when the reservoir pool is at the spillway crest (El. 2,238 NGVD). Under these conditions the velocity of flow is 71 fps. Plate 2-05 shows the outlet discharge as a function of gate opening.

c. Control House. A control house is located on the crest of the dam just to the east of the outlet works. It is a rectangular concrete structure 18 feet wide, 58 feet long and 10 feet high. Within the house there is a generator room and a control room separated by a 10 foot wide enclosed carport which reduces objectionable noise when the generator is operating. The carport currently houses electronic equipment for the FAA. FAA radio and radar antennae are located on the roof of the control house. The control room contains the gate operating equipment, three gate position indicators and recorders, a reservoir stage indicator and recorder with a remote terminal unit (RTU), a radio transmitter and receiver, an electrical control panel, a glass-tube rain gage, and other operating and maintenance equipment.

d. Outlet Access Gallery. The outlet access gallery consists of a 5 foot by 10 foot reinforced concrete box placed on a 2.25H:1V slope in the embankment fill from the outlet gate chamber to its entry point on the downstream face of the embankment (El. 2,247.5). The centerline of the gallery is 13 feet to the west of the control house. The gallery provides the sole access to the outlet gate chamber. A three foot wide stairway with 12 inch wide skids on both sides of the stairway are contained within the gallery. Also, the gallery contains water, telephone, power, gate position indicator, and oil pressure lines that extend from the control house to the gate chamber.

e. Spillway. The spillway is situated to the west of the San Antonio Dam in the hill forming the dam's western abutment. It is about 600 feet west of the outlet works. Plate 2-06 shows the spillway general plan and its relationship to the outlet works. Profile and typical sections of the spillway are shown on plate 2-07.

(1) Approach channel. The trapezoidal approach channel (fig. 2-06) is 200 feet long and is excavated to an elevation of 2,228 feet NGVD. The high bank between the approach channels and the reservoir floor is graded generally on a slope of 1 on 2 with ends warped to meet the dam embankment slope at the left side and the existing bank on the right side.

(2) Control section. The spillway control is formed by a concrete ogee weir, 200 feet in length. The weir crest is at elevation 2,238 feet. The spillway has a design surcharge of 16.4 feet with a corresponding discharge of 51,160 cfs.

(3) Discharge channel. The spillway discharge channel (fig. 2-07) consists of a rectangular side channel with baffle piers and a 825 foot long reinforced concrete rectangular curved section terminating in a 75 foot radius flip bucket with a turnup of 20 degrees. The spillway discharge is directed across and away from the outlet works channel. Plate 2-08 shows the spillway discharge curve.

f. Reservoir. Reservoir boundaries are defined by the extent of land acquired by the Federal Government for the purpose of flood control behind San Antonio Dam. The boundary is shown as the Taking Line on plate 2-09, Real Estate Acquisition Boundary.

A February 1990 survey of the reservoir is the latest source of elevation-storage information. Reservoir area and capacity as a function of elevation, from the survey data, are shown on plate 2-10. The tabular form of the elevation vs. capacity data is contained on plate 2-11. The elevation-area table is shown on plate 2-12. When the reservoir is filled to the spillway crest elevation of 2238.0 feet, the impounded storage is 8,535 acre feet, covering 145 acres.

2-04 Related Control Facilities. There are several small diversion structures upstream of San Antonio Dam which divert water for the San Antonio Land and Water Company, the City of Pomona, and the Southern California Edison Company. Water diverted by these structures flows to the City of Pomona through a conduit located in the west abutment of San Antonio Dam or to the City of Upland through a conduit located in the east abutment of the dam. These small diversions do not affect flood-control operations at San Antonio Dam.

Downstream of San Antonio Dam, the Pomona Valley Protective Association (PVPA) operates three diversion structures. Two structures divert water to the east into the San Antonio Spreading Grounds and one diverts water to the west into the Pomona Spreading Grounds. Just upstream of Baseline Road, the Metropolitan Water District(MWD) has an inlet diversion which allows imported water to enter San Antonio Creek Channel. The Chino Basin Water Conservation

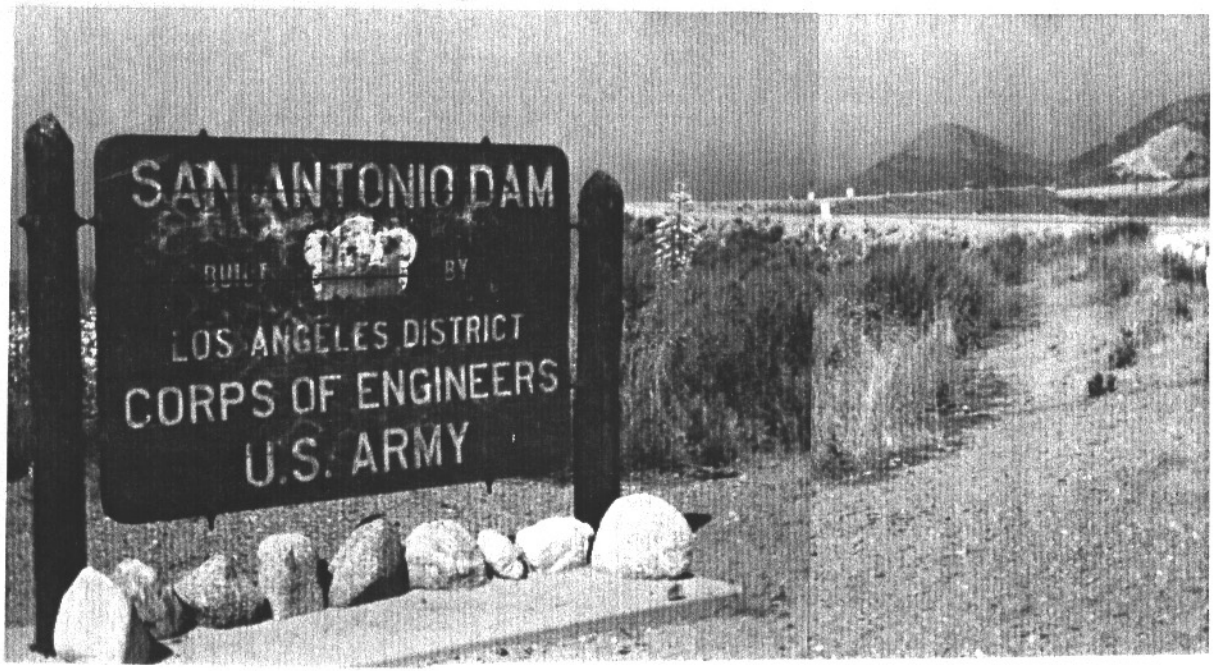
District operates a diversion just downstream of the Atichson Topeka & Santa Fe Railroad Crossing. This diversion diverts water to the east into the Montclair Basin, and may be able to divert between 100 to 300 cfs during flood-control releases from San Antonio Dam. Plate 2-13 shows the locations of Pomona Valley Protective Association spreading basin below San Antonio Dam.

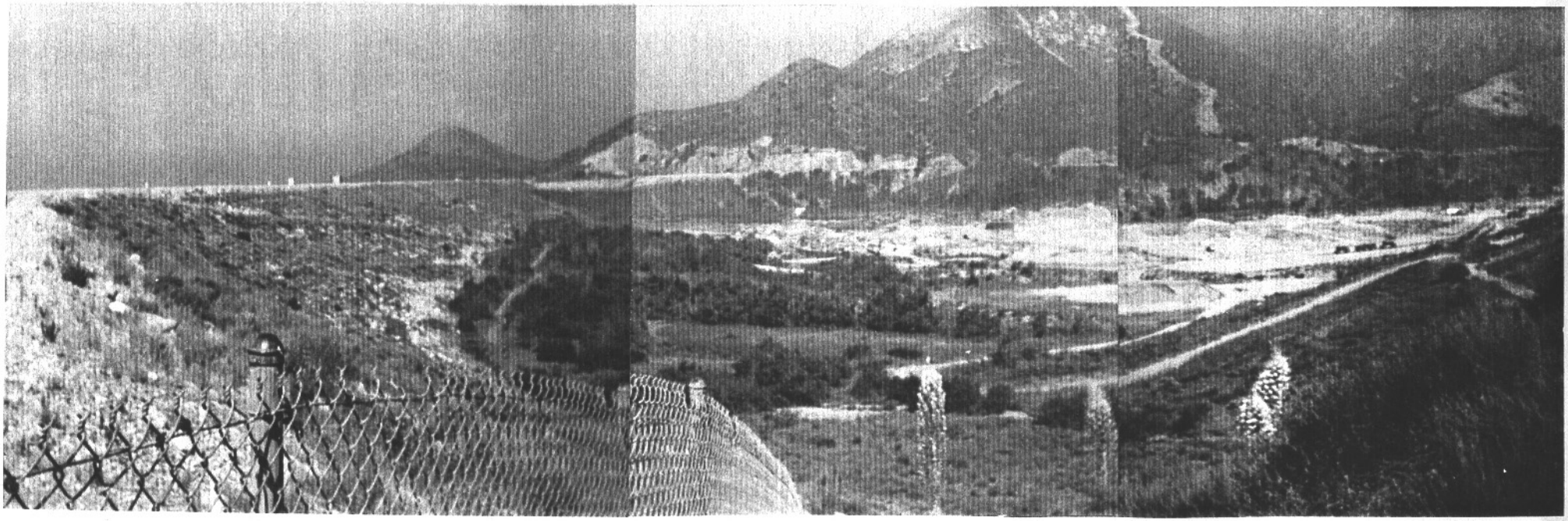
Outflows from San Antonio Dam normally flow down the San Antonio Creek Channel into the Chino Creek Channel and into Prado Reservoir. San Antonio Dam is operated as a component of the Santa Ana River reservoir system.

2-05 Real Estate Acquisition. Acquisition of the lands for the San Antonio Dam and reservoir were completed on or about June 30, 1953. A total of 370 acres were purchased. They included: 90 acres of urban subdivision lots; 90 acres of irrigated citrus groves; 20 acres of hillside pastures; and 170 acres of river channel and gravel land. In 1953, $474,000 had been budgeted for land acquisition for the dam and reservoir. See plate 2-09 for the real estate taking line.

The San Antonio and Chino Creeks improvement project required acquisition of lands, easements and rights-of-way. For the rectangular portion of the channel a width varying from 75 feet to 110 feet was required. The paved trapezoidal section of the channel required widths varying from 200 to 250 feet. Rights-of-way for the unpaved trapezoidal channel was determined to be 750 feet wide. Costs of lands for the channel improvements was estimated at $599,000 in 1954.

2-06 Public Facilities. There are no public use facilities associated with the reservoir lands or the downstream channel improvements. The only activity within reservoir boundaries is an on-going maintenance operation to remove debris (including sand and gravel) which accumulates in the reservoir during storm events.





San Antonio Dam and Flood Control Basin showing gravel removal work within Basin 1990. Looking West

FIGURE 2-01

Figure 2-02 Outlet works at San Antonio Dam. Elevation 2125 ft. NGVD. Control House at top of Dam. Looking South.

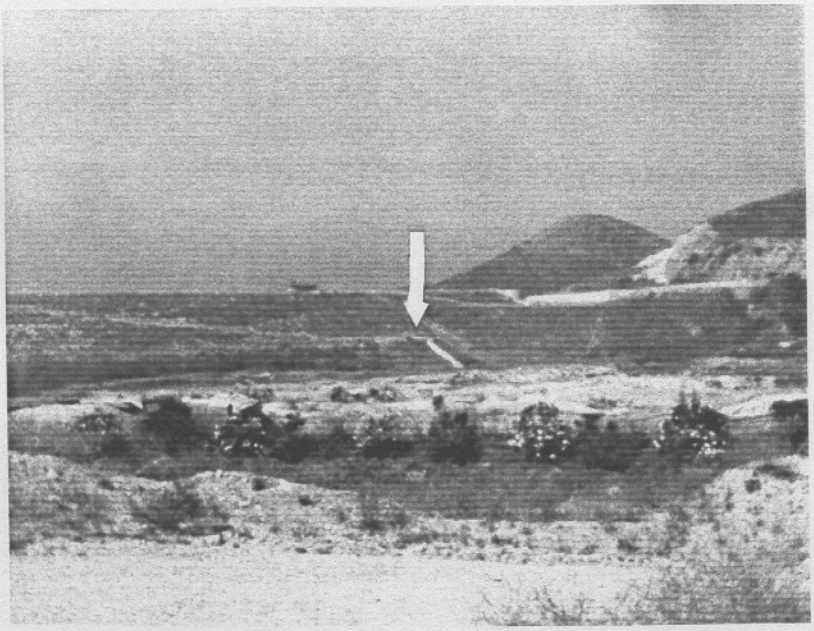


Figure 2-03 San Antonio Dam and Flood Control Basin showing outlet works and spillway. Looking Southwest.

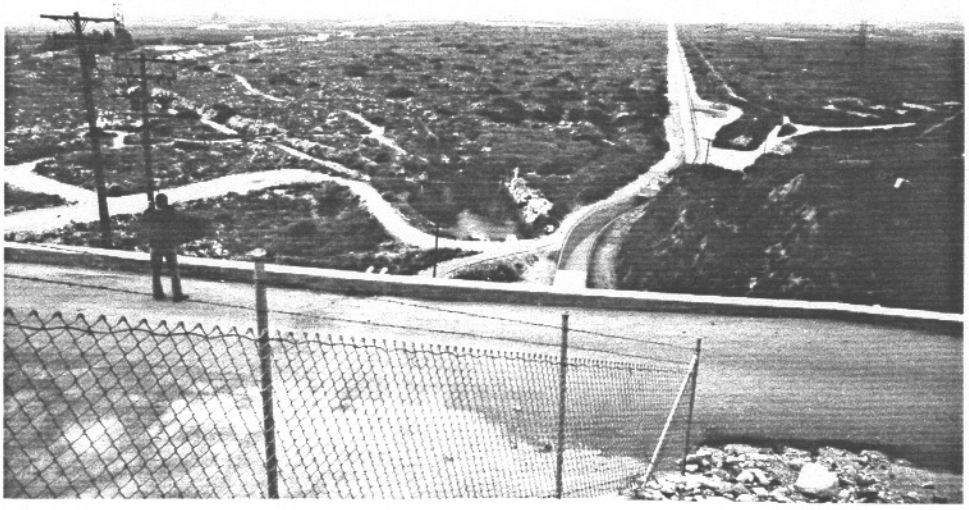


Figure 2-04 Looking South from top of San Antonio Dam at San Antonio and Chino Creeks Channel.

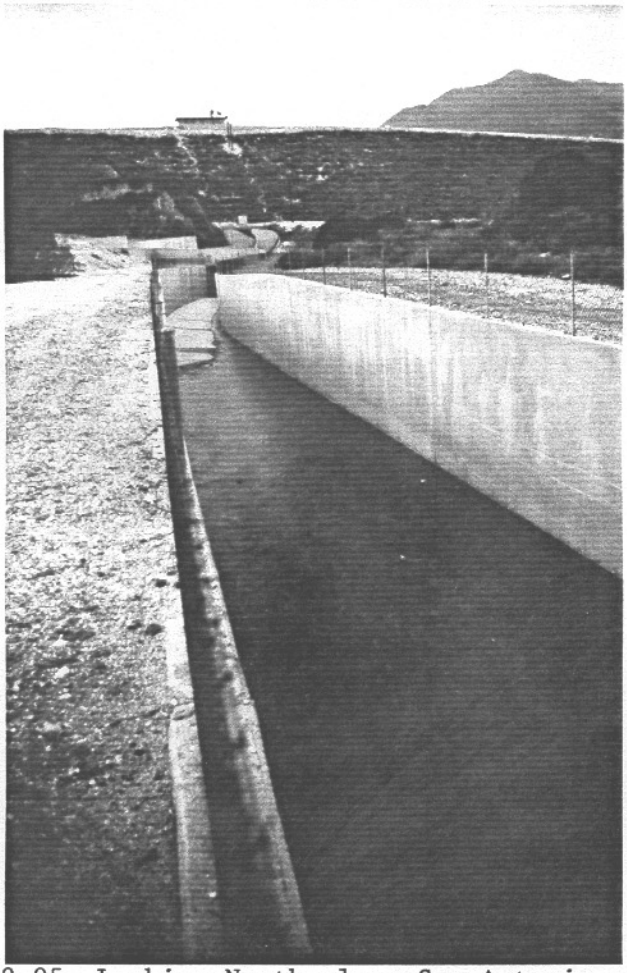


Figure 2-05 Looking North along San Antonio and Chino Creeks Channel at San Antonio Dam, outlet works and Control House.

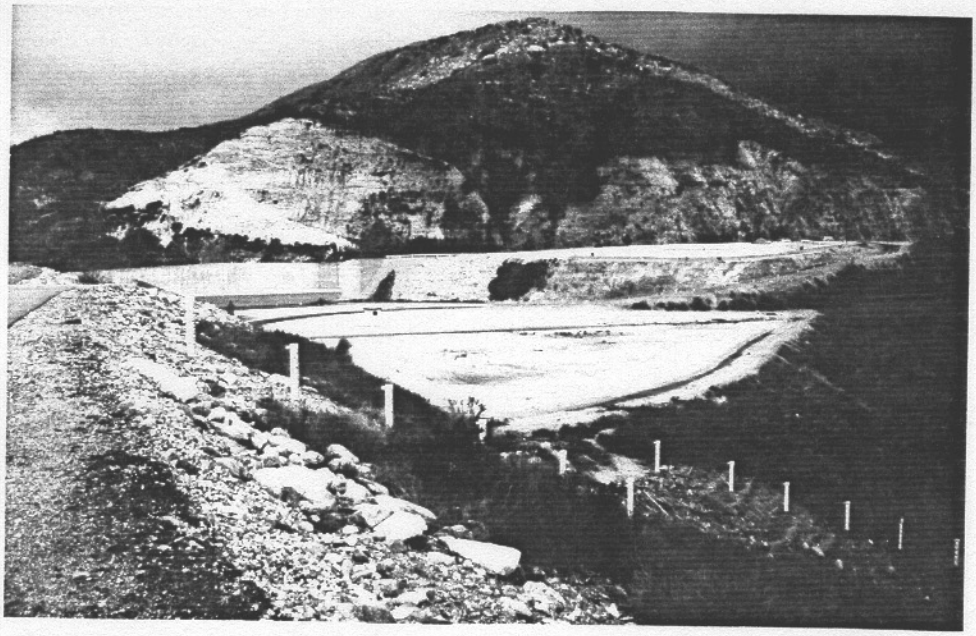


Figure 2-06 San Antonio Dam Spillway Approach Channel with Ogee Spillway and Staff Boards showing. Looking West.

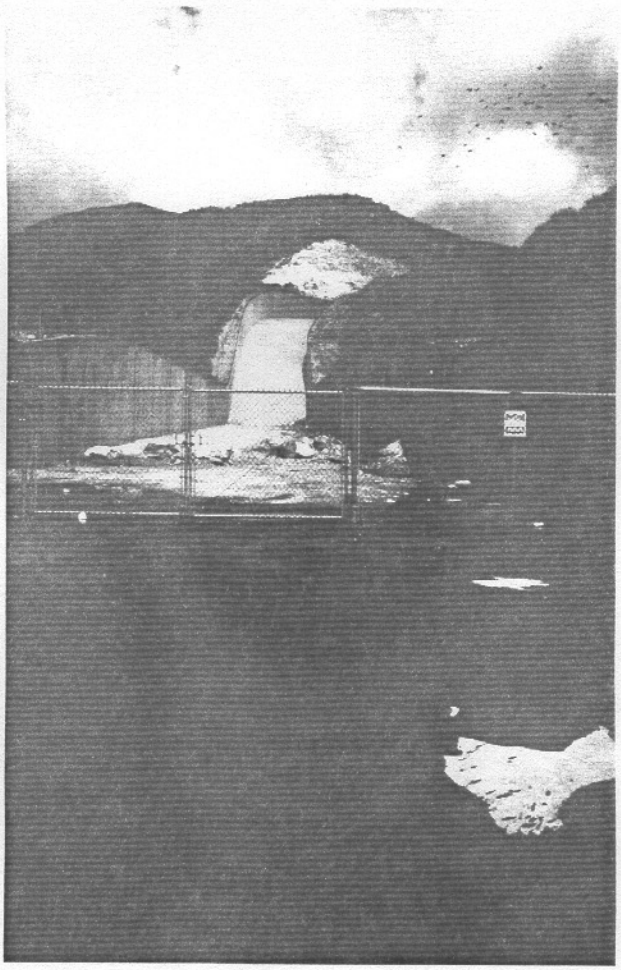


Figure 2-07 Spillway Terminus at San Antonio Dam. Looking Northwest.

III - HISTORY OF PROJECT

3-01 Authorization. San Antonio Dam and the San Antonio and Chino Creek Improvements Project was authorized by P.L. 761 of the 75th Congress, 3rd Session which was approved on 28 June 1938. Under Section 4 of P.L. 761, the Act reads:

SANTA ANA RIVER BASIN

> The project for flood control in the Santa Ana River Basin of California, authorized by the Act of June 22, 1936 (Public, Numbered 738, Seventy-fourth Congress), is hereby modified to provide for the control of floods on San Antonio Creek and Chino Creek in accordance with plans approved by the Chief of Engineers pursuant to preliminary examinations and surveys authorized by the Act of August 28, 1937 (Public, Numbered 406, Seventy-fifth Congress), and for the initiation and partial accomplishment of these plans there is hereby authorized $6,500,000.

3-02 Planning and Design. Historically San Antonio Creek has been noted for its flash floods that transport large quantities of debris. Prior to authorization of the San Antonio Dam by Congress, the Corps (District Engineer) conducted a public hearing at Riverside, California, on February 25, 1938. Representatives from San Bernardino, Riverside, and Orange Counties as well as representatives from other interested agencies attended the hearing. The purpose of this public forum was to obtain the views of the local interests on the nature of protection to be included in the project. A preliminary plan was formulated that called for debris control with some channel improvement having an estimated cost of $1,260,000. On March 2, 1938, only five days after this public meeting a major storm hit the area inflicting damages estimated at $1,687,000 and disrupting the mainflow of east-west traffic for a period of 30 to 60 days. This storm demonstrated the need for more extensive and costly improvements than those proposed by the local interests. The June 28, 1938, authorization by Congress provided $6,500,000 for the initial and partial development of flood control plans, design, and construction. Subsequently, through a series of public hearings (June 17, 1939 at Ontario, California, November 21, 1939 at San Bernardino, and February 21, 1940 at Ontario) the essential elements of the current flood control plan were developed. Both the Los Angeles and San Bernardino County Flood Control Districts participated in the planning process.

Planning, analyses, and design activities slowed appreciably during the years of World War II. By 1951 preliminary planning and analyses were completed and a cost was submitted to Congress. In 1952 a revised cost estimate incorporating some minor changes was submitted to Congress. By June of 1953 ninety-nine (99) percent of planning and design were completed. Contract plans and specifications for the embankment, spillway, and outlet works were also finalized at this time.

3-03 Construction. Construction of the Dam (outlet works) was initiated in April 1952. The embankment, outlet works and spillway were essentially completed by November 1, 1955. The Dam was officially completed on May 1, 1956. The funds appropriated for completing the Dam were $8,351,000. Construction on the San Antonio and Chino Creek channels started in 1956 and was completed in 1960. The appropriation for completion of the channel improvements was $11,473,000.

3-04 Related Projects. San Antonio Dam was authorized as part of the Santa Ana River Basin flood protection program. Other Corps projects (pl. 3-01) which aid in flood-control within the Santa Ana River Basin included Prado Dam, Carbon Canyon Dam, and Villa Park Dam. Prado and Carbon Canyon Dams are Corps projects. Villa Park Dam is maintained and operated by OCEMA. Prado Dam is the largest and most directly related to San Antonio Dam. Floodflows released from San Antonio Dam join Chino Creek and flow into Prado Reservoir. Releases from San Antonio Dam are therefore coordinated with the operation of Prado Dam during flood periods. Another basin east of San Antonio Creek that contributes to the Prado Reservoir inflow is the Cucamonga Creek Basin, (see figs. 3-01 and 3-02). A Corps project the flood control improvements for Cucamonga Creek and its tributaries Demens Creek, Deer Creek, Hillside, and San Antonio Diversion System consist of ten debris basins and about 27 miles of concrete lined rectangular, and trapezoidal channels. A debris basin was constructed at the headwater of Cucamonga Creek, Demens Creek, Deer Creek and at Hillside, and six debris basins were provided at the canyons consists of 54,800 feet of rectangular channel, 20,700 feet of concrete-lined trapezoidal channel and 1,700 feet of covered double box section under the Ontario International Airport. The Demens Creek channel is rectangular in cross section and approximately two miles in length. Deer Creek (8-mile-long) and its tributary Hillside Channel (one-mile-long) are also rectangular in cross section with reinforced concrete lining. The diversion channel of the San Antonio Heights Diversion System is also a reinforced rectangular channel with a length of approximately one mile.

3-05 Modifications of Regulation. Plans for regulating flows at San Antonio dam have not changed significantly over the life of the project. The following sections discuss the initial (ultimate) plan, an interim plan, and the current plan. (Exhibit B.)

a. 1951 Initial (Ultimate) Plan. The ultimate plan of operation to regulate floodflows was prepared and presented in "Definite Project Report on San Antonio and Chino Creeks, San Antonio Dam", October 1951. The plan was proposed for use after the completion of the San Antonio and Chino Creeks improvements. The plan called for controlling the flood inflows up to the spillway crest with a maximum release of 8,000 cfs (downstream channel capacity). Under the plan, a debris pool is developed to elevation 2,164 by limiting releases. Above 2,164 the outflow is gradually increased until at elevation 2,185 a discharge of 8,000 cfs is reached. This discharge is maintained at high pool levels by gradually closing the gate outlets, thereby transferring the flow to the spillway. During falling stages, the gate setting for the maximum elevation attained (up to the spillway crest) remains unchanged until elevation 2,164 is reached. At this elevation the gates are adjusted so that outflow is approximately equal to inflow.

b. 1951 Interim Plan. In order to minimize flood damage, an interim plan was formulated for use until the downstream San Antonio Creek and Chino Creek channel improvements were completed. Under this plan, a debris pool would be maintained to elevation of 2,164 (gross storage 1,590 acre-feet). At that level, outflow would approximately equal inflow until an inflow of 480 cubic feet per second occurred. At this point, the gate operation schedule would be followed. In this schedule, outflows would be increased to 1,000 cubic feet per second at elevation 2,166. This outflow would be maintained up to elevation 2,234. At this elevation, the outflow would be increased to 3,000 cubic feet per second and maintained as long as possible. Above elevation 2,238, the gated outlets would be closed gradually, transferring flow to the spillway. During falling stages, the gate setting for the maximum water surface attained, up to the setting at spillway crest, would remain unchanged until the water surface fell to elevation 2,164. At elevation 2,164, the gates would be operated so that outflow equals inflow. Deviations from the fixed schedule could be made to secure better operation as indicated by forecasts or to reduce flows due to unforeseen circumstances downstream.

c. 1957 Revision. Additional hydrologic information and the development of refinements in hydrologic methods resulted in the development of a revised reservoir design and spillway design floods. These revised design floods caused the "ultimate plan" to change slightly. Instead of reaching a maximum discharge of 8,000 cfs at WSE 2,185 feet, the 1957 revision reached the maximum design discharge of 8,000 cfs at WSE 2,175 feet. The "ultimate plan" would go into effect only after the completion of the San Antonio and Chino Creeks Improvement Project (i.e., Dec. 1960).

Meetings between the Corps and LACFCD, SBCFCD, and the PVPA resulted in the creation of a water-conservation operation plan. The water-conservation plan consisted of (1) a separate three step gate schedule for use below the debris pool (WSE 2,164 feet) and (2) the allowance of water-conservation storage between the debris pool and WSE 2,176 during the receding limb of a flood event; and when weather and runoff forecasts are favorable. The storage corresponding to a water surface elevation of 2,176 is approximately 10 percent of the flood-control storage space.

d. 1982 Operation Schedule. The operation schedule established in 1982 required zero releases up to elevation 2164. Between 2169 and 2170 all gates were gradually opened to release between 600 to 5030 cubic feet per second (cfs). Above elevation 2170 the flood control releases are adjusted between 7500 to 8500 cfs. All gates are slowly lowered as the dam experiences spillway flow such that total outflow does not exceed 8500 cfs.

e. 1991 Operation Schedule. With the extensive urbanization in the drainage basin downstream of San Antonio Dam maximum releases are limited to 8,000 cfs from San Antonio Dam. Controlling releases to the exact 8,000 cfs channel capacity of San Antonio and Chino Creeks Channel is needed for protection of downstream urban areas where side inflows from new storm drains impact upon freeboard space in some reaches of the channel. Therefore, the 1982 reservoir regulation has been altered such that releases above elevation 2170 are limited to between 7,000 and 8,000 cfs. The 1991 Operations Schedule is shown on Exhibit B.

An SPF flood routing was performed with the 1991 operation schedule and the original net storage data. This routing resulted in a maximum water surface elevation of 2231.92, which is about 6 feet below the spillway crest (2238 ft). Based on 1990 survey data this 6 feet of space translates to 866 ac-ft available for emergency flood control.

3-06 Principal Regulation Problems. Following are some past, existing, and/or potential problems associated with regulating the flow at San Antonio Dam:

a. Following the high precipitation and runoff years of 1978-1983, high groundwater was a problem for downstream communities. The downstream communities have, in the past, associated high groundwater conditions with the Corps alleged groundwater recharge activities. It should be noted that the Corps does not operate any recharge facilities. Any water diverted from San Antonio Creek Channel for any purpose is done by either the PVPA or the Chino Basin Water Conservation District. The Corps has no jurisdiction in controlling the quantity of water diverted from San Antonio Creek Channel.

b. An updated Hydrology Report (April 1986) prepared by the Corps indicates that the downstream San Antonio Creek Channel and Chino Creek Channel have less than 100-year flood protection capacity. This deficiency is due to increased urban runoff from the highly urbanized areas below the dam. In the event of a major flood event, flood releases from San Antonio Dam may need to be cut back to avoid or minimize downstream flooding.

c. Roller waves set-up in the channel upstream of the diversion works for the San Antonio spreading grounds. The second westward PVPA diversion (2 gates at 4' x 4') is greatly impacted by the waves, especially at flows of around 2,000 cfs. The force of the waves hitting the headworks has created pressures large enough to blow off the diversion's manhole cover. The PVPA maintains that the wave problem has to do with channel design and all they can do when the waves set-up is request adjustment to the release rate of the dam.

d. Seepage Problems. Seepage and boils were observed along the downstream toe of San Antonio Dam during high pools in 1983. Similar problems had been observed before. Because of these conditions it was recommended, after proper evaluations, that a toe drain be designed and constructed along the downstream toe of the embankment to control underseepage and eliminate the boils. The toe drain was designed in 1983 and constructed in 1985. Three observation wells were also installed in 1985 to monitor and evaluate the performance of the toe drain.

e. Toe Drain Evaluation. Since completion of the toe drain the maximum water surface in the reservoir was at elevation 2156 feet which occurred on 21 February 1986. The gate sill elevation is 2125. Readings from the observation wells, were taken on the 21 February 1986, they indicate that the surface of the groundwater was below the invert of the toe drain which makes it impossible to evaluate performance of the toe drain due to the lack of hydrostatic head. It is estimated that seepage will occur in the toe drain when the reservoir pool is above elevation 2175 feet. For location of observation wells, see figures 5-01 through 5-05.

f. The San Antonio Land and Water Company's water lines passes through the east abutment of the Dam. A manhole cover, covering one of the standpipes, was removed by vandals prior to the 1980 flood. As floodwaters rose, the open standpipe filled causing problems downstream.

g. In December of 1966, a Mr. Scheller was killed as Moreno Road in Montclair was washed out when the PVPA spreading grounds spilled. PVPA was notified of releases from San Antonio Dam, but failed to act on the notification.

h. In December of 1966, the San Bernardino Board of Supervisors passed a resolution which requires the PVPA to accept 900 cfs through their diversion structures during a standard project flood. In exchange for this agreement, the Corps would allow the San Bernardino County Flood Control District to attach the west State Street drain to San Antonio Creek Channel. This agreement has never been acted upon by the Corps.

Currently, the PVPA is incapable of accepting 900 cfs during a standard project flood. Since releases from Corps projects should not contribute to downstream flooding, the Corps would not insist that the PVPA accept 900 cfs. In addition, informal conversation with PVPA officials have raised the question of the San Bernardino Board of Supervisor's authority in passing this resolution.

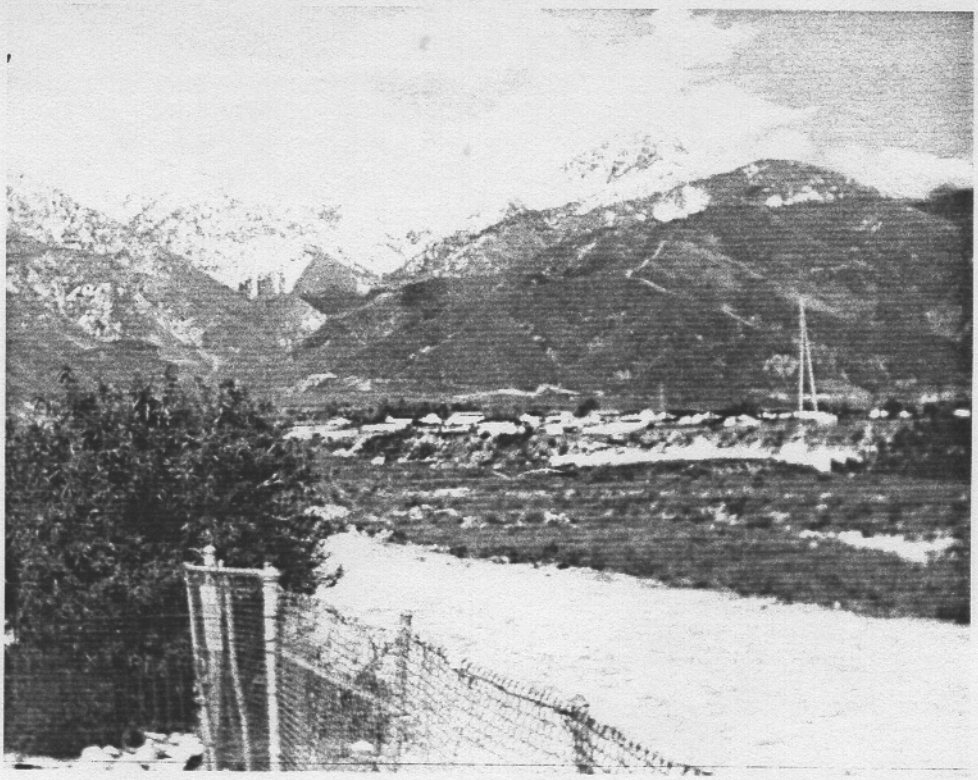


Figure 3-01 Cucamonga Peak and Canyon Just East of San Antonio Canyon. Looking Northeast.

Figure 3-02 Cucamonga Canyon Debris Basin. Looking Southeast.

IV - WATERSHED CHARACTERISTICS

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

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

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

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

The dam crosses the canyon mouth about one mile downstream from the apex of an alluvial fan, which extends southward 10 miles across the valley. This fan is the westernmost of a series of fans that coalesce to form a piedmont alluvial slope along the south front of the mountains. Over time, the larger

flood events have built up a large fan-shaped detrital cone (alluvial fan) at the mouth of the San Antonio Creek Canyon. The fan, one of the largest in southern California, averages about 2 miles in width and extends about 7 miles in the southerly direction to the vicinity of the City of Pomona. The cone is comprised mostly of large boulders, gravel, and coarse sand at the canyon mouth. The edges and apron areas of the fan are comprised of finer materials primarily sand, silt, and clay. The fan-bay above the dam is characterized by coarse alluvium containing many boulders as much as 3 feet in diameter and occasional ones as much as 10 feet. The maximum known thickness of stream-bed alluvium at the site exceeds 200 feet. Stream-bed alluvium in this vicinity is underlain by a basement complex of crystalline rocks and bordered by terrace deposits of older alluvium.

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

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

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

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

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

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

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

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

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

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

Plate 4-04 lists the mean and maximum monthly and annual precipitation, as well as the maximum daily precipitation for each month of the year, for Upland, California. Also listed in plate 4-04 are the probabilities (from 5 to 95 percent) for each month of the year that the monthly total precipitation at Upland will be equal to or less than the indicated amounts. This table demonstrates that there can be great year-to-year variability in

annual, monthly, and daily precipitation. Not listed in this table are the minimum observed monthly precipitation values, which in the Upland-San Antonio area are at most 0.01 to 0.02 inches for each month of the year.

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

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

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

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

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

4-06 Storms and Floods.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4-09 Channel and Floodway Characteristics. In order to protect the highly developed areas in the San Antonio Creek overflow zone downstream of the dam, channel improvements were made a part of the project. A total of 15.7 miles of channel improvements to San Antonio and Chino Creeks were completed in 1960. Detailed hydrologic studies were performed in order to determine the

channel capacities required to route the design dam release of 8,000 cfs with provisions for storm drain and tributary inflows. Design flows required a channel with the following capacities:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

a. Population.

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

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

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

(3) Cities.

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

b. Employment.

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

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

c. Agriculture.

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

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

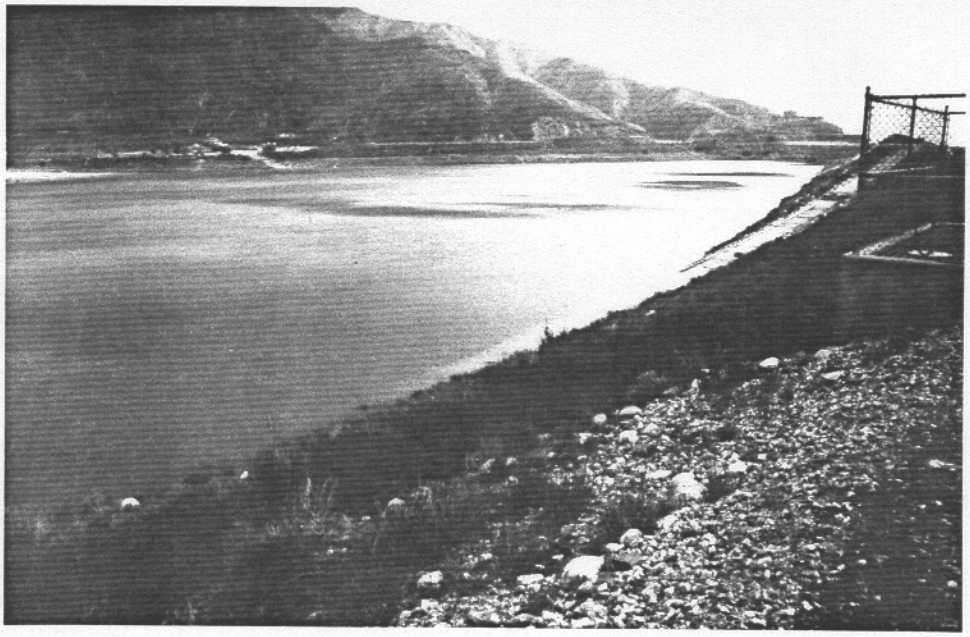


Figure 4-01 Floodwaters In San Antonio Reservoir
February 1980.

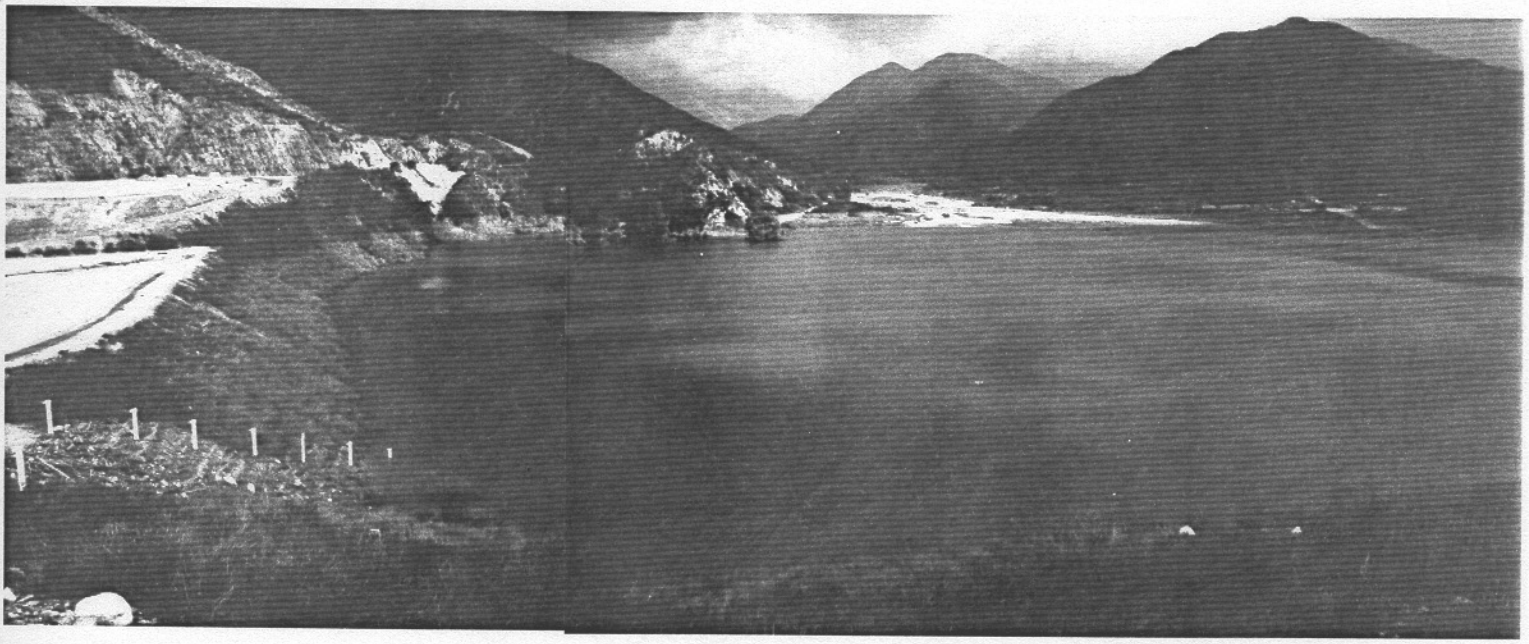
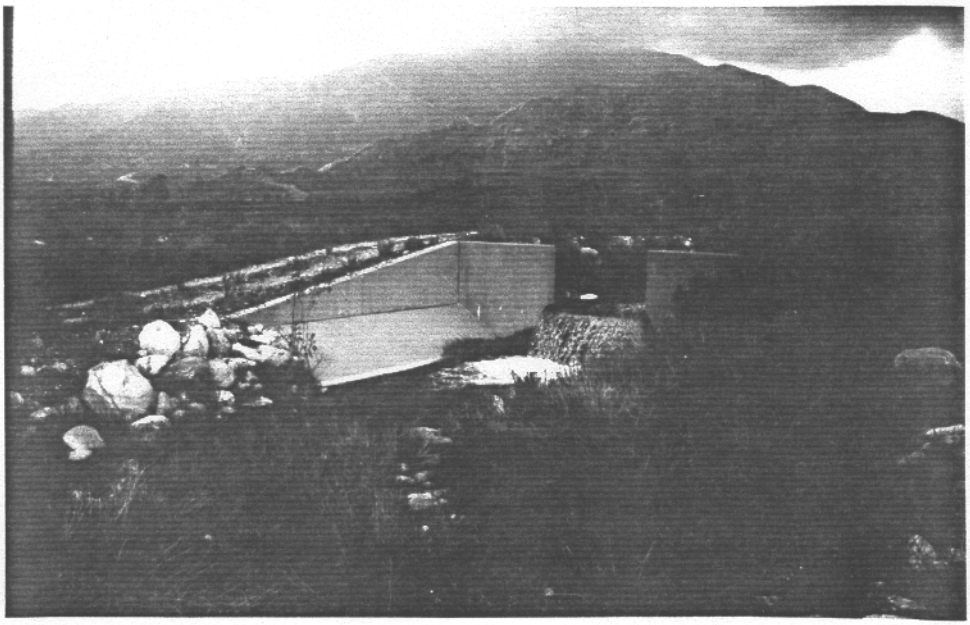


Figure 4-02 Floodwaters Entering San Antonio Flood Control Basin
February 1980.

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

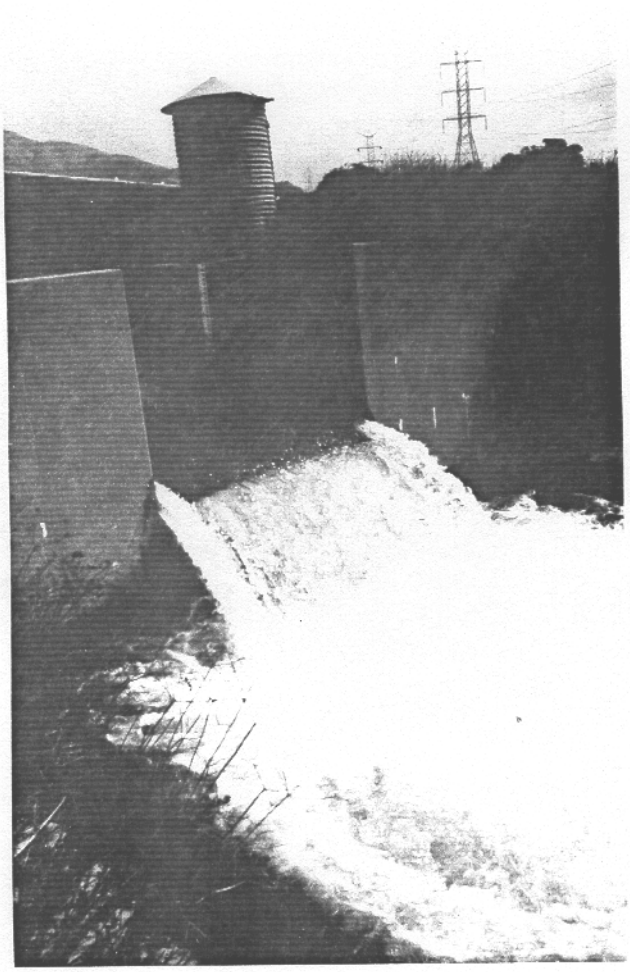
The San Antonio Canyon Water Treatment Plant, located at the base of San Antonio Dam, began operation early in 1990. The $7 million facility, owned solely by the City of Upland, is designed to treat and filter five million gallons of canyon water per day. The canyon water had not previously been used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

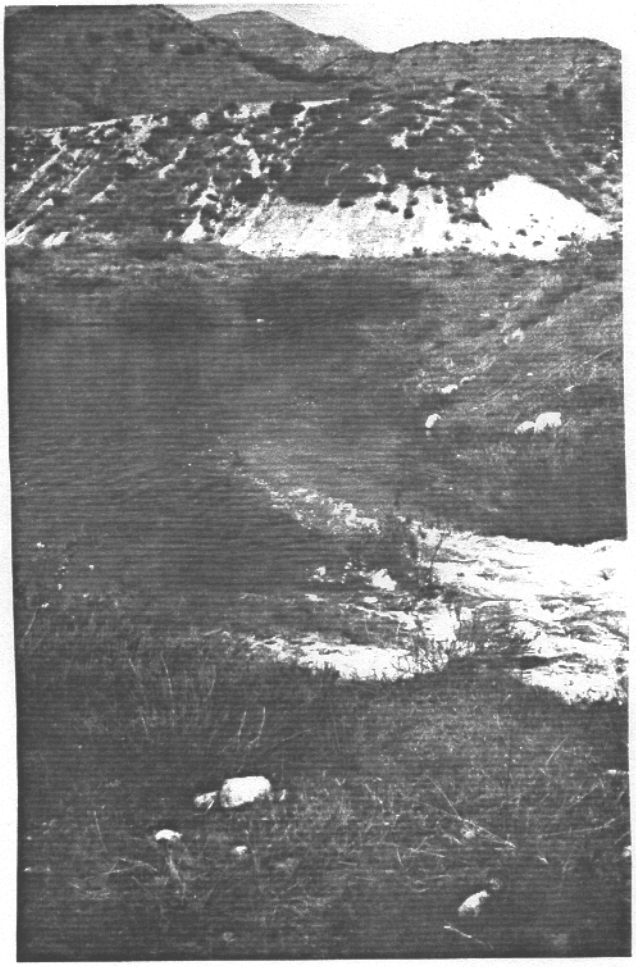
Water Conservation Spreading Below San Antonio Dam



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

Figure 4-04 a,b,c





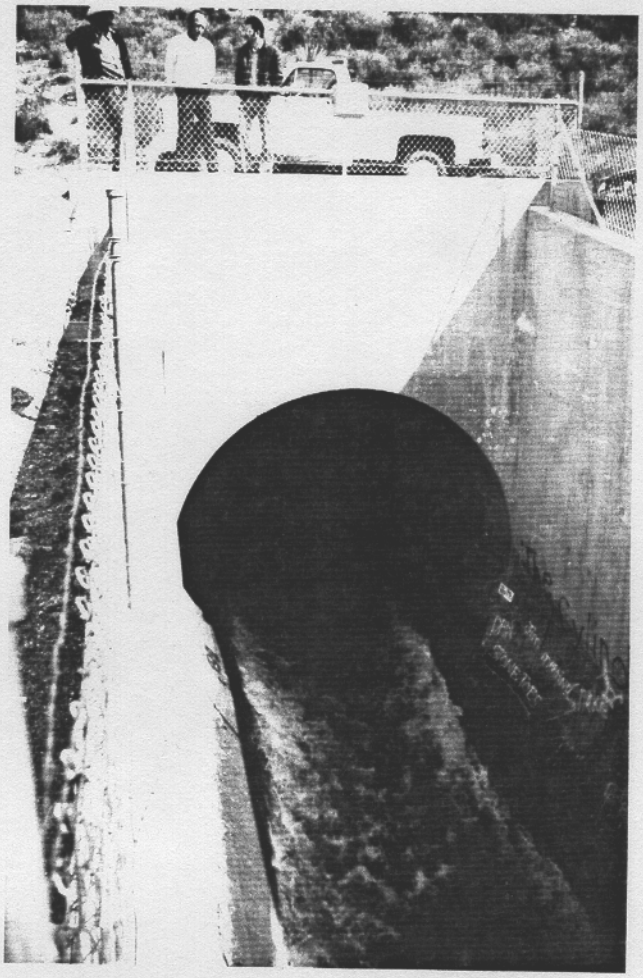


Figure 4-05 Water Passing Through San Antonio Dam Outletworks, 21 March 1980.

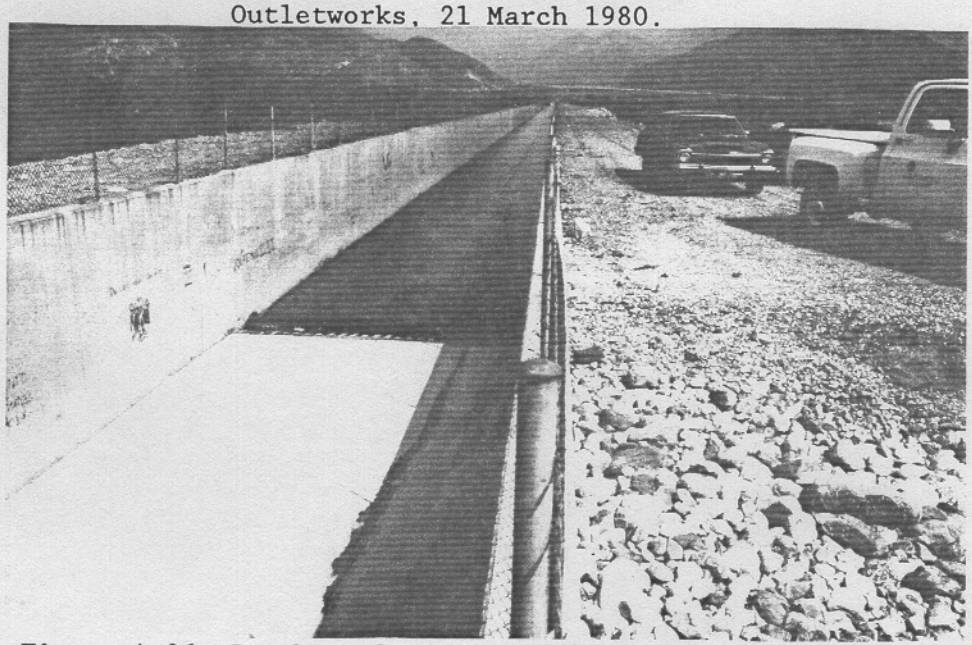


Figure 4-06 In-channel Diversion In San Antonio And Chino Creeks Channel For Water Spreading, 21 March 1980.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01 Hydrometeorological Stations

a. Facilities. Hydrometeorological data is obtained in the San Antonio Creek drainage area that provide accurate real-time information required for the operation of the Dam as well as providing a historical data base for performing various types of studies. Instrumentation at the San Antonio Dam provide data on precipitation, water surface elevation, and outlet gate settings. In addition, precipitation is recorded at stations on Mt. Baldy and on Chino Creek near the San Antonio Creek confluence. There are no stream discharge gaging facilities located on San Antonio Creek. There is a stage recorder on Chino Creek near the location of the precipitation station. Instrumentation at the dam site, parameters measured, and mode of reporting are listed on plate 5-01.

Real-time data is available through two telemetry networks operating in the region: (1) The Los Angeles Telemetry System (LATS) is operated in the LAD in Los Angeles County and the Santa Ana River Basin; and (2) The Automatic Local Evaluation in Real Time (ALERT) system sponsored by the National Weather Service (NWS) operates throughout Southern California. The San Bernardino County Flood Control District (SBCFCD) maintains a network of gauges within the ALERT system.

Plate 5-02 shows LATS and ALERT precipitation stations located in the Santa Ana River Basin. Plate 5-03 shows the stream gauges and reservoir water surface elevation gauges operating in the Santa Ana River Basin. LATS stations are identified by a four (4) letter alphabetic code and the ALERT Stations by a three (3) digit numerical code.

Through the LATS network, precipitation is monitored at Mt. Baldy (MTBY) and at San Antonio Dam (SNTO). Water surface elevation at the Dam is also monitored (SNTO). Data from these stations are transmitted directly to the water control mini computer (Harris 800) located in the LAD office. Through the ALERT network, precipitation is monitored at the Dam (#828), gauge height on Chino Creek (#819) and precipitation (#820). Data from these stations are transmitted to the offices of the NWS in Los Angeles and the SBCFCD in San Bernardino. The LAD is able to receive ALERT transmissions, since its offices are within radio range of the NWS's office.

b. Reporting. The data from San Antonio Dam and drainage area is reported in three separate ways. Readings are made visually by the dam tender, recorded automatically by recording gauges, and/or reported in real-time by telemetry to the LAD office. The releases from the dam can be monitored by the dam tender by the use of the gauge height immediately below the dam. The downstream gauge is being moved farther downstream in summer of 1991 to increase accuracy of readings, some of which were abnormal in past years due to roller waves discussed in Section 7-02, c.

(1) Manual. The San Antonio Dam tender reports by radio or telephone each morning (Monday through Friday) between 15 November and 15 April to the Reservoir Operations Center (ROC) of the LAD. The report includes water surface elevation, precipitation, and gate settings. Reporting is more frequent during periods of rain, as specified by the ROC. Between 15 April and 15 November, reports are made on Monday mornings only.

(2) Recording Instruments. Precipitation and water surface elevation are recorded on paper strip charts and on punched tape. Outlet gate settings are recorded on paper charts. These paper records are retrieved on a monthly basis in the rainy season and on a quarterly basis during the remainder of the year.

(3) Telemetry. Data from the LATS stations are obtained in one of three modes: On an event basis; on an interrogation or polled basis; and on a self timed preset interval. Data on precipitation and water surface elevation are automatically transmitted at a 24-hour interval. The event mode provides the majority of the data from the LATS gauges. Precipitation gauges are programmed to trigger a transmission on a 0.04 inch increment of rainfall. Water surface elevation recorders trigger a transmission on each 0.25 foot of change.

ALERT data transmission to the NWS can be monitored by the LAD. Also access to the Chino Creek stage and precipitation data (Station #819 and #820) can be obtained through the REPORT program resident on the Water Control Data System Mini Computer.

c. Maintenance. The Water Control Data Unit of the Reservoir Regulation Section (RRS) of the LAD is responsible for maintaining the gauges and instrumentation at the San Antonio Dam. The ALERT stations are maintained by the SBCFCD and the Mt. Baldy precipitation station is maintained by the NWS.

5-02 Water Measurement Stations. There are no water quality monitoring or sampling stations operated or maintained by the Corps within the San Antonio Creek drainage area, however records of toe drain observation well depths are taken when the pool is above elevation 2175 to evaluate performance of toe drains installed in 1985 (See Sect. 3-06d.) The location of the toe drain observation wells are shown in figures 5-01 through 5-05.

5-03 Sediment Stations. There are no sediment sampling stations located within the San Antonio Creek drainage area. Periodic surveys are performed within the reservoir area in order to determine the elevation-capacity relationships. The 1990 survey data indicates reservoir storage is 11,992 acre-feet at the top of the dam elevation 2260 as compared to 12,719 acre-feet when it was completed in 1956.

5-04 Recording Hydrologic Data. In addition to the LATS and ALERT data storedin a data base on the Water Control System computer, several forms are utilized. A report of daily observations is made 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 from the reservoir water surface recorder, reservoir computations are made by the Water Control Data Unit on form SPL-30, Reservoir Computations. Data from these forms are manually entered in DSS files on the Water Control System Computer. The information transmitted by radio or telephone to the Reservoir Regulation Section is recorded on form SPL-424, Reservoir Operation Report. This information is entered into the RESCAL computer program which stores the recordin a computer data base and produces a "Daily Reservoir Report" that is

issued by the Reservoir Regulation Section. However, the SPL-30 form is the official record of the District. Observation well data is reported as shown on figure 9-07 and is evaluated by LAD Geotechnical Branch. Examples of these report forms are shown in figures 9-01 through 9-07.

The strip chart of precipitation from San Antonio Dam is sent to the National Climatic Center in Asheville, North Carolina, for publication in the NOAA monthly report Hourly Precipitation Data. ALERT telemetry data is published by the State of California, Department of Water Resources on a monthly basis. The SBCFCD archives their data and will furnish these data to other agencies upon request. See plate 5-01 for Methods of Reporting.

5-05 Communication Network. The LAD maintains a voice communication network connecting all of its operations. This F14 radio system uses repeaters on Mount Disappointment and/or Pleasants Peak. When Pleasants Peak fails, Mt. Disappointment can be used to contact all dams, although difficulties may be encountered receiving transmissions from San Antonio Dam. In this event, the dam operator should use his mobile unit through the Toro Peak repeater. This network is backed up by a second, parallel radio system and by local telephone systems.

Power at the LAD office, and San Antonio Dam is backed up by emergency generators. If all systems fail at the LAD office, there is a complete radio system installed at the LAD Base Yard in South El Monte, eleven (11) miles to the east of the downtown office, that can be used to relay instructions to San Antonio Dam tender.

5-06 Communication With Project.

a. Between the ROC and San Antonio Dam. During the flood season (15 November through 15 April), a routine radio call is made at least once each day from the ROC to the San Antonio dam tender. This Reservoir Operation Report (or "morning report") is usually made at 0800 hours Monday through Friday. During flood events, the reporting interval is usually reduced to one hour with the ROC originating the radio 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 of these instructions for San Antonio Dam is included in Exhibit A of this manual.

b. Between San Antonio Dam and Others. No routine communication exists between San Antonio Dam and other agencies.

c. Between ROC and Others. Before and during the earliest stage of any reservoir releases, the LAD notifies officials of some eight (8) different agencies. 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 current notifications list is provided in plate 9-02.

5-07 Project Reporting Instructions. Through the utilization of data obtained through the LATS and possibly the ALERT network, the Reservoir Regulation Section regularly monitors rainfall and water surface elevations. The LAD maintains contact with the Dam tender on a regular basis. If a gate change is required, the Reservoir Regulation Section transmits a change order to the dam tender via radio. When the gate change is completed, the dam tender calls back to the LAD radio operator to confirm the change.

Other special instructions to the dam tender are conducted in similar fashion. Radio communication is used by the dam tender to report any malfunction of machinery or equipment or any other unusual conditions at the dam site.

5-08 Warnings. The responsibility for issuing all weather watches and warnings and all flood and flash flood watches and warnings rests with the 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. LAD is responsible for providing these officials with current information, and when possible, forecasts of water elevations within San Antonio Reservoir, and release rates to San Antonio Creek downstream of the dam.

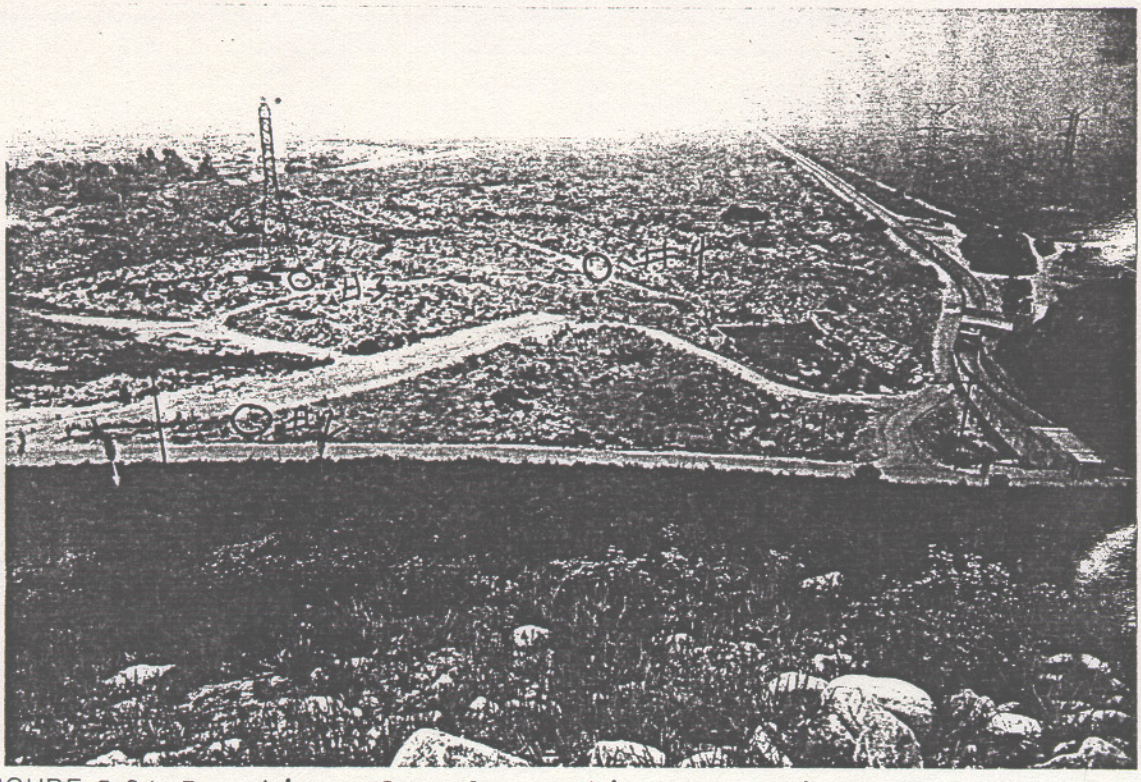


FIGURE 5-01 Location of 4 observation wells installed in 1959

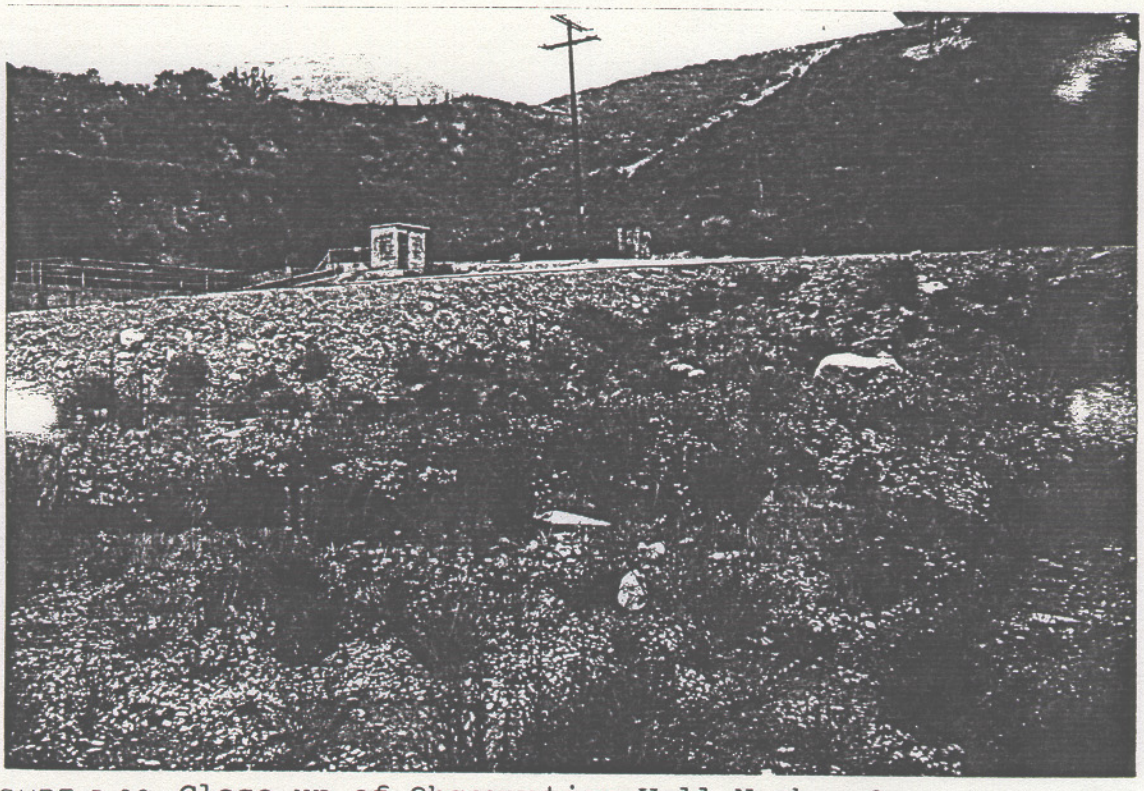


FIGURE 5-02 Close up of Observation Well Number 1

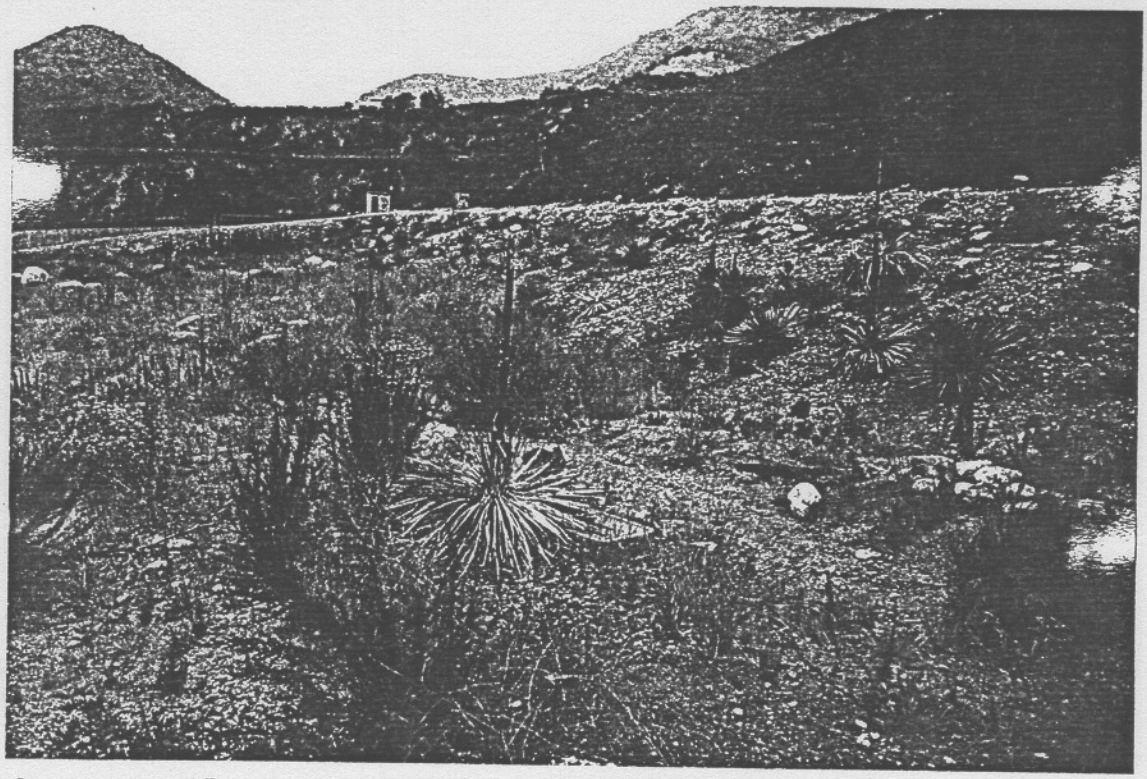


FIGURE 5-03 CLose up of Observation Well Number 2

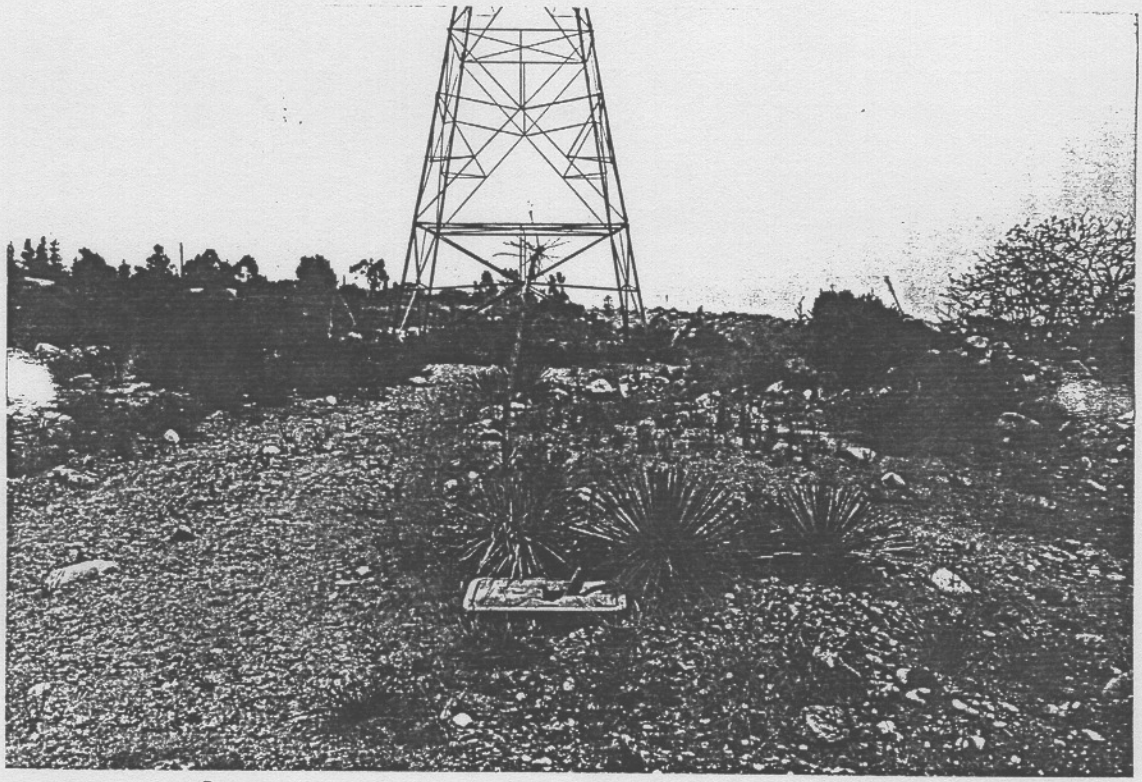


FIGURE 5-04 Close up of Observation Well Number 3

FIGURE 5-05 Close up of Observation Well Number 4

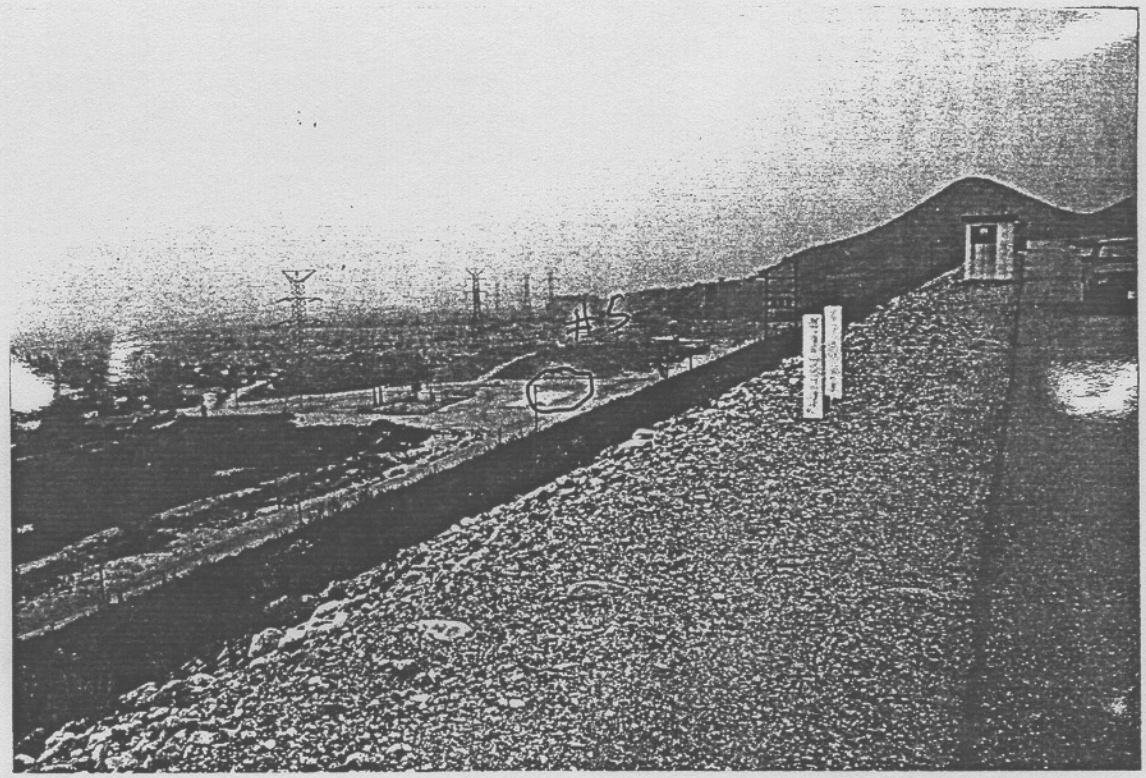


FIGURE 5-06 Location of Oberservation Well Number 5

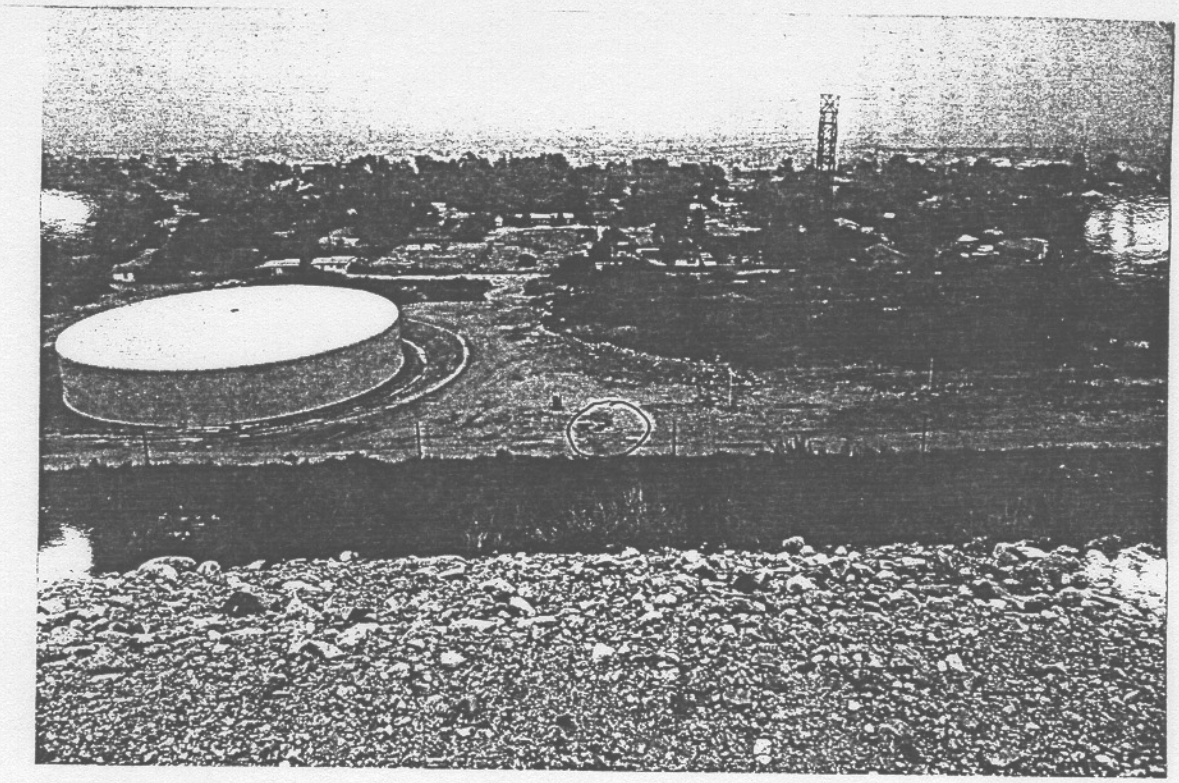


FIGURE 5-07 Location of Observation Well Number 6

FIGURE 5-08 Close up of Observation Well Number 6

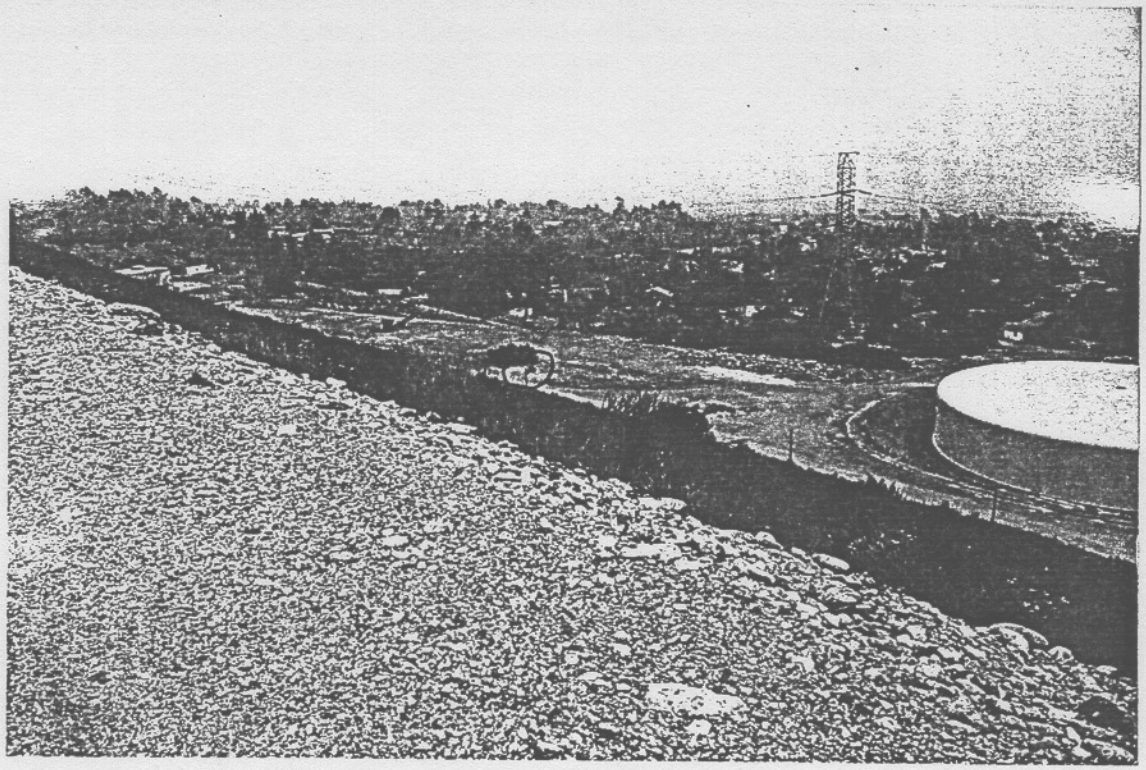


FIGURE 5-09 Location of Observation Well Number 7

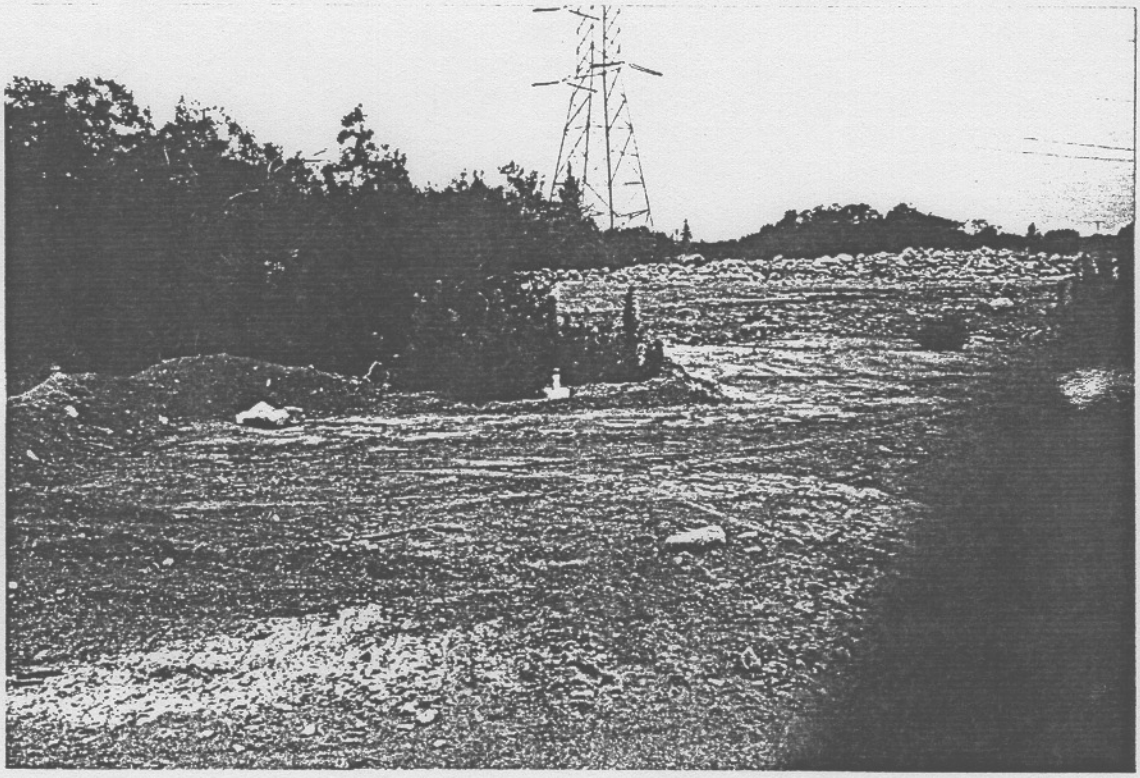


FIGURE 5-10 Close up of Observation Well Number 7

VI - HYDROLOGIC FORECASTS

6-01 General. There are no official hydrologic forecasts made by the U.S. Army Crops of Engineers or the National Weather Service (NWS) for San Antonio Dam. The water quality of San Antonio Creek is not predicted by any agency at this time.

a. Role of Corps of Engineers. Although no formal hydrologic forecasts are made for San Antonio Dam, the Corps of Engineers does carefully monitor conditions at the dam and makes a general forecast of inflow to the dam for floodflow regulation as needed. Any significant change in hydrologic conditions at the dam will prompt the LAD to notify pertinent agencies (see pl. 9-02), and coordinate with them when necessary.

The LAD has a Meteorologist on contract who prepares quantitative precipitation forecasts (QPF), when significant rain is forecasted in any region of the district. The San Antonio Dam watershed is a subbasin of the larger Santa Ana River watershed. Plate 6-01 shows the entire Santa Ana watershed and the eight zones which are used to model the precipitation of the watershed. The San Antonio Dam watershed is part of the Zone 3. The LAD Meteorologist lists QPF's for Zone 3 using the abbreviations SA03. The QPF assists in estimating the severity of the upcoming event, and in scheduling personnel to man the affected LAD facilities.

The LAD maintains historical data regarding the operation of San Antonio Dam. These data, while not of use in real-time, are important to studies of historical storms and floods that aid in the development and refinement of computerized rainfall-runoff forecasts models.

b. Role of Other Agencies. No other agency currently prepares forecasts of inflow to San Antonio Dam. The LAD does receive real-time weather reports and forecasts from the NWS. This is accomplished primarily by means of weather facsimile pictures and text forecasts received at the LAD office. Historical precipitation and streamflow data are also available from the LACDPW, OCEMA, NWS, USGS, and others.

6-02 Flood Condition Forecasts. San Antonio Dam and its watershed are included within the Santa Ana River Real-Time Water Control System (SARRT). The SARRT water control system uses several generalized computer programs developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center (HEC) in combination with calibrated data sets describing the subbasins of the Santa Ana River watershed.

Using the SARRT water control system, inflow flood hydrographs for San Antonio Dam can be generated. These forecast inflow flood hydrographs are based on real-time telemetry data and QPF's prepared by the LAD Meteorologist.

a. Requirements. The SARRT water control system uses the HEC program HEC1F to perform streamflow forecasting. The SARRT water control system requires from less than a minute up to several minutes to calculate a streamflow forecast for San Antonio Dam. The difference in computation time is due to whether one uses the SARK water control system to only calculate

the streamflow forecast or if one uses the SARRT water control system to complete an entire water control simulation over the entire Santa Ana watershed.

Plate 6-02 shows a schematic of the entire SARRT water control system HEC1F model. San Antonio Dam (SNTO) is located at the headwaters of San Antonio Creek which receives inflow from a single subbasin (M). The first control point for the subbasin is San Antonio Dam, control point 8. Several precipitation gages as well as the LAD Meteorologist's QPF are used by HEC1F to determine a subbasin hydrograph.

All reservoir storage at San Antonio Dam is allocated to flood control. (See pl. 7-01, Exhibit B). Note that releases for water conservation may be made below elevation 2,176 feet when projected reservoir inflows indicate rapid evacuation of this storage space is not needed to achieve flood control objectives.

b. Methods. Calculations of a forecast hydrograph for San Antonio Reservoir is a two step process. The first step is to run HEC1F in order to optimize the six runoff parameters which describe the San Antonio Canyon subbasin. HEC1F optimizes the pre-determined subbasin runoff parameters by "comparing" the observed hydrograph with the computed hydrograph. The six runoff parameters for the San Antonio Canyon subbasin are listed in table 6-01.

Table 6-01. Initial Runoff Parameters for the San Antonio Canyon Subbasin.

Time to Peak of the Unit Hydrograph	TP	4.12	hr.
Coefficient for Snyder's Method	CP	0.60	--
Starting Loss Rate	STRTL	1.28	in.
Constant Loss Rate	CNSTL	0.49	in./hr.
Base Flow at Time of Forecast	BFFCST	from current date	cfs
Recession Constant	RTIOR	1.005	--

The second step is the blending of the observed hydrograph with the calculated hydrograph. This is accomplished by running HEC1F using the F-Model data set. The blending procedure produces a smooth transition between the observed hydrograph and the computed hydrograph. Plate 6-03 illustrates the blending procedure. The observed hydrograph is used up to the time of forecast. Blending occurs over the subsequent six time ordinates. At the end of the sixth time ordinate the calculated hydrograph becomes the forecast hydrograph. Thirty minute time intervals are used by the SARRT water control system.

6-03 Conservation Purpose Forecasts. Hydrologic forecasts for water conservation are not routinely prepared by the LAD, however the Reservoir Operation Center will assess such factors as a major storm occurring at the

end of the flood season, local forecasts of more precipitation to come, reservoir elevation and need for water conservation in determining a decision to store water to be spread at 600 to 900 cfs for water conservation purposes.

6-04 Long Range Forecasts. Long range forecasts (in excess of 72 hours) are normally not prepared for San Antonio Dam and Reservoir. The reservoir regulation schedule will, in general, empty the reservoir quickly (less than 24 hours). Emptying of the reservoir is facilitated by the average downstream channel capacity of 8,000 cfs.

VII - WATER CONTROL PLAN

7-01 General Objectives. San Antonio Dam was originally designed and built as a single purpose flood-control facility. Flood protection is provided for the downstream cities of Upland, Claremont, Montclair, Pomona, Ontario, and Chino. Normally, San Antonio Dam is operated independently of other flood-control facilities within the Santa Ana watershed. Floodwaters are released as soon as available downstream channel capacity permits. In addition to flood-control, San Antonio Dam is operated for water conservation during periods of favorable weather and runoff forecasts. The channel capacities are schematically illustrated on pl. 4-12. Allocation of storage is depicted on pl. 7-01.

7-02 Major Constraints. The following constraints impact the regulation of San Antonio Dam and Reservoir:

a. Inadequate Downstream Channel Capacity.

(1) In 1966 the San Bernardino County Flood Control District requested that they be allowed to connect the West State Street Drain to San Antonio Creek. The Corps required that the SBCFCD agree to have the Pomona Valley Protective Association (PVPA) divert 900 cfs from San Antonio Creek during times of flood releases to compensate for the West State Street Drain's additional flows to San Antonio Creek. The minutes of December 19, 1966 of the San Bernardino County Board of Supervisors assures the Corps of Engineers that "the gates controlling the diversions of 600 cfs and 300 cfs into San Antonio spreading grounds will be kept open at all times during the occurrence of the channel design flood and to maintain capacity of the spreading grounds at all times to provide said flow".

(2) The Los Angeles District Hydrology Section's San Antonio Creek and Chino Creek Channel Updated Hydrologic Study, dated 1 April 1986, has demonstrated that, due to the increased urbanization downstream of San Antonio Dam, portions of the downstream channel are no longer capable of carrying either the 100-year or SPF flood events. The information developed was used for formulating policy regarding allowances of additional drains into the channels of San Antonio and Chino Creeks. At this writing the San Bernardino County Flood Control District is preparing a Master Drainage Plan for San Antonio and Chino Creeks. One of the primary purposes of the Master Drainage Plan is to accurately identify which portions of the channel are currently undersized so that corrective measures can be undertaken.

b. Roll Waves. A series of roll waves will form at low to moderate releases (i.e., releases 2,000 cfs). The roll waves cause over pressures to form at the (Sta. 1030+00) water-conservation diversion structure. This diversion should be monitored for damage during and after releases. Should damage occur to the diversion or channel an assessment should be made on the effects of future releases from San Antonio Dam.

7-03 Overall Plan for Water Control. Exhibit B is the Reservoir Regulation Schedule for San Antonio Dam. San Antonio Dam is operated to protect the communities along San Antonio and Chino Creeks from floods. In general, the

operational emphasis is to release stored water as quickly as possible without exceeding downstream channel capacity, thereby maintaining the greatest amount of flood-control space available for subsequent storm events. Reservoir releases for water conservation will be made in coordination with Los Angeles County Flood Control District, who co-ordinate requests from water agencies, between elevations 2,164 and 2,176 ft., whenever the forecasted reservoir stage will not exceed elevation 2,176 ft., and the weather and runoff forecasts are favorable. Reservoir releases from the debris pool will be made consistent with PVPA's capability to recharge the releases for water conservation through groundwater recharge.

Water conservation regulation between 2,176 ft and 2,164 ft is permitted because the reservoir storage space required for flood control can be recovered very quickly if needed to control subsequent inflows. With an average release of 8,000 cfs, the reservoir can be drawn down from 2,176 to 2,164 in 1-1/2 hours, assuming no inflow.

During the early stages of an inflow event, the stand-by setting of 0.3 ft, is maintained until a debris pool is formed at elevation 2,164 ft. From 2,164 ft. to 2,170 ft., the gates are opened as indicated on Exhibit B, increasing the outflow from 80 cfs to 5,030 cfs. Above elevation 2,170 ft., an average release of 7,500 cfs is maintained with the maximum release capped at 8,000 cfs. During falling stages the schedule is followed in reverse to elevation 2,176 ft., at which time a decision can be made to continue flood-control releases or go off-schedule for water-conservation regulation (Exhibit B). During water conservation operations, releases from San Antonio Dam are coordinated with the Los Angeles County Flood Control District. The determination to either commence or cease incidental water conservation operations is made by the LAD.

The Santa Ana River Real-Time (SARRT) runoff forecast model can be used to aid LAD personnel in determining the appropriateness of continuing scheduled flood control releases or commencing water conservation operations.

7-04 Standing Instructions to the Project Operator. The standing instructions to the project operator for regulation of San Antonio Dam and Reservoir are given in Exhibit A. During periods of normal communications, the dam tender will receive operating instructions from the Reservoir Operation Center, located at the District Office in Los Angeles. In the event that communications with the ROC are interrupted, the dam tender should follow the standing instructions in Exhibit A.

7-05 Flood-Control. The regulation of San Antonio Dam for flood control is described in this section. After major flood events, the reservoir regulation schedule should be reevaluated to determine if modifications to the schedule should be made to better protect the downstream communities and avoid spillway flows.

The reservoir regulation schedule, presented in para. 7-03 and Exhibit B, was formulated to pass inflow through the dam as quickly as possible, without exceeding the downstream channel capacity of 8,000 cfs. In this manner flood control storage space is maintained at a maximum in order to handle succeeding

flood inflow events. Reservoir releases will be reduced whenever downstream channel capacity is exceeded, or anticipated to be exceeded, due to the combination of reservoir release and locally heavy precipitation and runoff downstream of the dam. Specific actions related to the downstream channel capacity are:

a. The downstream gage on Chino Creek (ALERT Gage 819) should be monitored during flood releases. The channel design capacity at the gage is 17,000 cfs. If this flow is exceeded, releases from San Antonio Dam should be reduced accordingly.

b. Any reports of bank overtopping along San Antonio and Chino Creeks should be heeded and releases from San Antonio Dam reduced accordingly.

c. The SARRT water control system can be used by ROC personnel to forecast inflows to San Antonio Dam. Using the forecast information, operational decisions regarding current or anticipated releases from San Antonio Dam can be enhanced.

San Antonio Dam is a component of the Santa Ana River watershed. Releases from San Antonio Dam flow into Prado Reservoir located 15.7 miles downstream. The two reservoirs are normally regulated independently of each other. During extreme events, such as the 1980 flood, San Antonio Dam was operated off-schedule so as to achieve the basin-wide flood-control objectives of the entire Santa Ana River Reservoir system.

In the event of imminent spillway flow, the dam tender should be requested to report to the ROC with reservoir stage (staff) observations at frequent intervals. The operational objective at this point is to maintain a total combined release (outlet plus spillway) releases of 8,000 cfs. When the spillway flow from the dam exceeds 8,000 cfs, all gates should be closed.

The reservoir regulation schedule (Exhibit B) is applicable for the rising and falling limb of a flood event. Below elevation 2,176 feet the ROC has the option of going off-schedule, for the purpose of cooperating with PVPA water conservation operations, if runoff and weather conditions are favorable.

7-06 Recreation. There is no allocation of storage for recreation within San Antonio Dam and hence there are no recreation related releases scheduled for San Antonio Dam. The downstream channel is a rectangular concrete lined channel and is not suitable for recreational use.

7-07 Water Quality. San Antonio Creek upstream of San Antonio Dam drains the undeveloped, rugged, and mountainous San Antonio Canyon. Although the water quality of the runoff is relatively free of man-made pollutants, the runoff does carry a substantial debris load. Debris sizes vary from fines to boulders, which are carried down the canyon.

The Corps does not monitor the water quality in or through the San Antonio basin. San Antonio Reservoir does not normally maintain a pool except during flood events.

7-08 Fish and Wildlife. San Antonio Reservoir maintains no fisheries or wildlife sanctuary. The absence of a permanent pool and the on-going maintenance activity within the reservoir precludes the existence of either a fishery or wildlife sanctuary.

7-09 Water Supply-Drought Contingency Plan. The only Congressionally authorized purpose for San Antonio Dam is flood-control. It is, however, the policy of the Corps to assist local agencies in the conservation of water to the maximum extent possible without compromising the flood-control mission of a project. In the enclosure to accompany the Survey Report for San Antonio Creek and Chino Creek, California, Flood Control, April 15, 1938, paragraph 28, page 28, of the basis of design reads as follows:

> "28. Water Conservation.--The use of the San Antonio Basin to assist in water conservation is anticipated. It is proposed to provide two outlets in the dam for diversion to the spreading grounds on each side of the channel downstream from the dam."

During water conservation operation, releases are coordinated with the Los Angeles County Flood Control District. Chino Basin Water Conservation District and PVPA operate spreading grounds downstream of San Antonio Dam in both Los Angeles and San Bernardino Counties. The operation of San Antonio Dam for water conservation augments the quantity of water available to the Chino Basin member agencies. The Corps, however, does not control the quantity of water diverted by the PVPA nor does it control the end use of the diverted water. PVPA has and continues to have the option of diverting or not diverting water at any time except during an extreme flood event, as per San Bernardino County Flood Control District's commitment (See Section 7-02-a-(1)). In May 1991 we contacted the Pomona Valley Protection Agency to update the water spreading capacity of their facilities. Their head of operation, Mr. Cecil McAlister, informed us that their 1983 operation experience indicated that their basin infiltration capacity is limited to 450 cfs on the east side and is limited to 200 cfs on the west side of the San Antonio Channel. The major limiting factor is groundwater percolating into the aquifer from the backyards of nearby residential homes.

7-10 Hydroelectric Power. There are no hydroelectric power plants at San Antonio Dam.

7-11 Navigation. The San Antonio Creek is not suitable for any navigation.

7-12 Other.

a. Debris Removal Operation. The original design sediment inflow rate for San Antonio Dam was 67 ac-ft/yr. The July 1969 survey indicated that for the period from May 1956 to July 1969 the actual inflow sediment rate was 119 ac-ft/yr (i.e., 78 percent greater than expected). In an effort to compensate for lost flood-control storage due to the actual sediment inflow, a debris removal operation was begun in 1972. Based on 1990 survey data, the storage volume at top of dam elevation (2,260 ft.) is 11,992 ac-ft compared with the 1956 data of 12,719 ac-ft. The net capacity is that storage level at which the sediment allowance (2,000 ac-ft) is completely filled. Plate 7-02 compares the original gross and net storage capacities with the 1990 survey data for the San Antonio Reservoir.

The debris removal operator projects removal of an additional 1,860 ac-ft of material over the next 4 years. This would reflect a 24 percent increase in flood-control storage. It should be noted that these projections do not account for any debris inflows over the next 4 year period.

b. High Groundwater. A series of years with above average precipitation and runoff produces high groundwater conditions in the communities immediately downstream of San Antonio Dam.

The degree to which local spreading operations have contributed to the high groundwater problem has been an item of contention. It should be noted that although the water used in the spreading operations is diverted from San Antonio Creek, the Corps does not control the quantity of water diverted or the end use of the diverted water. The PVPA controls the diversion of flows leaving the San Antonio Dam.

7-13 Deviation from Normal Regulation. As previously discussed in Sections 7-05 and 7-09, deviations from the reservoir regulation schedule as presented in Exhibit B may be desirable or necessary at times. In addition to the previously discussed situations the following deviations can also be considered by the ROC.

a. Emergencies. Emergencies may take the form of drownings or other accidents, chemical spills, and failure of operation facilities. Necessary action should be taken immediately, so long as this does not create a worsened overall condition. In any action taken, assessment of the situation by the dam tender should rely on his knowledge of the dangers involved. The Reservoir Operation Center, LAD, and the Water Control Center of South Pacific Division should be informed of any deviations due to emergencies as soon as practical.

b. Unplanned Minor Deviations. Instances arise where there is a need for minor deviations from the normal regulation of the reservoir, although they are not considered emergencies. Construction activities are the primary source of these deviations. Downstream maintenance of culverts and channel sections are another reason for minor regulation changes. Each request is analyzed on its own merits. Consideration is given to the potential of flooding and possible alternative measures. Approval for these minor deviations should be obtained from the Reservoir Operation Center, LAD, and should also be coordinated with approval from SPD.

c. Planned Deviations. There are planned instances which require deviations from normal regulation. Each condition is to be judged on its own merits. One possible deviation may involve impounding water for the purpose of making test releases to correlate the gate rating curves with measured outflow. Request for planned deviations would most likely originate from either the Reservoir Operations Center, LAD or the San Bernardino County Flood Control District. Any planned deviations would require the approval of the Reservoir Operations Center, LAD, as well as approval by the Water Control Center of South Pacific Division.

7-14 Rate of Release Change. The outlet gates consist of three 5'8" x 10'0" rectangular slide gates operated by hydraulic cylinders. The adopted design

is an improved design based on results of the full scale tests made by the Corps of Engineers at Norfolk Dam in April 1948. These tests indicated that if the gate leaf and liners were shaped as shown on Drawing, O.C.E. 72/2 (Rev. 20 Aug. 1947), "Typical Slide Gate Details", gate chatter at partial openings would be reduced to a minimum. Further stabilization of movement of the gate leaf has been assured by specifying tight fitting piston rings and careful finishing of the inside of the hoist cylinder, and by adding a counterbalance valve to the oil lines between the upper and lower ends of the cylinders. The weight of the moving parts of one gate is around 14,000 pounds. The three hydraulic gates at San Antonio Dam move at a rate of 1 ft/min. The dam tender can operate one gate at a time in succession, operating controls on one until the desired setting is reached, then operating the adjacent gate. The concrete lining of the downstream channel precludes concern over bank erosion or sloughing, or rate of change of outflow.

7-15 Water Control Planning Tools. Specific planning tools have been utilized in the development of the water control plan. These tools are also used to evaluate and regulate planned deviations, and also facilitate operation of the dam during emergencies and unplanned deviations. Water control planning tools used for San Antonio Dam include:

a. Outlet Rating Curves (pl. 2-05).

b. Spillway Discharge Curve (pl. 2-08).

c. Area-Capacity Tables (pl. 2-11).

d. Downstream Channel Capacity Plate (pl. 4-12).

e. SARRT Water Control System (Sec. 6-02; pl. 6-02, 6-03).

VIII - EFFECT OF WATER CONTROL PLAN

8-01 General. Although the only congressionally authorized purpose for San Antonio Dam is flood-control, water conservation operation as approved by the Office of the Chief of Engineers has also provided additional water supply benefits. The communities of Upland, Montclair, Pomona, Ontario, and Chino are protected from the floodwaters originating from the steep and rugged San Antonio Canyon. In addition to flood protection the above communities also benefit from augmented water supplies for their spreading operations, when the dam is operated for water conservation.

8-02 Flood Control.

a. Spillway Design Flood. Corps dams are designed to safely pass (i.e., without overtopping and/or dam failure) the Probable Maximum Flood (PMF). The PMF is based upon the most severe combination of rainfall and runoff conditions that could reasonably occur. In both the original and revised PMF flood routings the reservoir outlets were assumed blocked and the reservoir was filled to the spillway crest at the beginning of the flood.

(1) Original Criteria. The San Antonio Dam spillway was designed in 1951 to pass a flow of 53,700 cfs having a surcharge on the ogee crest of 16.9 ft. An additional 5.1 ft. of freeboard placed the top-of-dam at elevation 2,260 ft.

The original PMF was based on the U.S. Weather Bureau's estimate of maximum possible precipitation. A constant precipitation loss rate of 0.15 in/hr and a constant base flow of 1,300 cfs were used to develop the PMF. The resulting peak inflow to San Antonio Dam was 60,000 cfs with a total runoff volume of 18,500 ac-ft over a 22 hour period.

(2) Revised Criteria. The probable maximum flood was selected as the spillway design flood. Estimates of the probable maximum precipitation for the basin above San Antonio Dam site is given by the Hydrometerological Section of the United States Weather Bureau in the report dated August 1972, titled "Probable Maximum Thunderstorm Precipitation Estimates for Southwest States", which was revised 5 April 1973. The 6-hour basin average PMP thunderstorm had a maximum 1/4-, 1/2-, l-, 2-, 3-, 4-, 5-, and 6-hour precipitation values of 3.4, 5.0, 6.6, 8.4, 9.7, 10.5, 11.2, 11.9 inches respectively, compared with original 1/2-, l-, and 3-hour values of 3.1, 5.5, and 12.0 inches. A 15-minute time interval was selected as it provided adequate definition of unit hydrograph. The time distribution of rainfall was patterned after the rainfall-time sequence from EM 1110-2-1411. The basin lag time was reduced 15 percent to account for the reduction in time of concentration of rainfall excess characteristics of large floods where the hydraulic efficiency of the watershed was increased by high depths of flow. The loss rate was taken as a constant equal to 0.15 inches per hour for the entire duration of the storm. A basin n value of 0.05, along with the Mountain S-graph was used to develop the synthetic unit graph. A constant base flow of 1,300 cfs was adopted from the previous study. The probable maximum flood peak inflow for San Antonio Dam, using the updated PMP criteria, is 59,700 cfs which is almost identical to the original peak inflow. The

volume for the probable maximum flood, using the updated PMP criteria is 18,200 acre-feet as compared to the original estimate of 18,500 acre-feet. Plate 8-01 shows the revised PMF routing.

The revised spillway design (probable maximum) flood for San Antonio Dam was routed through the reservoir assuming all outlets blocked and the reservoir filled to spillway crest at the beginning of the flood. This routing (see pl. 801) resulted in a maximum water surface elevation of 2254.4 which is 5.6 feet below the existing top of dam (El. 2260).

Based on a design wind speed of 45 mph from the north and using the procedure described in ETL 1101-2-221, the calculated freeboard was 2.4 feet. However, a minimum freeboard of 3.0 feet is required for a Standard 1 dam with a protected downstream face (App. A, EC 110-2-163). The available freeboard is 5.6 feet.

b. Standard Project Flood (SPF). The Standard Project Flood selected as the reservoir design flood for San Antonio Dam has an inflow peak of 19,000 cubic feet per second and maximum 2-day volume of 22,500 acre-feet. The flood was based on the January 1943 storm which had flood-producing characteristics more severe than any storm that occurred during the 77-year period 1880-1956. This storm as transposed so that it was centered over the drainage area above the dam and was assumed to occur when ground conditions were similar to those existing prior to the March 1938 storm. Rainfall loss rates were assumed to vary from 0.80 inch per hour at the beginning of the storm to 0.15 inch per hour at the end of the storm with an average loss rate of 0.40 inch per hour. A base flow, varying from 400 cubic feet per second at beginning of storm runoff to a peak of 1,300 cubic feet per second was assumed. Snowmelt was not considered an appreciable factor in developing the flood.

(1) Original Criteria. The original planned reservoir regulation schedule restricted outflows from San Antonio Dam to 8,000 cfs. With this release constraint the SPF would form a maximum pool elevation 2,238 ft (i.e., spillway crest).

(2) Revised Criteria (1978). At the time of project completion in 1956, it was determined that sufficient downstream channel freeboard existed to permit a maximum release of up to 8,500 cfs for short periods of time. With this revised schedule the SPF would form a maximum pool elevation of 2230.7 ft. This is 7.3 ft. below spillway crest which indicates that San Antonio Dam provides better than SPF protection.

(3) The 1991 Operations Criteria. The recent hydraulic analysis (See Sect. 7-02, a. (2)) has shown that the maximum channel capacity below San Antonio Dam is 8,000 cfs. The reservoir design flood (SPF) is routed through the Dam, with reduced gate openings for maximum release set at 8,000 cfs and the maximum water surface elevation reached 2231.92 ft. This is about 6.08 feet below the spillway crest (2238 ft.) leaving approximately 1034 ac-ft of emergency flood-control storage space to spillway crest relative to net capacity. Plate 8-02 shows the revised routing of the SPF through San Antonio Dam.

c. Other Floods.

(1) Storms and floods of January 1969. A series of storms that began on January 18 and continued through January 27 was caused by a strong flow into southern California of very warm, moist air originating over the tropical Pacific Ocean south and east of Hawaii. This series of storms was interrupted by a brief ridge of high pressure that moved through the area on January 22 and 23 and caused a short break in the rainfall. Except for this lull on January 22 and 23, heavy precipitation occurred during most of the January 18-26 period. An intense downpour occurred on January 25. Nine-day totals ranged from 10 to 20 inches in the lowlands and from 25 to more than 50 inches over mountain areas of southern California. The total storm amount at Mt. Baldy Notch was nearly 53 inches, including 28.25 inches during the two-day period 24-25 January. Lytle Creek Ranger Station recorded over 42 inches. Peak discharge on San Antonio Creek (USGS 11-0730) 4.5 mi. above San Antonio Dam was 16,400 cfs on 25 January, while peak inflow to San Antonio Reservoir was recorded at 6570 cfs on 25 January. Plate 8-03 displays storm data for this flood event at San Antonio Reservoir.

(2) Storms and floods of February 1969. The storm series that occurred in late February 1969 climaxed more than a month of extremely heavy, recurring rainfall in southern California. The storms occurred as a number of Pacific cyclones traveled southward off the west coast of the United States and then curved inland across California carrying copious quantities of moisture. Several cold fronts and other disturbances that moved across southern California from 22 February through 24 February dropped moderately heavy amounts of precipitation. Early on 25 February a strong cold front moved slowly southeastward across southern California; the front was accompanied by strong low-level winds that, when lifted by the mountains, resulted in great quantities of orographic precipitation. As a result, rainfall was generally heavy everywhere and particularly heavy in the mountains. Total storm amounts recorded at selected mountain stations were 19.5 inches at Mt. Baldy Notch, including 12.45 inches on in two days, 24-25 February, and 14.22 inches at nearby Lytle Creek, including 11.85 inches during the same two days. Peak discharge on San Antonio Creek (USGS 11-0730) 4.5 mi. above San Antonio Dam was 4,560 cfs on 25 February, while peak hourly inflow to San Antonio Dam was 3132 cfs on 25 February. San Antonio Dam recorded a higher proportion of the discharge, reflecting more highly saturated soil conditions due to the prior January 18-26 storm. Plate 8-04 displays storm data for this flood event at San Antonio Reservoir.

(3) Storm and flood of February 1978. After several moderately heavy storms during January and early February 1978, one low-latitude Pacific storm developed west of southern California and moved into the area during the night of 9-10 February. After a day of heavy rain in the San Gabriel and San Bernardino Mountains on 9 February, a major cloudburst struck portions of coastal southern California during the early hours of 10 February, with brief intensities exceeding 3 inches per hour. The very heaviest rain fell in Los Angeles County, but several stations in the Santa Ana River Basin reported intense rainfall between 0200 and 0400 hours 10 February, including 1.6 inches in 2 hours at Lytle Creek Ranger Station and 1.2 inches in 1 hour at Running Springs, in the mountains east of San Antonio Creek. The peak hourly

discharge on San Antonio Creek for that period was 2070 cfs at San Antonio Dam on 10 February at 0600 hours. Plate 8-05 displays storm data for this flood event at San Antonio Reservoir.

(4) Storm and flood of March 1978. In a pattern very similar to that of exactly 40 years earlier, a series of low-latitude Pacific storms moved in southern California at the end of February and beginning of March 1978. There were four major periods of rainfall during the storm period: 28 February, 1 March, 4 March, and 5 March. Total rain from 27 February through 6 March exceeded 29 inches in the eastern San Gabriel Mountains, with Lytle Creek Ranger Station recording 29.62 inches. The heaviest sustained rain fell during the mornings of 1 March and again during mid-day 4 March. The Lytle Creek station measured up 2.7 inches in 3 hours on 4 March. With the ground highly saturated from an already very wet winter, runoff from these storms was very high, especially in terms of flood volumes. The water surface elevation behind San Antonio Dam reached 2198 ft NGVD on 15th of March. The peak flow for the storm period on San Antonio Creek was 2040 cfs on 5th of March.

(5) Storm and flood of February 1980. The floods of February 1980 resulted from a series of low-latitude Pacific storms that moved into southern California from out of the west. The heaviest bursts of rain occurred on 14, 16, and 19 February. Rainfall intensities of 1 inch per hour for 5 to 6 hours was observed in the Sepulveda Basin during the afternoon of 16 February. Briefer bursts occurred in other areas, where Lytle Creek Ranger Station reported exactly 1 inch in 1 hour and 2.6 inches in 3 hours. The water surface elevation behind San Antonio Dam reached 2225.6 ft NGVD on 6 March. The peak flow for the storm period on San Antonio Creek was 1624 cfs on 16th of February. Plate 8-06 displays storm data for this flood event at San Antonio Reservoir.

(6) Storm and flood of February-March 1983. During the winter of 1982-1983 a series of low-latitude Pacific storms moved into southern California from the west from late November through February. These storms were the result of atmospheric flow patterns associated with the strongest El Nino condition since at least 1891. The rains climaxed between 25 February and 2 March 1983, during which a storm reminiscent of those of 5 and 45 years earlier moved into southern California at the end of February and first of March 1983. Up to 20 inches fell in the Lytle Creek area (approximately 8 inches of it on 1 March), with 12-18 inches in other San Gabriel Mountain areas and 8-10 inches over the foothill areas. The heaviest rainfall 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. Several stations experienced rainfall having return periods in excess of 100 years for durations between 30 minutes and 6 hours. One Los Angeles County cloudburst of 2 inches in 5 minutes (Bel Air Hotel, 1 March 1983) was more than 4 times the 100-year rainfall for that duration at that station. Plate 8-07 displays storm data for this flood event at San Antonio Reservoir.

The rainfall through late February had saturated the ground everywhere, resulting in very favorable runoff conditions when the storm of 1-2 March dropped warm rain over the basin. The maximum hourly inflow to San Antonio Reservoir on 1 March was 998 cfs with maximum reservoir level 2188 ft.

8-03 Recreation. There are no recreational facilities either upstream or downstream of San Antonio Dam which depend on or are affected by the inflows to San Antonio Dam.

8-04 Water Quality. The short residence time of floodwaters does not appreciably affect the water quality within the reservoir.

8-05 Fish and Wildlife. The short inundation time does not adversely affect the vegetation within the reservoir and has minimal adverse affects on wildlife. There are currently no threatened, endangered, or candidate species within the reservoir. There are no fisheries within the reservoir. A Finding of No Significant Impact (FONSI) for this Water Control Plan was issued in the Environmental Assessment for the San Antonio Dam Water Control Plan, dated June 1991 (Exhibit D).

8-06 Water Supply. San Antonio Dam can be operated for water conservation below water surface elevation 2,176 ft. when runoff and weather forecasts indicate that no compromise of the flood control purpose of the dam will occur.

Regulation of the dam for water conservation enables augmentation of local water supply through the downstream groundwater recharge of floodwaters released.

8-07 Hydroelectric Power. There are no hydroelectric power facilities at San Antonio Dam.

8-08 Navigation. San Antonio and Chino Creeks are ephemeral streams and therefore not suitable for navigation. During floodflows the steep supercritical flows preclude safe use of the waterways and so navigation of any kind is prohibited at all times.

8-09 Frequencies.

a. Peak Inflow and Outflow Probabilities. Plate 8-08 is an analytical graph of the peak inflow frequency at San Antonio Dam computed from the historical records at the damsite from 1931 to 1990. Plates 8-09 and 8-10 are best fit graphical curves of median plotting points of peak annual outflow and reservoir elevation data of San Antonio Dam. The table on plate 8-11 gives specific values of inflow, outflow and filling frequency for San Antonio Reservoir as derived from curves shown on plates 8-08, 8-09, and 8-10.

b. Pool Elevation Frequency. Plate 8-10 shows the computed elevation frequency curve for San Antonio Dam. The values for this curve at specific return periods is listed on plate 8-11.

8-10 Other Studies.

a. Hydrology. The "Interim Report on Hydrology and Hydraulic Review of Design Features of Existing Dams for Carbon Canyon, San Antonio, and Tahchevah Dams" dated August 1978 reevaluated the hydrology of the San Antonio Canyon

upstream of San Antonio Dam. The Probable Maximum Flood routing presented on plate 8-01 was taken from this report.

b. Channel and Floodway Improvements. The cursory report "San Antonio Creek and Chino Creeks Channel Updated Hydrologic Study" dated April 1986 determined that portions of the downstream channel are no longer capable of carrying either the Standard Project Flood or the 100-year flood. In light of this information, the San Bernardino County Flood Control District is currently developing a Master Drainage Plan for the area. One of the primary goals of the study will be to accurately identify the inadequate portions of both San Antonio and Chino Creeks so that corrective measures can be taken.

IX - WATER CONTROL MANAGEMENT

9-01 Responsibilities and Organization

a. Corps of Engineers. San Antonio Dam is owned, operated, and maintained by the U.S. Army Corps of Engineers, LAD. The LAD has complete regulatory responsibility for the dam and reservoir lands. The Reservoir Regulation Section of the LAD is charged with the responsibility of directing reservoir operations. Plate 9-01 shows the organization and chain of command for regulatory decisions at San Antonio Dam.

The improved downstream San Antonio and Chino Channels are maintained by the U.S. Army Corps of Engineers, LAD. Maintenance activities within the channel are coordinated between the Construction Operations Branch and the ROC.

The LAD has a responsibility to notify the public of pending changes in reservoir release rates. Plate 9-02 contains the list of key agencies that are contacted by the LAD during flood operation at San Antonio Dam.

During operations, the Reservoir Regulation Section issues gate operation instructions to the dam tender. Instructions are communicated via the LAD radio network system. In the event that communications between the Reservoir Regulation Section and San Antonio Dam are interrupted, the dam tender has a set of Standing Instructions to follow until communication is reestablished. Exhibit A contains the Standing Instructions to be followed by the San Antonio Dam Tender. The dam tender is assigned to the Operations Branch of the Construction-Operations Division of the LAD. The overall duties of the Dam tender are listed in Table 9-01.

The Corps is responsible for maintenance of the downstream channel to Prado Reservoir.

Table 9-01. Duties of the Dam Tender.

- Routine test operation and maintenance of the project.
- Services all gages and recorders (winds the clocks, installs new record paper, etc.)
- Operates the gates in accordance with instructions from the Reservoir Regulation Section.
- Guards the project against vandalism, sabotage, and fires.
- Guards against unsafe conditions in the project area.
- Performs routine inspection and maintenance.
- Reports on trespassing and encroachment of right-of-way.
- Maintains the best possible relations with communities interested in the project.

b. Other Federal A Agencies. The U.S. Army Corps of Engineers, LAD, is the only federal agency with water control responsibilities at San Antonio Dam.

c. State and County Agencies. No County of State agencies have regulatory responsibilities for flows passing through San Antonio Dam. The Corps does remain in close contact with the LACDPW and the SBCDPW during flood events, in order to assess downstream conditions. In this way the ROC can determine the appropriate regulation schedule for the existing conditions.

d. Private Organizations. There are no private organizations which have regulatory responsibilities for flows passing through San Antonio Dam. The Corps does maintain close contact with the PVPA, when water is available for water conservation. The PVPA is solely responsible for maintaining its division works and determining the quantity of water to be diverted by its diversion works.

9-02 Interagency Coordination. The U.S. Army Corps of Engineers, LAD, coordinates with other federal, state, county, and local organizations and informs the press concerning flood control activities at San Antonio Dam and Reservoir.

a. Local Press and Corps of Engineers Bulletins. The Public Affairs Office of the Corps of Engineer, LAD is responsible for notifying the press regarding operations at all District dams. 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 to the general public. These notifications are the responsibility of the National Weather Service (NWS).

b. National Weather Service. The Corps of Engineers, LAD, utilizes NWS data and forecasts to assist in the operation of San Antonio Dam. The LAD shares data with the NWS and other agencies both on a real-time basis and on a post-event basis.

c. U.S. Geological Survey. The Corps of Engineers receives streamflow data from the U.S. Geological Survey, primarily on a historical basis in southern California. The LAD coordinated data collection on San Antonio Creek just downstream of the Dam with the USGS through the Cooperative Stream Gaging Program. The gage (11073200) was taken out of operation in 1980.

d. Other Agencies. The Corps of Engineers, LAD, cooperates to the extent possible with the water conservation activities of Chino Basin Water Conservation District and the Pomona Valley Protective Association (PVPA). PVPA personnel are notified prior to releases from the reservoir so that they can adjust their gates and divert according to their needs at that time.

9-03 Interagency Agreements. There are no formal agreements in effect with any agency.

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

a. Santa Ana Watermaster. On April 17, 1969, the Orange County Superior Court entered a Stipulated Judgment in Case No. 117628 involving the Orange County Water District vs. City of Chino et al. The judgment, which became effective on October 1, 1970, contained a declaration of rights of the entities in the Lower Area of the Santa Ana River basin (i.e., the Orange County Water District) as against those in the Upper Area (i.e., the San Bernardino Valley Municipal Water District, the Western Municipal Water District, and the Chino Basin Municipal Water District). The arrangement leaves to each of the major hydrologic units in the watershed the determination and regulation of individual rights therein and the development an implementation of its own basin management plans. A court appointed Watermaster, consisting of five persons, prepares an annual report of the Santa Ana Watermaster which documents and accounts for flows within the Santa Ana River. San Antonio and Chino Channels are tributary to the Santa Ana River and are therefore monitored by the Santa Ana Watermaster.

9-05 Reports. As required by ER 1110-2-240 "Water Control Management," the LAD prepares three types of reports for transmittal to the South Pacific Division Office concerning the operation of San Antonio Dam:

a. Annual Division Water Control Management Report (RCS DAEN-CWE-16 (R1)). This report covers significant activities of the previous water year and a description of project accomplishments planned for the current year.

b. Summary of Runoff Potential in Current Season (RCS DAEN-CWO-2). This report is generally submitted monthly during the storm season (October 15-April 15), and covers snow accumulation and runoff potential in the District. Supplemental reports are submitted in the event of severe situations.

c. Monthly Water Control Charts (RCS DAEN-CWE-6 (R1)). A monthly record of reservoir operations prepared in either a graphical or tabular format.

d. Forms used for reporting reservoir data are shown in figures 9-01 through 9-07.

Two reports that are produced for District use are:

a. Flood Control Basin Operation Report. A report of daily observations is made at the dam and this record, figure 9-01, is stored at the Water Control Data Unit of the Reservoir Regulation Section in the District's baseyard office.

b. Daily Reservoir Report. The daily observations from the data are entered into the RESCAL computer program which stores the record in a computer data base and produces a "Daily Reservoir Report" that is issued by the Reservoir Regulation Unit.

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 9-01

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 OUT-LETS CFS	INST. OUTFLOW DOWNSTREAM G. HT. FT.	INST. OUTFLOW DOWNSTREAM FLOW CFS	HRS.	STORAGE CHANGE ACRE-FEET	STORAGE CHANGE CFS	AV. OUT-FLOW CFS	AV. INFLOW CFS	GATE SETTINGS FT.
PREVIOUS REPORT													
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	10												
	11												
	12												
	13												
	14												
	15												
	16												
	17												
	18												
	19												
	20												
	21												
	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

ARMY - C. OF E. - LOS ANGELES

FIGURE 9-02

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	GH					LACFCD DIVERSION GATE OPEN FT. GATE 1 OPEN FT. GATES 2, 3, & 4 OPEN FT. FT. ☐
		E. PIT						
		COMB.						
	WHITTIER NARROWS — SAN GABRIEL POOL	TELEMARK	GH		XXXX	XXXX	XXXX	GATE #8 OPEN 0.30 FT. ☐
		W. STAFF						
		E. STAFF						
		COMB.						
429	PAINTED ROCK	RES: S T	XXXX	XXXX				GATES OPEN 0.5 FT ☐ HOOK: ANEMOMETER: TEMPERATURE:
		B. PIT						
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.

IX-6

FIGURE 9-03

RECORD OF DATA FROM DIGITAL RECORDERS				NAME OF DAM	
DATE	TIME	WATER SURFACE	GAGE HEIGHT	PRECIPITATION	OPERATOR

SPL FORM 648
1 FEB 77

FIGURE 9-04

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 28 APR 58 188 PREVIOUS EDITIONS ARE OBSOLETE

IX-8

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							

SPL FORM 31 OCT 65

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

FIGURE 9-06

San Antonio Dam

Observation Well Data

Date: _____

Reservoir Elevation: _____

Observation Well Number	Station of Embankment	Elevation at top of Well (ft.)	Depth of Well (+) (ft.)	Depth to Water (ft.)
1	10+50	2093	45	---
2	16+00	2090	49	---
3	15+50	2075	46	---
4	11+50	2075	49	---
5	21+00	2115	48	---
6	29+00	2120	37	---
7	35+00	2117	54	---

+from top of casing.

1. Until data is obtained from the observation wells, when the pool is above elevation 2175, the performance of the toe drain and/or seepage at San Antonio Dam can not be evaluated.

2. The seven observation wells should be monitored and data collected whenever the pool behind San Antonio Dam is above elevation 2175. The data obtained should include (a) reservoir elevation, (b) depth to water in each observation well, (c) quantity of flow from the to drain, and (d) notation of any seepage or boils observed.

The location of the toe drain and observation wells are shown in figures 5-01 through 5-10.

FIGURE 9-07

San Antonio Dam, Related Manuals and Reports.

	Title	Date
1.	U.S. Engineer Office, Los Angeles, California, "Hydrology Basis of Design and Cost Estimate, San Antonio and Chino Creeks Improvements"	April 1938
2.	U.S. Engineer Laboratory. U.S. Engineer Office, Los Angeles, California, "Model Studies on the San Antonio Flood Control Basin Earth Dam"	May 1940
3.	U.S. Engineer Office, Los Angeles, California, "Hydrology in the San Antonio and Chino Creeks Drainage Area"	May 1938
	Reprint	March 1942
4.	U.S. Engineer Office, Los Angeles, California, "Design Memorandum No. 1, Hydrology for San Antonio and Chino Creeks Channel"	December 1943
5.	U.S. Engineer Office, Los Angeles, California, "Hydrology San Antonio Creek above San Antonio Dam"	May 1946
6.	U.S. Engineer Office, Los Angeles California, "Report to Board of Consultants on San Antonio Dam"	July 1946
7.	U.S. Army Corps of Engineers, Los Angeles District, "Interim Definite Project Report of San Antonio Dam Covering Hydrology, General Plan, and Hydraulic Design"	May 1951
8.	U.S. Army Corps of Engineers, Los Angeles, California, "Definite Project Report on San Antonio and Chino Creeks Improvement San Antonio Dam"	October 1951
9.	U.S. Army Corps of Engineers, Los Angeles District, "Analysis of Design on San Antonio and Chino Creeks Improvements - San Antonio Dam Outlet Works"	January 1952
10.	U.S. Army Corps of Engineers, Los Angeles, California, "Planning Report - San Antonio Reservoir, Santa Ana River Basin, California"	January 1953
11.	U.S. Army Corps of Engineers, Los Angeles, California, "Design Memorandum No. 1 on San Antonio and Chino Creeks Improvement - San Antonio Dam Spillway"	January 1953
12.	U.S. Army Corps of Engineers, Los Angeles, California, "Analysis of Design on San Antonio and Chino Creeks Improvement - San Antonio Dam 5'8" x 10'-0" Slide Gates"	May 1953
13.	U.S. Army Corps of Engineers, Los Angeles, California, "Design Memorandum No. 1, Hydrology for San Antonio and Chino Creeks Channel"	December 1953
14.	U.S. Army Corps of Engineers, Los Angeles, California, "Design Memorandum No. 2 on San Antonio and Chino Creeks Improvement - San Antonio Dam Embankment and Completion of Outlet Works"	January 1954
15.	U.S. Army Corps of Engineers, Los Angeles, California, "Design Memorandum No. 2, General Design for San Antonio and Chino Creeks Improvement, San Antonio and Chino Creeks Channel"	May 1954
16.	U.S. Army Corps of Engineers, Los Angeles, California, "Report on Construction Control and Embankment Construction, San Antonio Dam, San Antonio Creek, California"	July 1957
17.	U.S. Army Corps of Engineers, Los Angeles, California, "Reservoir Regulation Manual for San Antonio Flood - Control Reservoir"	October 1957
18.	U.S. Army Corps of Engineers, Los Angeles, California, "Prototype Report for San Antonio Dam"	December 1959
19.	U.S. Army Corps of Engineers, Los Angeles, California, "Instruction for Operation of Gates and Appurtenances for San Antonio Dam"	February 1960
20.	U.S. Army Corps of Engineers, Los Angeles District, "Operation and Maintenance Manual for San Antonio Dam, and Chino Creeks Improvement"	July 1963
21.	U.S. Army Corps of Engineers, Los Angeles, California, "Summary Report on Review of Design Features and Existing Dams"	June 1967
22.	U.S. Army Corps of Engineers, Los Angeles, California, Bernardino County, Appendix F Report on Floods of January and February 1969"	December 1969

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RELATED MANUALS
AND REPORTS

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Compiled for Water Control Manual by LAD, USACOE 1991

PLATE 1-01A

San Antonio Dam, Related Manuals and Reports.

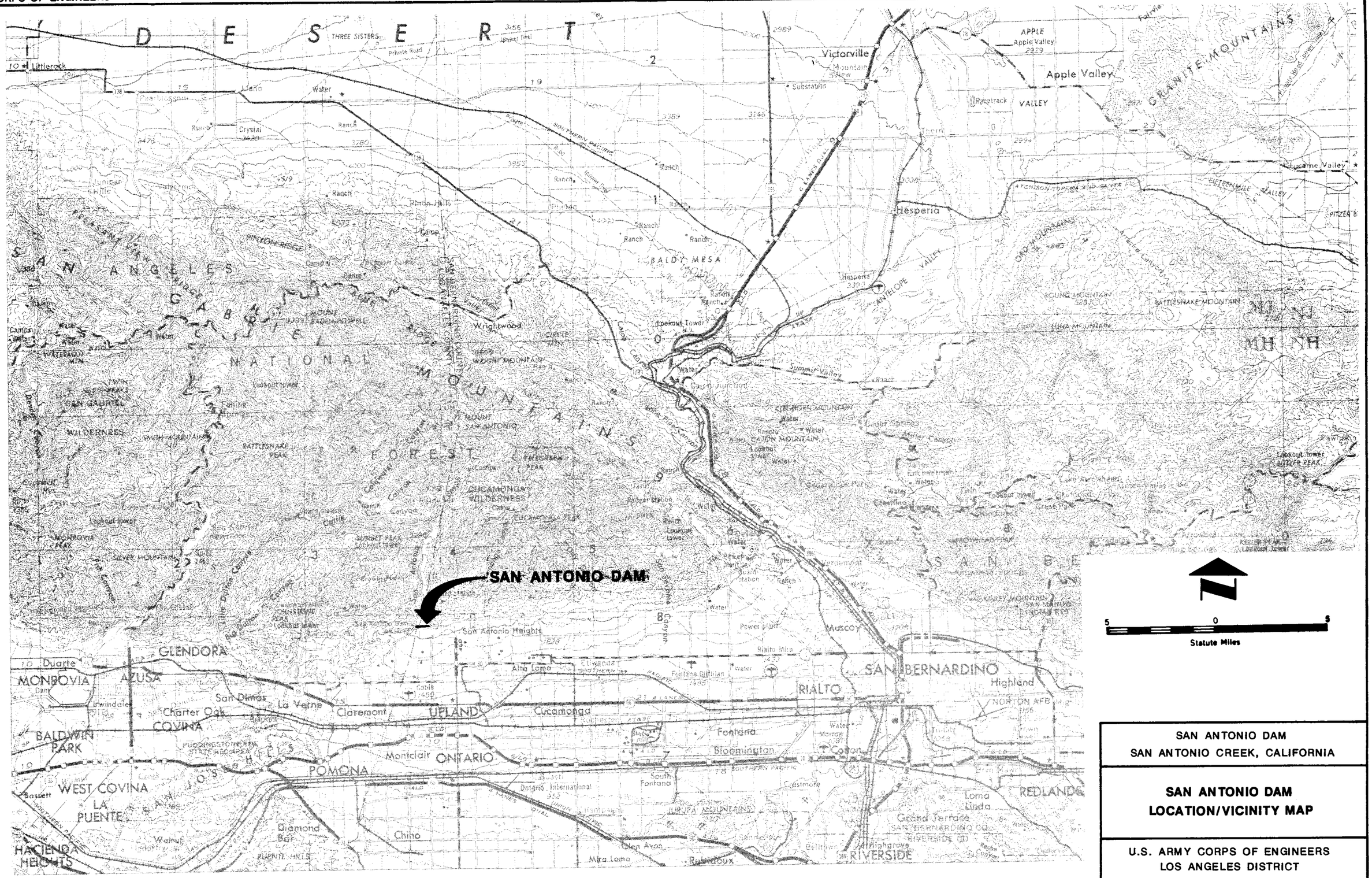
	Title	Date
23.	U.S. Army Corps of Engineers, Los Angeles, California, "Periodic Inspection Report #1"	September 1971
24.	U.S. Army Corps of Engineers, Los Angeles, California, "Engineering Study of Hydraulic System of Gate Operation at San Antonio Dam"	July 1975
25.	U.S. Army Corps of Engineers, Los Angeles, California, "Dam, Outlet Works, and Spillway Periodic Inspection Report #2"	September 1976
26.	U.S. Army Corps of Engineers, Los Angeles, California, "Interim Report on Hydrology and Hydraulic Review of Design Features of Existing Dams for Carbon Canyon, San Antonio, and Tahchevah Dams"	August 1978
27.	U.S. Army Corps of Engineers, Los Angeles, California, "Dam, Outlet Works, and Spillway Periodic Inspection Report #3"	May 1981
28.	City of Claremont, California, Engineering Department, "Ground Water Seepage Investigation, Longwood/Greenwood Area", By Converse Consultants, Inc.	1983
29.	U.S. Army Corps of Engineers, Los Angeles, California, Environmental Assessment, "San Antonio Dam Sediment Removed License Renewal"	October 1984
30.	U.S. Army Corps of Engineers, Los Angeles District, "Specification for San Antonio Dam Toe Drain, Santa Ana River Basin, Los Angeles and San Bernardino Counties, California	March 1985
31.	U.S. Army Corps of Engineers, Los Angeles, California, "Santa Ana River Real-Time Water Control System"	February 1987

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RELATED MANUALS
AND REPORTS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 1-01B



SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO DAM
LOCATION/VICINITY MAP

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 2-01

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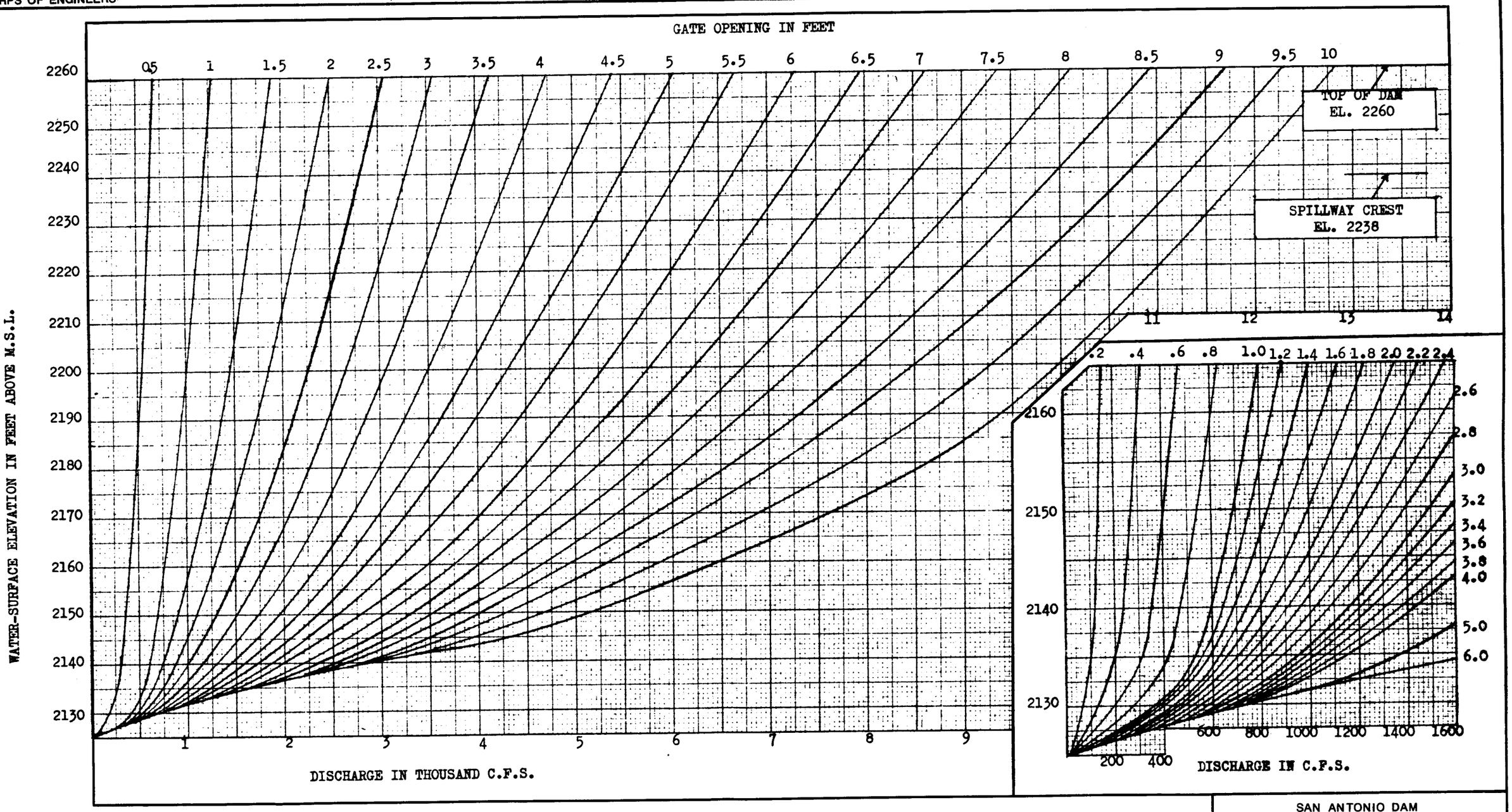

Note: Above curves are based on the model study.

NOTE: Settings are for discharges with all three gates at same setting.

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

OUTLET DISCHARGE CURVES

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 2-05

SOURCE: Plate 1, Ref. 19

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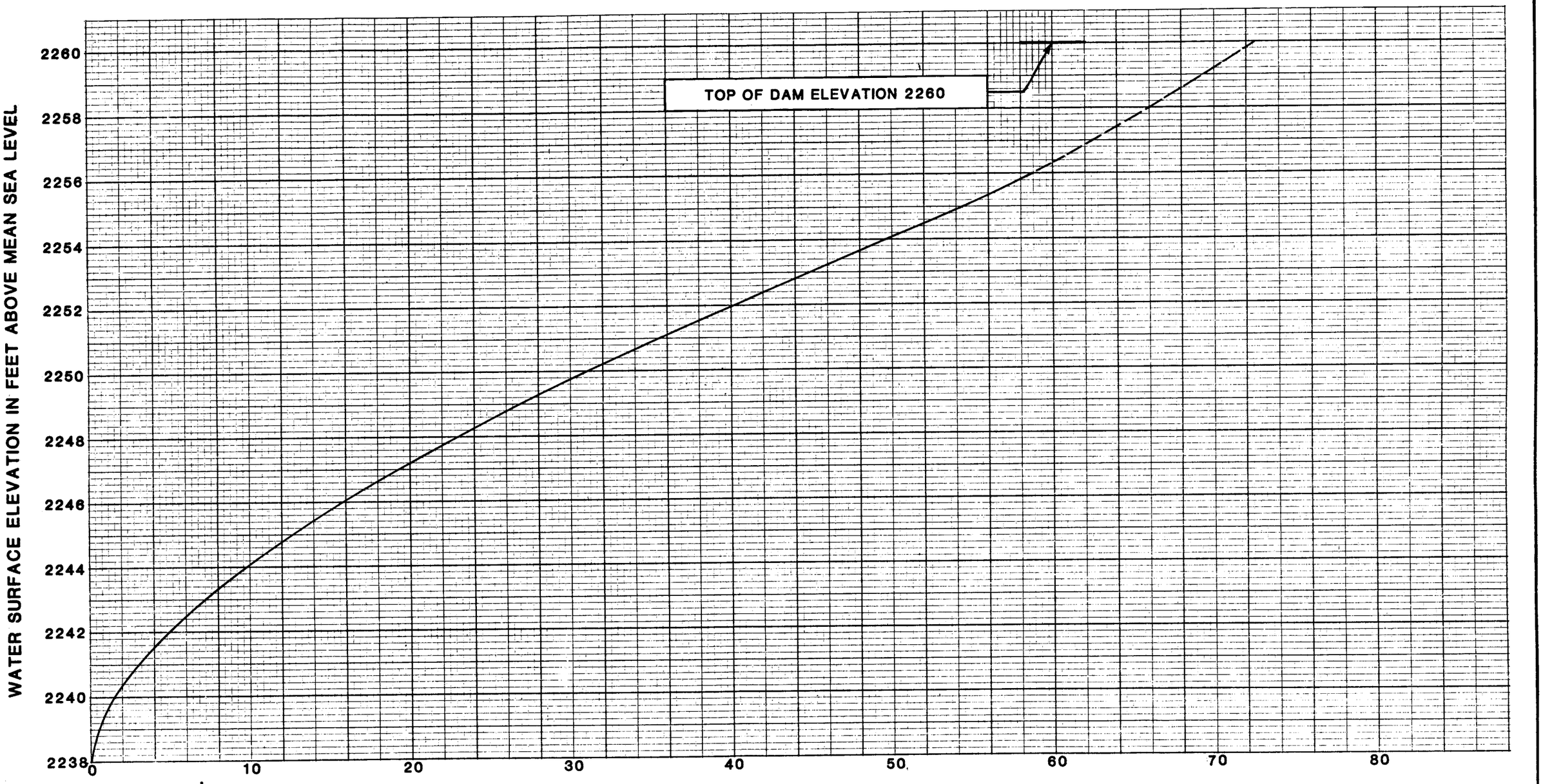
For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.



NOTE:

CURVE BASED ON 1:36 SCALE MODEL STUDY

SPILLWAY LENGTH = 200 FEET

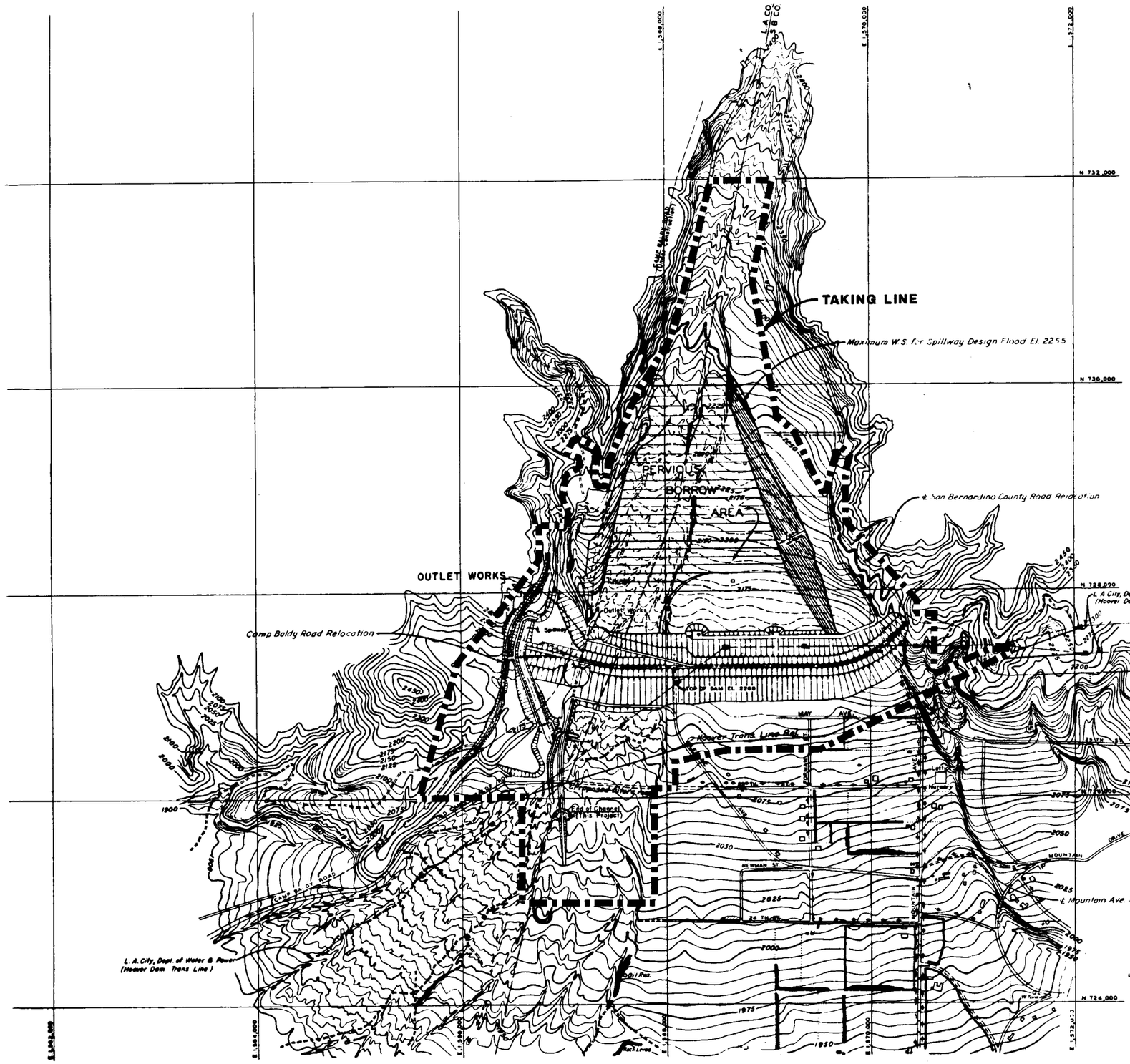
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

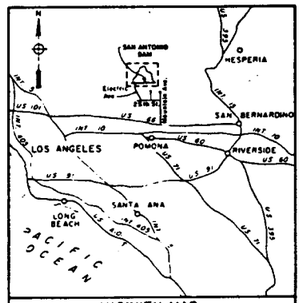
SPILLWAY DISCHARGE CURVE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 17

PLATE 2-08





VICINITY MAP

SCALE 1 2 3 MILES

AREA COVERED BY MAP

500 0 1000

scale feet

REV. 1 OCT. 58

DATUM IS MEAN SEA LEVEL

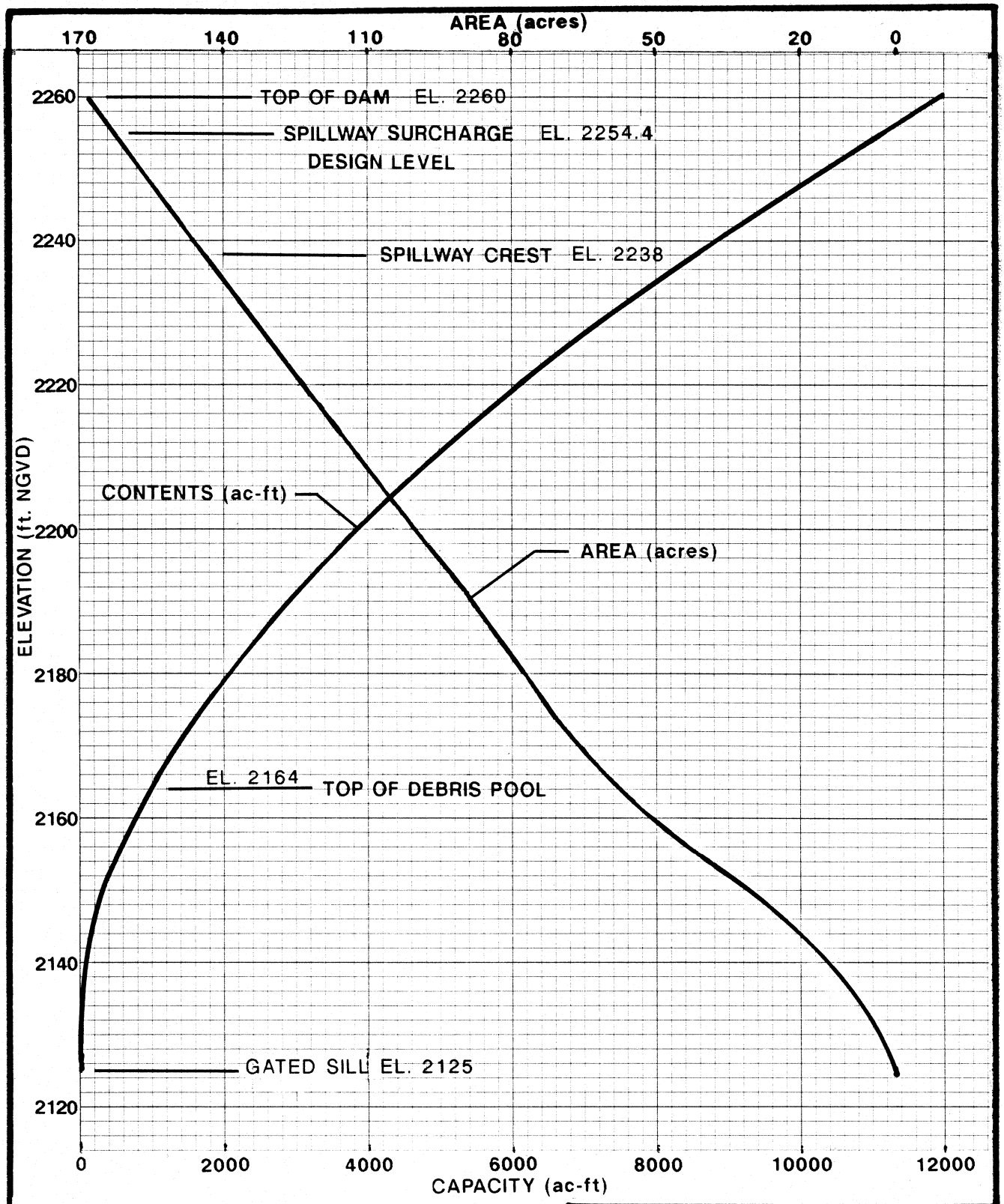
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RESERVOIR AND EMBANKMENT REAL ESTATE ACQUISITION BOUNDARY

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 17

PLATE 2-09



SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO DAM

ELEVATION-AREA-CAPACITY CURVES

SURVEY OF 21 FEBRUARY 1990

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE:
LAD RESERVOIR REGULATION

PLATE 2-10

SAN ANTONIO DAM ..... ELEVATION VS. CAPACITY ..... SURVEY DATE: 21 FEB 1990

ELEV FEET	CAP .0	CAP .1	CAP .2	CAP .3	CAP .4	CAP .5	CAP .6	CAP .7	CAP .8	CAP .9
2125.0	0	0	0	0	0	0	0	0	0	0
2126.0	0	0	0	0	0	0	0	0	0	0
2127.0	0	0	0	0	0	0	0	1	1	1
2128.0	1	1	1	2	2	2	2	2	3	3
2129.0	3	3	4	4	4	5	5	5	6	6
2130.0	6	7	7	8	8	9	9	10	10	10
2131.0	11	11	12	12	13	13	14	14	15	15
2132.0	15	16	16	17	17	18	18	19	19	20
2133.0	20	21	21	22	23	23	24	24	25	25
2134.0	26	26	27	27	28	28	29	30	30	31
2135.0	31	32	33	33	34	34	35	36	36	37
2136.0	37	38	39	39	40	41	41	42	43	44
2137.0	44	45	46	47	47	48	49	50	50	51
2138.0	52	53	54	55	55	56	57	58	59	60
2139.0	61	62	64	65	66	67	68	69	71	72
2140.0	73	74	76	77	79	80	81	83	84	86
2141.0	87	89	90	92	93	95	97	98	100	102
2142.0	103	105	107	109	110	112	114	116	118	120
2143.0	122	123	125	127	129	131	133	135	137	139
2144.0	141	143	146	148	150	152	154	156	159	161
2145.0	163	165	168	170	172	175	177	179	182	184
2146.0	187	189	192	194	197	199	202	205	207	210
2147.0	213	215	218	221	224	227	230	232	235	238
2148.0	241	244	247	250	253	256	260	263	266	269
2149.0	272	275	278	282	285	288	291	295	298	301
2150.0	305	308	311	315	318	321	325	328	332	335
2151.0	339	342	346	349	353	356	360	363	367	370
2152.0	374	378	381	385	388	392	396	399	403	407
2153.0	411	414	418	422	426	430	433	437	441	445
2154.0	449	453	457	461	465	469	473	477	481	485
2155.0	489	493	497	502	506	510	514	519	523	527
2156.0	532	536	540	545	549	554	558	563	567	572
2157.0	576	581	586	590	595	600	605	609	614	619
2158.0	624	629	633	638	643	648	653	658	663	668
2159.0	673	679	684	689	694	699	704	710	715	720
2160.0	726	731	736	742	747	753	758	764	769	775
2161.0	780	786	791	797	802	808	814	819	825	831
2162.0	836	842	848	854	859	865	871	877	883	888
2163.0	894	900	906	912	918	924	929	935	941	947
2164.0	953	959	965	971	977	983	989	995	1001	1008
2165.0	1014	1020	1026	1032	1038	1044	1051	1057	1063	1069
2166.0	1075	1082	1088	1094	1101	1107	1113	1120	1126	1132
2167.0	1139	1145	1151	1158	1164	1171	1177	1184	1190	1197
2168.0	1203	1210	1216	1223	1230	1236	1243	1249	1256	1263
2169.0	1269	1276	1283	1289	1296	1303	1309	1316	1323	1330
2170.0	1337	1343	1350	1357	1364	1371	1377	1384	1391	1398
2171.0	1405	1412	1419	1426	1433	1439	1446	1453	1460	1467
2172.0	1474	1481	1488	1495	1503	1510	1517	1524	1531	1538
2173.0	1545	1552	1559	1567	1574	1581	1588	1595	1603	1610
2174.0	1617	1624	1632	1639	1646	1654	1661	1668	1676	1683
2175.0	1690	1698	1705	1713	1720	1728	1735	1743	1750	1758
2176.0	1765	1773	1780	1788	1795	1803	1810	1818	1826	1833
2177.0	1841	1849	1856	1864	1872	1879	1887	1895	1902	1910
2178.0	1918	1925	1933	1941	1949	1956	1964	1972	1980	1988
2179.0	1995	2003	2011	2019	2027	2034	2042	2050	2058	2066
2180.0	2074	2082	2090	2098	2106	2113	2121	2129	2137	2145
2181.0	2153	2161	2169	2177	2185	2193	2201	2210	2218	2226
2182.0	2234	2242	2250	2258	2266	2274	2282	2291	2299	2307
2183.0	2315	2323	2332	2340	2348	2356	2364	2373	2381	2389
2184.0	2397	2406	2414	2422	2431	2439	2447	2456	2464	2472
2185.0	2481	2489	2497	2506	2514	2523	2531	2540	2548	2556
2186.0	2565	2573	2582	2590	2599	2607	2616	2624	2633	2641
2187.0	2650	2658	2667	2676	2684	2693	2701	2710	2719	2727
2188.0	2736	2745	2753	2762	2770	2779	2788	2797	2805	2814
2189.0	2823	2831	2840	2849	2858	2866	2875	2884	2893	2902
2190.0	2910	2919	2928	2937	2946	2955	2964	2972	2981	2990
2191.0	2999	3008	3017	3026	3035	3044	3053	3062	3071	3080
2192.0	3089	3098	3108	3117	3126	3135	3144	3153	3162	3171
2193.0	3181	3190	3199	3208	3218	3227	3236	3245	3255	3264
2194.0	3273	3283	3292	3301	3311	3320	3329	3339	3348	3358

SAN ANTONIO DAM ..... ELEVATION VS. CAPACITY ..... SURVEY DATE: 21 FEB 1990

ELEV FEET	CAP .0	CAP .1	CAP .2	CAP .3	CAP .4	CAP .5	CAP .6	CAP .7	CAP .8	CAP .9
2195.0	3367	3376	3386	3395	3405	3414	3424	3433	3443	3452
2196.0	3462	3472	3481	3491	3500	3510	3520	3529	3539	3549
2197.0	3558	3568	3578	3587	3597	3607	3616	3626	3636	3646
2198.0	3656	3665	3675	3685	3695	3705	3714	3724	3734	3744
2199.0	3754	3764	3774	3784	3794	3804	3814	3824	3834	3844
2200.0	3854	3864	3874	3884	3894	3904	3914	3924	3934	3944
2201.0	3955	3965	3975	3985	3995	4006	4016	4026	4036	4047
2202.0	4057	4067	4077	4088	4098	4108	4119	4129	4139	4150
2203.0	4160	4171	4181	4192	4202	4212	4223	4233	4244	4254
2204.0	4265	4275	4286	4297	4307	4318	4328	4339	4350	4360
2205.0	4371	4382	4392	4403	4414	4424	4435	4446	4456	4467
2206.0	4478	4489	4500	4510	4521	4532	4543	4554	4565	4576
2207.0	4586	4597	4608	4619	4630	4641	4652	4663	4674	4685
2208.0	4696	4707	4718	4729	4740	4751	4763	4774	4785	4796
2209.0	4807	4818	4829	4841	4852	4863	4874	4885	4897	4908
2210.0	4919	4930	4942	4953	4964	4976	4987	4998	5010	5021
2211.0	5032	5044	5055	5067	5078	5090	5101	5112	5124	5135
2212.0	5147	5158	5170	5181	5193	5205	5216	5228	5239	5251
2213.0	5263	5274	5286	5298	5309	5321	5333	5344	5356	5368
2214.0	5379	5391	5403	5415	5427	5438	5450	5462	5474	5486
2215.0	5498	5509	5521	5533	5545	5557	5569	5581	5593	5605
2216.0	5617	5629	5641	5653	5665	5677	5689	5701	5713	5725
2217.0	5737	5749	5761	5774	5786	5798	5810	5822	5834	5846
2218.0	5859	5871	5883	5895	5908	5920	5932	5944	5957	5969
2219.0	5981	5994	6006	6018	6031	6043	6056	6068	6080	6093
2220.0	6105	6118	6130	6143	6155	6168	6180	6193	6205	6218
2221.0	6230	6243	6255	6268	6281	6293	6306	6318	6331	6344
2222.0	6356	6369	6382	6394	6407	6420	6433	6445	6458	6471
2223.0	6484	6497	6509	6522	6535	6548	6561	6574	6587	6599
2224.0	6612	6625	6638	6651	6664	6677	6690	6703	6716	6729
2225.0	6742	6755	6768	6781	6794	6807	6821	6834	6847	6860
2226.0	6873	6886	6899	6913	6926	6939	6952	6965	6979	6992
2227.0	7005	7018	7032	7045	7058	7072	7085	7098	7112	7125
2228.0	7138	7152	7165	7179	7192	7206	7219	7232	7246	7259
2229.0	7273	7286	7300	7314	7327	7341	7354	7368	7381	7395
2230.0	7409	7422	7436	7449	7463	7477	7491	7504	7518	7532
2231.0	7545	7559	7573	7587	7600	7614	7628	7642	7656	7669
2232.0	7683	7697	7711	7725	7739	7753	7767	7780	7794	7808
2233.0	7822	7836	7850	7864	7878	7892	7906	7920	7934	7948
2234.0	7963	7977	7991	8005	8019	8033	8047	8061	8076	8090
2235.0	8104	8118	8132	8147	8161	8175	8189	8204	8218	8232
2236.0	8246	8261	8275	8289	8304	8318	8333	8347	8361	8376
2237.0	8390	8405	8419	8433	8448	8462	8477	8491	8506	8520
2238.0	8535	8550	8564	8579	8593	8608	8622	8637	8652	8666
2239.0	8681	8696	8710	8725	8740	8754	8769	8784	8798	8813
2240.0	8828	8843	8857	8872	8887	8902	8917	8932	8946	8961
2241.0	8976	8991	9006	9021	9036	9051	9065	9080	9095	9110
2242.0	9125	9140	9155	9170	9185	9200	9215	9230	9245	9260
2243.0	9275	9291	9306	9321	9336	9351	9366	9381	9396	9412
2244.0	9427	9442	9457	9472	9488	9503	9518	9533	9549	9564
2245.0	9579	9594	9610	9625	9640	9656	9671	9686	9702	9717
2246.0	9732	9748	9763	9779	9794	9810	9825	9840	9856	9871
2247.0	9887	9902	9918	9933	9949	9965	9980	9996	10011	10027
2248.0	10043	10058	10074	10089	10105	10121	10136	10152	10168	10183
2249.0	10199	10215	10231	10246	10262	10278	10294	10309	10325	10341
2250.0	10357	10373	10388	10404	10420	10436	10452	10468	10484	10499
2251.0	10515	10531	10547	10563	10579	10595	10611	10627	10643	10659
2252.0	10675	10691	10707	10723	10739	10755	10771	10787	10803	10820
2253.0	10836	10852	10868	10884	10900	10916	10933	10949	10965	10981
2254.0	10998	11014	11030	11046	11063	11079	11095	11111	11128	11144
2255.0	11160	11177	11193	11210	11226	11242	11259	11275	11292	11308
2256.0	11325	11341	11357	11374	11390	11407	11424	11440	11457	11473
2257.0	11490	11506	11523	11539	11556	11573	11589	11606	11623	11639
2258.0	11656	11673	11689	11706	11723	11739	11756	11773	11790	11806
2259.0	11823	11840	11857	11874	11890	11907	11924	11941	11958	11975
2260.0	11992									

CAPACITY IN ACRE-FEET

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RESERVOIR
ELEVATION-CAPACITY TABLES
1990 SURVEY

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE Survey 21 February 1990

SAN ANTONIO DAM ..... ELEVATION VS. AREA ..... SURVEY DATE: 21 FEB 1990

ELEV FEET	AREA .0	AREA .1	AREA .2	AREA .3	AREA .4	AREA .5	AREA .6	AREA .7	AREA .8	AREA .9
2125.0	0	0	0	0	0	0	0	0	0	0
2126.0	0	0	0	0	0	0	0	0	0	0
2127.0	0	0	0	0	0	1	1	1	1	1
2128.0	1	1	1	1	1	2	2	2	2	2
2129.0	2	2	2	3	3	3	3	3	3	4
2130.0	4	4	4	4	4	4	4	4	4	4
2131.0	4	4	4	4	4	4	4	4	4	4
2132.0	4	4	4	4	4	4	4	5	5	5
2133.0	5	5	5	5	5	5	5	5	5	5
2134.0	5	5	5	5	5	5	5	5	5	5
2135.0	5	5	5	6	6	6	6	6	6	6
2136.0	6	6	6	6	6	6	6	7	7	7
2137.0	7	7	7	7	7	7	7	7	8	8
2138.0	8	8	8	8	9	9	9	9	10	10
2139.0	10	10	11	11	11	11	12	12	12	12
2140.0	13	13	13	13	13	14	14	14	14	14
2141.0	15	15	15	15	15	16	16	16	16	17
2142.0	17	17	17	17	17	18	18	18	18	18
2143.0	18	19	19	19	19	19	19	20	20	20
2144.0	20	20	21	21	21	21	21	22	22	22
2145.0	22	22	23	23	23	23	23	24	24	24
2146.0	24	24	25	25	25	25	26	26	26	26
2147.0	27	27	27	28	28	28	28	29	29	29
2148.0	29	30	30	30	30	30	30	31	31	31
2149.0	31	31	31	32	32	32	32	32	33	33
2150.0	33	33	33	33	33	34	34	34	34	34
2151.0	34	34	34	35	35	35	35	35	35	35
2152.0	36	36	36	36	36	36	36	37	37	37
2153.0	37	37	37	38	38	38	38	38	38	38
2154.0	39	39	39	39	39	40	40	40	40	41
2155.0	41	41	41	41	42	42	42	42	43	43
2156.0	43	43	44	44	44	44	45	45	45	45
2157.0	46	46	46	46	47	47	47	47	47	48
2158.0	48	48	48	49	49	49	49	50	50	50
2159.0	50	51	51	51	51	52	52	52	52	53
2160.0	53	53	53	54	54	54	54	54	54	55
2161.0	55	55	55	55	56	56	56	56	56	57
2162.0	57	57	57	57	57	57	57	58	58	58
2163.0	58	58	58	58	58	59	59	59	59	59
2164.0	59	59	59	60	60	60	60	60	60	60
2165.0	61	61	61	61	61	61	61	62	62	62
2166.0	62	62	62	62	63	63	63	63	63	63
2167.0	63	64	64	64	64	64	64	64	65	65
2168.0	65	65	65	65	65	65	66	66	66	66
2169.0	66	66	66	66	67	67	67	67	67	67
2170.0	67	67	68	68	68	68	68	68	68	68
2171.0	68	69	69	69	69	69	69	69	69	69
2172.0	70	70	70	70	70	70	70	70	71	71
2173.0	71	71	71	71	71	71	72	72	72	72
2174.0	72	72	72	73	73	73	73	73	73	73
2175.0	73	74	74	74	74	74	74	74	75	75
2176.0	75	75	75	75	75	75	75	76	76	76
2177.0	76	76	76	76	76	76	76	76	77	77
2178.0	77	77	77	77	77	77	77	77	77	78
2179.0	78	78	78	78	78	78	78	78	78	78
2180.0	79	79	79	79	79	79	79	79	79	79
2181.0	79	80	80	80	80	80	80	80	80	80
2182.0	80	80	81	81	81	81	81	81	81	81
2183.0	81	81	82	82	82	82	82	82	82	82
2184.0	82	82	82	83	83	83	83	83	83	83
2185.0	83	83	83	83	84	84	84	84	84	84
2186.0	84	84	84	84	84	85	85	85	85	85
2187.0	85	85	85	85	85	85	86	86	86	86
2188.0	86	86	86	86	86	86	86	87	87	87
2189.0	87	87	87	87	87	87	87	87	88	88
2190.0	88	88	88	88	88	88	88	89	89	89
2191.0	89	89	89	89	89	90	90	90	90	90
2192.0	90	90	90	91	91	91	91	91	91	91
2193.0	91	92	92	92	92	92	92	92	92	93
2194.0	93	93	93	93	93	93	93	94	94	94

SAN ANTONIO DAM ..... ELEVATION VS. AREA ..... SURVEY DATE: 21 FEB 1990

ELEV FEET	AREA .0	AREA .1	AREA .2	AREA .3	AREA .4	AREA .5	AREA .6	AREA .7	AREA .8	AREA .9
2195.0	94	94	94	94	94	94	95	95	95	95
2196.0	95	95	95	95	96	96	96	96	96	96
2197.0	96	96	96	97	97	97	97	97	97	97
2198.0	97	98	98	98	98	98	98	98	98	98
2199.0	99	99	99	99	99	99	99	99	100	100
2200.0	100	100	100	100	100	100	101	101	101	101
2201.0	101	101	101	101	102	102	102	102	102	102
2202.0	102	102	103	103	103	103	103	103	103	103
2203.0	104	104	104	104	104	104	104	104	105	105
2204.0	105	105	105	105	105	105	106	106	106	106
2205.0	106	106	106	106	107	107	107	107	107	107
2206.0	107	107	108	108	108	108	108	108	108	108
2207.0	109	109	109	109	109	109	109	109	110	110
2208.0	110	110	110	110	110	110	111	111	111	111
2209.0	111	111	111	111	111	112	112	112	112	112
2210.0	112	112	112	113	113	113	113	113	113	113
2211.0	113	114	114	114	114	114	114	114	114	114
2212.0	115	115	115	115	115	115	115	115	116	116
2213.0	116	116	116	116	116	116	117	117	117	117
2214.0	117	117	117	117	117	118	118	118	118	118
2215.0	118	118	118	118	119	119	119	119	119	119
2216.0	119	119	120	120	120	120	120	120	120	120
2217.0	120	121	121	121	121	121	121	121	121	121
2218.0	122	122	122	122	122	122	122	122	123	123
2219.0	123	123	123	123	123	123	123	124	124	124
2220.0	124	124	124	124	124	124	125	125	125	125
2221.0	125	125	125	125	126	126	126	126	126	126
2222.0	126	126	127	127	127	127	127	127	127	127
2223.0	127	128	128	128	128	128	128	128	128	129
2224.0	129	129	129	129	129	129	129	130	130	130
2225.0	130	130	130	130	130	130	131	131	131	131
2226.0	131	131	131	131	131	132	132	132	132	132
2227.0	132	132	132	133	133	133	133	133	133	133
2228.0	133	134	134	134	134	134	134	134	134	134
2229.0	135	135	135	135	135	135	135	135	135	136
2230.0	136	136	136	136	136	136	136	137	137	137
2231.0	137	137	137	137	137	137	138	138	138	138
2232.0	138	138	138	138	138	139	139	139	139	139
2233.0	139	139	139	139	140	140	140	140	140	140
2234.0	140	140	141	141	141	141	141	141	141	141
2235.0	141	142	142	142	142	142	142	142	142	142
2236.0	143	143	143	143	143	143	143	143	144	144
2237.0	144	144	144	144	144	144	144	145	145	145
2238.0	145	145	145	145	145	145	146	146	146	146
2239.0	146	146	146	146	146	147	147	147	147	147
2240.0	147	147	147	147	148	148	148	148	148	148
2241.0	148	148	148	148	149	149	149	149	149	149
2242.0	149	149	149	150	150	150	150	150	150	150
2243.0	150	150	150	151	151	151	151	151	151	151
2244.0	151	151	152	152	152	152	152	152	152	152
2245.0	152	152	153	153	153	153	153	153	153	153
2246.0	153	154	154	154	154	154	154	154	154	154
2247.0	155	155	155	155	155	155	155	155	155	156
2248.0	156	156	156	156	156	156	156	156	156	157
2249.0	157	157	157	157	157	157	157	157	157	157
2250.0	158	158	158	158	158	158	158	158	158	158
2251.0	159	159	159	159	159	159	159	159	159	160
2252.0	160	160	160	160	160	160	160	160	161	161
2253.0	161	161	161	161	161	161	161	162	162	162
2254.0	162	162	162	162	162	162	163	163	163	163
2255.0	163	163	163	163	163	164	164	164	164	164
2256.0	164	164	164	164	165	165	165	165	165	165
2257.0	165	165	165	166	166	166	166	166	166	166
2258.0	166	166	167	167	167	167	167	167	167	167
2259.0	167	167	168	168	168	168	168	168	168	168
2260.0	168									

AREA IN ACRES

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RESERVOIR
ELEVATION-AREA TABLES
1990 SURVEY

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE Survey 21 February 1990

PLATE 2-12

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26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION											
	117–	100–	80–60	60–40	40–20	20–	crest	22				
	100	80	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION									
Jul 69	21	39	31	12	2	-1	-4					
Aug 78	Excavation changed distribution of storage											
Sep 80	"	"	"	"	"	"						
Feb 90	"	"	"	"	"	"						

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR														
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.
1969-70	2153.95	2125.00	2,090	1979-80	22225.60	2125.00	28,800
1970-71	2148.70	2125.00	250	1980-81	2144.76	2125.00	274
1971-72	2151.05	2125.00	147	1981-82	2157.60	2125.00	9,756
1972-73	2160.95	2125.00	7,364	1982-83	2188.22	2125.00	49,510
1973-74	2154.19	2125.00	478	1983-84	2156.33	2125.00	13,387
1974-75	2145.00	2125.00	44	1984-85	2141.80	2125.00	1,438
1975-76	2153.50	2125.00	712	1985-86	2158.94	2125.00	10,536
1976-77	2153.10	2125.00	1,170	1986-87	2128.50	2125.00	48
1977-78	2198.40	2125.00	65,040	1987-88	2145.24	2125.00	3,452
1978-79	2171.16	2125.00	4,900	1988-89	2130.47	2125.00	216

46. Feb 90 ELEVATION-AREA-CAPACITY DATA

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY
2125	0	0	2205	106	4,371			
2135	5	31	2215	118	5,498			
2145	22	163	2225	130	6,742			
2155	41	489	2235	141	8,104			
2165	61	1,014	2245	152	9,579			
2175	73	1,690	2255	163	11,160			
2185	83	2,481	2260	168	11,992			
2195	94	3,367						

47. REMARKS AND REFERENCES

1/ Item 25 - Temperature taken at Claremont, California.
2/ Revision due to revised method in computing storage table.
3/ Item 37 - Sediment removed at various times.

50. DATE 20 Mar 91

48. AGENCY MAKING SURVEY C of E
49. AGENCY SUPPLYING DATA C of E

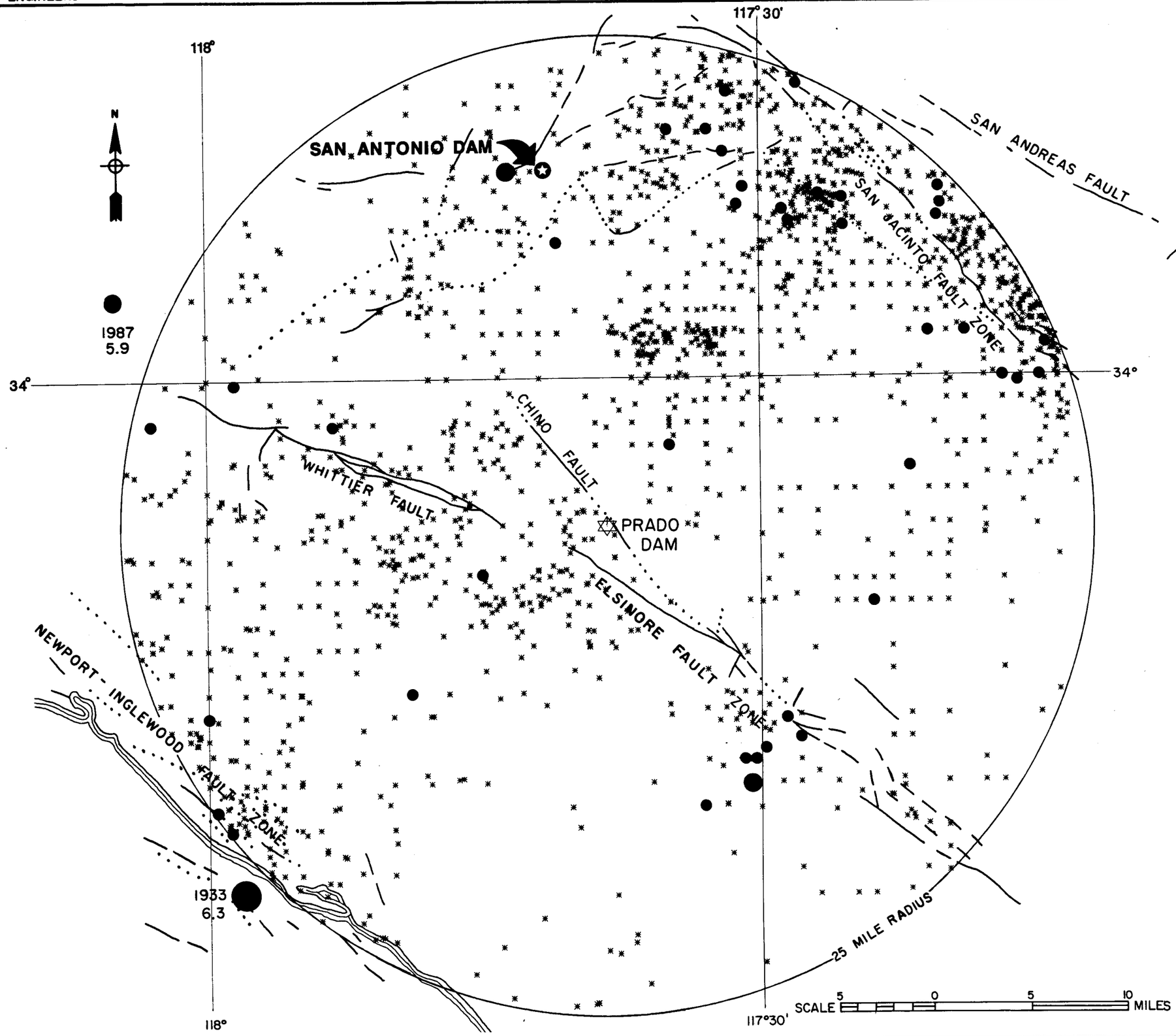
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RESERVOIR DATA
SEDIMENT SURVEY

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

PLATE 4-03B



LEGEND

- EARTHQUAKE WITH MAGNITUDE LESS THAN 4.0
- EARTHQUAKE WITH MAGNITUDE 4.0 THROUGH 4.9
- EARTHQUAKE WITH MAGNITUDE 5.0 THROUGH 5.9
- EARTHQUAKE WITH MAGNITUDE 6.0 THROUGH 6.9
- TRACE OF FAULT, DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE INFERRED OR CONCEALED

NOTES:

1. EARTHQUAKES SHOWN REPRESENT ALL EVENTS WITH RICHTER MAGNITUDES EQUAL TO OR GREATER THAN 2.0 WITHIN 25 MILES OF PRADO DAM DURING THE PERIOD 1932 THROUGH 1987.
2. EARTHQUAKE EPICENTER LOCATIONS ARE FROM CALIFORNIA INSTITUTE OF TECHNOLOGY'S SEISMOLOGIC DATA BASE FOR SOUTHERN CALIFORNIA, NEVADA, AND ARIZONA.
3. FAULT TRACES DEPICTED REPRESENT FAULTING WITH EVIDENCE OF POST-TERTIARY ACTIVITY AS SHOWN ON FAULT MAP OF CALIFORNIA COMPILED BY JENNINGS (1975).

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

FAULT ZONES & SEISMIC ACTIVITY

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Prado WCM, LAD, USACOE 1990

PLATE 4-02

RESERVOIR SEDIMENT
DATA SUMMARY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

SAN ANTONIO FLOOD CONTROL BASIN(Revised)
NAME OF RESERVOIR

DATA SHEET NO.

DAM

1. OWNER Corps of Engineers	2. STREAM San Antonio Creek	3. STATE California
4. SEC. 24 TWP. 1N RANGE 8W	5. NEAREST P. O. Claremont4.5NNE	6. COUNTY L.A.-San Bernard.
7. LAT. 34° 09' 26" LONG 117° 40' 50"	8. TOP OF DAM ELEVATION 2,260	9. SPILLWAY CREST ELEV. 2,238

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, ACRES	13. ORIGINAL CAPACITY, ACRE-FEET	14. GROSS STORAGE, ACRE-FEET	15. DATE STORAGE BEGAN
a. FLOOD CONTROL	2,238	143	9,285	9,285	Nov 55
b. MULTIPLE USE					
c. POWER					16. DATE NORMAL OPER. BEGAN
d. WATER SUPPLY					
e. IRRIGATION					May 56
f. CONSERVATION					
g. INACTIVE					

17. LENGTH OF RESERVOIR	0.51 MILES	AV. WIDTH OF RESERVOIR	0.44 MILES

WATERSHED

18. TOTAL DRAINAGE AREA	26.7 SQ. MI.	22. MEAN ANNUAL PRECIPITATION	34.0 INCHES
19. NET SEDIMENT CONTRIBUTING AREA	26.7 SQ. MI.	23. MEAN ANNUAL RUNOFF	7.25 INCHES
20. LENGTH 11.0 MILES	AV. WIDTH 2.43 MILES	24. MEAN ANNUAL RUNOFF	10,318 (13) AC.-FT.
21. MAX. ELEV. 10,080	MIN. ELEV. 2,125	25. ANNUAL TEMP.: MEAN	62.1 RANGE 47.2 - 76.9

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, ACRES	32. CAPACITY, ACRE-FEET	33. C/I. RATIO, AC.-FT. PER AC.-FT.
Jul 69 2/	12.92	12.92	Range Line	18	147	7,746	0.75
Aug 78	9.08	22.00	Contour	2'	144	7,650	0.74
Sep 80	2.08	24.16	Contour	2'	145	7,703	0.75
Feb 90	9.42	33.58	Contour	2'	145	8,535	0.83

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW, ACRE-FEET a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	36. WATER INFL. TO DATE, AC.-FT. a. MEAN ANNUAL	b. TOTAL TO DATE
Jul 69	32.92	10,381	67,356	134,128	10,381	134,128
Aug 78	20.26	8,513	65,040	77,295	9,610	211,423
Sep 80	46.36	16,202	28,800	33,700	10,146	245,123
Feb 90	23.19	9,407	49,510	88,617	9,939	333,740

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	38. TOTAL SED. DEPOSITS TO DATE, ACRE-FEET a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
Jul 69	1,539	119	4.43	1,539	119	4.43
Aug 78	Intermittent excavation since 1972 disrupts data on sed. deposit.					
Sep 80	"	"	"	"	"	"
Feb 90	"	"	"	"	"	"

26. DATE OF SURVEY	39. AV. DRY WGT., LBS. PER CU. FT.	40. SED. DEP., TONS PER SQ. MI.-YR. a. PERIOD	b. TOTAL TO DATE	41. STORAGE LOSS, PCT. a. AV. ANN.	b. TOT. TO DATE	42. SED. INFLOW, PPM a. PERIOD	b. TOT. TO DATE
Jul 69				1.28	16.58		
Aug 78				0.80	17.61		
Sep 80				0.71	17.04		
Feb 90				0.24	8.05		

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION: 117-100	100-80	80-60	60-40	40-20	20-crest	
	80 PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION						
Jul 69	21	39	31	12	2	-1	-4
Aug 78	Excavation changed distribution of storage						
Sep 80	"	"	"	"	"	"	"

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR: 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.
1956-57	2127.50	2125.00	33	1968-69	2192.80	2125.00	67,356
1957-58	2144.18	2125.00	13,604	1969-70	2153.95	2125.00	2,090
1958-59	2132.25	2125.00	318	1970-71	2148.70	2125.00	250
1959-60	2125.80	2125.00	15	1971-72	2151.05	2125.00	147
1960-61	2125.00	2125.00	0	1972-73	2160.95	2125.00	7,364
1961-62	2141.84	2125.00	2,066	1973-74	2154.19	2125.00	478
1962-63	2130.45	2125.00	110	1974-75	2145.00	2125.00	44
1963-64	2127.26	2125.00	842	1975-76	2153.50	2125.00	712
1964-65	2129.86	2125.00	73	1976-77	2153.10	2125.00	1,170
1965-66	2168.50	2125.00	27,726	1977-78	2198.40	2125.00	65,040
1966-67	2168.33	2125.00	20,406	1978-79	2171.16	2125.00	4,900
1967-68	2142.40	2125.00	1,579	1979-80	2225.60	2125.00	28,800

46. Sep 80 ELEVATION-AREA-CAPACITY DATA

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY
2125	.08	0	2205	106	3,557			
2135	.16Est	.4	2215	118	4,672			
2145	3.5	8.2	2225	130	5,914			
2155	25	148	2235	141	7,275			
2165	45	511	2245	152	8,740			
2175	59	1,033	2255	163	10,315			
2185	77	1,708	2260	169Est	11,144			
2195	93	2,560						

47. REMARKS AND REFERENCES

1/ Item 25 - Temperature taken at Claremont, California.
2/ Revision due to revised method in computing storage table.
3/ Item 37 - Sediment removed at various times.

48. AGENCY MAKING SURVEY C of E
49. AGENCY SUPPLYING DATA C of E

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

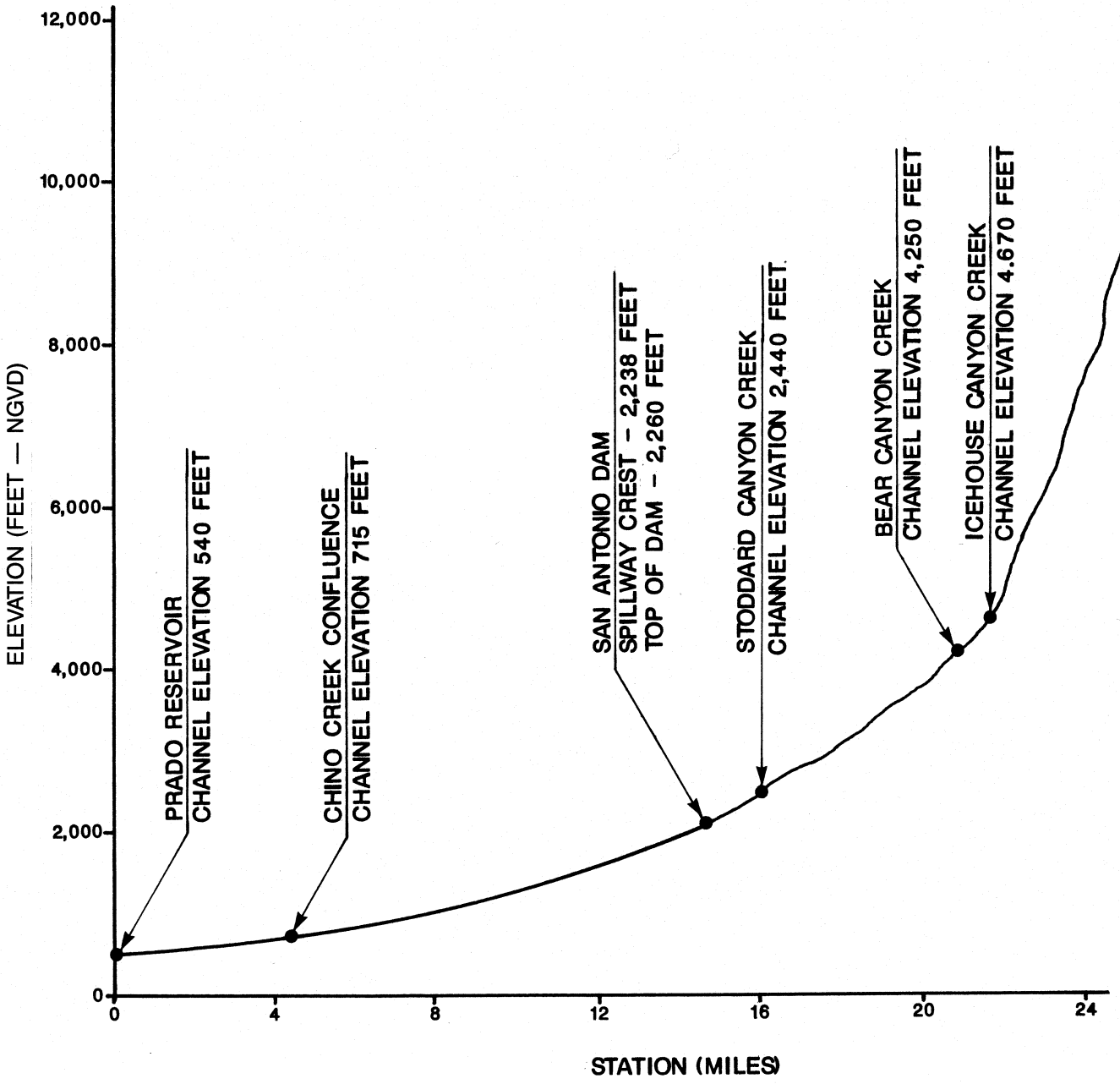
RESERVOIR DATA
SEDIMENT SURVEY

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

ENG FORM 1787 NOV 66 PREVIOUS EDITIONS ARE OBSOLETE.

SOURCE: LAD, USACOE 1990

PLATE 4-03A



SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

CHINO & SAN ANTONIO CREEK CHANNEL PROFILE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Compiled for Manual 1990

PLATE 4-01

CLIMATOGRAPHY OF THE UNITED STATES NO. 20

UPLAND, CA

PERIOD: 1951-80
ELEVATION: 1605 FT

CLIMATOLOGICAL SUMMARY

	TEMPERATURE (F)														PRECIPITATION TOTALS (INCHES)											
	MEANS			EXTREMES						MEAN NUMBER OF DAYS				DEGREE DAYS		*	*					SNOW			MEAN NUMBER OF DAYS		
										MAX		MIN															
	* DAILY MAXIMUM	* DAILY MINIMUM	* MONTHLY	RECORD HIGHEST	YEAR	DAY	RECORD LOWEST	YEAR	DAY	90 AND ABOVE	32 AND BELOW	32 AND BELOW	0 AND BELOW	* HEATING BASE 65	* COOLING BASE 65	MEAN	GREATEST MONTHLY	YEAR	GREATEST DAILY	YEAR	DAY	MEAN	MAXIMUM MONTHLY	YEAR	.10 OR MORE	.50 OR MORE	1.00 OR MORE
JAN	63.4	40.6	52.0	89+	71	18	25+	63	13	0	0	3	0	403	0	4.79	19.64	69	6.38	69	25	.0	.0		5	3	2
FEB	66.1	41.6	53.9	88+	63	3	29+	65	10	0	0	2	0	319	8	3.77	17.79	80	3.65	69	24	.0	.0		4	2	1
MAR	67.4	42.0	54.7	97+	66	31	29+	71	2	0	0	1	0	328	8	3.40	14.71	78	3.48	52	07	.0	.0		5	2	1
APR	71.8	44.5	58.2	100+	66	1	31+	53	9	2	0	0	0	230	26	1.70	6.81	58	2.75	58	01	.0	.0		3	1	0
MAY	76.3	48.5	62.4	104+	67	21	31	59	31	3	0	0	0	124	44	.57	4.03	77	2.01	77	09	.0	.0		1	0	0
JUN	83.4	52.5	68.0	109+	61	15	38+	67	2	8	0	0	0	50	140	.06	.42	67	.19	70	10	.0	.0		0	0	0
JUL	91.8	58.1	75.0	111+	60	17	44+	56	14	21	0	0	0	0	310	.05	.86	68	.84	68	28	.0	.0		0	0	0
AUG	90.9	58.6	74.8	108+	62	25	45+	71	31	19	0	0	0	5	309	.10	2.13	77	1.92	77	17	.0	.0		0	0	0
SEP	88.3	56.8	72.6	111+	71	13	42	51	2	14	0	0	0	13	241	.36	3.59	76	1.43	63	19	.0	.0		1	0	0
OCT	80.0	51.1	65.6	104+	64	5	32+	71	30	6	0	0	0	91	110	.44	3.93	57	2.02	79	20	.0	.0		1	0	0
NOV	70.4	45.3	57.9	93#	56	9	30+	75	29	0	0	0	0	231	18	1.96	10.46	65	3.35	70	29	.0	.0		3	1	1
DEC	64.8	41.1	53.0	88+	58	3	23+	68	21	0	0	2	0	381	9	2.69	12.67	66	4.61	66	03	.0	.0		3	2	1
YEAR	76.2	48.4	62.3	111	SEP 71	13	DEC 23	68	21	73	0	8	0	2175	†223	19.89	19.64	JAN 69	6.38	JAN 69	25	.0	.0		26	11	6

*FROM 1951-80 NORMALS

ESTIMATED VALUE BASED ON DATA FROM SURROUNDING STATIONS

+ ALSO ON EARLIER DATES.

DEGREE DAYS TO SELECTED BASE TEMPERATURES (F)

BASE	HEATING DEGREE DAYS												
BELOW	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
65	403	319	328	230	124	50	0	5	13	91	231	381	2175
60	260	198	196	131	46	14	0	0	0	32	126	245	1248
57	183	140	135	85	19	6	0	0	0	15	79	179	841
55	140	109	101	59	10	0	0	0	0	9	53	142	623
50	60	45	36	19	0	0	0	0	0	0	15	67	242

BASE	COOLING DEGREE DAYS												
ABOVE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
55	47	79	92	155	239	390	620	614	528	337	140	80	3321
57	28	54	63	121	187	336	558	552	468	281	106	55	2809
60	12	27	31	77	121	254	465	459	378	205	63	28	2120
65	0	8	8	26	44	140	310	309	241	110	18	9	1223
70	0	0	0	8	9	62	168	174	128	42	0	0	591

DERIVED FROM THE 1951-80 MONTHLY NORMALS

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

PROBABILITY LEVELS	MONTHLY PRECIPITATION (INCHES)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.05	.00	.04	.00	.01	.00	.00	.00	.00	.00	.00	.01	.00
.10	.43	.12	.00	.07	.00	.00	.00	.00	.00	.00	.06	.04
.20	1.25	.38	.84	.24	.02	.00	.00	.00	.00	.00	.23	.28
.30	2.01	.77	1.43	.45	.09	.00	.00	.00	.00	.00	.46	.61
.40	2.80	1.30	2.02	.71	.18	.00	.00	.00	.00	.03	.75	1.03
.50	3.68	2.01	2.66	1.04	.29	.02	.00	.00	.00	.13	1.13	1.57
.60	4.71	2.95	3.40	1.46	.45	.04	.00	.00	.00	.27	1.62	2.25
.70	5.95	4.25	4.31	2.01	.66	.07	.00	.00	.08	.47	2.27	3.16
.80	7.67	6.21	5.50	2.81	.96	.11	.00	.00	.42	.77	3.24	4.49
.90	10.51	9.76	7.48	4.22	1.50	.19	.11	.14	1.23	1.33	4.95	6.84
.95	13.27	13.47	9.40	5.65	2.06	.26	.35	.62	2.15	1.90	6.70	9.24

THESE VALUES WERE DETERMINED FROM THE INCOMPLETE GAMMA DISTRIBUTION.

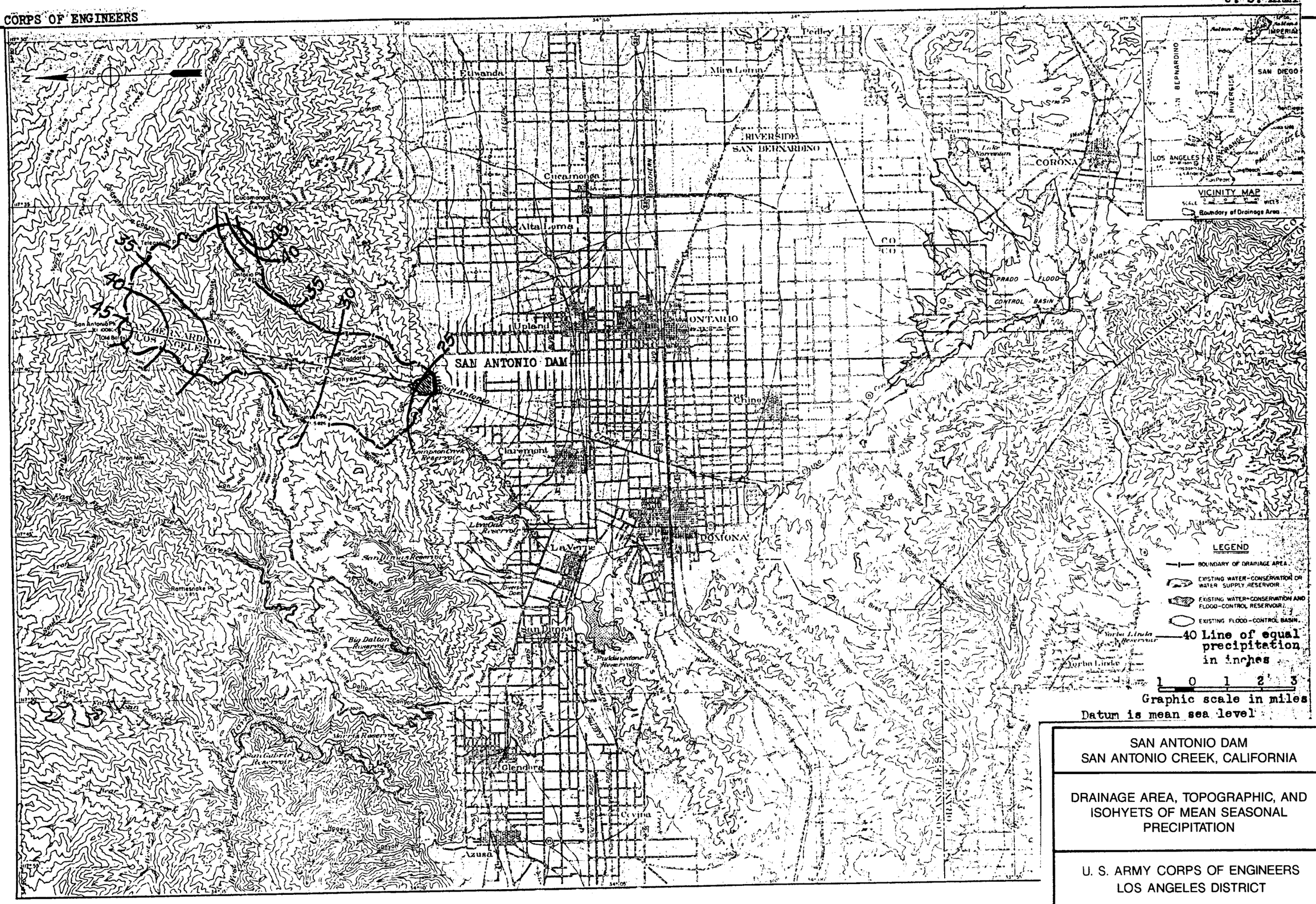
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

CLIMATOLOGICAL SUMMARY
UPLAND, CALIFORNIA
1951-1980

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: NOAA, Climatography of the United States No. 20, 1980

PLATE 4-04



SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

DRAINAGE AREA, TOPOGRAPHIC, AND ISOHYETS OF MEAN SEASONAL PRECIPITATION

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 17

PLATE 4-05

SOURCE: LACDPW, LAD, USACOE 1990

LACDPW NUMBER	STATION NAME	LAT(W)	LONG(W)	ELEV. (FT NGVD)	PERIOD OF RECORDS
1115	SAN ANTONIO DAM	34-09-24	117-40-20	2120	1956-1991
619	SAN ANTONIO CANYON	34-12-29	117-40-26	3110	1900-1991
85G	MT. BALDY	34-14-12	117-39-32	4275	1920-1977
1109	USFS RANGER STATION MT.BALDY	34-16-53	117-37-00	8650	1955-1979

INCHES PRECIPITATION

STN.	HIST. AVG.	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1115	1964-1990	.639	2.687	3.471	4.864	4.401	3.969	1.733	.592	.095	.026	.187	.643
STN 619	HIST. AVG. 87 YRS 1900-1989	1.06	3.11	5.34	6.19	6.93	5.20	2.60	.62	.07	.03	.20	.59

ANNUAL AVERAGE: 31.94 IN.

ANNUAL PRECIPITATION TOTAL BY STATION

WY	1115	619	85G	1109
1900-01		31.90		
1901-02		19.78		
1902-03		31.07		
1903-04		18.34		
1904-05		34.88		
1905-06		37.96		
1906-07		39.48		
1907-08		25.51		
1908-09		35.30		
1909-10		26.12		
1910-11		42.88		
1911-12		23.83		
1912-13		15.98		
1913-14		48.05		
1914-15		34.89		
1915-16		55.26		
1916-17		37.31		
1917-18		30.50		
1918-19		20.45		
1919-20		31.18		
1920-21		34.98	34.01	
1921-22		52.84	66.57	
1922-23		27.01	30.85	
1923-24		19.46	19.82	
1924-25		19.89	21.99	
1925-26		37.01	38.29	
1926-27		38.47	39.42	
1927-28		19.55	21.41	
1928-29		28.10	25.89	
1929-30		27.19	27.63	
1930-31		25.04	25.44	
1931-32		39.91	40.68	
1932-33		21.06	20.41	
1933-34		24.31	23.35	
1934-35		39.19	43.27	
1935-36		28.09	27.99	
1936-37		51.90	52.67	
1937-38		57.94	57.35	
1938-39		34.47	34.47	
1939-40		24.20	24.20	
1940-41		58.54	57.32	
1941-42		20.51	23.05	
1942-43		24.45	57.22	
1943-44		33.64	43.26	
1944-45		37.07	36.67	
1945-46		31.57	34.75	
1946-47		33.63	35.69	
1947-48		17.41	19.30	
1948-49		17.89	20.38	
1949-50		24.07	22.34	
1950-51		13.33	11.73	
1951-52		46.54	50.26	
1952-53		17.40	18.01	
1953-54		29.53	30.93	
1954-55		20.69	21.06	
1955-56		21.05	20.32	27.59
1956-57	15.53	21.77	20.99	26.31
1957-58	41.35	57.80	57.31	63.45
1958-59	10.54	17.27	20.04	22.60
1959-60	12.20	INC	17.40	24.07
1960-61	9.2	13.23	12.89	14.95
1961-62	25.31	34.47	37.28	48.63
1962-63	15.85	19.84	21.88	24.03
1963-64	14.23	19.96	23.25	31.17
1964-65	17.55	24.60	25.29	27.77
1965-66	25.25	47.57	53.10	57.41
1966-67	38.31	52.42	56.06	65.15
1967-68	14.90	INC	24.74	30.97
1968-69	46.81	80.70	88.80	117.23
1969-70	13.72	19.44	22.83	NO RCD
1970-71	17.43	18.88	24.73	NO RCD
1971-72	10.78	13.52	19.97	NO RCD
1972-73	25.77	36.43	41.60	69.51
1973-74	18.27	24.97	26.90	27.75
1974-75	17.55	22.90	27.05	29.36
1975-76	16.79	26.67	30.44	37.38
1976-77	17.58	26.00	26.24	23.92
1977-78	47.78	75.70		87.30
1978-79	24.09	33.80		55.48
1979-80	45.32	61.40		
1980-81	12.13	17.00		
1981-82	26.64	37.20		
1982-83	INC	67.50		
1983-84	14.41	21.30		
1984-85	17.48	24.80		
1985-86	27.78	26.61		
1986-87	11.86	13.24		
1987-88	22.13	28.90		
1988-89	18.26	21.27		
1989-90	14.10	16.30		

SUMMARY OF PRECIPITATION DATA AT SAN ANTONIO DAM AND THREE STATIONS IN WATERSHED ABOVE DAM

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

PRECIPITATION DATA SUMMARY
FOR SAN ANTONIO WATERSHED
1900-1990

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 4-06

MAXIMUM PRECIPITATION FOR INDICATED DURATION***

RETURN PERIOD IN YEARS	5M	10M	15M	30M	1H	2H	3H	6H	12H	24H	C-YR	STATION
2	.12	.18	.23	.33	.43	.60	.75	1.11	1.56	2.07	15.63	NAME:
5	.18	.27	.35	.51	.65	.91	1.13	1.68	2.37	3.14	21.99	BEAUMONT
10	.22	.33	.43	.63	.81	1.12	1.40	2.07	2.91	3.87	25.94	
20	.26	.39	.51	.74	.95	1.32	1.65	2.44	3.44	4.56	29.54	ELEVATION:
25	.27	.41	.53	.77	.99	1.38	1.72	2.56	3.60	4.78	30.65	2610 FT
40	.30	.45	.58	.85	1.09	1.52	1.89	2.80	3.94	5.23	32.92	
50	.31	.47	.60	.88	1.13	1.58	1.96	2.91	4.10	5.44	33.97	LAT/LONG**
100	.35	.52	.68	.99	1.27	1.77	2.20	3.26	4.59	6.09	37.16	33.933/116.967
200	.38	.58	.75	1.09	1.40	1.95	2.43	3.60	5.07	6.73	40.23	
2	.14	.21	.27	.40	.63	1.01	1.37	2.18	3.22	4.35	32.42	NAME:
5	.21	.32	.42	.60	.96	1.56	2.08	3.30	4.88	6.60	45.60	BIG BEAR LAKE
10	.26	.40	.51	.74	1.18	1.89	2.56	4.07	6.01	8.1	53.79	DAM
20	.31	.47	.60	.88	1.39	2.23	3.02	4.79	7.08	8.58	61.25	
25	.33	.49	.63	.92	1.46	2.34	3.16	5.02	7.42	9.04	63.55	ELEVATION:
40	.36	.54	.69	1.01	1.59	2.56	3.46	5.50	8.13	10.99	68.26	6815 FT
50	.37	.56	.72	1.05	1.66	2.66	3.61	5.72	8.46	11.44	70.45	
100	.42	.62	.81	1.17	1.86	2.98	4.04	6.41	9.47	12.80	77.05	LAT/LONG**
200	.46	.69	.89	1.29	2.05	3.29	4.46	7.08	10.46	14.15	83.42	34.233/116.967
2	.13	.18	.24	.32	.44	.67	.84	1.22	1.62	2.09	11.93	NAME:
5	.19	.27	.35	.47	.65	1.00	1.24	1.80	2.38	3.09	16.80	PRADO DAM
10	.23	.32	.43	.57	.78	1.21	1.50	2.18	2.89	3.74	19.88	
20	.27	.37	.50	.67	.91	1.40	1.74	2.54	3.36	4.35	22.72	ELEVATION:
25	.28	.39	.52	.70	.95	1.46	1.82	2.65	3.51	4.54	23.59	560 FT
40	.30	.42	.56	.76	1.03	1.59	1.98	2.88	3.81	4.94	25.39	
50	.31	.44	.58	.79	1.07	1.65	2.05	2.99	3.95	5.12	26.23	LAT/LONG**
100	.35	.49	.65	.87	1.19	1.83	2.27	3.32	4.38	5.68	28.77	33.890/117.635
200	.38	.54	.71	.96	1.30	2.01	2.49	3.64	4.81	6.23	31.23	
2	0.00	0.00	0.00	0.00	.34	.48	.57	.78	1.01	1.26	9.52	NAME:
5	0.00	0.00	0.00	0.00	.51	.73	.87	1.19	1.53	1.91	13.38	RIVERSIDE
10	0.00	0.00	0.00	0.00	.63	.90	1.07	1.47	1.89	2.35	15.79	CITRUS EXP STA
20	0.00	0.00	0.00	0.00	.74	1.06	1.27	1.73	2.23	2.77	17.98	
25	0.00	0.00	0.00	0.00	.78	1.11	1.33	1.87	2.33	2.90	18.6	ELEVATION:
40	0.00	0.00	0.00	0.00	.85	1.21	1.45	1.98	2.56	3.17	20.04	1015 FT
50	0.00	0.00	0.00	0.00	.88	1.26	1.51	2.06	2.66	3.30	20.68	
100	0.00	0.00	0.00	0.00	.99	1.41	1.69	2.31	2.98	3.70	22.62	LAT/LONG**
200	0.00	0.00	0.00	0.00	1.09	1.56	1.87	2.55	3.29	4.09	24.49	33.967/117.334
2	0.00	0.00	.25	.35	.5	.77	0.00	1.45	1.98	2.69	*16.91	NAME:
5	0.00	0.00	.38	.54	.77	1.17	0.00	2.20	3.01	4.08	*23.78	UPLAND
10	0.00	0.00	.46	.66	.95	1.44	0.00	2.71	3.71	5.02	*28.05	
20	0.00	0.00	.55	.78	1.12	1.69	0.00	3.19	4.37	5.92	*31.94	ELEVATION:
25	0.00	0.00	.57	.82	1.17	1.77	0.00	3.35	4.58	6.21	*33.14	1840 FT
40	0.00	0.00	.63	.89	1.29	1.94	0.00	3.66	5.01	6.79	*35.60	
50	0.00	0.00	.65	.93	1.34	2.02	0.00	3.81	5.22	7.07	*36.74	LAT/LONG**
100	0.00	0.00	.73	1.04	1.50	2.26	0.00	4.27	5.84	7.92	*40.18	34.140/117.677
200	0.00	0.00	.81	1.15	1.66	2.50	0.00	4.72	6.46	8.75	*43.50	

* THE DURATION IS FOR FISCAL-YEAR (JULY TO JUNE)

** LATITUDE/LONGITUDE

*** M: MINUTES
H: HOURS
C-YR: CALENDER YEAR

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

PRECIPITATION

DEPTH - DURATION - FREQUENCY

TABLE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: CALIFORNIA STATE DEPT. OF WATER RESOURCES
NOVEMBER 1982

SOURCE: Compiled for manual, LAD, USACOE 1990 FROM USGS, LACFCD, USACOE RECORDS

ANNUAL MAXIMUM INFLOW, OUTFLOW, AND STORAGE OF WATER AT SAN ANTONIO DAM

WATER YEAR	PEAK INFLOW cfs	DATE	PEAK OUTFLOW cfs	DATE	MAX. WATER SURFACE ELEVATION (ft. NGVD)	MAX. STORAGE (AC-ft)	DATE	ANNUAL INFLOW (AC-ft)
56-57	82	23 FEB	0	-	2127.50	43	13 JAN	33
57-58	549	3 APR	855	2 APR	2144.14	520	4 APR	13,604
58-59	220	11 FEB	0	-	2139.37	350	11 FEB	318
59-60	5	27 APR	0	-	2125.00	0	-	15
60-61	0	-	0	-	2125.00	0	-	0
61-62	376	20 NOV	239	14 MAR	2141.94	444	13 FEB	2,066
62-63	244	9 FEB	0	-	2132.46	160	11 FEB	110
63-64	125	22 JAN	.1	-	2127.26	39	2 APR	842
64-65	558	2 APR	7	2 APR	2129.84	90	10 APR	73
65-66	2422	29 DEC	920	30 DEC	2168.25	1780	25 NOV	27,726
66-67	3098	6 DEC	3900	6 DEC	2168.33	1780	6 DEC	20,406
67-68	1579	19 NOV	601	2 JAN	2143.43	500	5 DEC	1,579
68-69	6570	25 JAN	8420	25 JAN	2192.80	2319	27 FEB	67,356
69-70	106	1 MAR	2141	4 MAR	2153.95	173	2 MAR	2,090
70-71	174	29 NOV	21	1 DEC	2148.70	86	30 NOV	250
71-72	50	24 DEC	66	3 JAN	2151.05	121	28 DEC	147
72-73	537	12 MAR	590	11 FEB	2160.95	340	13 FEB	7,364
73-74	52	7 JAN	73	16 JAN	2154.17	177	9 JAN	478
74-75	31	6 MAR	7	26 MAR	2144.95	36	1 MAR	44
75-76	294	9 FEB	103	17 SEP	2153.5	164	4 MAR	712
76-77	422	3 JAN	250	25 JAN	2153.1	157	10 JAN	1,170
77-78	2040	4 MAR	1979	1 MAR	2198.39	2850	15 MAR	65,040
78-79	266	27 MAR	77	20 MAR	2171.16	781	4 APR	4,900
79-80	1624	16 FEB	2057	20 FEB	2225.6	5948	19 FEB	28,800
80-81	172	29 JAN	106	29 JAN	2146.00	14	2 MAR	2,450
81-82	121	17 MAR	125	14 APR	2157.60	215	14 APR	10,111
82-83	998	1 MAR	351	4 MAR	2188.13	1965	4 MAR	50,046
83-84	102	2 JAN	120	27 DEC	2156.33	178	28 DEC	8,853
84-85	62	19 DEC	61	19 DEC	2141.80	2	19 DEC	1,137
85-86	149	19 FEB	149	19 FEB	2158.94	258	19 FEB	10,242
86-87	26	4 JAN	26	4 JAN	2128.5	2	4 JAN	54
87-88	63	3 NOV	64	3 NOV	2145.3	170	2 NOV	3,052
88-89	198	18 MAR	198	18 MAR	2128.43	2	21 DEC	257
89-90	21	9 FEB	21	9 FEB	2127.28	.5	31 JAN	26

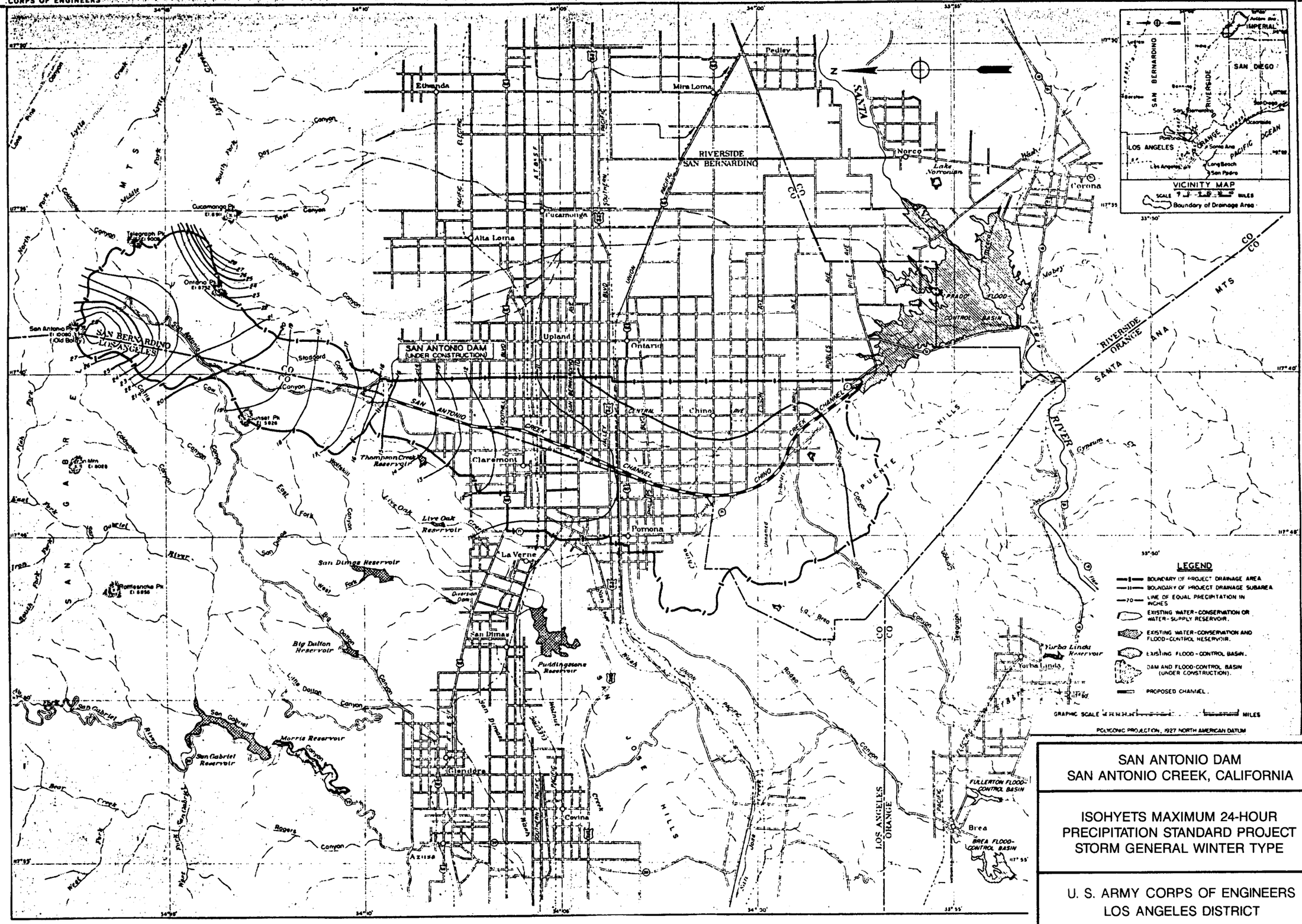
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

ANNUAL MAXIMUM INFLOW, OUTFLOW, AND STORAGE OF WATER AT SAN ANTONIO DAM

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 4-08

CORPS OF ENGINEERS — U.S. ARMY



SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

ISOHYETS MAXIMUM 24-HOUR
PRECIPITATION STANDARD PROJECT
STORM GENERAL WINTER TYPE

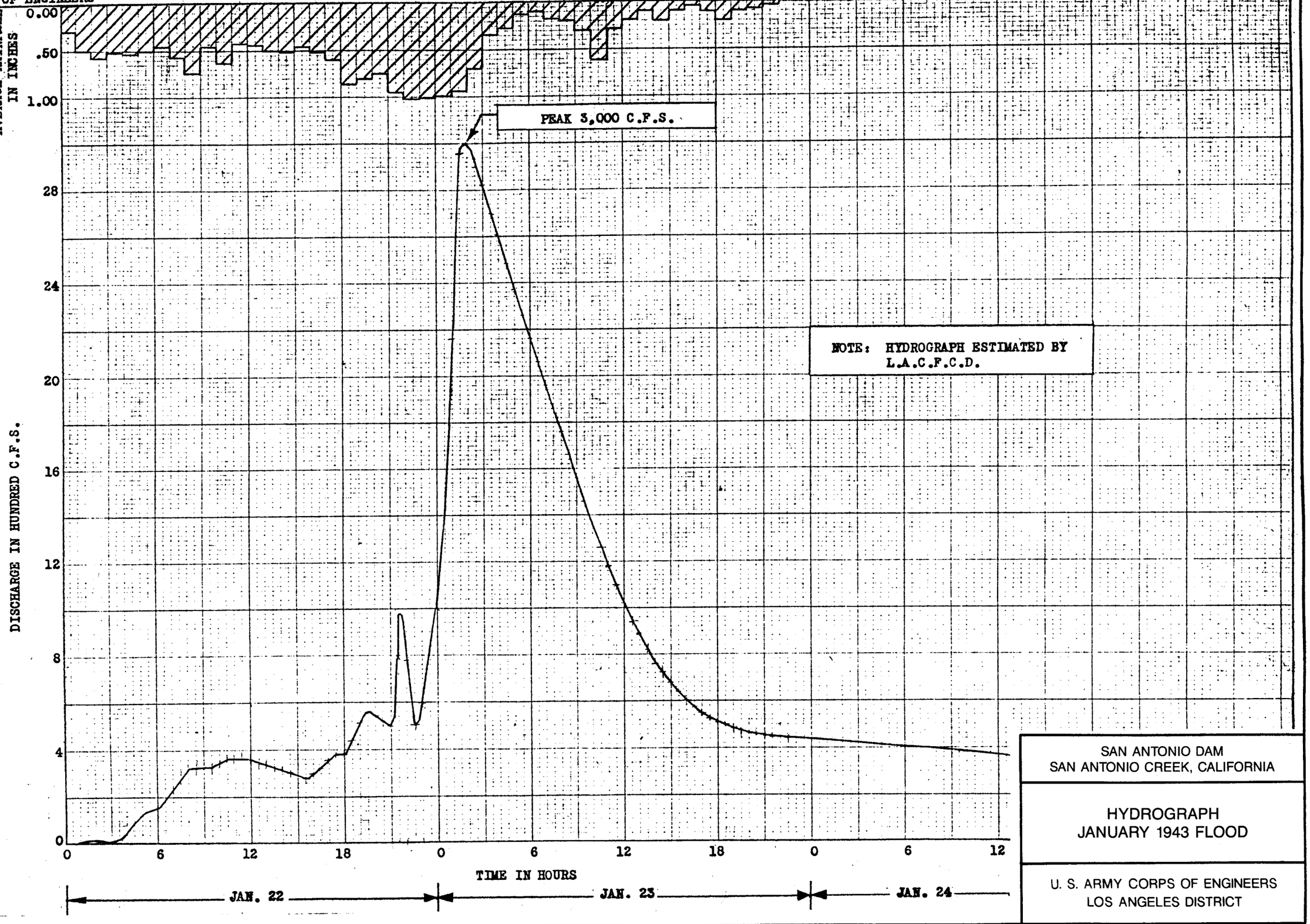
U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 13

PLATE 4-09

CORPS OF ENGINEERS

U. S. ARMY



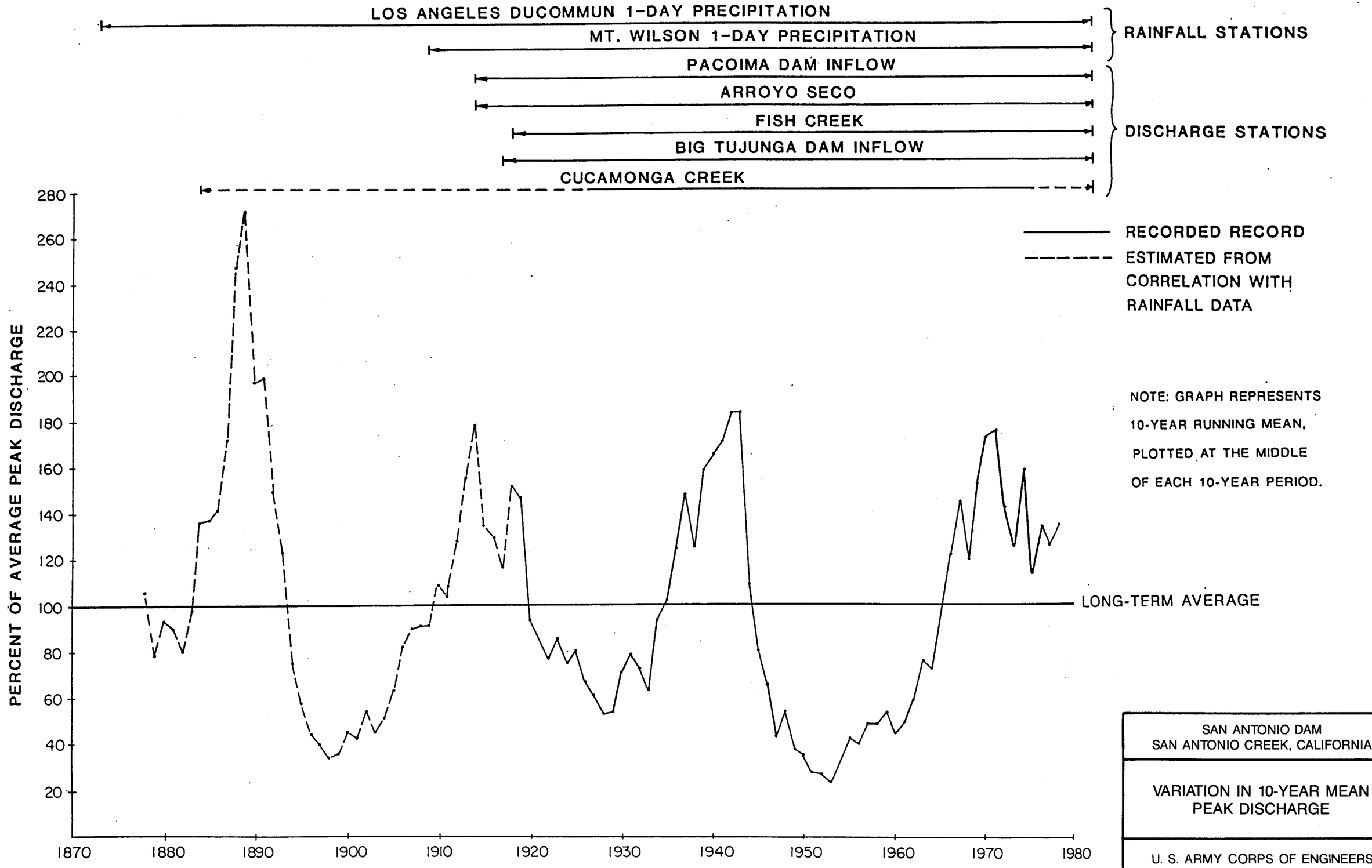
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

HYDROGRAPH
JANUARY 1943 FLOOD

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 17

PLATE 4-10



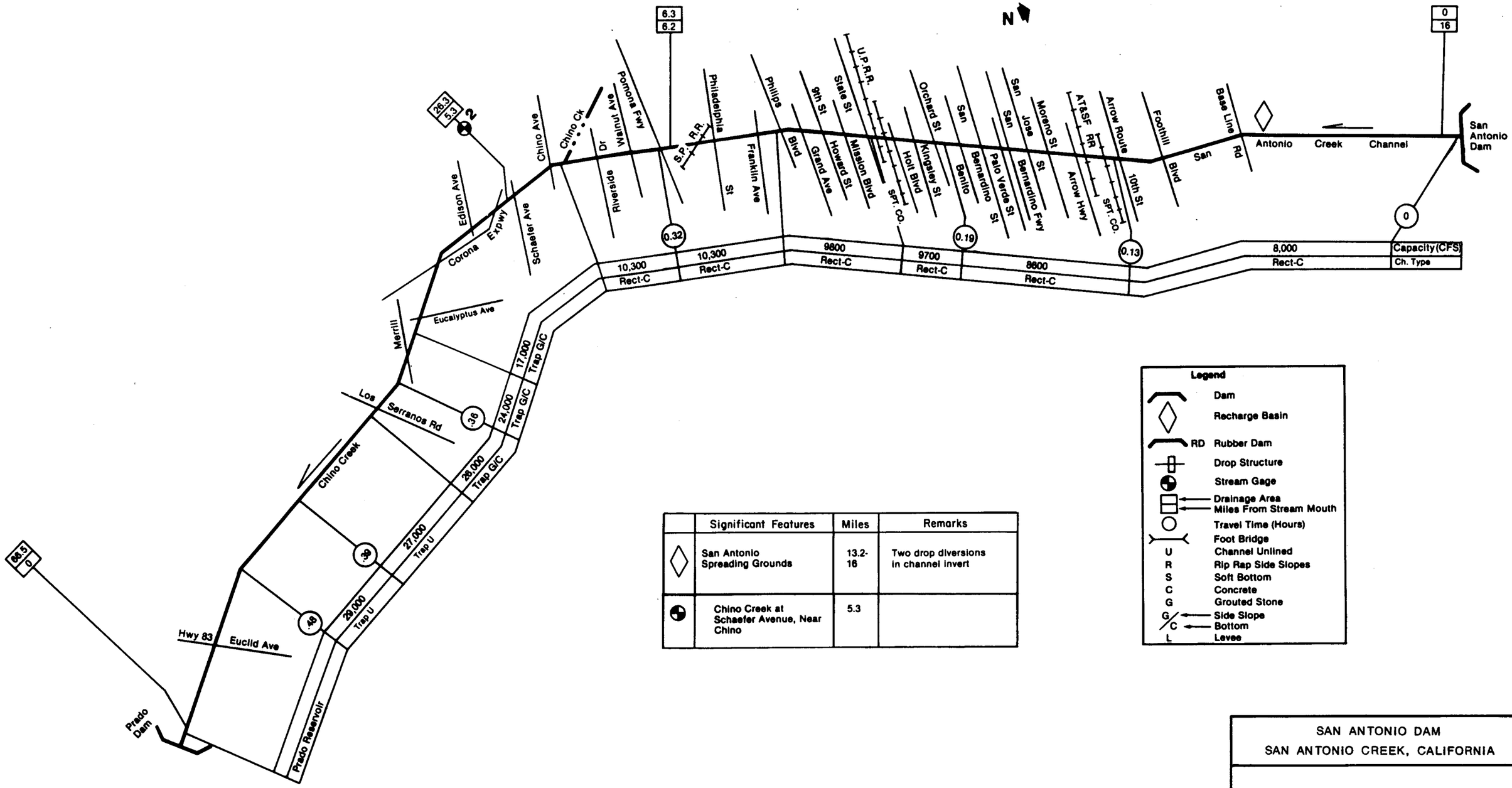
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

VARIATION IN 10-YEAR MEAN PEAK DISCHARGE

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: SEPULVEDA DAM WATER CONTROL MANUAL

PLATE 4-11



	Significant Features	Miles	Remarks
◇	San Antonio Spreading Grounds	13.2-16	Two drop diversions in channel invert
◓	Chino Creek at Schaefer Avenue, Near Chino	5.3	

Legend

- Dam
- Recharge Basin
- RD Rubber Dam
- Drop Structure
- 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

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO & CHINO CREEKS SCHEMATIC

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

SOURCE: Plate 1, Ref. 15

SAN ANTONIO CHANNEL BELOW SAN ANTONIO DAM

HIGHWAY BRIDGES

Location of Proposed Crossings	Station	Width (feet)	Length (feet)	No. of Spans
Base Line Rd	978+41	49	20	1
Foothill Blvd	924+41	96	20	1
Arrow Highway (10th St.)	897+52	58	20	1
8th St. (Cucamonga Ave.)	869+17	83	25	1
7th St. (Moreno Ave.)	855+03	55	25	1
San Jose Ave.	841+39	46	25	1
Interstate 10*	830+00			
Margarita Ave.	827+56	45	25	1
San Bernardino Ave.	813+68	84	25	1
Ramona Ave. (Olive Ave.)	808+01	100	25	1
Benito Ave.	797+73	68	25	1
Orchard Ave.	783+84	56	25	1
Kingsley Ave.	768+54	73	25	1
Holt Blvd.*	753+00			
State St. (1st St.)	737+94	84	25	1
Kodata Ave. (5th)	734+91	88	25	1
9th St.	706+34	55	25	1
East End Ave.	696+35	144	25	1
Grand Ave.	690+29	110	25	1
Phillips Blvd.	676+40	80	25	1
Franklin Ave.	662+58	58	30	1
Philadelphia Ave.	634+07	92	30	1
Interstate 60*	609+65			
Walnut Ave.	607+15	67	30	1
Riverside Dr.	579+28	80	30	1
Chino Ave.	552+63	32	115	2
Schaefer Ave.	525+01	32	130	2
Corona Freeway (71)	516+51	32	360	4
Edison Ave.	494+62	20	130	2
Carey Ave.	458+80	230	55	1
Ramona Ave. (Olive Ave.)	429+66	32	192	3
Merrill Ave.	398+50	32	271	4
Los Serranos Rd.	366+37	32	184	3

*Constructed after project design was completed and approved.

RAILROAD BRIDGES

Name	Station	Width (feet)	Length (feet)
Pacific Electric (interurban line)	882+47	67	25
Atchison, Topeka & Santa Fe (main line)	875+08	48	25
Southern Pacific (main line)	739+35	78	25
Union Pacific (main line)**	738+46	60	25
Southern Pacific (Chino branch line)	617+44	41	30

**Combination highway and railroad bridge; dimensions given are for railroad part only.

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

HIGHWAY AND RAILROAD CROSSINGS ON SAN ANTONIO AND CHINO CREEKS CHANNEL

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 4-13

HYDROLOGIC INSTRUMENTATION OF SAN ANTONIO DAM

Parameter	Gauge Type	Report Mode	Stored Record (period available)	Comments
Water surface elevation	Staff boards	VISUAL	Flood Control Basin Operation Report SPL 19 (1955-present)	
	Stevens A-35 recorder	Visual	Reservoir Operation Report SPL 424 (1955-present) paper strip chart (1955-present) punch tape (1974-present)	The Stevens A-35 recorder is driven by an Exactel servamanometer that measures water-surface elevation
	D.R.*	Telemetry	Telemetry data file	
Outlet gate opening	Gate opening indicator	Visual	Flood Control Basin Operators Report SPL 19 (1955-present)	
	Stevens PL	None	Paper chart (1955-present)	
Precipitation	Tipping bucket gauge connected by magnetic sensor to D.R.*	Telemetry	Reservoir Operation Report SPL 424 (1955-present) punch tape (1974-present) telemetry data file	Tipping bucket type gauge installed in 1985.
	Belfort recording gauge	None	Paper chart (1955-present)	Data on paper charts is evaluated for daily rainfall amounts and charts are then sent to NWS in Asheville, N.C. for publication.
	Glass raintube	Visual	Rainfall Records SPL 31 (1955-present)	

*Digital Recorder -- A device that converts gauge motion into coded digital information and records this periodically as a pattern of punched holes in paper tape.

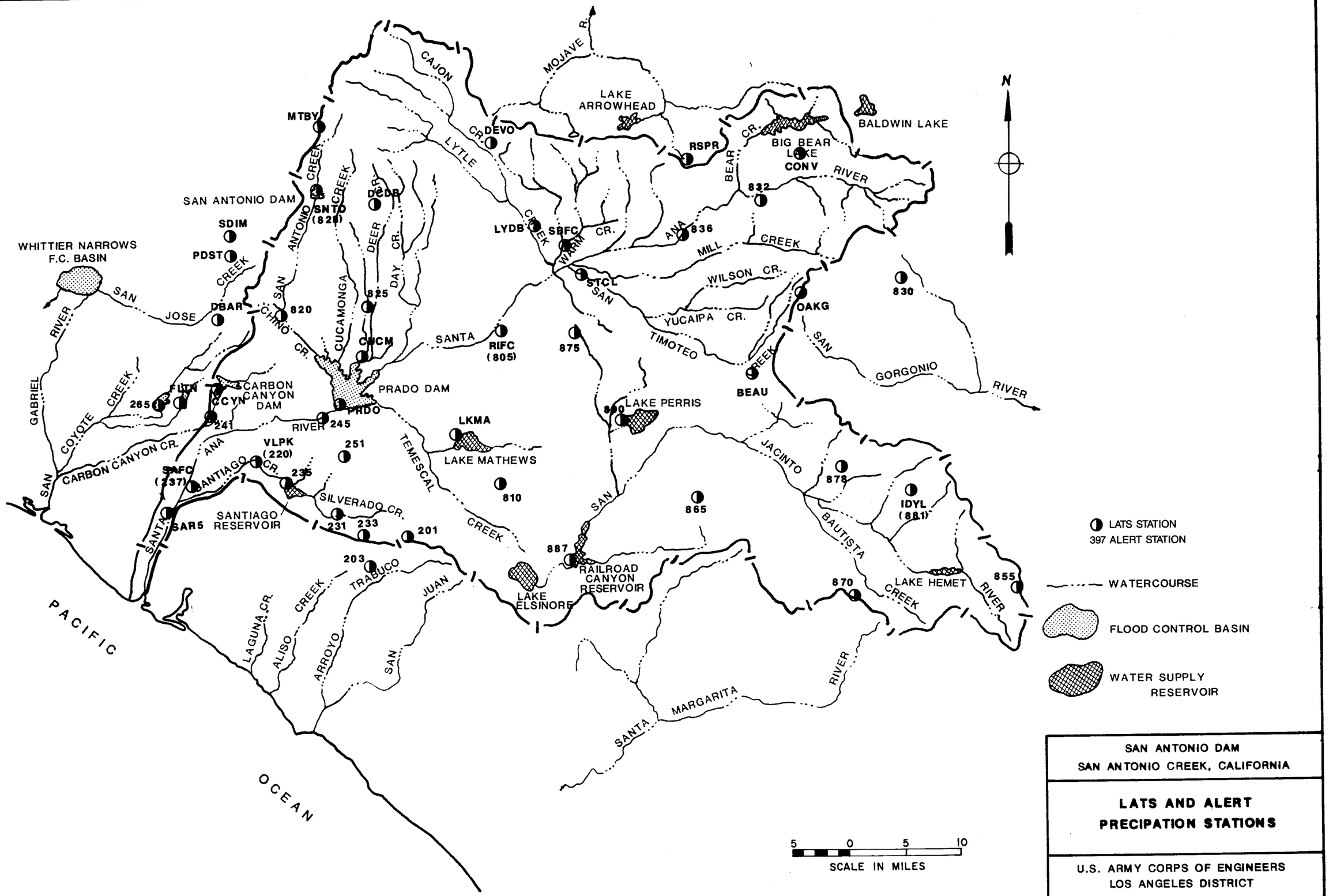
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

HYDROLOGIC INSTRUMENTATION OF SAN ANTONIO DAM

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Prepared for Manual 1990, LAD, USACOE

PLATE 5-01



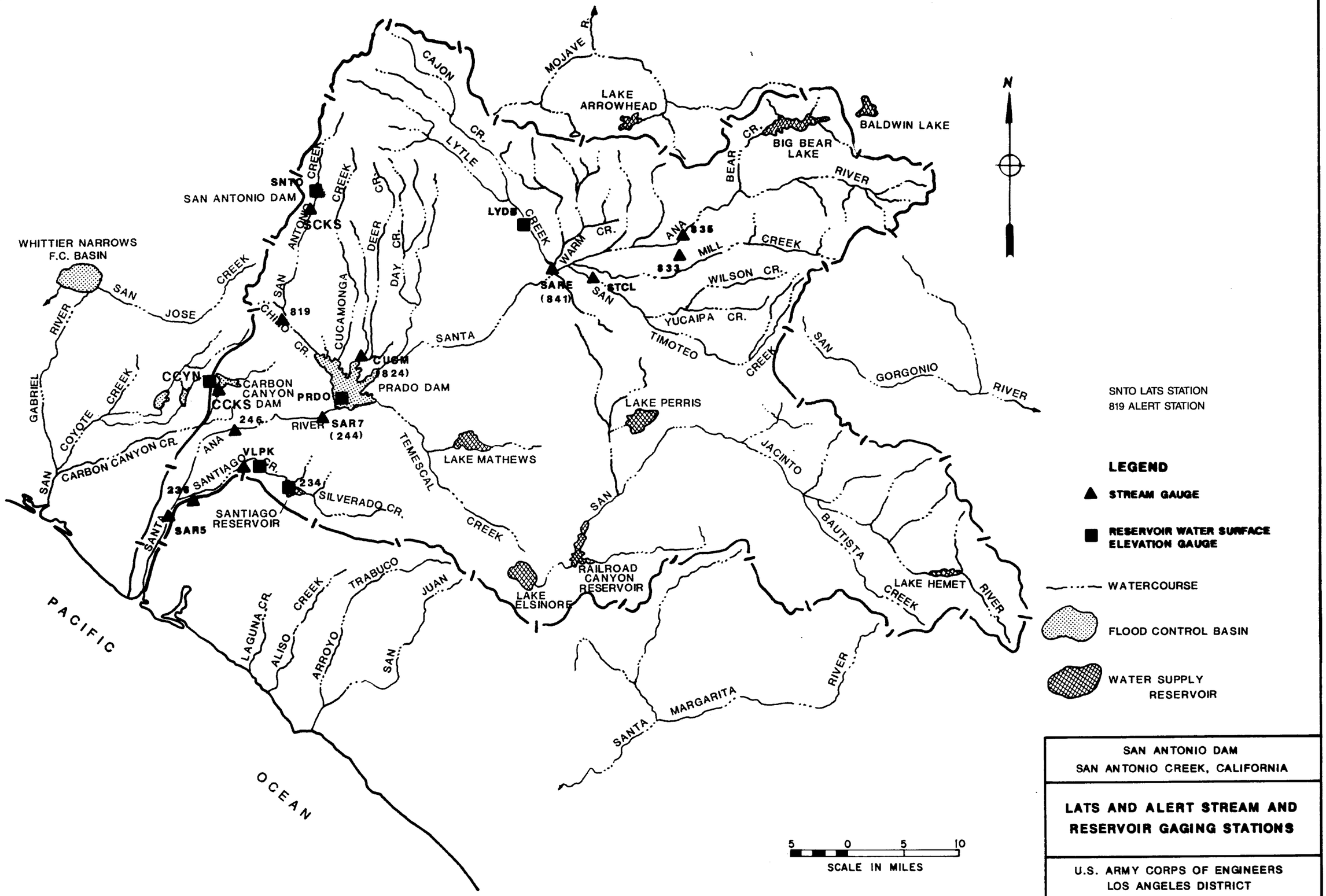
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

LATS AND ALERT PRECIPATION STATIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 5-02

SOURCE: LAD, USACOE 1988, Real-time Hydrologic Data Acquisition with the Los Angeles Telemetry System



SNTO LATS STATION
819 ALERT STATION

LEGEND

- ▲ STREAM GAUGE
- ■ RESERVOIR WATER SURFACE ELEVATION GAUGE
- WATERCOURSE
- FLOOD CONTROL BASIN
- WATER SUPPLY RESERVOIR

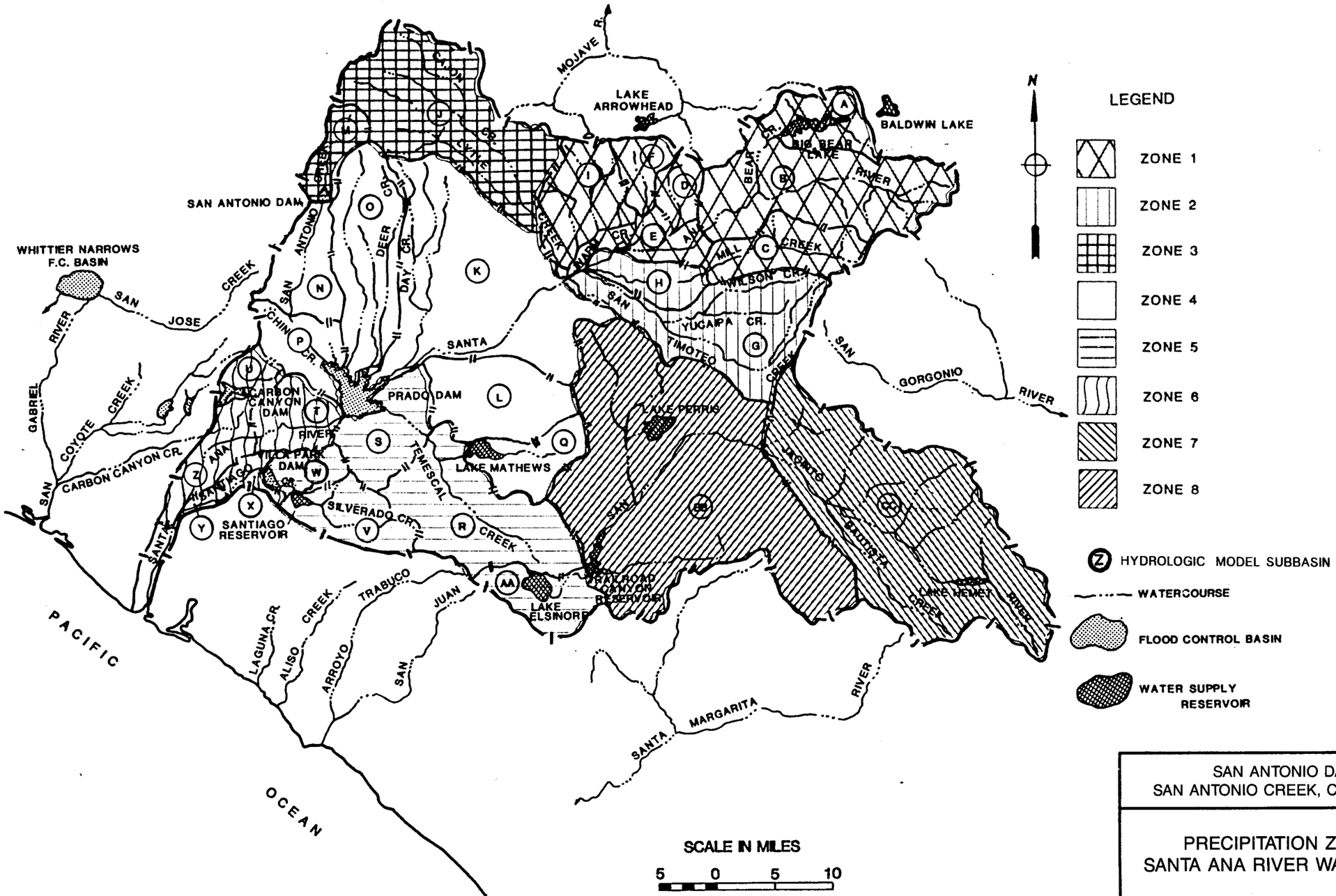
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

LATS AND ALERT STREAM AND RESERVOIR GAGING STATIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE 1988, Real-time Hydrologic Data Acquisition with the Los Angeles Telemetry System

PLATE 5-03



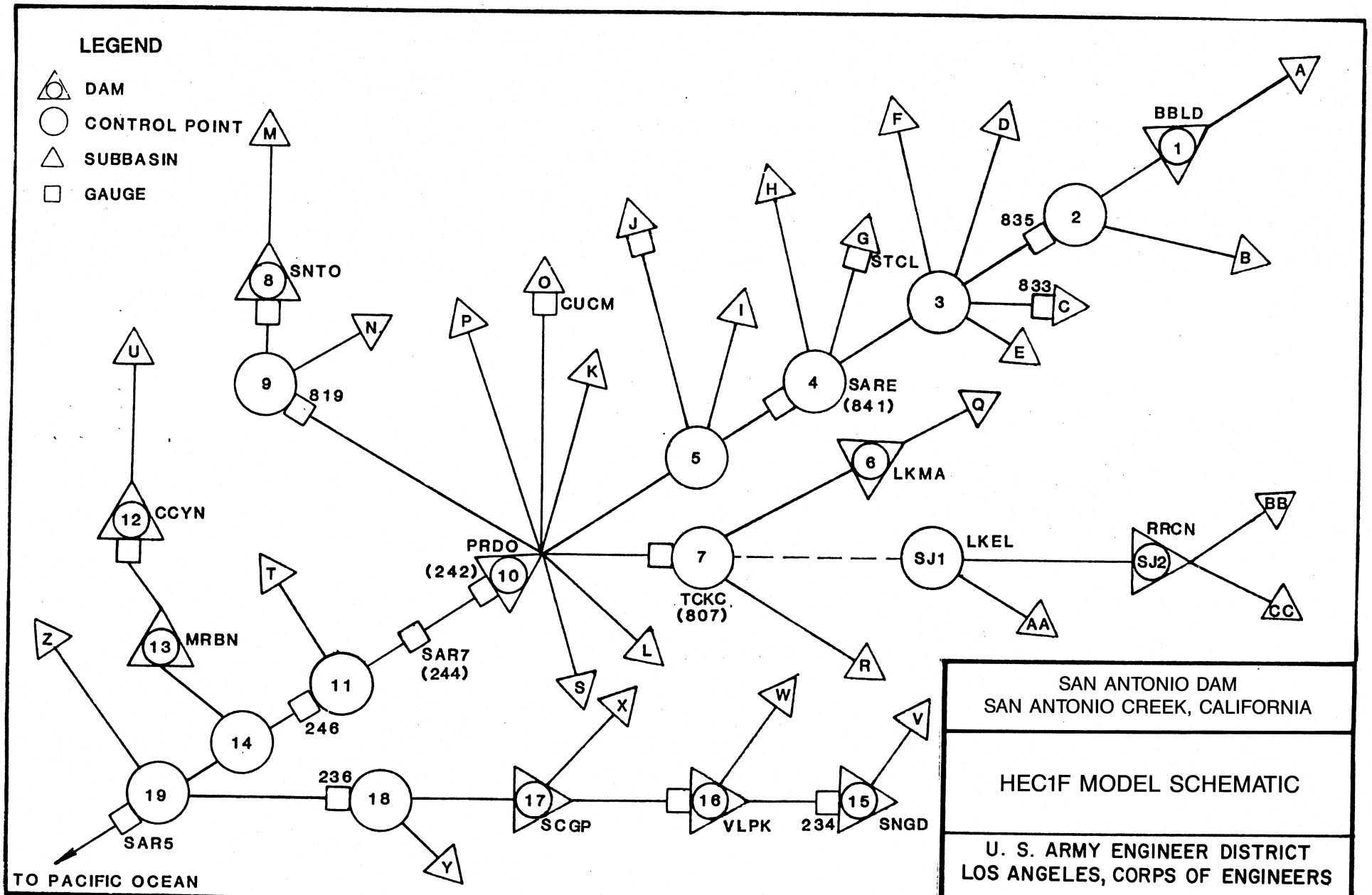
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

PRECIPITATION ZONES
SANTA ANA RIVER WATERSHED

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 31

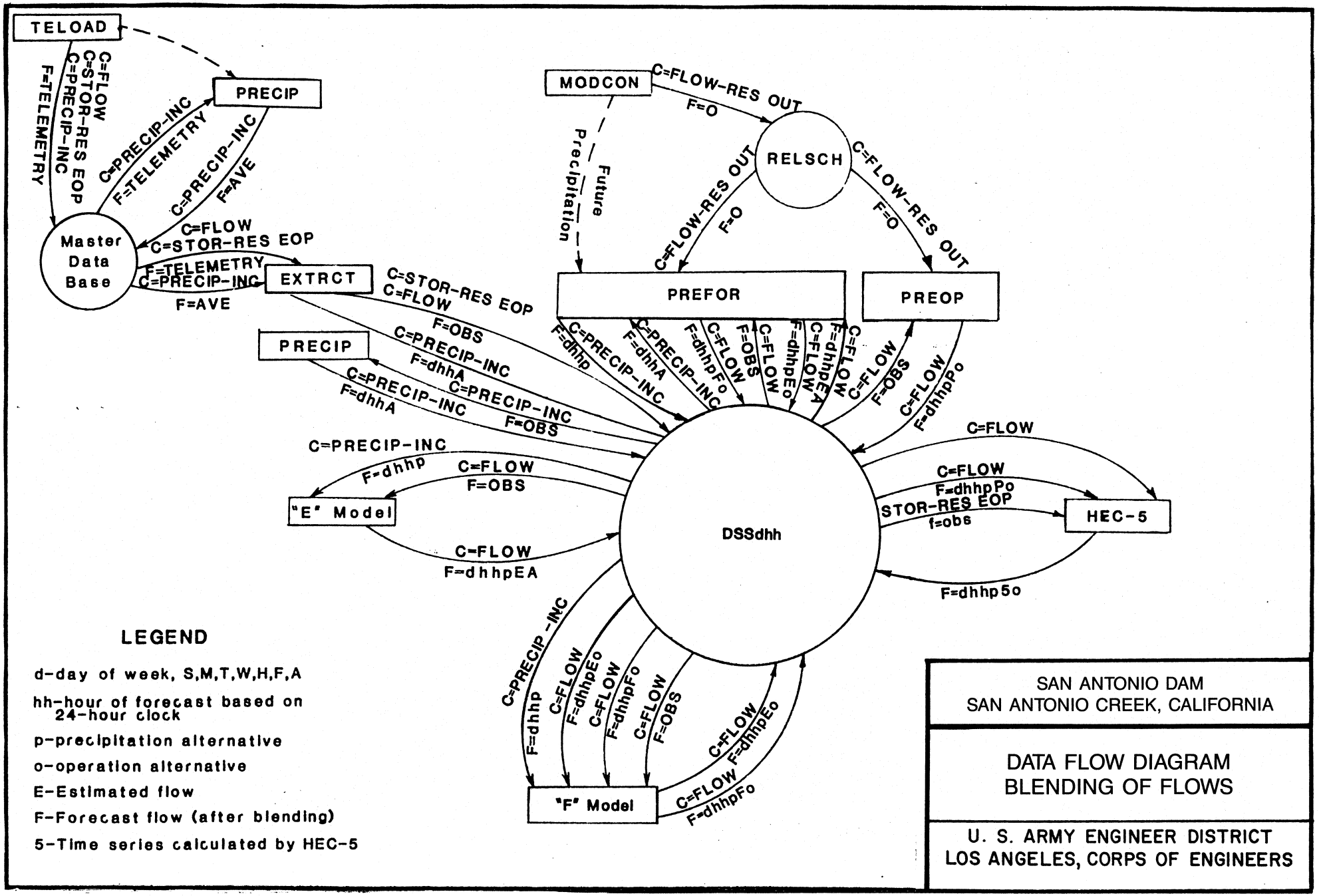
PLATE 6-01



NOTE: — — — — Indicates upstream drainage area rarely contributes to downstream control point.

SOURCE: Plate 1, Ref. 31

PLATE 6-02



LEGEND

d-day of week, S,M,T,W,H,F,A

hh-hour of forecast based on 24-hour clock

p-precipitation alternative

o-operation alternative

E-Estimated flow

F-Forecast flow (after blending)

5-Time series calculated by HEC-5

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

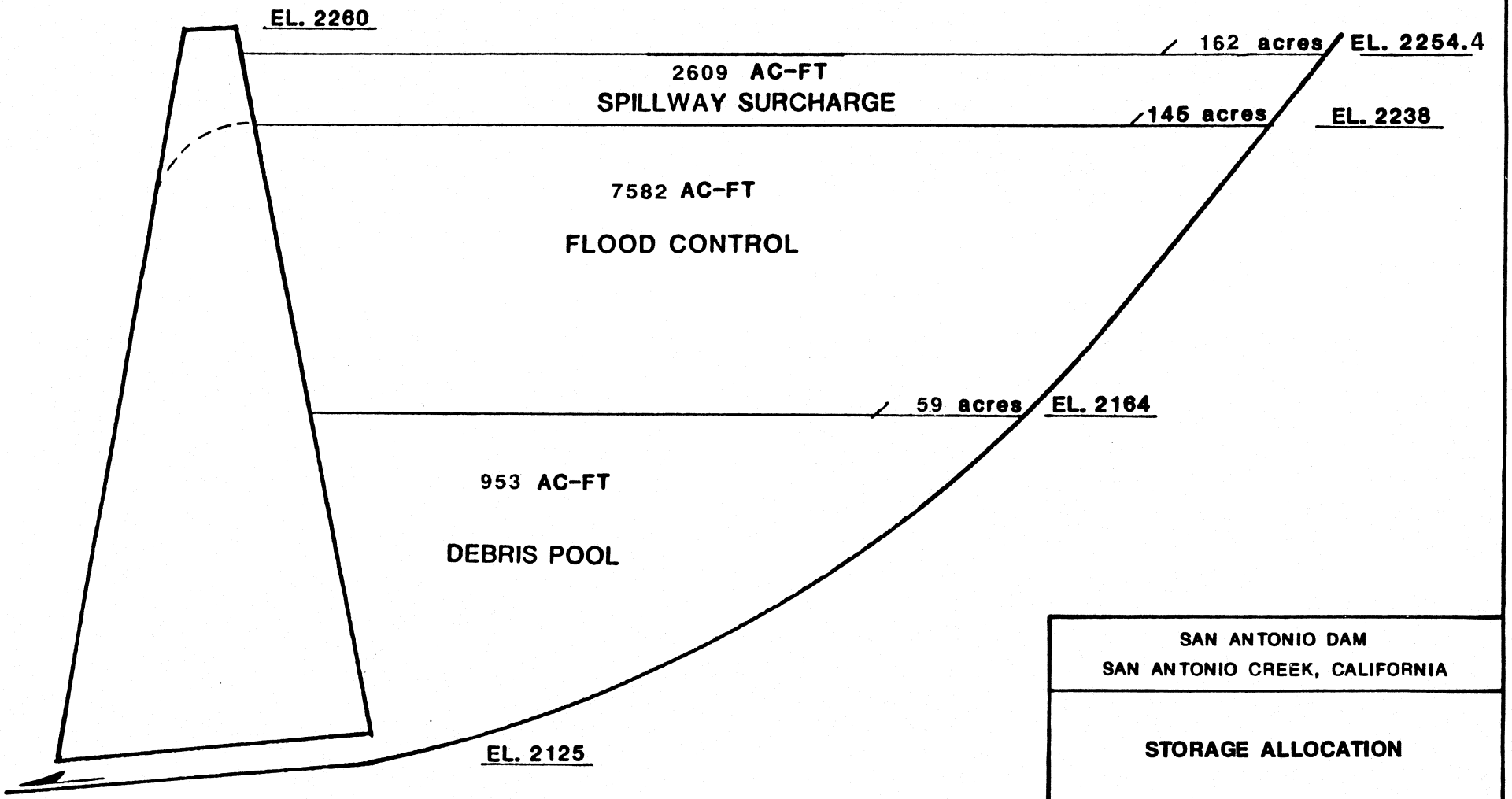
DATA FLOW DIAGRAM
BLENDING OF FLOWS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

SOURCE: Plate 1, Ref. 31

PLATE 6-03

SAN ANTONIO RESERVOIR, CALIFORNIA



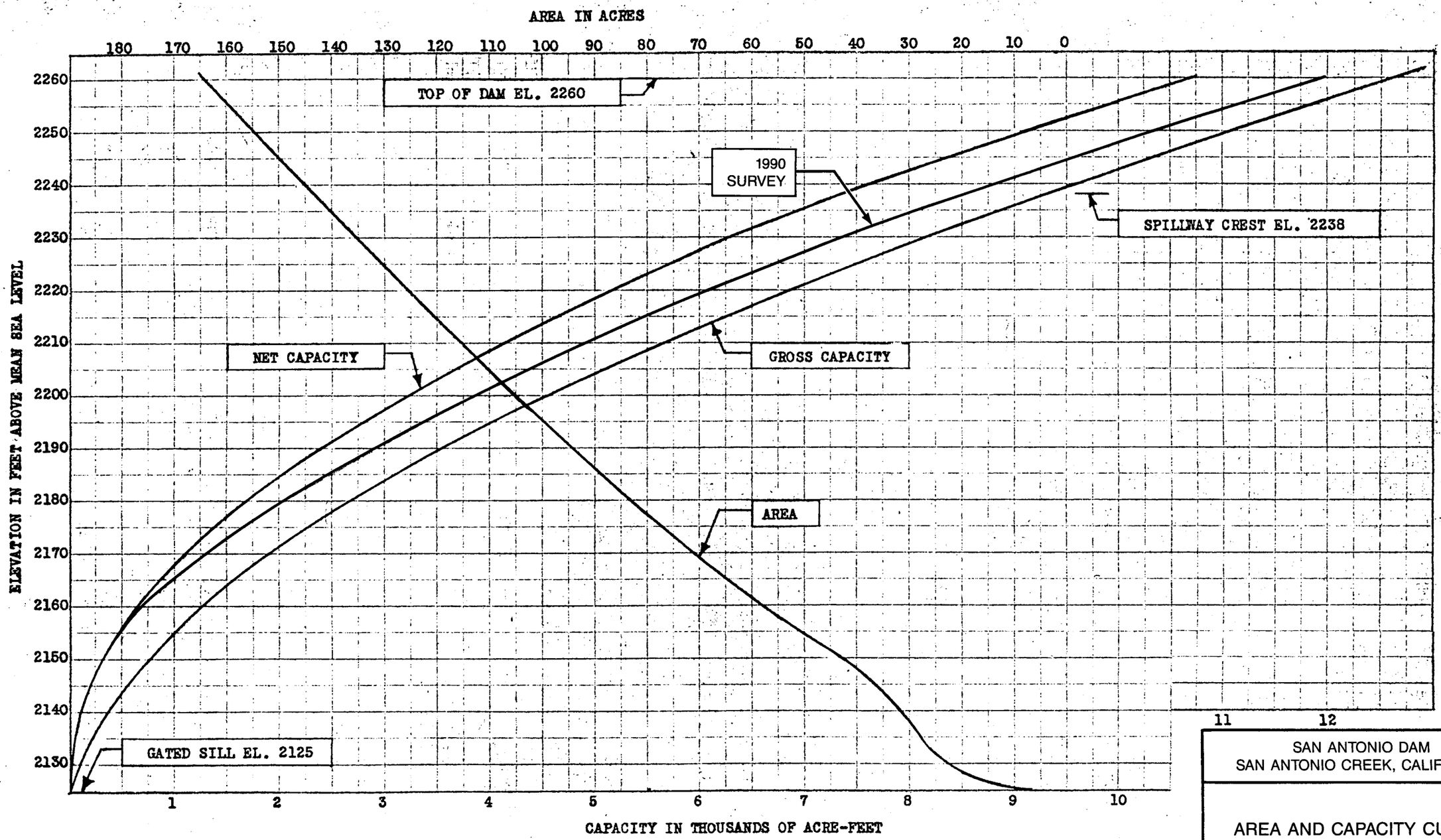
SOURCE:
LAD RESERVOIR REGULATION FROM SURVEY OF 21 FEBRUARY 1990

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

STORAGE ALLOCATION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 7-01



SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

AREA AND CAPACITY CURVES

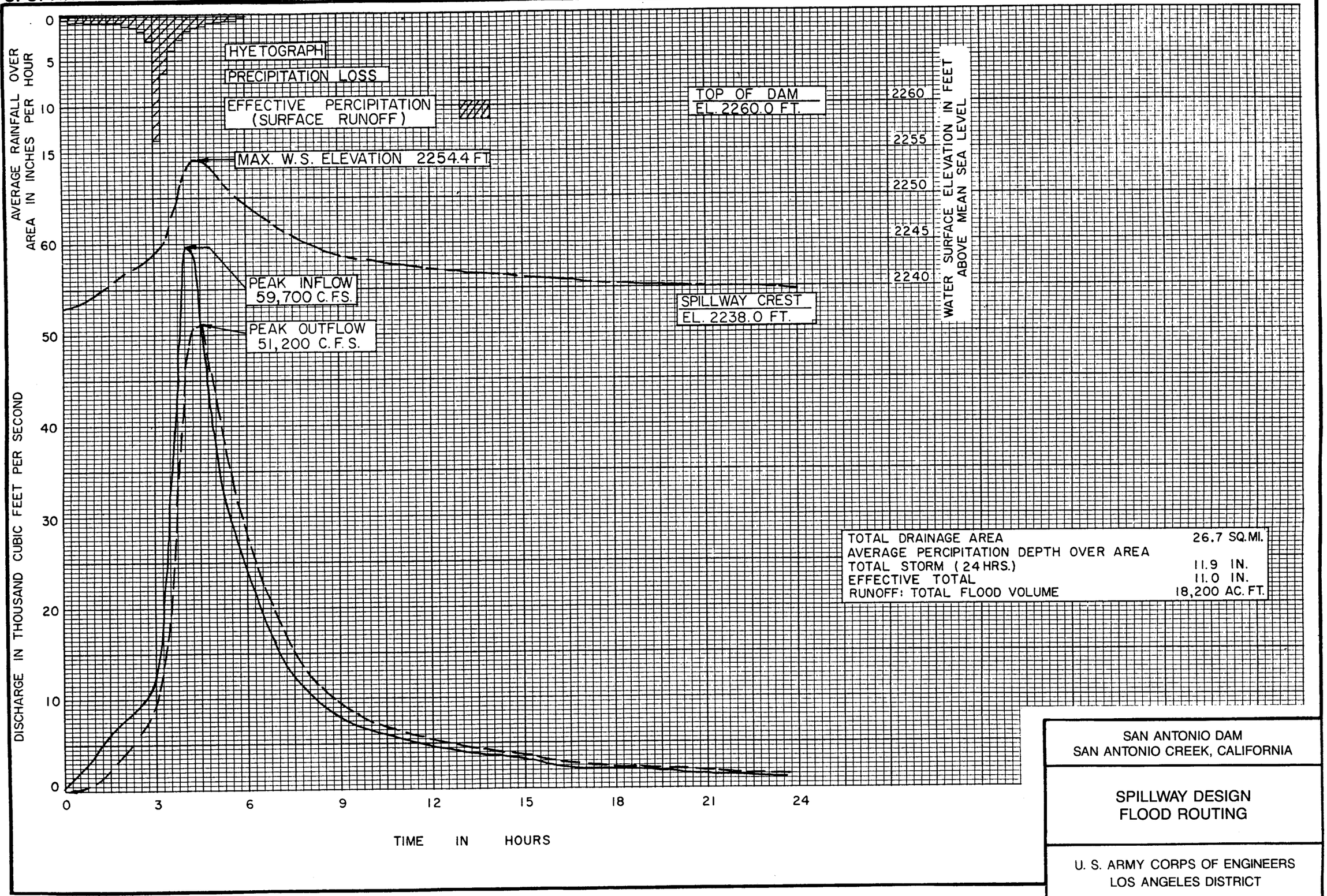
U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 17, Modified 1990 LAD, USACOE

PLATE 7-02

U. S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



TOTAL DRAINAGE AREA	26.7 SQ.MI.
AVERAGE PERCIPITATION DEPTH OVER AREA	
TOTAL STORM (24 HRS.)	11.9 IN.
EFFECTIVE TOTAL	11.0 IN.
RUNOFF: TOTAL FLOOD VOLUME	18,200 AC. FT.

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SPILLWAY DESIGN
FLOOD ROUTING

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. **26**

PLATE 8-01

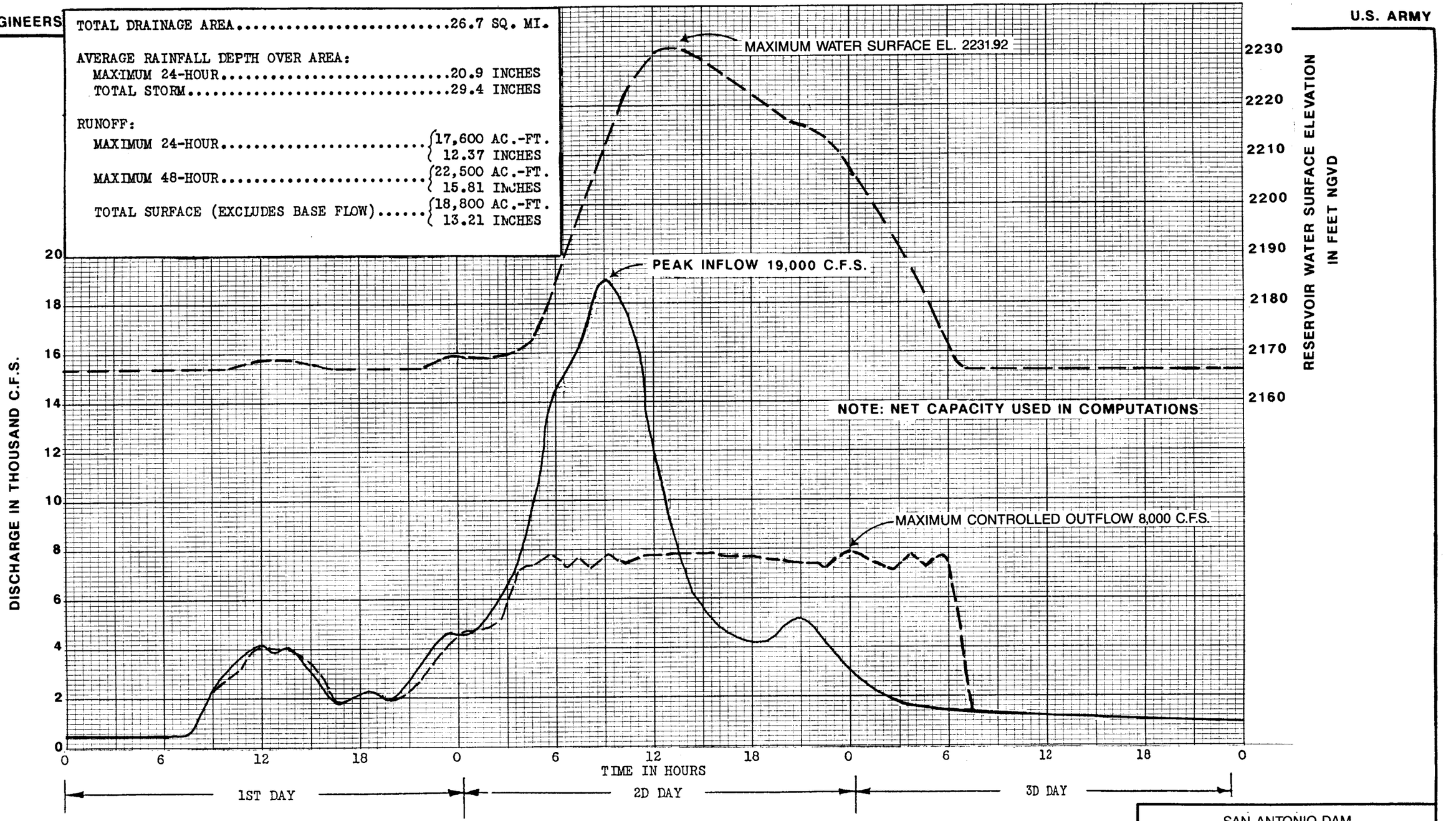
CORPS OF ENGINEERS

U.S. ARMY

TOTAL DRAINAGE AREA.....26.7 SQ. MI.

AVERAGE RAINFALL DEPTH OVER AREA:
- MAXIMUM 24-HOUR.....20.9 INCHES
- TOTAL STORM.....29.4 INCHES

RUNOFF:
- MAXIMUM 24-HOUR.....17,600 AC.-FT. / 12.37 INCHES
- MAXIMUM 48-HOUR.....22,500 AC.-FT. / 15.81 INCHES
- TOTAL SURFACE (EXCLUDES BASE FLOW).....18,800 AC.-FT. / 13.21 INCHES



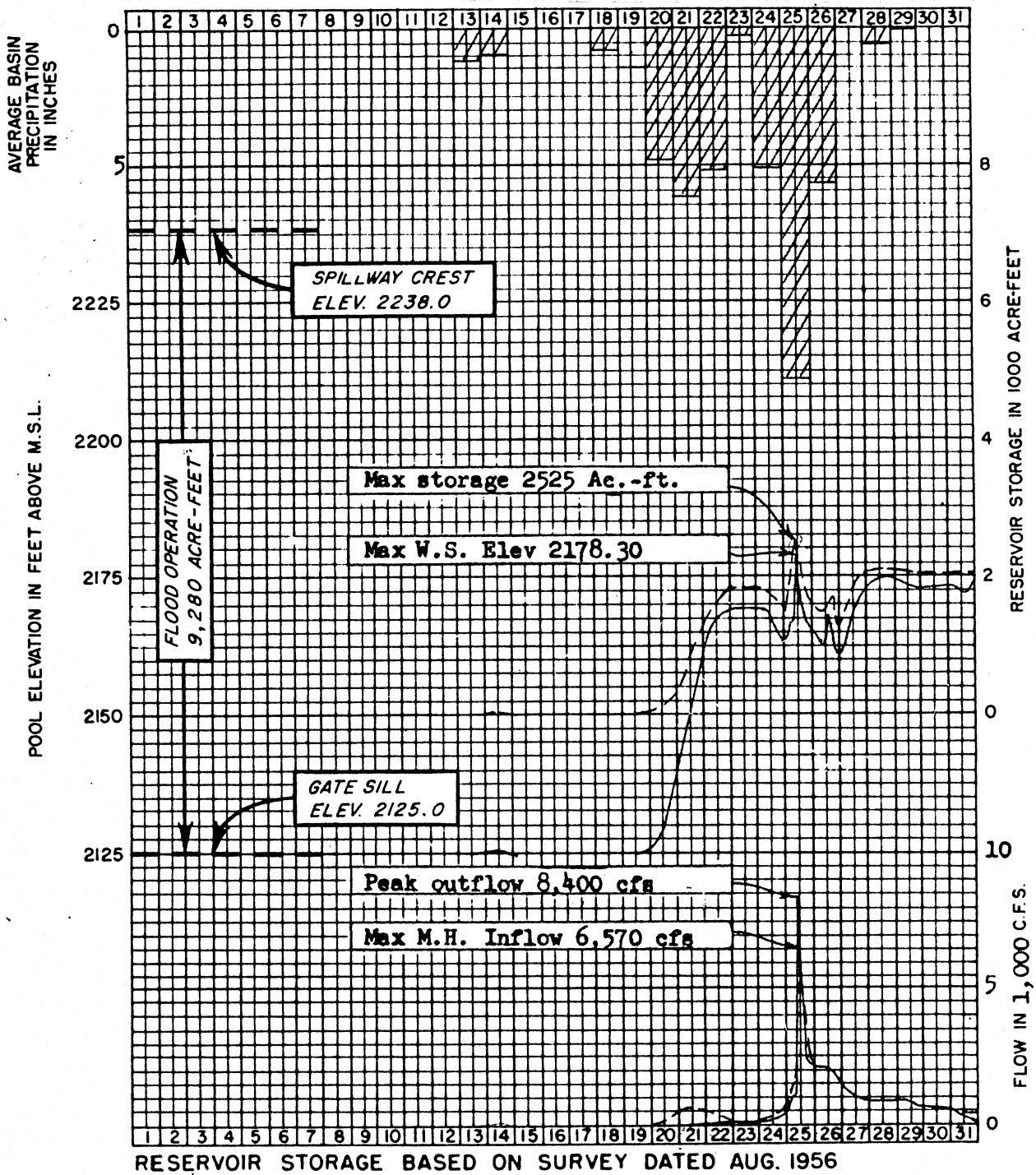
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO DAM
RESERVOIR DESIGN
STANDARD PROJECT FLOOD ROUTING

U. S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: Plate 1, Ref. 25, Modified 1991

PLATE 8-02



MONTH OF Jan 19 69

MONTHLY RESERVOIR OPERATION

SAN ANTONIO FLOOD-CONTROL BASIN

	ELEV.	GROSS STORAGE (ACRE-FT.)
Conservation Pool		NONE
Full Pool	2,238	9,280

Outlet Capacity at Full Pool 11,800 c.f.s.

SANTA ANA RIVER BASIN
DRAINAGE AREA 26.7 SQ. MILES

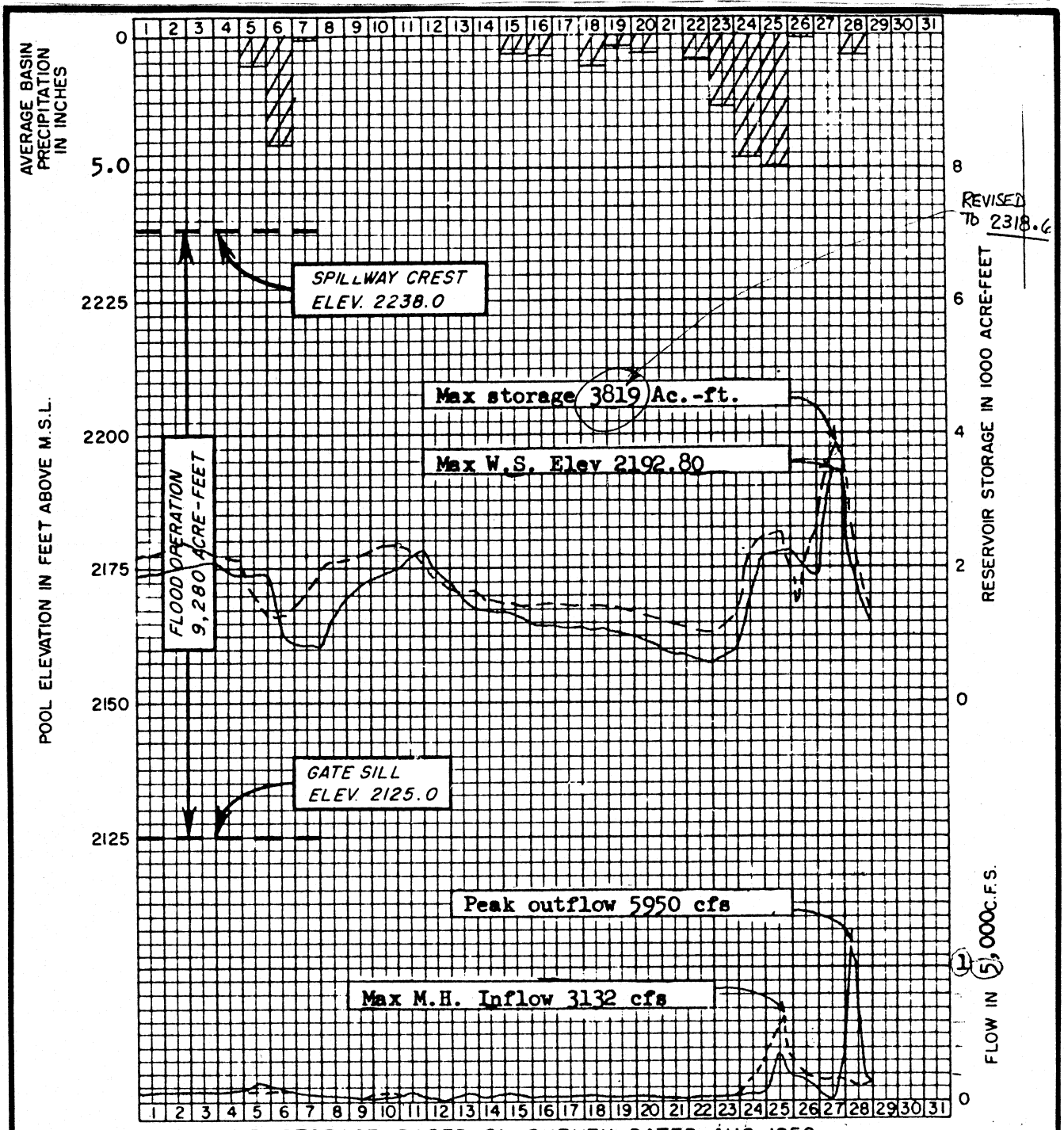
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

OPERATION HYDROGRAPH
24-28 JANUARY 1969

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

PLATE 8-03



RESERVOIR STORAGE BASED ON SURVEY DATED AUG. 1956

MONTH OF FEB 19 69

MONTHLY RESERVOIR OPERATION

SAN ANTONIO FLOOD-CONTROL BASIN

	ELEV	GROSS STORAGE (ACRE-FT.)
Conservation Pool		NONE
Full Pool	2,238	9,280

Outlet Capacity at Full Pool 11,800 c f.s.

SANTA ANA RIVER BASIN
DRAINAGE AREA 26.7 SQ. MILES

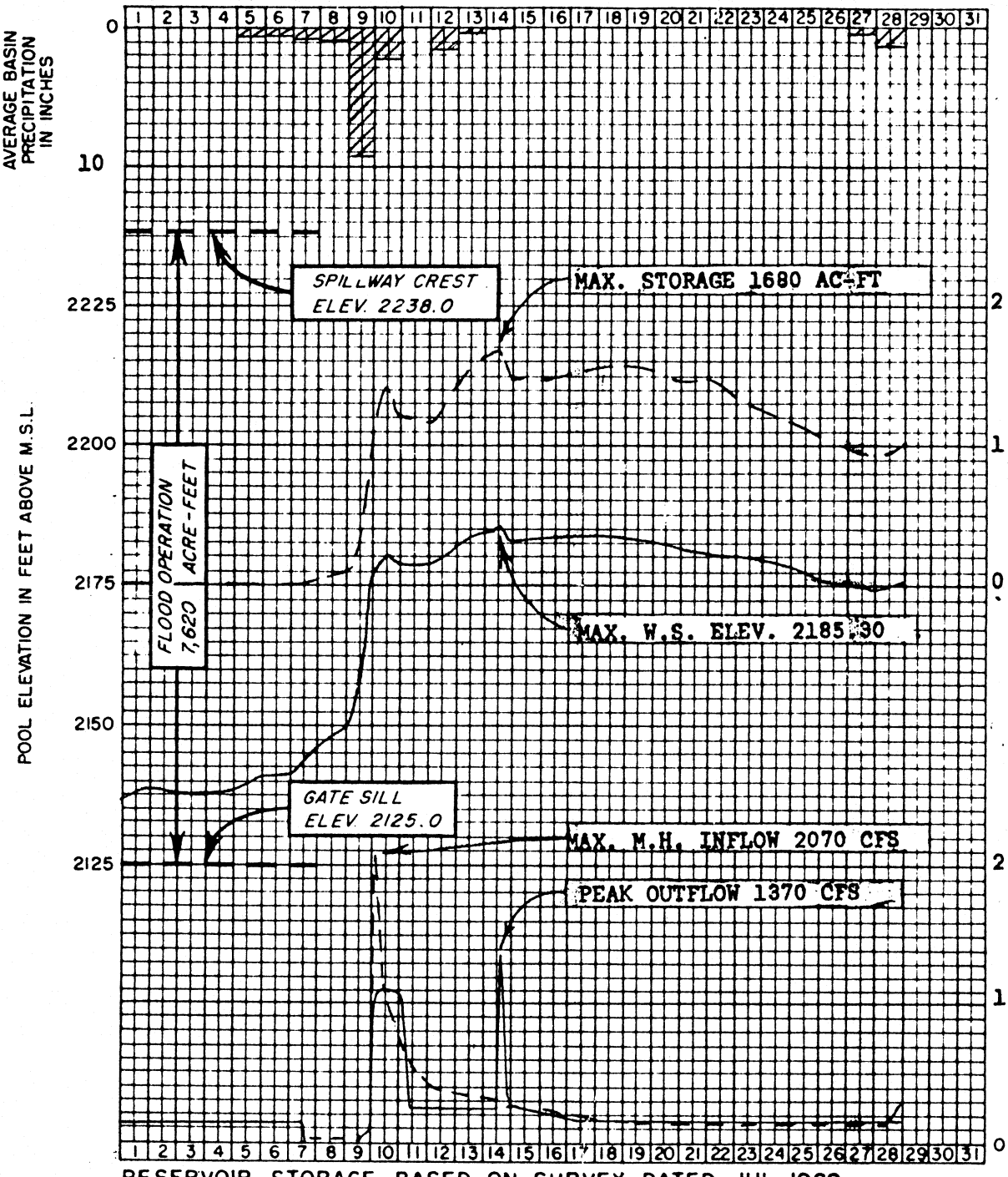
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

OPERATION HYDROGRAPH
23-27 FEBRUARY 1969

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

PLATE 8-04



RESERVOIR STORAGE BASED ON SURVEY DATED JUL 1969

MONTH OF FEB 19 78

MONTHLY RESERVOIR OPERATION

SAN ANTONIO FLOOD-CONTROL BASIN

	ELEV	GROSS STORAGE (ACRE-FT.)
Conservation Pool		NONE
Flood Control Pool	2,238	7,620

Outlet Capacity at Full Pool 11,800 c.f.s.

SANTA ANA RIVER BASIN

DRAINAGE AREA 26.7 SQ. MILES

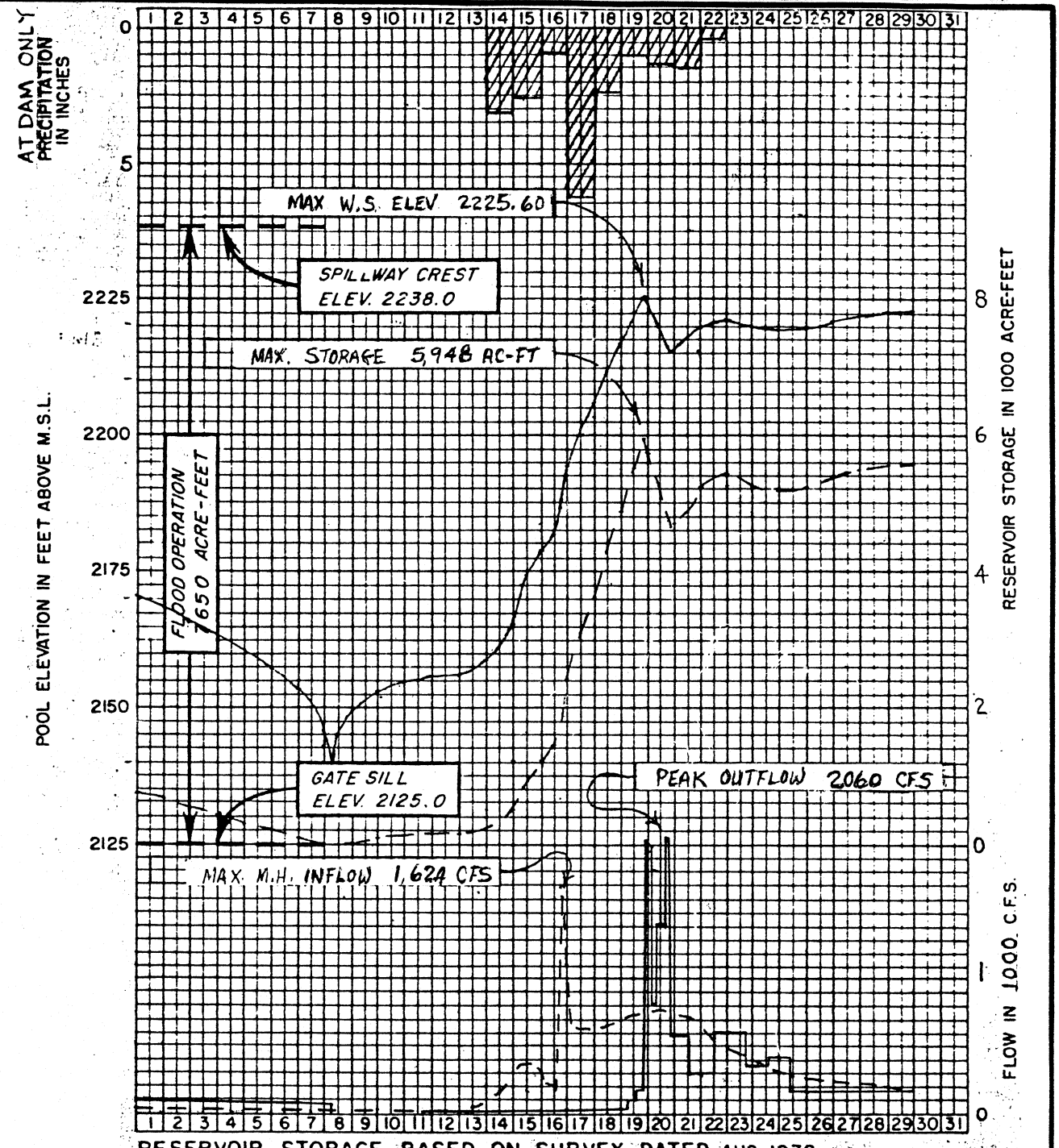
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

OPERATION HYDROGRAPH
9-11 FEBRUARY 1978

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

PLATE 8-05



MONTH OF FEB 1980

	ELEV	GROSS STORAGE (ACRE-FT.)
Conservation Pool		NONE
Flood Control Pool	2,238	7650

Outlet Capacity at Full Pool 11,800 c.f.s.

SANTA ANA RIVER BASIN
DRAINAGE AREA 26.7 SQ. MILES

MONTHLY RESERVOIR OPERATION

SAN ANTONIO FLOOD-CONTROL BASIN

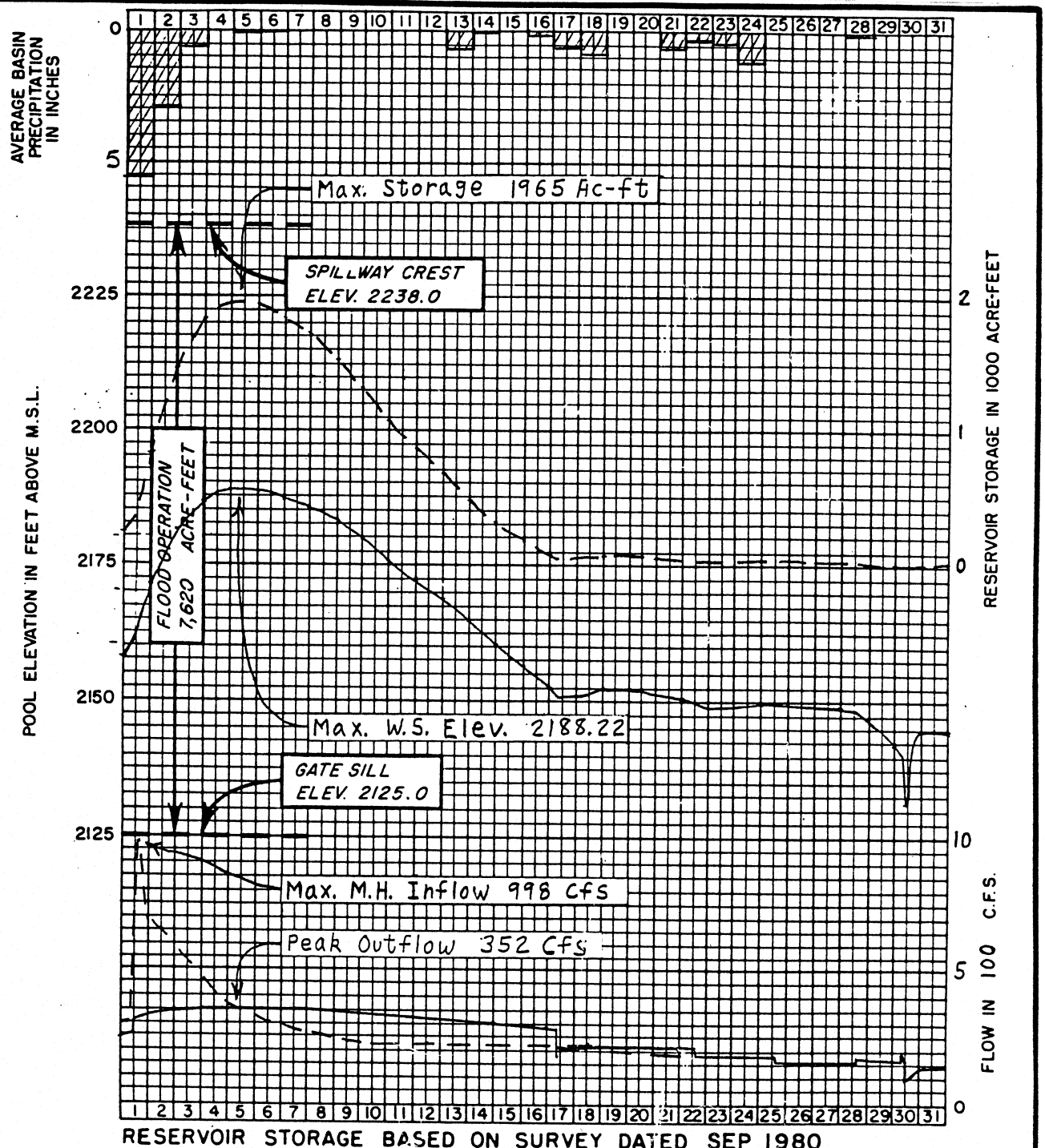
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

OPERATION HYDROGRAPH
13-14 FEBRUARY 1980

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

PLATE 8-06



RESERVOIR STORAGE BASED ON SURVEY DATED SEP 1980

MONTH OF MAR 1983

MONTHLY RESERVOIR OPERATION

SAN ANTONIO FLOOD-CONTROL BASIN

	ELEV.	GROSS STORAGE (ACRE-FT.)
Conservation Pool		NONE
Flood Control Pool	2,238	7,700

Outlet Capacity at Full Pool 11,800 c.f.s.

SANTA ANA RIVER BASIN

DRAINAGE AREA 26.7 SQ. MILES

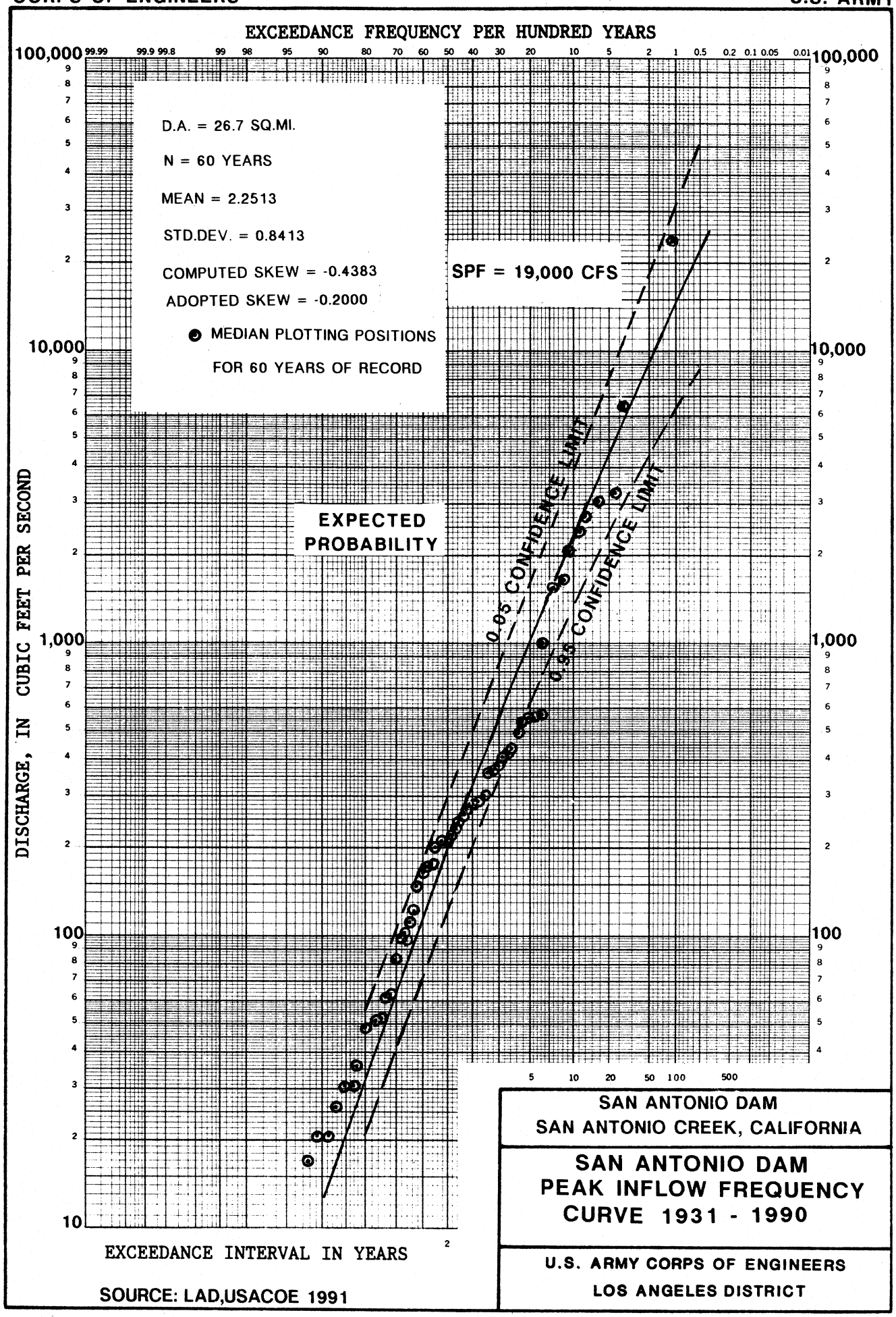
SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

OPERATION HYDROGRAPH
1-4 MARCH 1983

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE

PLATE 8-07



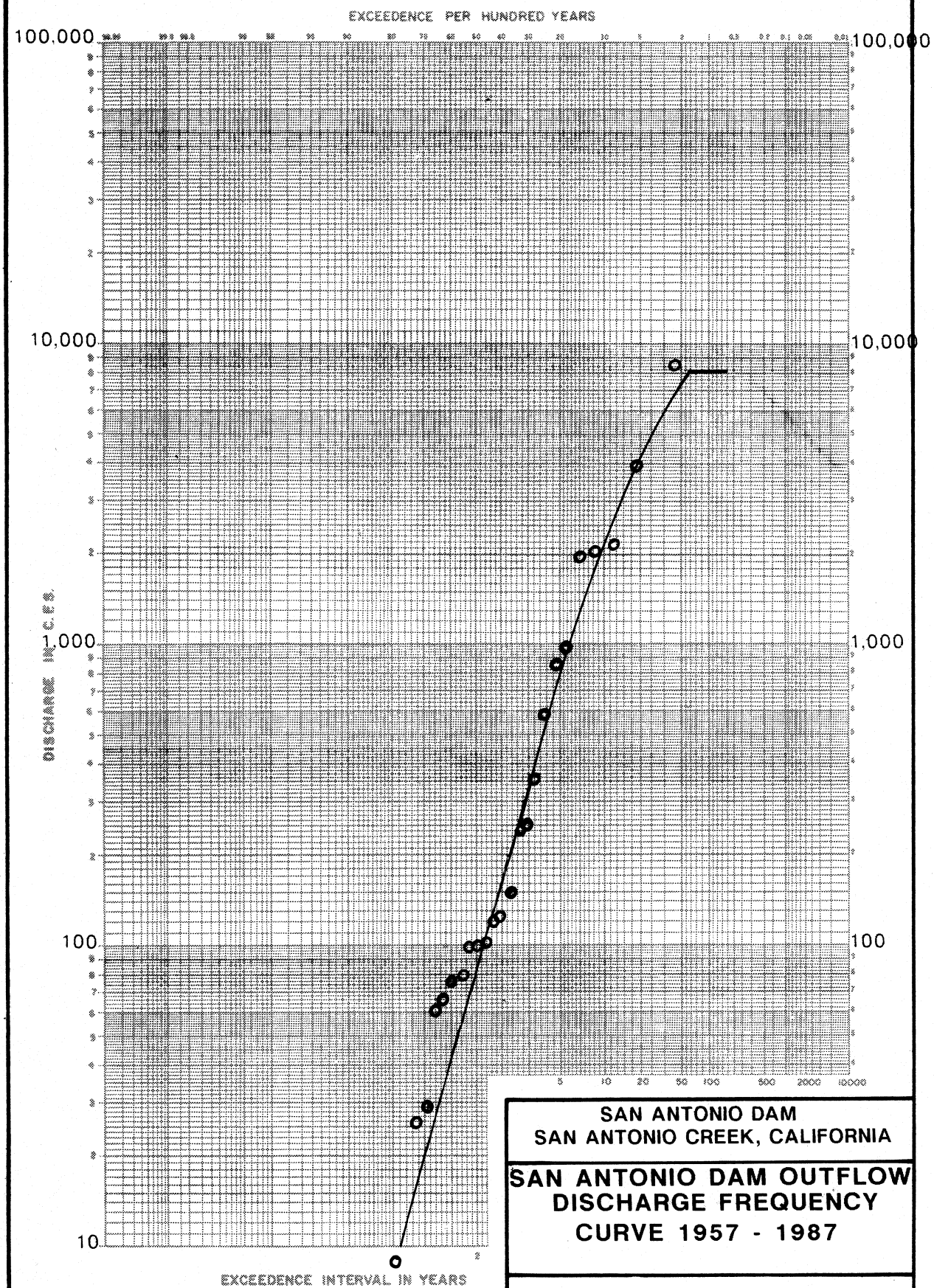
SOURCE: LAD,USACOE 1991

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO DAM PEAK INFLOW FREQUENCY CURVE 1931 - 1990

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 8-08



MEDIAN PLOTTING POSITIONS N=31

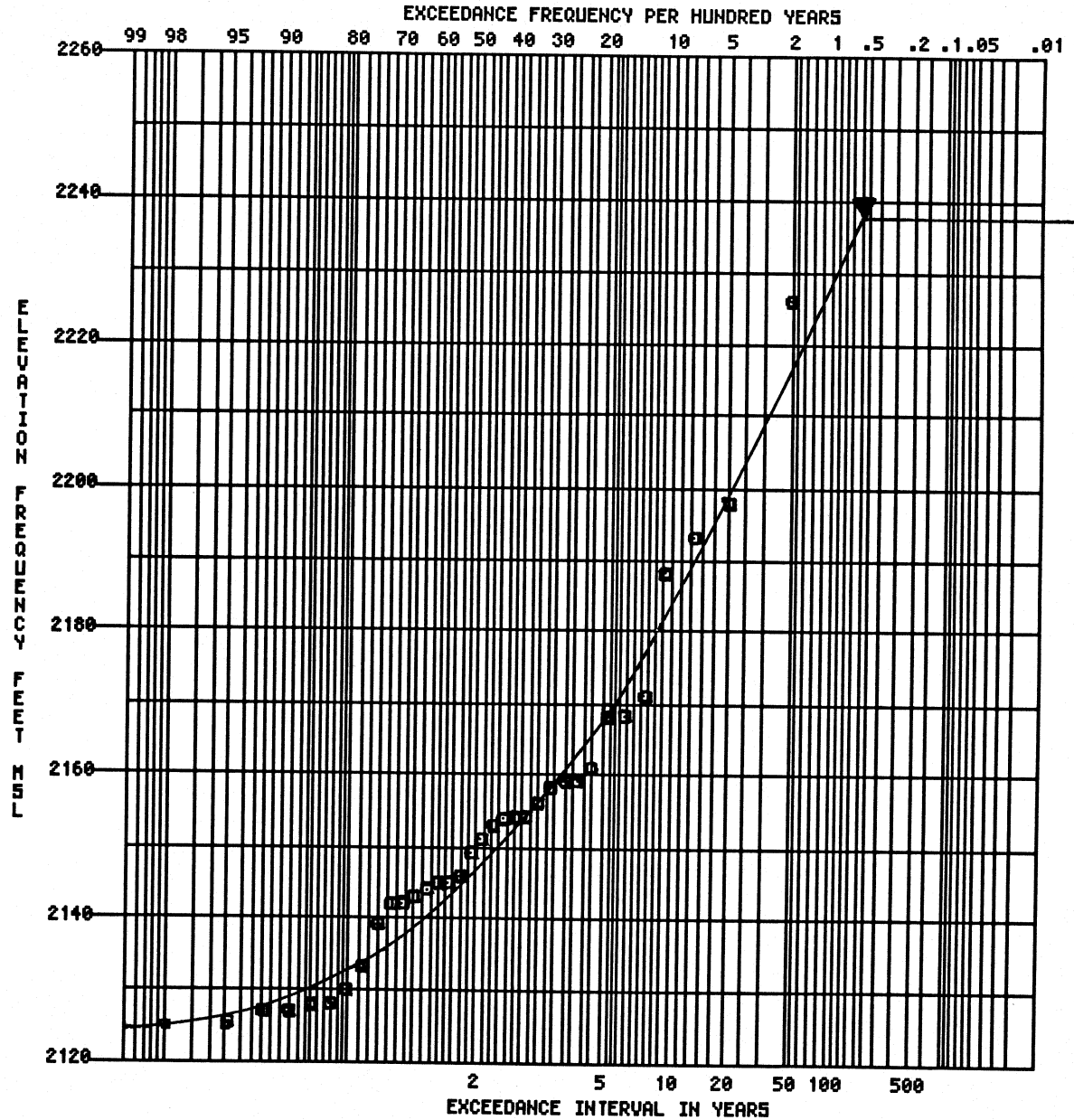
SOURCE: LAD, USACOE 1991

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO DAM OUTFLOW DISCHARGE FREQUENCY CURVE 1957 - 1987

U S ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 8-09



2238 FEET SPILLWAY CREST ELEVATION

ANNUAL PEAK ELEVATION - 1956-1990
MEDIAN PLOTTING POSITIONS N=34

SOURCE: LAD, USACOE 1991

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

SAN ANTONIO DAM
FILLING FREQUENCY CURVE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE 8-10

INFLOW, OUTFLOW, AND FILLING FREQUENCY VALUES FOR SAN ANTONIO RESERVOIR

RETURN PERIOD (YEARS)	2	5	10	20	50	100	200
PEAK INFLOW (FT3/S)	190	950	2150	4150	8500	14000	21700
PEAK OUTFLOW (FT3/S)	83	800	2300	4200	7400	8000	8000
PEAK ELEVATION (FT NGVD)	2146	2167	2184	2200	2216	2229	2238

NOTE: These values, representing data verified for San Antonio Reservoir, were obtained from the peak inflow and outflow analysis of plates 8-08 and 8-09, and from the elevation frequency curve of plates 8-10. The curves were drawn as best-fit lines through data points derived from actual data from San Antonio Canyon and San Antonio Reservoir.

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

INFLOW, OUTFLOW, AND FILLING FREQUENCY VALUES

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

SOURCE: LAD, USACOE 1990

PLATE 8-11

Chain of Command for Reservoir
Operations Decisions.

Title	Office Phone Number
Corps of Engineers	
Los Angeles District	
District Engineer	(213) 894-5300
Water Control Decisions	
Chief, Engineering Division	(213) 894-5470
Chief, Hydrology and Hydraulics Branch	(213) 894-5520
Chief, Reservoir Regulation Section	(213) 894-6915
Chief, Reservoir Regulation Unit	(213) 894-6916
Operational and Maintenance	
Chief, Construction-Operations Division	(213) 894-5600
Chief, Operations Branch	(213) 894-5620
Chief, Operations and Maintenance Section	(818) 401-4008
Dam Tender Foreman	(818) 401-4006
San Antonio Dam Tender	(714) 982-5494

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

CHAIN OF COMMAND FOR RESERVOIR OPERATION DECISIONS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE 1990

PLATE 9-01

Reservoir Operations Notification

	Office Phone Number
At State of Release Notify:	
LA County Flood Control District	(818) 458-6309
LA County Sheriff (24-hour) will notify all stations (San Dimas Station)	(213) 974-4211
U.S. Geological Survey	(714) 383-5617
San Bernardino Cnty. Tran. & Flood Control District (Operations)	(714) 387-2800
After 5:00 and weekends	(714) 387-6077
Dept. Head: Chuck Laird	(714) 387-2799
Kennith Miller	(714) 387-2806
Emergency (Radio Dispatch)	(714) 387-2599
San Bernardino County Sheriff, Ontario	(714) 988-6571
City of Pomona - City Manager: Anthony Skvarek	(714) 620-2231
Pomona Valley Water Protective Association - Spreading Grounds: Cecil McAlister	(714) 620-2251
Chino Basin Water Conservation District	(714) 626-2711
Chino Basin Municipal Water District: Dan Peters	(714) 987-1712
Treatment Plant (24 Hours)	(714) 947-4131
When Releases Above 400 cfs are Expected Notify:	
Orange County Storm Center -	(714) 567-6300
Environmental Management Agency	(714) 567-6300
Bill Reiter	(714) 567-6230
At Water Surface Elevation 2,164 Notify:	
Chief, Oper. & Maint. USACOE	(818) 401-4008
Ignazio Intravaia Sand and Rock Co.	(714) 982-6713

SAN ANTONIO DAM
SAN ANTONIO CREEK, CALIFORNIA

RESERVOIR OPERATION NOTIFICATION LIST FOR SAN ANTONIO DAM

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

SOURCE: LAD, USACOE 1990

PLATE 9-02