SURVEY REPORT
ON
SAN FRANCISQUITO CREEK
SAN MATEO AND SANTA CLARA COUNTIES, CALIFORNIA
FOR FLOOD CONTROL AND ALLIED PURPOSES

JUNE 1972

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO

CORPS OF ENGINEERS

SAN FRANCISCO, CALIFORNIA

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

IN REPLY REFER TO

DAEN-CWP-A

SUBJECT: San Francisquito Creek Basin, California

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers, authorized by Section 4 of the Flood Control Act of 18 August 1941 directing an examination and survey for flood control on San Francisquito Creek, San Mateo and Santa Clara Counties, California.

2. The District Engineer finds that structural improvements for flood control and allied water resources development are not economically justified on the basis of existing and prospective benefits. He finds that local interests should continue to take advantage of flood plain management and flood insurance programs to reduce residual flood damages. The District Engineer recommends that no project be authorized in the San Francisquito Creek Basin for flood control and allied purposes at this time. The Division Engineer concurs.

3. The Board of Engineers for Rivers and Harbors, noting the findings of the reporting officers, reports that structural improvements in the San Francisquito Creek Basin, California, in the interest of flood control and allied purposes are not advisable at this time.

4. I concur in the views of the Board.

F. J. CLARKE
Lieutenant General, USA
Chief of Engineers

DAEN-BR (June 72) 2d Ind
SUBJECT: Survey Report on San Francisquito Creek, San Mateo and Santa Clara Counties, California, for Flood Control and Allied Purposes

Board of Engineers for Rivers and Harbors, Washington, D. C. 20315
24 November 1972

TO: Chief of Engineers, Department of the Army

1. The Division Engineer issued a public notice stating his recommendations and affording interested parties an opportunity to present additional information to the Board. Careful consideration has been given to the communications received.

2. The Board notes the findings of the District and Division Engineers that structural improvements for water and related resource development are not economically justified on the basis of existing and prospective benefits. To further reduce residual flood damages, local interests should continue to implement flood plain management and flood insurance programs. The Corps of Engineers will, on request, supply local officials with information on floods, flood frequencies, and general information and guidance on flood plain regulations.

3. In addition to considering the proposed improvements on the basis of national economic efficiency, the Board has also considered the objectives of social well-being, regional economic efficiency, and environmental quality, as required by Section 209 of the Flood Control Act of 1970. The social well-being, regional, or environmental benefits that could be expected are not sufficient to warrant favorable consideration of structural improvements. Accordingly, the Board reports that structural improvements in the San Francisquito Creek Basin, California, in the interest of flood control and allied purposes are not advisable at this time.

FOR THE BOARD:

/s/ W. Roper
W. ROPER
Major General, USA
Chairman

SURVEY REPORT
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SYLLABUS

The San Francisquito Creek drainage basin is located on the easterly slope of the Santa Cruz mountains near the southern extremity of the San Francisco Peninsula. The creek enters San Francisco Bay about 25 miles south of San Francisco. The total area of the drainage basin is about 45 square miles.

Periodic floods, particularly the flood of record in 1955, caused extensive damage in the flood plain. Water supply sources within the basin are inadequate to meet present and future needs. However, the basin is expected to be adequately supplied in the foreseeable future by existing sources of import water. Water related recreation facilities in the basin are not sufficient to provide for the immediate and future needs. In an endeavor to determine a suitable solution to these problems consideration was given to dams, channel improvements, levees, diversions, recreation facilities, water supply and combinations thereof. Under present conditions these measures cannot be economically justified. Consequently, the District Engineer recommends that no project be adopted by the United States for the San Francisquito Creek Basin and that no further studies be conducted for flood control and allied purposes at this time.

Local interests should give serious consideration, within practical limits, to flood plain management and to flood insurance programs. The Corps of Engineers will supply local officials, on request, information on floods, flood frequencies and general information and guidance on flood plain regulations.

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DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
100 McALLISTER STREET
SAN FRANCISCO, CALIFORNIA 94102

REPLY TO
ATTENTION OF:

SPNED-WC

June 1972

SUBJECT: Survey Report on San Francisquito Creek, San Mateo and Santa Clara Counties, California, for Flood Control and Allied Purposes

THRU: Division Engineer
U.S. Army Engineer Division, South Pacific
San Francisco, California

TO: Chief of Engineers
Department of the Army
Washington, D.C.

INTRODUCTION

1. AUTHORITY AND BACKGROUND

This report is submitted pursuant to Section 4 of the Flood Control Act approved August 18, 1941 (Public Law No. 228, 77th Congress) which reads, in part, as follows:

> Section 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following named localities.....
>
> * * *
>
> San Francisquito Creek, San Mateo and Santa Clara Counties, California
>
> * * *

2. A preliminary examination on San Francisquito Creek for flood problems was submitted by the District Engineer 10 April 1942 which recommended that a survey be authorized. The Board of Engineers for

Rivers and Harbors concurred with the District Engineer's findings. The Chief of Engineers approved the survey on 6 June 1945. After 1945 little work could be accomplished on the study because of concentration on national defense and curtailment of funds for conducting investigations. The December 1955 flood demonstrated the seriousness of the flood problem on San Francisquito Creek. This stream was included in a study of the Guadalupe River and adjacent streams until the Chief of Engineers approved a separate study in March 1957. Funds were provided to pursue the study in June 1957. A Survey Report on San Francisquito Creek was completed by the San Francisco District in January 1961 which featured a multiple-purpose dam and reservoir project at the Ladera damsite, located at river mile 10.2. Because of the differences of opinion among various groups of local interests regarding the proposed project, the Chief of Engineers, at the request of the Boards of Supervisors of San Mateo and Santa Clara Counties, returned the report for restudy in July 1966. This report presents the results of the restudy.

3. PURPOSE AND SCOPE

The purpose of this report is to present the findings of studies on San Francisquito Creek, San Mateo and Santa Clara Counties, California and also to present conclusions and recommendations made on the basis of these findings. The information and data contained in this report were obtained from both field investigations and office studies and are considered to be adequate in scope to determine engineering and economic feasibility. Field studies consisted of a general reconnaissance of the basin, evaluation and inspection of potential damsites, subsurface soils explorations, flood damage surveys, appraisal of developments in the flood plain, instrumental surveys and aerial photography. Office studies consisted of hydrology and hydraulic investigations, economic analyses, evaluations of flood damages and benefits for flood control, recreation and water supply purposes, design and cost estimates for several alternative plans of improvement and general planning. Sufficient studies were made to determine the need and economic justification of possible water resources developments in the San Francisquito Creek Basin. During the course of this investigation coordination was maintained with Federal, State and local agencies.

4. PRIOR REPORTS

The previously mentioned office reports, the preliminary examination report and the 1961 survey report, are on file in the District office and available for reference use.

BASIN DESCRIPTION

5. LOCATION AND EXTENT

The San Francisquito Creek drainage basin is located on the easterly slope of the Santa Cruz Mountains at the southern extremity of the San Francisco Peninsula (see Plate 1, General Map of Basin). The creek begins at Searsville Dam and flows northeast to enter San Francisco Bay about 25 miles south of San Francisco. It forms a partial boundary between San Mateo and Santa Clara Counties and also between the cities of Palo Alto and Menlo Park. The total drainage area of the basin is 45 square miles. The upper portion of the watershed is elliptical shaped with its major axis, about 12 miles long, lying in a northwest-southeast direction. In the lower reaches below Alameda De Las Plugas the basin narrows to a strip about one mile wide and about 7.5 miles long with the principal axis lying generally in a northeast-southeast direction. The upper portion of the basin is mountainous with peaks about half a mile high. The basin slopes gently downstream from the foothills of the mountains to the marshlands of San Francisco Bay. The area is surburban residential with many beautiful and expensive homes along San Francisquito Creek and in the watershed. The basin is endowed with an abundant growth of lush vegetation, including stands of redwood and California Black Oak. The climate is mild and is conducive to outdoor activities and to the growth of numerous species of shrubs and flowers. The area is a retail trading center with a number of light industries. The area is adequately served by a network of roads, commercial carriers and airlines (San Francisco International Airport). The population of the area has continued to grow since the 1940's, however, recently the growth trend appears to be leveling off. A more detailed description of the basin characteristics is given in the following paragraphs.

6. STREAMS AND STREAM CHARACTERISTICS

Corte Madera, Alambique and Martin Creeks drain the upper watershed of San Francisquito Creek above Searsville Lake, a water supply reservoir constructed by Stanford University in 1890. The principal tributaries below Searsville Lake are: West Union and Bear Creeks from the northwest and Los Trancos Creek from the southeast. These tributaries have adequately contained all known historical flows. San Francisquito Creek begins at the outlet of Searsville Dam and flows 12.7 miles in a northeasterly direction to San Francisco Bay. The lower six miles of the creek transverse a narrow portion of the drainage basin and follows along the crest and southerly slope of an extensive alluvial cone. San Francisquito Creek has a comparatively uniform slope of 50 feet per mile as it progresses downstream from Searsville Lake to river mile 5.8. From that point to the mouth the

slope is about 13 feet per mile. The principal tributaries have slopes varying from 50 to 100 feet per mile in the lower two-thirds of their lengths and as much as 500 feet per mile in the upper reaches.

7. In the foothill and mountainous parts of the watershed, the San Francisquito Creek channel is adequate to contain all flows of record. Where the stream emerges from the hills at river mile 7.5 the channel capacity is 12,000 cubic feet per second. The capacity decreases downstream to about 9,000 cubic feet per second at river mile 5 and to about 6,000 cubic feet per second at river mile 4.2. Downstream from Middlefield Road local interests have constructed channel improvements and levees to carry a design capacity of 6,000 cubic feet per second. The reach between Middlefield Road and Bayshore Freeway was improved in 1970. The reach below Bayshore Freeway was enlarged and levees were constructed after the 1958 flood.

8. Depths of the channel from the hills to Bayshore Freeway average between 25 and 13 feet and widths vary from 48 to 75 feet. Downstream from Bayshore Freeway the depth of the channel averages between 15 and 19 feet below the top of the existing levees. Widths between the levees vary from 90 to 150 feet.

9. TOPOGRAPHY

The general locality consists of a mountainous ridge along the western and southeast perimeter of the basin with peaks as high as 2,650 feet above sea level and a gently sloping plain extending from the foothills, generally just west of Junipero Serra Boulevard and Alameda De Las Pulgas, at an elevation of about 150 feet, to the marshland adjoining San Francisco Bay. Practically all flood damages are concentrated in the sloping plain area. The elevation distribution of the basin area is as follows:

Elevation (Feet-M.S.L.)	Topography	Area (Square Miles)	(Percent)
0-150	Flat	7.4	16.4
150-1,000	Foothill	23.5	52.0
1,000-2,000	Mountainous	12.4	27.8
Above 2,000	Peaks	1.7	3.8
Total (above mouth)		45.0	100.0

10. GEOLOGY AND SOILS

The geology of the basin is typical of the central Coast Range of California. Structurally, the basin is divided into four sections, namely, the Santa Cruz Mountains in the upper portions along the western and southeastern perimeter, a rift valley just east of the San Andreas rift zone, the foothills of the Santa Cruz Mountains which are previously discussed, and the outlet portion of the San Francisquito alluvial cone extending east of Junipero Serra Boulevard to San Francisco Bay. The San Andreas Fault passes through the rift valley in a north-westerly direction and is the basis of the formation of the valley (see Plate 1). This fault can be traced through San Mateo County and hundreds of miles beyond.

11. The soils of the basin are loams, chiefly of the Altamont series in the mountainous area and of the Pleasanton series in the rift valley and on the alluvial cone.

12. Foundation materials along San Francisquito Creek upstream from the marshland near the mouth are suitable for construction of flood control works such as levees, dams, floodwalls and similar structures. Impervious earthfill material suitable for use in embankments is available in the basin. Subsurface soils explorations have been made along San Francisquito Creek from the mouth to El Camino Real (State Route 82). The logs of these explorations are on file in the District office.

13. SURFACE AND GROUND WATER RESOURCES

Water conservation reservoirs have been constructed in the San Francisquito Creek Basin to provide a portion of domestic and irrigation water for Stanford University, Menlo Park and Palo Alto. The main water supply for Palo Alto and Menlo Park comes from the Hetch Hetchy System of the San Francisco Water Department. This supply is supplemented by wells which are used to irrigate a golf course, green belts, parks, etc. Palo Alto purchased about 19,000 acre-feet of municipal and industrial water from the San Francisco Water Department in 1971 and Menlo Park used about 5,000 acre-feet. Irrigation water for Stanford University comes from Searsville and Felt Lake reservoirs. Lagunita Lake at Stanford University is supplied with water by a diversion canal from San Francisquito Creek. This lake is used for recreational purposes only. These reservoirs have little or no effect on floodflows because they are normally full when floods occur. Floodflows are also bypassed because of the silt load carried by them. Pertinent data concerning the reservoirs in the area are summarized below.

Name	Purpose	Capacity (Ac-Ft)	Cost at Time of Construction	Year of Construction	Owner
Searsville Lake	Irrigation	930	$320,000	1890	Stanford University
Felt Lake	Irrigation	1,000	119,000	1930	Stanford University
Lagunita Lake	Recreation	360	14,000	1900	Stanford University
Bear Gulch Reservoir	Domestic	660	162,000	1896	California Water Service Company

ECONOMIC DEVELOPMENT

14. POPULATION

From data published by the U.S. Department of Commerce, Bureau of the Census, the population of Palo Alto, the second largest city in Santa Clara County, was 16,744 in 1940; 52,281 in 1960 and 55,413 in 1970 representing an increase of 330 percent during that period. The population of Menlo Park in 1940 was 3,258 and in 1970 it was 26,445 which is an increase of 815 percent. The large influx of people into the area occurred during and after World War II. More recent trends, however, have leveled off from the rapid increase of the previous 20 years; much of this is because of the decrease in growth in the aerospace and related industries in the area. In 1950 San Mateo and Santa Clara Counties had a combined population of 526,200 and by 1960 had increased to more than 1,080,000. In 1970 the combined population was over 1,600,000. Based upon State of California, Department of Finance population projections the combined population of those two counties is estimated to be 2,820,000 in the year 2000 and 3,660,000 in 2020.

15. LAND USE, DEVELOPMENT AND INDUSTRY

Palo Alto and Menlo Park are suburban residential cities known for their community centers, cultural and recreational resources. The area is a major retail trading center and has a number of light industries. The manufacturing plants produce electrical equipment, television sets and scientific instruments. The administrative offices, laboratory facilities and division and regional headquarters for many nationally

known firms are located in the San Francisquito Creek Basin. Stanford University and Stanford Research Institute are also in the basin. The Institute conducts studies for projects that require industrial and economic research. Menlo Park extends east to the San Francisquito Creek boundary which separates it from Palo Alto and the University Campus. East Palo Alto lies between Menlo Park, Palo Alto and San Francisco Bay. East Palo Alto is at the western terminus of Dumbarton Bridge, the most southerly crossing of San Francisco Bay. The San Francisquito Creek flood plain is practically all developed with little open land remaining and is expected to remain as such in the foreseeable future.

16. TRANSPORTATION FACILITIES

The basin is served by the main coast rail line of the Southern Pacific Company commuter trains and local and coastwide bus service. El Camino Real follows the old mission trail of the Padres through the major communities. Bayshore Freeway (Highway U.S. 101), an industrial highway, follows the shoreline of San Francisco Bay. Interstate Highway 280, Junipero Serra Freeway, has recently been completed through the basin. Several State highways and a number of improved county roads provide additional traffic arteries to complete the transportation system. The Palo Alto Municipal Airport, used by charter and privately-owned aircraft, is located near the mouth of San Francisquito Creek. San Francisco International Airport also serves the study area.

17. NAVIGATION

There are no navigation improvements or harbors on San Francisquito Creek. The Palo Alto Yacht Harbor is located about one mile south from the mouth of the creek on Mayfield Slough.

18. HYDROELECTRIC POWER

No hydroelectric power developments exist in the basin. The creek and tributaries have a low annual runoff with all of the flow occurring from December through May. These conditions are not favorable for the production of hydroelectric power.

19. RECREATION FACILITIES

The area has a variety of recreation facilities serving many types of recreation needs. These range from tot lots, neighbornood parks and community parks provided by the cities to county and State parks serving the entire region. A number of special facilities such as golf courses, historic sites and trails are also provided by public jurisdictions. Privately-owned facilities, including boating, campgrounds, golf courses and a marina also contribute substantially to the recreation facilities available in the area. Portola State

Park consisting of 1,740 acres in a redwood forest astride Pescadero Creek, about 12 miles south of Palo Alto, provides camping facilities, picnic units and a small swimming area. The San Mateo Coast State Beaches on the Pacific Ocean lie about 17 miles southwest of Palo Alto and provide an ocean frontage of about nine miles for picnickers, swimmers and surfers. San Mateo County Memorial Park located about ten miles south of Searsville Lake covers 315 acres of heavily wooded redwood stands. Facilities are provided for campsites, picnicing and riding and hiking trails. Palo Alto Bay Lands consisting of 1,800 acres on San Francisco Bay is owned by the City of Palo Alto for general recreation use. There are a number of other public parks and recreation areas available and easily accessible from and within the basin which consist of areas ranging in size from about four to 40 acres. These are administered by San Mateo and Santa Clara Counties and the cities of Menlo Park and Palo Alto.

CLIMATOLOGY

20. CLIMATE

The San Francisquito Creek Basin has the typical centra California climatic pattern characterized by warm dry summers and mild wet winters. The dominant influence on the climate is the position of the Pacific High Pressure Area. During the summer this high pressure area is located at northerly latitudes which causes a northwest circulation of maritime air. The typical coastal fogs are caused by this circulation of warm air over the cold water surface of the Pacific Ocean. During the winter the high pressure area moves to the south and allows passage of cyclones from the area of the Aleutian Low Pressure Area to intermittently affect the California climate. Occasionally the high pressure area will move back to the north in the winter. Less frequently, a continental high pressure area will move over the western states causing the low minimum temperatures noted in the basin. Temperatures as high as 105 degrees and as low as 20 degrees Fahrenheit have been recorded in the San Francisquito Creek drainage basin. However, such temperature extremes are rare because of the moderating effect of the Pacific Ocean. The mean annual temperature is approximately 57 degrees. The coldest month is January with an average temperature of 47 degrees. The warmest months are July and August with an average temperature of 65 degrees.

21. PRECIPITATION

The average annual precipitation varies from more than 44 inches in the Santa Cruz Mountains to 16 inches near the mouth of the creek. The average annual rainfall in the basin is about 32 inches. Approximately 90 percent of the seasonal rainfall occurs from October through

March. The topography of the basin has a pronounced effect on the total seasonal rainfall and the distribution over the basin. The heaviest rainfall occurs at the higher elevations because of the carry-over effect from the rapid orographic lifting of the air mass on the windward side of the mountains. Average annual precipitation is relatively high because the major axis of the basin is parallel to the mountain barrier. Records are available from 28 active and inactive precipitation stations within or adjacent to the basin. There are two recording precipitation gages adjacent to the basin, located at the Palo Alto City Hall and on the Stanford University Campus. Both are at low elevations near the mouth of San Francisquito Creek. Because of the inadequacy of the recording rainfall stations at high elevations within the basin, it was necessary to obtain precipitation data from the Boulder Creek Locatelli Ranch gage located about 13 miles south of the basin on the windward side of the ridge. This recorder is in an area of high rainfall and, therefore, more nearly represents the rainfall intensity patterns that occur at the higher elevations of San Francisquito Creek basin than those at Palo Alto and Stanford University. The average annual precipitation at this station is about 54 inches.

22. STORM ANALYSIS

Flood producing storms are caused by the formation of a pressure gradient between the prevailing north Pacific Low Pressure Area and the Pacific High Pressure Area to the south causing waves to form on the frontal barrier which move over the area at high velocity and bring in warm semi-tropical air. Major storms have varied in duration from one to several days. Storms of a recurrent nature have occurred for durations in excess of three days, but have been interrupted by periods of little or no rainfall which allowed the runoff to recede. Mass rainfall curves, Plate 2, show the depth of rainfall and intensity during four major storms which occurred in or near the basin in January 1911, December 1937, November 1950 and December 1955. Since 1892 there have been eleven flood producing storms over the basin. The average frequency of occurrence is once in about six years. The most severe of these storms occurred 11-14 January 1911 and 21-24 December 1955. The January 1911 storm produced 7.2 inches of rain during a 24-hour period and a total of 16.1 inches at the Boulder Creek gage. At the Palo Alto gage 3.4 inches were recorded during a 24-hour period and of 8.3 inches during the storm. A total of 17.7 inches was recorded at Boulder Creek during the 1955 storm with 10.4 inches falling within a 24-hour period. The Palo Alto gage recorded 4.9 inches during the storm and 2.8 inches during a 24-hour period.

23. STANDARD PROJECT STORM

The standard project storm is defined as the most severe storm of record within a more or less meteorologically homogenous region in which the basin is located. The major storms which have occurred in the region were analyzed to determine which would be most critical when transposed over the San Francisquito Creek Basin. It was determined that the storm of 21-24 December 1955 which was centered near Hollister, California, located about 60 miles south of the basin, was the most severe and was therefore, adopted as the standard project storm for this report. The transposition of this storm resulted in 17.2 inches of rainfall over the 37.5 square-mile drainage area above the gage at Stanford University as compared with 9.5 inches that actually occurred during 21-24 December 1955.

STREAMFLOW, RUNOFF AND FLOODS

24. STREAMFLOW

In 1892 a staff gage was established on San Francisquito Creek at the spillway crest of Searsville Lake Dam. Continuous streamflow records are available for the period from 1892 to 1913. Five stream gaging stations were operated in the watershed between 1931 and 1941 for hydraulic studies being made by Stanford University. Two were on San Francisquito Creek at river miles 7.6 and 4.6, one on Los Trancas Creek located about 800 feet upstream from the mouth and two on diversion canals; one located just south of Felt Lake and one just west of Lagunita Lake. An additional gage was established on San Francisquito Creek at river mile 5.4 from October 1934 to February 1936. The recording stream-gaging station at Stanford University at river mile 7.6 was established in October 1950 by the U.S. Geological Survey in cooperation with the Corps of Engineers. This gage monitors 37.5 of the 45 square mile drainage area of the basin. Records for this station are published in the U.S. Geological Survey Water Supply Papers. Other stations in the basin have been discontinued. The locations, drainage area, period of record, and maximum stage, and discharge of record are tabulated on the following page.

STREAM GAGING STATIONS AND RECORD FLOWS
SAN FRANCISQUITO CREEK BASIN

Station	Drainage Area (Sq.Mi.)	Period of Record	Stage (Ft.)	Maximum Discharge (c.f.s.)	Date	Maximum Yearly Runoff for Period (Acre-Feet)	Water Year	Minimum Yearly Runoff for Period (Acre-Feet)	Water Year
San Francisquito Creek at Palo Alto	38.4	1931-41	17.2	3,100	27 Feb 40	31,000	(1938)	296	(1934)
San Francisquito Creek at Menlo Park	38.3	1934-36[1/]	10.1	1.610	21 Feb 36	9,200[2/]	(1936)	6,900[2/]	(1935)
San Francisquito Creek at Stanford University	37.5	1931-41				30,800	(1938)	300	(1934)
		1950 to date	13.6	5,560	22 Dec 55	39,300	(1958)	45	(1961)

1/ Gage in operation from October 1934 to February 1936.
2/ For period of October 1935 through February 1936 only.

25. RUNOFF

Runoff occurs during the winter following periods of intense rainfall which is normally proceeded by periods of moderate precipitation. From May to October most tributaries have little or no flow. During the dry season, the flows from the upper reaches of San Francisquito Creek and the tributaries are diverted or percolated through the sands and gravels of the creekbed before reaching Highway U.S. 101. The annual runoff measured at the existing stream-gaging station at Stanford University has varied from about 45 acre-feet in water year 1961 to 39,000 acre-feet in water year 1958 during the period of record for water years 1931 through 1971. The average annual runoff is 13,000 acre-feet or about 350 acre-feet per square mile of drainage area above the gaging station. During the period of record, 1931 through 1971, the dry five years of record (1960-1964) indicate the average yearly runoff was about 5,100 acre-feet.

26. FLOOD CHARACTERISTICS

Floods in the San Francisquito Creek Basin are caused entirely by rainfall. The floods are characterized by rapid rise and recession. The flood peak usually occurs within three to four hours after the event of maximum rainfall and it recedes almost as rapidly. Flows above 1,500 cubic feet per second are seldom sustained for more than 6 hours.

27. IMPORTANT FLOODS

Data on floods antedating the period of streamflow records on San Francisquito Creek are meager. Information obtained from local residents indicates that bankfull capacity in the lower 5-mile reach of San Francisquito Creek was equalled or exceeded in 1894, 1895 and 1909. The flood of 4 January 1895 was the largest during this period with an estimated peak discharge of 6,100 cubic feet per second at Palo Alto. Since 1910 San Francisquito Creek has equalled or exceeded bankfull capacity eight times, namely, 1911, 1916, 1919, 1940, 1943, 1950, 1955 and 1958. The largest flood event in this period occurred during the storm of 21-24 December 1955. The storm produced a peak discharge of 5,560 cubic feet per second at the stream gaging station at Stanford University. Total runoff from this flood was about 9,600 acre-feet during a 60-hour period. The peak discharges for the above listed flood events since 1910 are tabulated below:

Date of Occurrence	Maximum Instantaneous Discharge-Cubic Feet Per Second (Stanford Gage D.A. 37.5 Sq.Mi.)	Storm Runoff Volume (Acre-Feet)
14 January 1911	5,000 1/	Not Available
3 January 1916	4,450 1/	Not Available
11 February 1919	4,000 1/	Not Available
27 February 1940	3,100	9,200
21 January 1943	4,400	Not Available
19 November 1950	3,600 1/	Not Available
22 December 1955	5,560	9,600
2 April 1958	4,460	9,400

1/ Estimated-Others Gaged

28. STANDARD PROJECT FLOOD

The standard project flood is defined as the flood which would result from the most severe combination of meterologic and hydrologic conditions that are considered reasonably characteristic of the geographic region involved, excluding extremely rare combinations. The transposed storm of 21-24 December 1955 (Hollister Center), which, as previously mentioned, was adopted as the standard project storm, was preceded by three weeks of intermittent rainfall which produced representative watershed conditions that are favorable to runoff. Apparent loss rates of the storm of December 1955, as it occurred over the basin were adopted for application to the derivation of the standard project flood. The derived peak discharge is estimated to be 13,800 cubic feet per second at the stream gaging station at Stanford University. The estimated volume of runoff from this flood would be about 25,000 acre-feet. The hydrograph for the standard project flood is shown on Plate 4.

29. FLOOD FREQUENCIES

A flood frequency analysis was made for San Francisquito Creek and used to derive an estimate of average annual damages for the purpose of determining economic justification of possible plans of improvement. The discharge frequency curve, shown on Plate 3, is based on a 79-year period (1893-1971). The data used to derive the curve include 31 years of gage records, calculated discharges at Searsville Dam wasteway wier and rainfall records. These data were also correlated with information obtained from the San Lorenzo River at Big Trees in Santa Cruz County. Estimated discharges for the standard project flood, one percent chance flood and two percent chance flood are 13,800, 9,400 and 7,500 cubic feet per second, respectively. Floods of selected frequency and the corresponding estimated discharge are tabulated below. Future development in the watershed is not expected to materially affect the flood frequency analysis. The upper portions of the basin is steep and rugged and is not conductive to development. The open lands in the basin are expected to be rigidly controlled by local entities and much of these lands will remain as open space areas. The lower portion of the watershed is now fully developed.

DISCHARGE FREQUENCY ANALYSIS
Palo Alto Gage

Drainage Area 38.4 Square Miles

Average Exceedence Interval (years)	Discharge (c.f.s.)
Standard Project Flood	13,800
100	9,400
50	7,500
25	6,000
20	5,400
10	4,000
5	2,900
2	1,300

WATER-RELATED PROBLEMS AND NEEDS

30. FLOODS AND EXTENT OF FLOODING

Accounts of historical flooding indicate that the creek has topped its banks near river mile 4 on several occasions downstream from Middlefield Road to San Francisco Bay. Under present conditions of improvement these flows would be contained within the channel. East of Bayshore Freeway the area is generally flooded to the tidal levees along San Francisco Bay. Floodwater flows southward along the west side of Bayshore Freeway to Matadero Creek. The flood plains of Matadero and San Francisquito Creeks overlap and floodflows from San Francisquito Creek are impounded until flow in Matadero Creek recedes. A discussion of historical floods is contained in the following sub-paragraphs.

a. February 1940 flood. Agricultural lands were flooded upstream of Bayshore Freeway and in the downstream area to the tidal levees. Inundation was caused by overbank flow about 300 feet upstream from Bayshore Freeway. Damages were relatively light as compared to the floods of 1955 and 1958, because the area was not highly developed at that time. The peak discharge during this flood was 3,100 cubic feet per second with a stage height of 17.22 feet at Stanford University gage.

b. December 1955 flood. Shortly after 6:00 p.m. on 22 December a heavy tropical-type storm, accompanied by near hurricane winds and torrential rainfall, struck the entire watershed. During the high flows of the early evening debris accumulated in the bridge opening of Bayshore Freeway which caused overbank flow on the south bank upstream of the freeway. This water flowed south into a new residential subdivision and reached a depth of three feet above the floors of many homes. Upstream at Pope-Chaucer Street a debris jam also developed at the bridge causing water to overflow the right bank and flow into Palo Alto. About midnight on 22 December the still rising

stream overflowed a leveed section and an unleveed section 400 and 2,000 feet upstream, respectively, from Bayshore Freeway. Peak overflow was observed at approximately 1:30 a.m. on 23 December at which time the creek overflowed at Middlefield Road and for approximately one mile downstream. This overflow was maintained for about one hour. During the period from 11:30 p.m., 22 December to 3:30 a.m., 23 December, floodwater was ten inches deep flowing over Bayshore Freeway near San Francisquito Creek and three inches deep near Matadero Creek. Bayshore Freeway was closed for several hours because of this. Downstream from the freeway water covered portions of the golf course and then flowed into the airport area. This flood, which is the maximum flood of record, with a peak flow of 5,560 cubic feet per second (stage height 13.6 feet) at the Stanford Gage, caused extensive damage to homes and furnishings and to commercial enterprises. As can be observed from Photographs 1 and 2, bank erosion was also severe because of sustained high magnitude flows. The area of the flood plain included approximately 1,200 acres of highly urbanized and commercial property and about 70 acres of agricultural lands. The area inundated by this flood is shown on Plate 5, Flood Plain Map.

c. April 1958 flood. Major flooding was caused by a break in the right levee about 1,000 feet downstream from the Bayshore Freeway bridge. The peak flow was 4,460 cubic feet per second with a stage height of 11.04 feet at the Stanford Gage. Flooding was confined almost entirely to municipal property of Palo Alto. The levee break funneled the flow into the city dump, the golf course and the city airport which occupies the lowest position inside the right bank tideland levee system. Depths of flooding varied up to about four feet. Pumping was required for two weeks to dewater the area. Eighty-four aircraft were damaged and 800 feet of new runway was damaged by settlement. Hangers, shops, aviation fuel tanks and administration buildings were flooded to depths up to two feet. Debris and silt deposits were heavy and required a considerable amount of cleanup. Only minor damages occurred upstream from the Bayshore Freeway bridge. Bank caving and revetment failure did occur in a few places. Portions of the area inundated by this flood are shown on Photographs 3 and 4.

FLOOD DAMAGES

31. FLOOD DAMAGE SURVEYS

The estimated value of flood damages is based on data gathered from property owners, industrial, commercial and utility interests, public officials and governmental representatives. Development in the area before 1940 was mostly agricultural and only fragmentary records are available concerning the flooding and the extent of damages. Surveys were made of damages resulting from the floods of 1940, 1955 and 1958.

32. HISTORICAL FLOOD DAMAGES

Before 1949 most of the land subjected to inundation was used for agricultural purposes and damages included loss of topsoil by erosion, loss of crops and expenses incurred for debris removal. This land has since been urbanized and floods during the past 20 years caused damage to residences, furnishings and landscaped grounds as well as business and commercial establishments.

33. The channel upstream from Newell Road is deep and winding with steep banks which are easily eroded. During high water stages the softer overlying soils are carried away. This type of damage is serious when structures are built close to the eroding banks.

34. The following tabulation summarizes the damages of the February 1940, December 1955 and April 1958 floods.

Primary Flood Damages
Price Levels and Conditions of Development at Time of Flood

Flood Date Peak Discharge	February 1940 3,100 c.f.s.	December 1955 5,560 c.f.s.	April 1958 4,460 c.f.s.
Type of damage			
Residential	$71,900	$1,514,000	-
Commercial	5,800	123,000	$200,000
Bank Erosion	4,800	112,000	30,000
Roads and Bridges	2,000	31,000	3,000
Emergency Aid	10,500	220,000	65,000
Total	$95,000	$2,000,000	$298,000

35. Under present hydraulic conditions, flows of similar magnitudes would be contained within the channel and the damages would be negligible. This is due to the channel improvements which were constructed by local interests since the 1958 flood.

36. Estimated damages that would be incurred under standard project flood conditions as based on November 1971 price levels and conditions of development and present hydraulic conditions would be about $14,000,000.

37. AVERAGE ANNUAL DAMAGES

Average annual damages were computed by standard analyses and correlation of relations between damages, discharges and flood frequency. Curves were developed for these relations which form the basis for estimating the average annual flood damages. The estimate of damages includes physical losses to homes, commercial establishments, roads, utilities and bank erosion and also losses resulting from decreased production, sales and earnings and the costs of flood fighting. Average annual damages, based on November 1971 prices, hydrologic and economic conditions amount to about $240,000. Under future hydrologic and economic conditions (100 years), the average annual damages are estimated to be about $500,000.

38. WATER QUALITY

There are no known water pollution or water quality problems in San Francisquito Creek. All municipalities in the basin have sewage treatment plants that discharge into San Francisco Bay. Formal water quality studies have not been made on the stream, however, the U.S. Geological Survey has made some studies of silt and dissolved solids transportation in the area which would be useful in the event water quality studies are undertaken in the future.

39. WATER SUPPLY

The existing sources of water supply within the basin are inadequate to meet present and future needs. However, within the foreseeable future, these water requirements will be fulfilled by existing sources of import water from the San Francisco Water Company. However, local spokesmen indicated an interest in developing local sources of supply if such development would be competitive with other available sources. Water supply was therefore, given consideration in the study of reservoirs.

40. RECREATION

There is an increasing need for water related recreation facilities in the basin. The recreation demand in 1970 was approximately 39,000 recreation days. Over a 100-year period, 1970 to 2070, the demand is expected to increase almost 300 percent. Swimming, walking, bicycling, picnicking, riding and nature hiking are considered relevant to the basin for an urban park development projection of activity day demands. An activity day is considered to be equivalent to three recreation days. The recreation demand projections for various time frames throughout the 100-year period are tabulated below. Existing facilities in the basin will not meet the recreation demands projected for the above mentioned activities.

Year	1970	2000	2030	2070
Recreation Days	39,000	58,000	83,000	107,000

41. FISH AND WILDLIFE

San Francisquito Creek maintains a small run of steelhead during years when flows are sufficient in the stream. The majority of the spawning areas are located upstream of river mile 10. However, there are some spawning areas located in Los Trancas Creek and that portion San Francisquito Creek from the mouth of Los Trancas Creek to river mile 10. Actual numbers of fish or frequency of runs are unavailable. Game and non-game species of wildlife utilize the riparian habitat along undeveloped reaches of the stream. Hunting is restricted along the creek by city and county ordinances. However, water fowl hunting is permitted in some areas of the southern part of San Francisco Bay.

42. WILD AND SCENIC RIVERS

The intense urban development on the lower reaches of San Francisquito Creek along with the Atomic Energy Commission's linear accelerator and Stanford University's Jasper Ridge Biological Preserve in the upper reaches limits public access to the stream. Flood control structures and erosion control measures have been constructed in the channel. In view of these conditions it is doubtful that San Francisquito Creek would be considered for inclusion under Public Law 90-542, the Wild and Scenic Rivers Act.

EXISTING IMPROVEMENTS

43. CORPS OF ENGINEERS IMPROVEMENTS

Except for emergency repair work, no water resources projects have been constructed by the Corps of Engineers in the San Francisquito Creek Basin. As a result of damages caused by the December 1955 flood, Federal funds totaling approximately $200,000 were expended in 1955 and 1956 by the Corps of Engineers for emergency channel clearing, levee restoration and bank protective riprap.

44. IMPROVEMENTS BY OTHER FEDERAL AGENCIES

There are no existing improvements for flood control or for other beneficial uses of water in the San Francisquito Creek Basin which were constructed by other Federal agencies.

45. IMPROVEMENTS BY NON-FEDERAL INTERESTS

Local interests have constructed intermittent improvements for flood control and bank erosion from the mouth of San Francisquito Creek to El Camino Real. Recently, in 1970, San Mateo and Santa Clara Counties in a joint venture constructed flood protection improvements between Middlefield Road and Bayshore Freeway at a cost in excess of $1,000,000 to carry a design flow of 6,000 cubic feet per second. These improvements consist of about 2,950 lineal feet of concrete gravity walls, 1,400 lineal feet of earth berms, 3,500 cubic yards of concrete sack riprap lining, 100 lineal feet of concrete crib wall and removal of brush and trees from 10,200 feet of channel. Examples of these improvements are shown on Photographs 5, 6, and 7.

46. Property owners along the creek at various locations have installed protection works consisting of concrete and timber walls, mats and fills, wire and poles, rock, scrap material and sack concrete revetment.

47. Reservoirs constructed in the basin have been discussed previously in paragraph 13.

IMPROVEMENTS DESIRED

48. PUBLIC HEARINGS

A public hearing was held in Palo Alto in 1942 in regard to the preliminary examination report for San Francisquito Creek. The record was transmitted to the Chief of Engineers with the report.

49. A second public hearing was held in 1956. This hearing was held under the title "Guadalupe River and Adjacent Streams" which included all streams in Santa Clara and southern Alameda Counties entering into San Francisco Bay. One hundred and twenty persons attended the hearing, including representatives of the U.S. Department of Agriculture, California Division of Highways, California Division of Water Resources (now the Department of Water Resources), San Mateo and Santa Clara Counties, Stanford University, the cities of Palo Alto and Menlo Park and property and business owners from within the basin. A record of the hearing is on file in the San Francisco District office.

50. At the first hearing, local interests expressed desires that prevention of inundation be accomplished by deepening and widening the San Francisquito Creek channel between University Avenue and Bayshore Freeway; deepening the channel and enlarging the levees along the creek between Bayshore Freeway and Mayfield Slough; and prevention of bank erosion from El Camino Real to the mouth.

51. At the second hearing, local interests presented data on effects of inundation and bank erosion. Belief was expressed that a solution to the flood problem could be found by construction of channel improvements or by dams and reservoirs.

52. In addition to the public hearings mentioned above, numerous meetings were held with various interested groups and committees in an endeavor to determine acceptable solutions to the water and water related problems in the basin.

SOLUTIONS CONSIDERED

53. GENERAL

Consideration was given to an array of alternatives of various types and magnitudes in an endeavor to determine suitable solutions to the water resources and related problems in the San Francisquito Creek Basin by means of structural and non-structural measures. Structural measures considered include dams and reservoirs with purposes for water supply, flood control and recreation, channel improvements, levees, conduits, diversions and combinations of these plans. Non-structural measures such as flood plain management, flood proofing and flood insurance were given consideration. A summary of alternative plans considered is presented in the following paragraphs. The location and type of various structural alternatives considered are depicted on Plates 6 and 7, Plan Considered. Benefit-cost analyses for these alternatives were based on an interest rate of 5-3/8 percent and an economic life of 100 years. Annual charges include interest and amortization, operation, maintenance and major replacement costs.

54. RESERVOIRS - LADERA DAMSITE

A number of possible damsites in the basin were investigated to determine which would provide the most suitable solution to the water and water-related problems in the area. Consideration was given to raising Searsville Dam. It was determined that enlarging the lake would cause inundation of expensive homes and real estate. In addition to this channel improvements would be required downstream. This alternative was found to be inferior to other possible plans of improvement. Sites upstream and downstream of the Ladera site were also investigated. Reservoirs upstream would also cause inundation of expensive real estate and of a larger portion of the Jasper Ridge Biological Preserve. Downstream reservoirs would interfere with the linear accelerator and road facilities. Operating Searsville and Felt Lakes as flood control reservoirs would not significantly reduce flood peaks downstream. The drainage areas of Searsville and Felt Lakes at the spillways are only 14.53 and 0.27 square miles, respectively. The Ladera damsite, which is shown on Plate 6, located at river mile 10.2 above the mouth of San Francisquito Creek proved to be the most promising in being capable of providing a high degree of flood protection, water supply and recreation opportunities. Previous studies made of this site indicated that a multiple-purpose dam and reservoir for flood control, water supply and recreation could be economically justified. These studies were reviewed in light of changed economic conditions, existing and future water resources needs and problems, environmental objectives and desires of local interests. Economic analyses for an array of various sized dams and reservoirs for combinations of flood control, water supply and recreation were updated. In

view of increased construction costs, interest rates, land values and improvements constructed by local interests it was determined that the costs of dams and reservoirs would far exceed the benefits that could be derived by construction of such improvements and therefore cannot be economically justified at this time. The first costs of a multiple-purpose dam and reservoir for flood control, water supply and recreation with a gross storage capacity of 13,100 acre-feet is estimated to be about $23,300,000. The storage capacity of the reservoir would be apportioned to 8,500 acre-feet for water supply and 1,100 acre-feet for silt reservation. The average annual charges would be $1,360,000. The average annual flood control benefits that could be expected would be $390,000 with the channel capacity improved to carry 6,000 cubic feet per second. It is estimated that $330,000 in average annual benefits, representing 275,000 visitor days, would be derived in recreation benefits. The least cost alternative for water supply is from the existing Hetch Hetchy System of the San Francisco Water Department. The cost of this water is $70 per acre-foot. The cost of treatment and conveyance of water developed at the damsite would be about $21 per acre foot. This would leave a net benefit of $49 per acre-foot to be applied towards the dam and reservoir. A water supply of 1,500 acre-feet (firm yield) could be developed to provide $74,000 in average annual benefits. The total benefits that could be expected from the dam and reservoir would be only $794,000 annually. The resulting benefit-to-cost ratio is 0.6. It is also believed that this reservoir would not be acceptable because of possible adverse effects on environmental and ecological values, such as encroachment upon Stanford University's Jasper Ridge Biological Experimental Area, a portion of which lies within the reservoir area.

55. CHANNEL IMPROVEMENTS

Channel improvements were considered on San Francisquito Creek from El Camino Real to San Francisco Bay. Concrete-lined channels, trapezoidal earth channels, levees, bypasses and combinations thereof were evaluated for one and two percent chance flood protection. Economic analyses indicate that these types of improvements cannot be economically justified at this time. The first costs for these types of channel improvement to provide one percent chance flood protection with the channel improved to carry 9,400 cubic feet per second are estimated to be $20,600,000. Average annual charges would be $1,140,000 and the average annual benefits that could be derived are estimated to be $365,000. This results in a benefit-to-cost ratio of 0.3. A rectangular concrete channel would be required from El Camino Real to Bayshore Freeway (3.4 miles) and a trapazoidal earth channel with levees from Bayshore Freeway to San Francisco Bay (1.5 miles).

This type of improvements would probably not be acceptable to local interests in view of the interference that would be caused with existing developments and facilties by construction of such improvements. The aesthetic and ecological values of the creek would also be depreciated by these improvements.

56. WILLOW ROAD DIVERSION SCHEME

This plan would consist of a concrete-lined channel three-quarters of a mile long from El Camino Real to a diversion point just upstream from Middlefield Road, an underground conduit following the alinement of Willow Road to Bayshore Freeway and a trapezoidal earth channel with levees to Ravenswood Slough. The layout of this plan may be seen on Plate 7, Plans Considered. Local interests adopted this plan as being the most desirable solution to the flood problem on San Francisquito Creek because this plan would alter only a small portion of the existing stream channel. Since the time of adoption, however, local interests have constructed channel improvements, which are previously discussed, on their own initiative. The diversion plan was evaluated to carry floodflows, in excess of the existing 6,000 cubic feet per second channel capacity, ranging in magnitudes from about 2,000 to 7,000 cubic feet per second. It was determined that under the existing conditions of improvement, this plan of improvements could not be economically justified. The first costs of this plan to provide one percent chance flood protection (diversion capacity 3,400 cubic feet per second) are estimated to be $11,600,000. The average annual charges would be $645,000. Average annual benefits would amount to $315,000. The resulting benefit-to-cost ratio is 0.5.

57. FLOOD PLAIN MANAGEMENT

Flood plain management is now an ongoing program along San Francisquito Creek. The cities of Palo Alto and Woodside have applied for and received permission to participate in the flood insurance program. By participating the cities have agreed to enact land use ordinances which will be consistent with the program. The removal of existing structures from the flood plain is not considered to be a practical alternative. However, flood plain management should be utilized to the maximum extent practical in any new development in the San Francisquito Creek flood plain.

58. FLOOD PROOFING

Flood proofing of some structures which would be affected by the more frequent floods would reduce damages somewhat. However, a large portion of the flood plain is devoted to residences, many of which are expensive and beautifully landscaped. Flood proofing of these structures would not only depreciate the aesthetic values of the area but would also place an undue financial burden on the property owners.

Flood proofing measures such as land fill, waterproofing, dikes and walls should be applied to new development and in redevelopment within the flood plain. Land fill or the construction of elevated structures would be the most desirable method for flood proofing in the area.

59. FLOOD INSURANCE

The National Flood Insurance Act of 1968, as amended, administered by the Federal Insurance Administration of the Department of Housing and Urban Development, utilizes the services of the private insurance industry and provides for Federal subsidization of the first $17,500 of flood insurance on single-family through four-family structures and up to $30,000 for other structures. Contents coverage up to $5,000 per unit is available at subsidized rates. The insurance covers damage caused by overflow of either inland or tidal waters on flood-prone land. Studies to establish actuarial rates or to determine the extent to which flood protection measures affect such rates are conducted by several agencies of the Federal Government including the U.S. Army Corps of Engineers. The subsidized premium rates established by the Federal Insurance Administration are given in the following tabulation:

	Type of Structure	Value of Structure	Rate 1/ per year per $100 structural coverage	Rate 1/ per year per $100 contents coverage
(1)	Single Family residential	$17,500 and under-	$0.25	$0.35
		17,501 - 35,000--	.30	.40
		35,001 and over--	.35	.45
(2)	All other residential	30,000 and under-	.25	.35
		30,001 - 60,000--	.30	.40
		60,001 and over--	.35	.45
(3)	All non-residential (including hotels and motels with normal occurpancy of less than six months in duration).	30,000 and under-	.40	.75
		30,001 - 60,000--	.50	.75
		60,001 and over--	.60	.75

1/ Rates effective 10 July 1972

60. A flood insurance study of Palo Alto is now being made by the San Francisco District. However, in order to provide coverage for a larger number of communities, the Federal Insurance Administration has been authorized to make a choice available to communities at a subsidized rate prior to completion of rate studies, provided that communities have adequate land use and control measures in effect. When a rate study has been completed additional insurance may be purchased at the actuarial rate determined from the study. The maximum coverage available at the actuarial rate is the same as that at the subsidized rate; i.e., a single family residence could be insured for $17,500 at the subsidized rate and $17,500 at the actuarial rate for a total coverage of $35,000. Actuarial rates may vary throughout any flood plain, depending upon the frequency and depth of flooding.

61. ESTIMATES OF COSTS AND BENEFITS

A summary of costs, benefits and benefit-to-cost ratios for various alternatives considered are tabulated on the following page. The reservoir and channel improvement alternatives were formulated to provide one percent chance flood protection for conditions prior to improvements constructed by local interests in 1970. The diversion plan was formulated to provide one percent chance protection under existing hydraulic conditions. The analyses presented in the tabulation are based on an interest rate of 5-3/8 percent and an economic life of 100 years. Annual charges include interest and amortization, operation, maintenance and major replacement costs. Benefits that would be derived by construction of the various alternatives are based on present hydraulic and future hydrologic conditions, 1971 price levels and future conditions of economic development for the period 1970 and 2070. Higher land utilization benefits were not considered in view of the extensive development and the high demand for land in the basin. The value of lands would not be materially affected by the presence of a flood control project.

COST-BENEFIT ANALYSES
ALTERNATIVE PLANS OF IMPROVEMENT
SAN FRANCISQUITO CREEK

Plan	First Costs	Annual 1/ Charges	Annual 2/ Benefits	Benefit-to-Cost Ratio
Reservoir - 13,100 Acre Feet - Flood Control - Water Supply - Recreation	$23,300,000	$1,360,000	$794,000	0.6
Channel Improvements 9,400 c.f.s. - Flood Control - Recreation	20,600,000	1,140,000	365,000	0.3
Diversion Scheme Flood Control Only	11,600,000	645,000	315,000	0.5

1/ Based on an interest of 5-3/8% and 100-year economic life.
2/ Channel improved to 6,000 cubic feet per second.

62. ECONOMIC JUSTIFICATION

As indicated in the cost-benefit analyses, none of the alternatives considered could be economically justified at this time. The annual charges for the Willow Road diversion scheme, which is considered to be the most desirable approach to solving the flood problem on San Francisquito Creek, would exceed the average annual benefits that could be derived by $330,000 or about 105 percent. Consequently, in view of these findings, further studies were not undertaken.

COORDINATION

63. GENERAL

Coordination has been maintained with San Mateo County Flood Control District, Santa Clara County Flood Control and Water District and interested Federal, State and local agencies and officials. Information obtained from these entities has been used as applicable throughout the course of the study. Copies of the draft of this report were sent to all known interested Federal and non-Federal agencies for their review and comment. These comments and pertinent discussion related thereto are included in this report as "Appendix A."

RESULTS OF THE INVESTIGATION

64. DISCUSSION AND CONCLUSION

a. Studies made for this report sought solutions to the flood and related water resources problems of the San Francisquito Creek Basin. Dams and reservoirs, channel improvements, stream diversion and combinations of these have been considered in an endeavor to determine suitable and acceptable solutions to these problems. In the evaluation of these alternatives appropriate consideration was given to the improvements constructed by local interests on San Francisquito Creek to enlarge the channel capacity to carry a design flow of 6,000 cubic feet per second. Non-strucutral measures including flood plain management, flood proofing and flood insurance were also given consideration. It was determined that an adequate solution to the water and water-related problems by above mentioned structural alternatives could not be economically justified by a substantial margin at this time.

b. The investigations indicate that a flood problem continues to exist along San Francisquito Creek and unless further protective measures are taken future floods will cause recurrent damages. Under similar conditions of runoff and locations of overbank flow as occurred during the 1955 flood, it is estimated that a peak discharge of about 8,000 cubic feet per second, at Stanford University gaging station would produce a flood plain approximating that shown on Plate 5. Prior to improvements constructed by local interests, this flood plain was produced by a peak discharge of 5,560 cubic feet per second. As it becomes necessary to rebuild roads and streets in the area, bridges and culverts should be designed to allow for the safe passage of high magnitude floodflows.

c. State, county and local officials could avail themselves of the assistance available from the Corps of Engineers under the Flood Plain Management Services Program and control to the maximum extent practicable future building and rebuilding in the San Francisquito Creek flood plain. Such assistance will be provided by the U.S. Army Engineer District, San Francisco at the request of a responsible governmental agency. The National Flood Insurance Program is also open to communities which have experienced flood damages and qualify under the provisions of the National Flood Insurance Act of 1968, as amended.

65. Additional information called for by Senate Resolution 148, 85th Congress adopted 28 January 1958 is contained herein as a supplement to this report.

66. STATEMENT OF FINDINGS

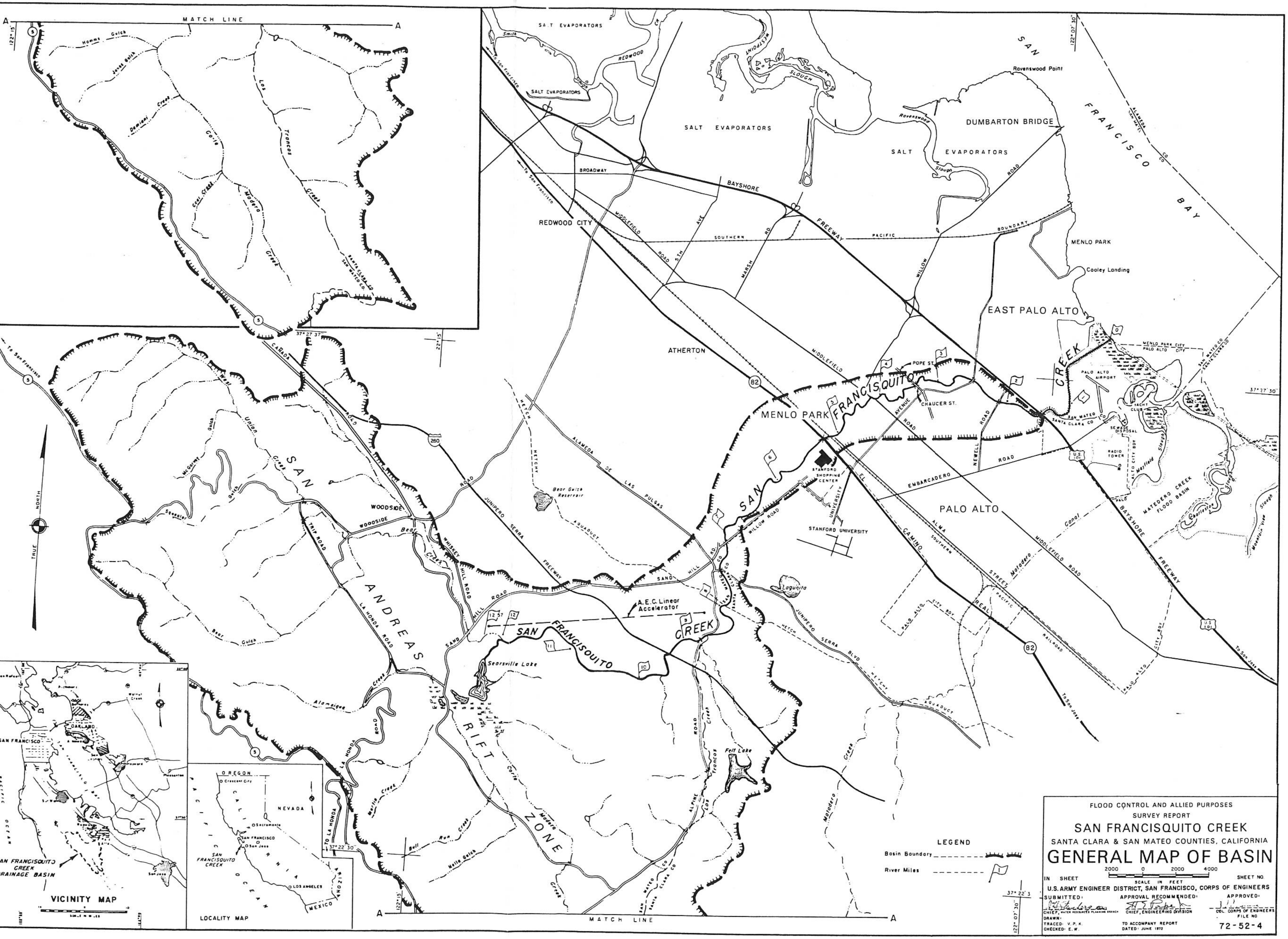
The District Engineer has reviewed and evaluated in the total public interest the data and information pertaining to the San Francisquito Creek survey study. The principal elements considered in this review include: (a) engineering feasibility, (b) environmental impacts, and (c) economic factors of regional and national resource development, all of which have been evaluated in light of the study purpose. Consideration was given to meet public needs for flood control, water supply and recreation. The District Engineer has considered the means available to him for meeting these needs and concludes that structural measures required to fulfill the needs cannot be economically justified at this time.

RECOMMENDATION

67. The District Engineer recommends that no project be authorized in the San Francisquito Creek Basin for flood control and allied purposes, at this time.

J. L. LAMMIE
Colonel, CE
District Engineer

(Revised 20 July 1972)


MATCH LINE
A
SALT EVAPORATORS
SALT EVAPORATORS
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SALT EVAPORATORS
REDWOOD CK
WESTPOINT
SLOUGH
Smith
To San Francisco
SAN FRANCISCO BAY
Ravenswood Point
DUMBARTON BRIDGE
Ravenswood Slough
BROADWAY
BAYSHORE FREEWAY
REDWOOD CITY
MIDDLEFIELD ROAD
5TH AVE
MARSH RD
SOUTHERN PACIFIC
WILLOW ROAD
BOUNDARY
MENLO PARK
Cooley Landing
EAST PALO ALTO
ATHERTON
MENLO PARK
POPE ST.
CHAUCER ST.
SAN FRANCISQUITO CREEK
PALO ALTO AIRPORT
YACHT CLUB
SEWAGE DISPOSAL
RADIO TOWER
EMBARCADERO ROAD
NEWELL ROAD
STANFORD SHOPPING CENTER
UNIVERSITY
STANFORD UNIVERSITY
PALO ALTO
EL CAMINO REAL
ALMA STREET
MIDDLEFIELD ROAD
MATADERO CREEK FLOOD BASIN
Charleston Slough
Mayfield Slough
Mountain View Slough
Lagunita
JUNIPERO SERRA BLVD
HETCH HETCHY AQUADUCT
PALO ALTO CITY BDY
RAILROAD
To San Jose
WOODSIDE
ALAMEDA DE LAS PULGAS
Bear Gulch Reservoir
JUNIPERO SERRA FREEWAY
SAND HILL ROAD
A.E.C. Linear Accelerator
SAN FRANCISQUITO CREEK
Searsville Lake
SAN ANDREAS RIFT ZONE
LA HONDA ROAD
WHISKEY HILL ROAD
TRIP ROAD
West Union Creek
McGarvey Gulch
Bear Gulch
Alambique Creek
Corte Madera Creek
Bull Run Creek
Los Trancos Creek
Felt Lake
Alpine Road
Matadero Creek
Hamms Gulch
Jones Gulch
Damiani Creek
Coal Creek
Los Trancos Creek
Madera Creek
SANTA CLARA CO
SAN MATEO CO
TRUE NORTH
VICINITY MAP
SAN FRANCISCO
OAKLAND
SAN FRANCISQUITO CREEK DRAINAGE BASIN
LOCALITY MAP
OREGON
NEVADA
PACIFIC OCEAN
Sacramento
San Francisco
San Jose
LOS ANGELES
MEXICO
ARIZONA
LEGEND
Basin Boundary
River Miles
122° 15'
122° 07' 30"
37° 27' 30"
37° 22' 30"

FLOOD CONTROL AND ALLIED PURPOSES
SURVEY REPORT

SAN FRANCISQUITO CREEK

SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA

GENERAL MAP OF BASIN

2000 0 2000 4000
SCALE IN FEET

IN SHEET — SHEET NO.

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS

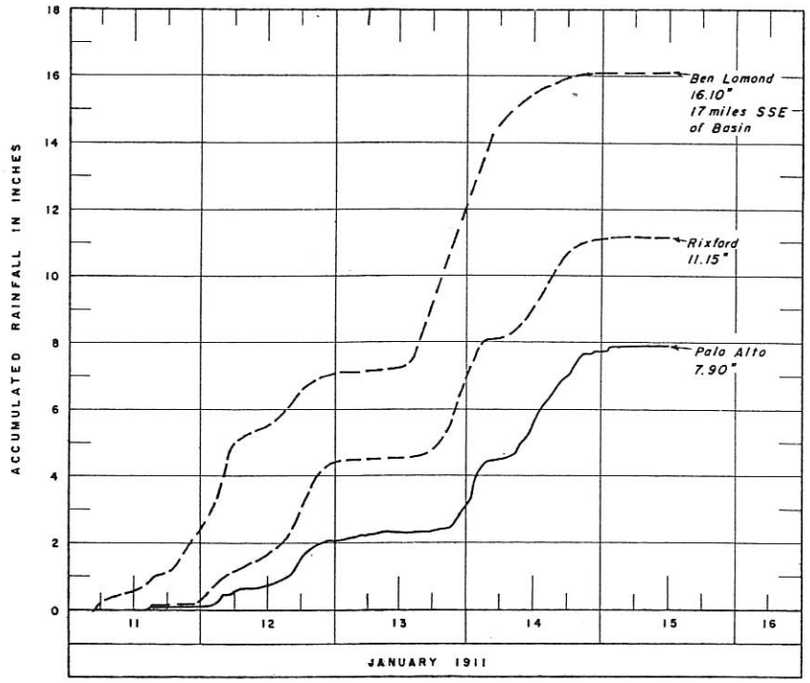
SUBMITTED: CHIEF, WATER RESOURCES PLANNING BRANCH — APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION — APPROVED: COL. CORPS OF ENGINEERS

DRAWN:
TRACED: V. P. K.
CHECKED: E. W.

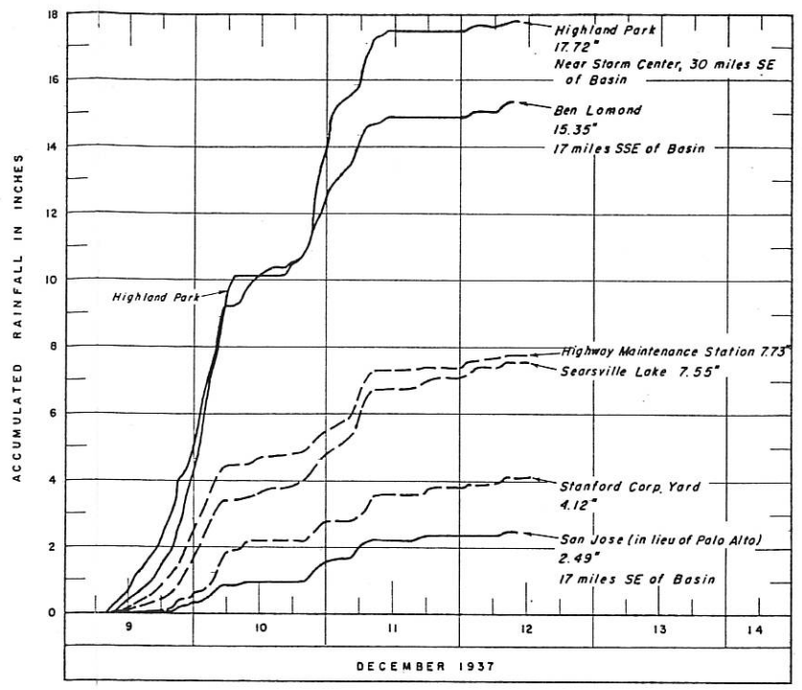
TO ACCOMPANY REPORT
DATED: JUNE 1972

FILE NO
72-52-4

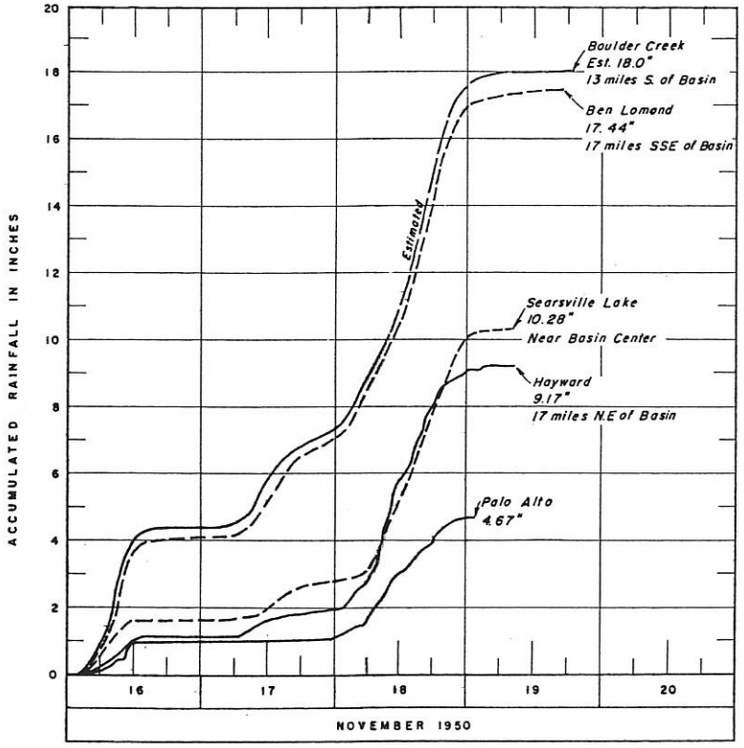
PLATE I



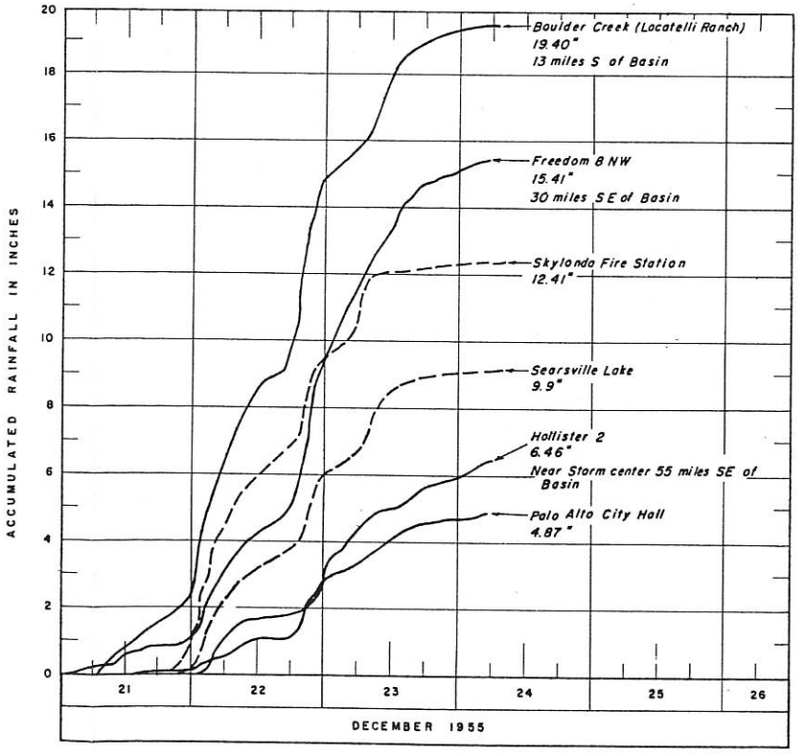
STORM OF 11-14 JANUARY 1911



STORM OF 9-12 DECEMBER 1937



STORM OF 16-18 NOVEMBER 1950



STORM OF 21-24 DECEMBER 1955

LEGEND

Recorder . . . . . ———

Curve Using Daily Totals . . . . . — — —

FLOOD CONTROL & ALLIED PURPOSES
SURVEY REPORT

SAN FRANCISQUITO CREEK

SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA

HYDROLOGY

MASS RAINFALL CURVES

MAJOR STORMS OF RECORD

IN SHEETS — SHEET NO.

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS

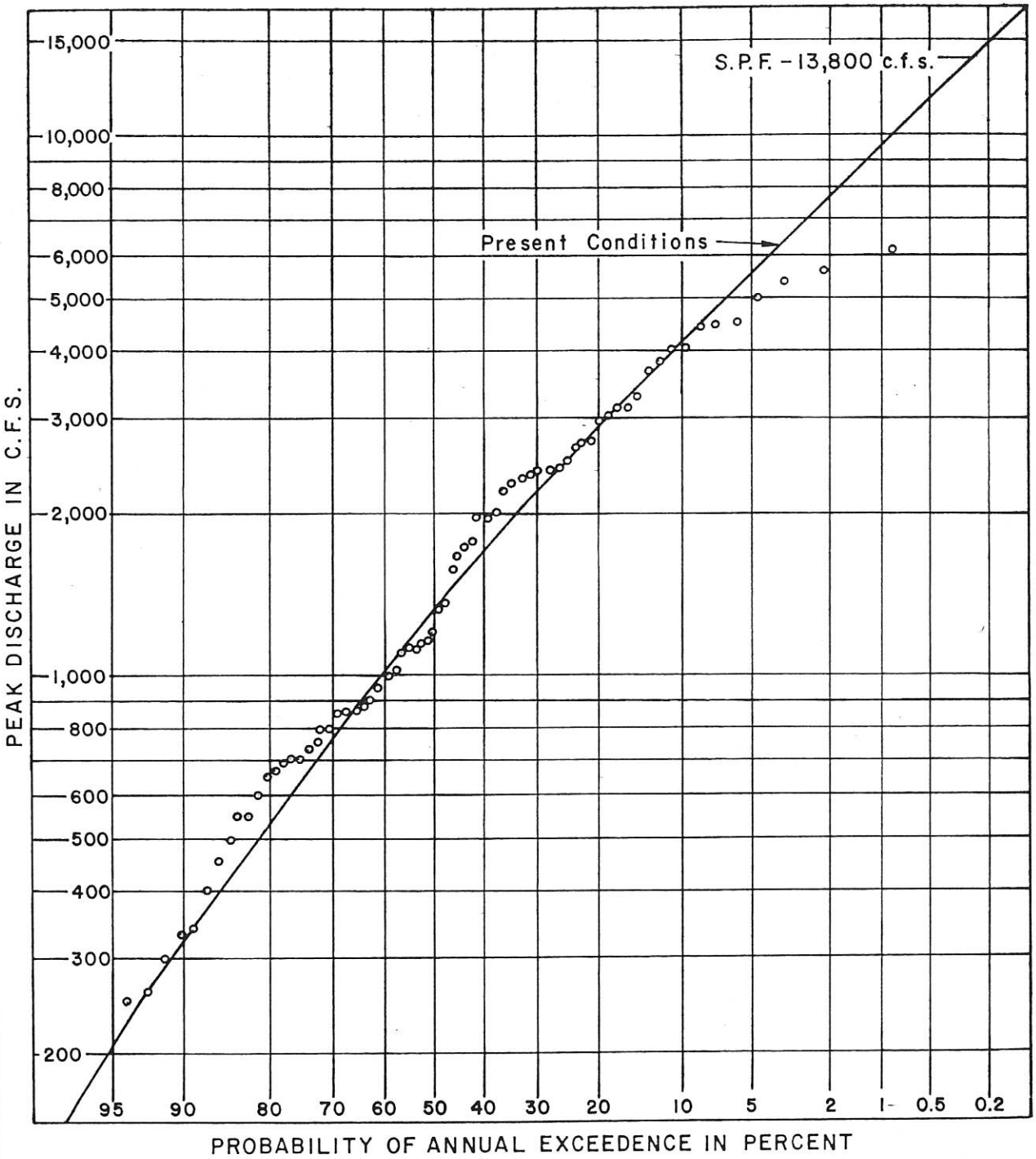
DRAWN: W.O.B. — FILE NO.

TRACED: C.L. — TO ACCOMPANY REPORT

CHECKED: E.W. — DATED:

72-46-3

PLATE 2



NOTES:

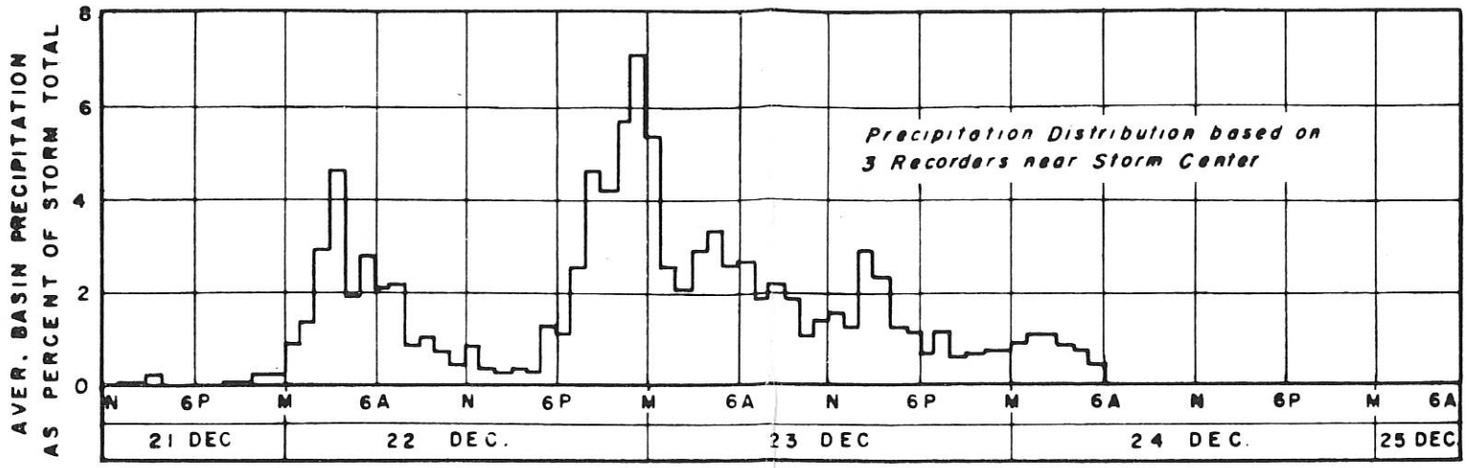
1893-1911 Based on Searsville Lake data.
1912-1930 " " " Rainfall study.
1931-1941 " " " Gage Readings.
1942-1950 " " " Correlation with San Lorenzo River at Big Trees.
1951-1971 " " " Gage at Stanford University.

* Present gage is at Stanford University. Discharge in excess of 3,000 c.f.s. require no adjustment.

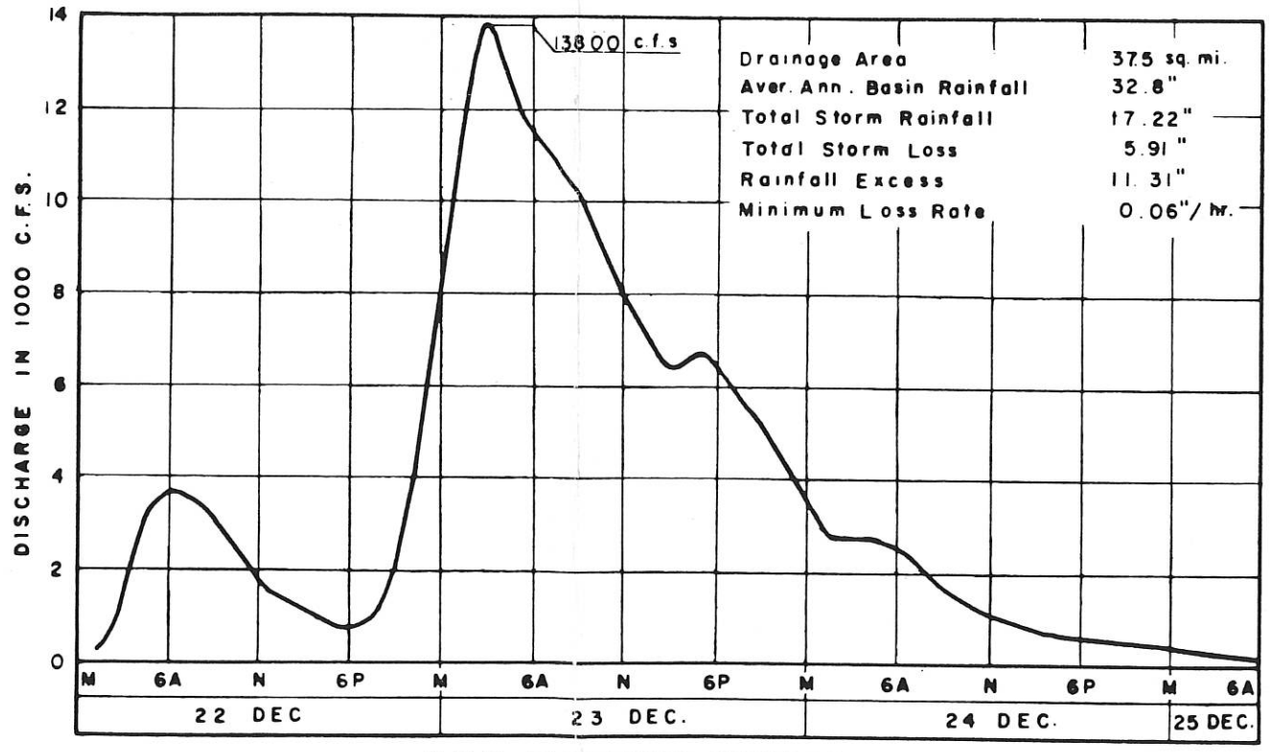
FLOOD CONTROL AND ALLIED PURPOSES
SURVEY REPORT
SAN FRANCISQUITO CREEK
SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA
HYDROLOGY
DISCHARGE FREQUENCY CURVE AT PALO ALTO *

IN SHEET SHEET NO.
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: V.P.K. FILE NO.
TRACED: V.P.K. TO ACCOMPANY REPORT 72-46-3
CHECKED: E.W. DATED

PLATE 3



STORM OF 21-24 DECEMBER 1955
TRANSPOSED OVER
SAN FRANCISQUITO CREEK BASIN



S.P.F. DISCHARGE HYDROGRAPH
SAN FRANCISQUITO CREEK
AT U.S.G.S. GAGE, STANFORD UNIVERSITY

FLOOD CONTROL AND ALLIED PURPOSES
SURVEY REPORT
SAN FRANCISQUITO CREEK
SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA
HYDROLOGY

HYDROGRAPH
STANDARD PROJECT FLOOD

IN SHEET SHEET NO.
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: FILE NO.
TRACED: TO ACCOMPANY REPORT
CHECKED: DATED 72-46-3

PLATE 4

NOTE:

Under existing hydraulic conditions the 1955 flood plain would be approximated by a peak discharge of about 8,000 cubic feet per second.

LEGEND

— — DEC. 1955 FLOOD

FLOOD CONTROL AND ALLIED PURPOSES
SURVEY REPORT
SAN FRANCISQUITO CREEK
SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA
FLOOD DAMAGE
FLOOD PLAIN

1000 0 1000 2000
SCALE IN FEET

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C.OF E.
DRAWN: D.M.F. FILE NO.
TRACED: C.L. TO ACCOMPANY REPORT 72-53-6
CHECKED: E.W. DATED:

PLATE 5

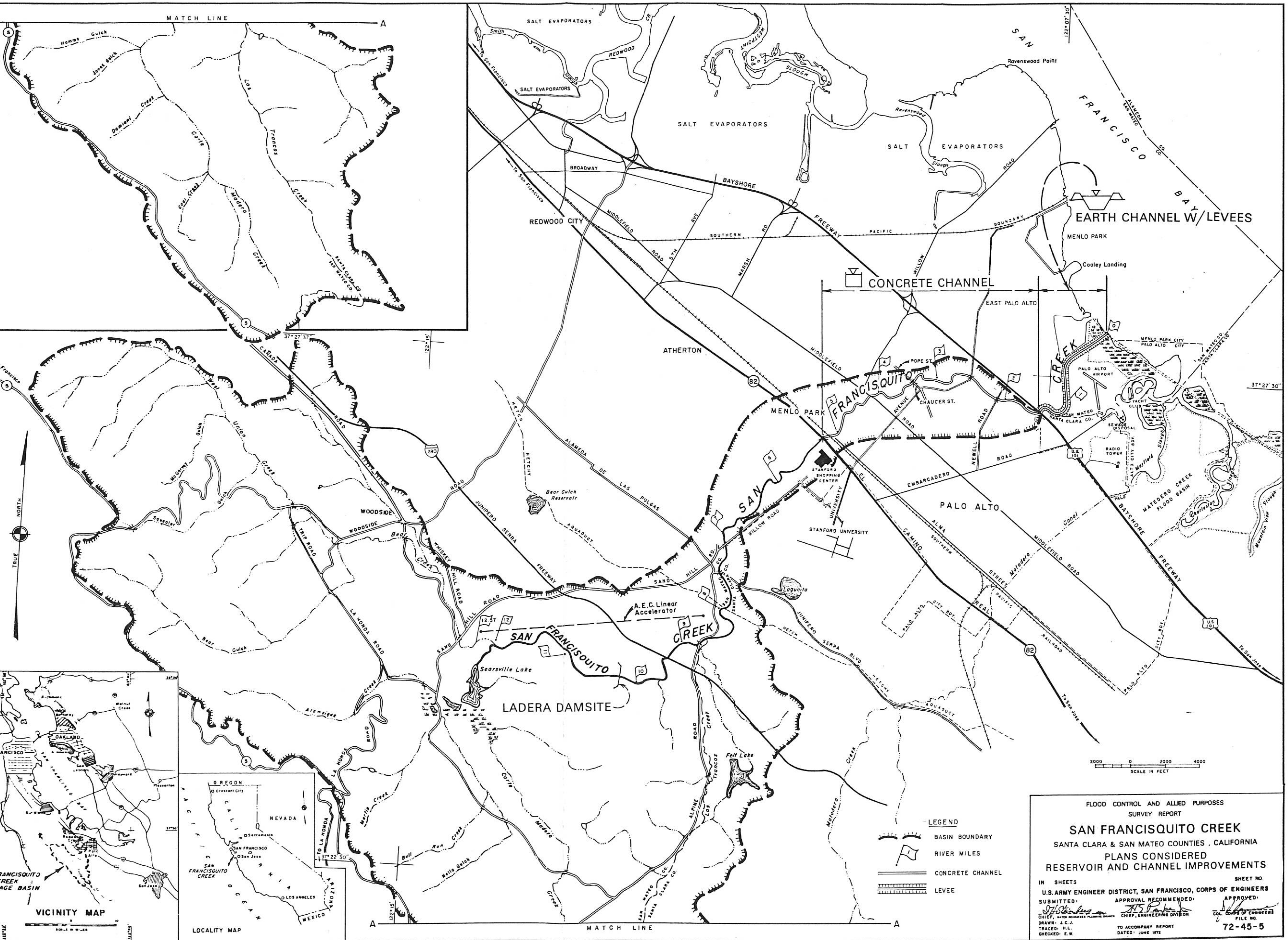
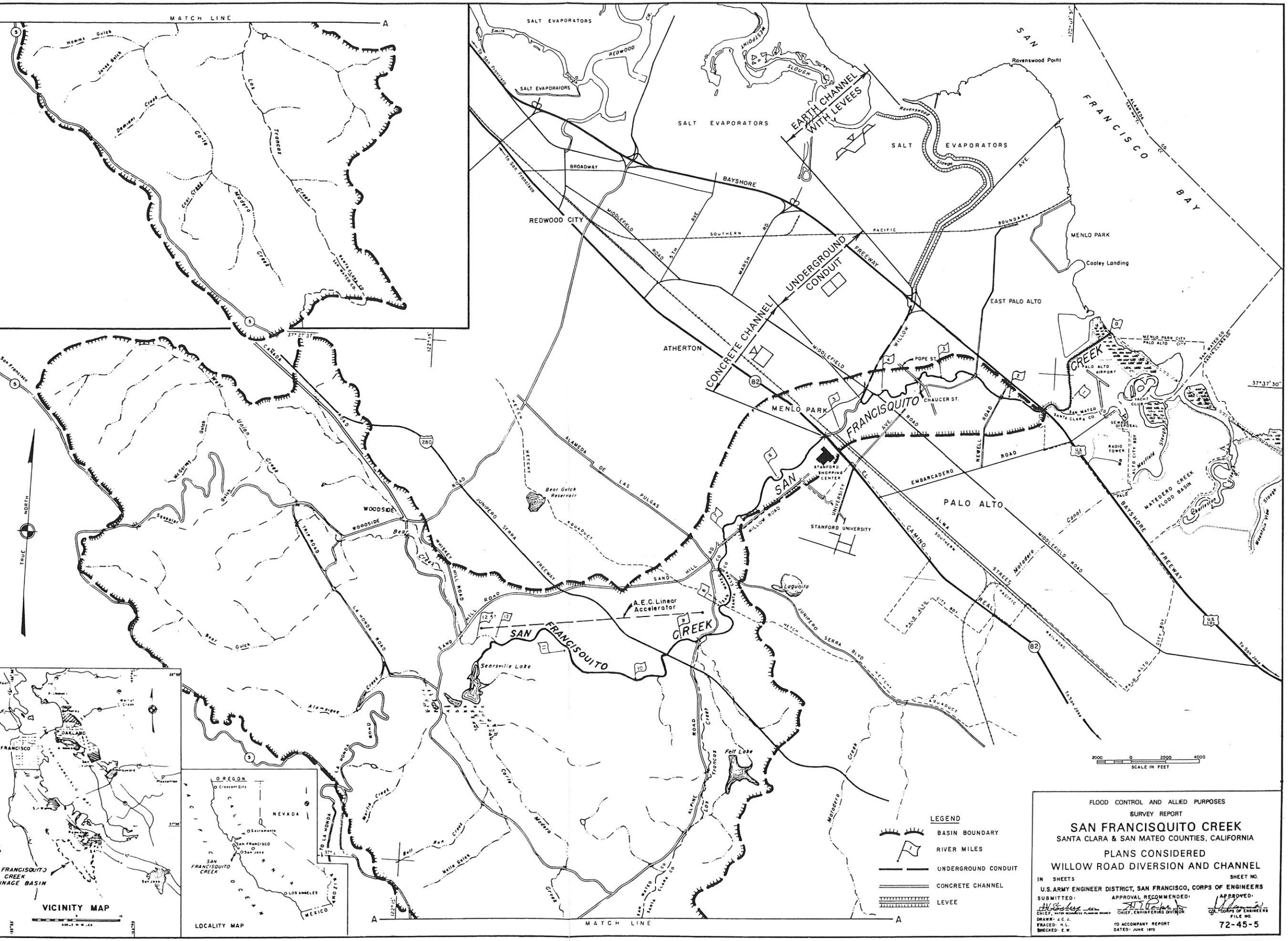

MATCH LINE
SALT EVAPORATORS
SAN FRANCISCO BAY
Ravenswood Point
EARTH CHANNEL W/LEVEES
MENLO PARK
Cooley Landing
CONCRETE CHANNEL
EAST PALO ALTO
BAYSHORE FREEWAY
REDWOOD CITY
ATHERTON
MENLO PARK
PALO ALTO
PALO ALTO AIRPORT
STANFORD SHOPPING CENTER
STANFORD UNIVERSITY
WOODSIDE
SAN FRANCISQUITO CREEK
A.E.C. Linear Accelerator
Searsville Lake
LADERA DAMSITE
Bear Gulch Reservoir
Lagunita
Felt Lake
MATADERO CREEK FLOOD BASIN
VICINITY MAP
LOCALITY MAP
LEGEND
BASIN BOUNDARY
RIVER MILES
CONCRETE CHANNEL
LEVEE
SCALE IN FEET
FLOOD CONTROL AND ALLIED PURPOSES
SURVEY REPORT
SAN FRANCISQUITO CREEK
SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA
PLANS CONSIDERED
RESERVOIR AND CHANNEL IMPROVEMENTS
IN SHEETS
SHEET NO.
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS
SUBMITTED:
APPROVAL RECOMMENDED:
APPROVED:
CHIEF, WATER RESOURCES PLANNING BRANCH
CHIEF, ENGINEERING DIVISION
COL. CORPS OF ENGINEERS
DRAWN: J.C.J.
TRACED: H.L.
CHECKED: E.W.
TO ACCOMPANY REPORT
DATED: JUNE 1972
FILE NO.
72-45-5

PLATE 6



FLOOD CONTROL AND ALLIED PURPOSES

SURVEY REPORT

SAN FRANCISQUITO CREEK

SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA

PLANS CONSIDERED

WILLOW ROAD DIVERSION AND CHANNEL

IN SHEETS SHEET NO.

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS

SUBMITTED: CHIEF, WATER RESOURCES PLANNING BRANCH

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

APPROVED: COL. CORPS OF ENGINEERS

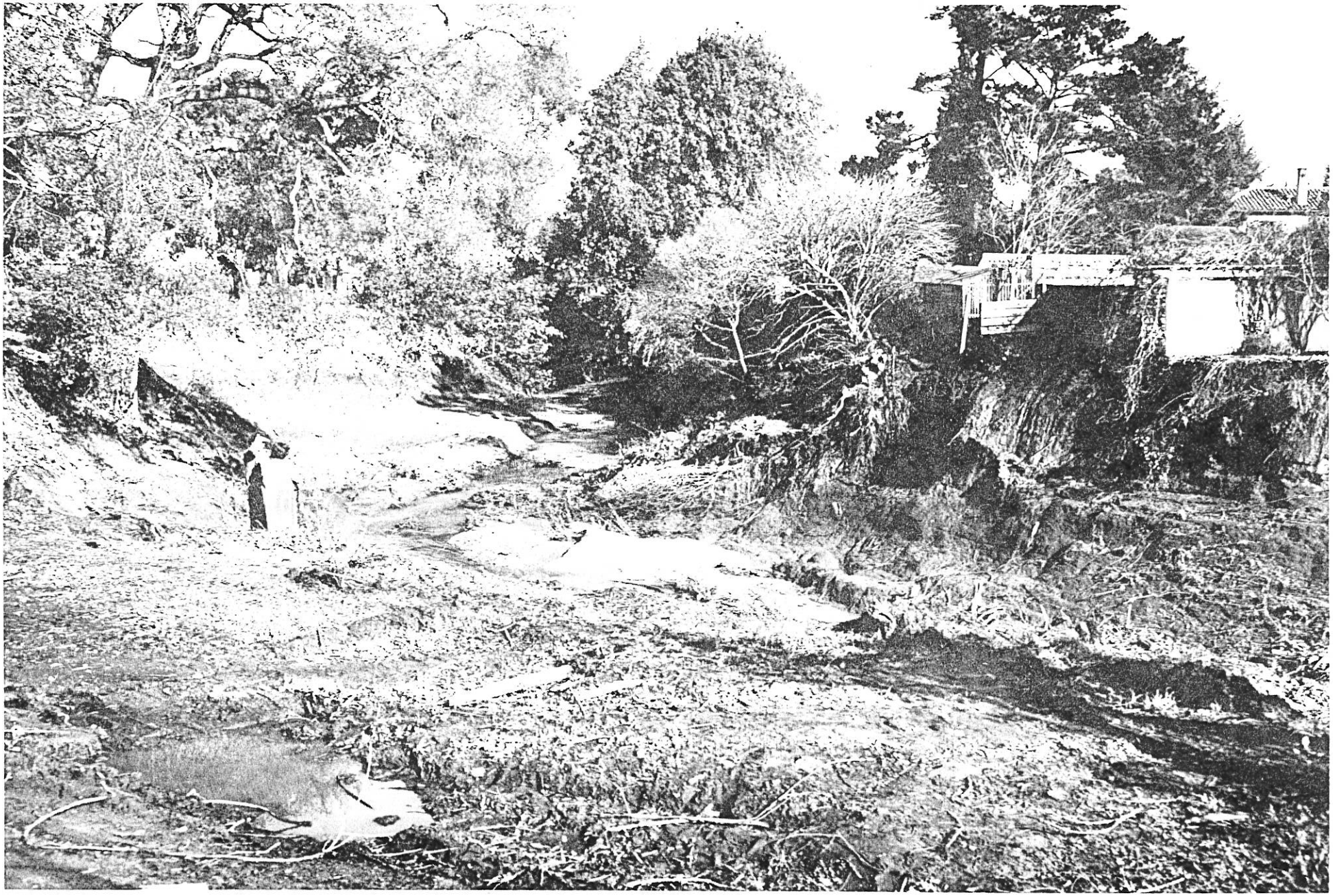
DRAWN: J.C.J.
TRACED: H.L.
CHECKED: E.W.

TO ACCOMPANY REPORT
DATED: JUNE 1972

FILE NO. 72-45-5

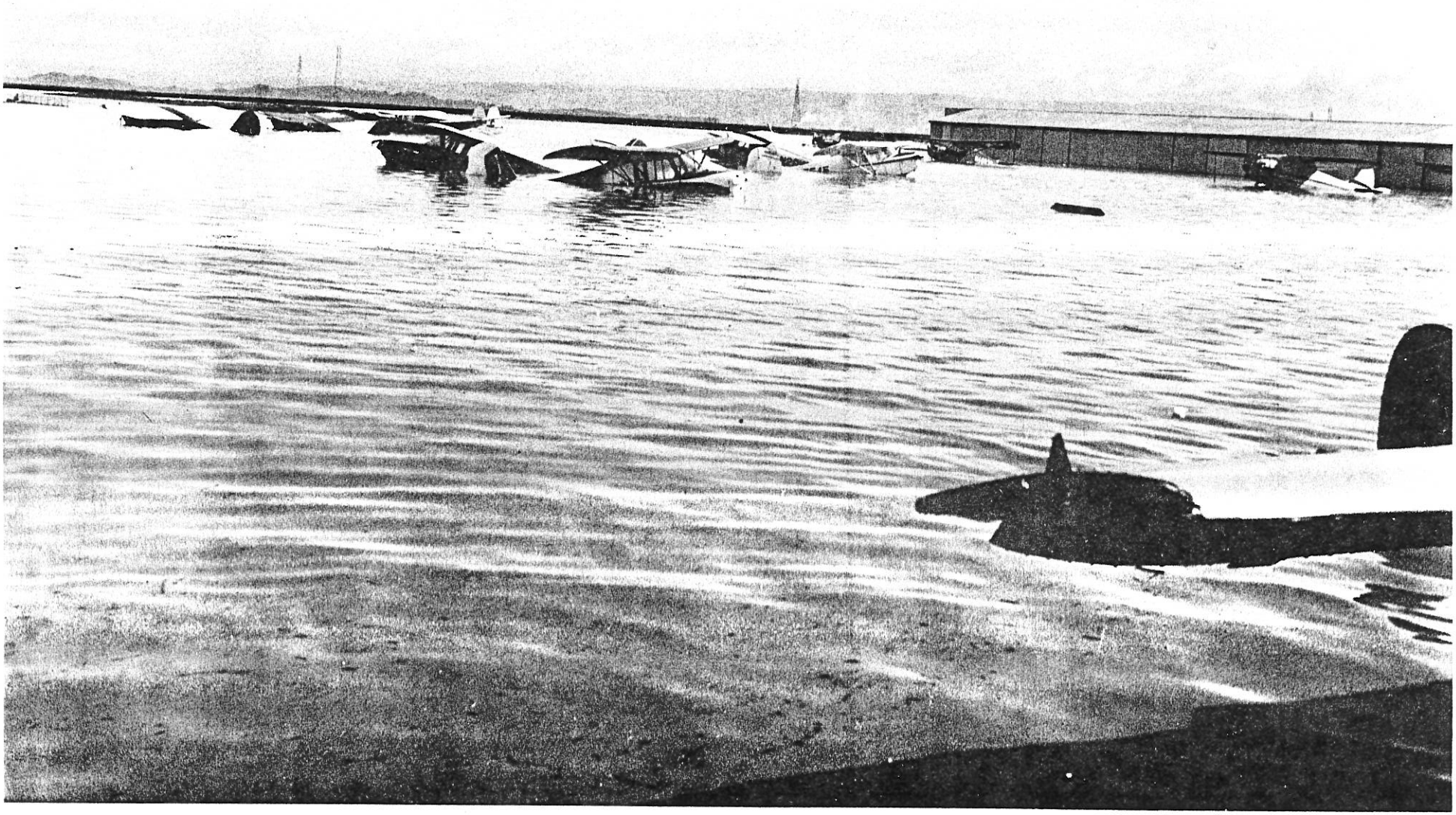
PLATE 7

PHOTOGRAPH 1 - FLOOD OF DECEMBER 1955 RIVER MILE 1.6

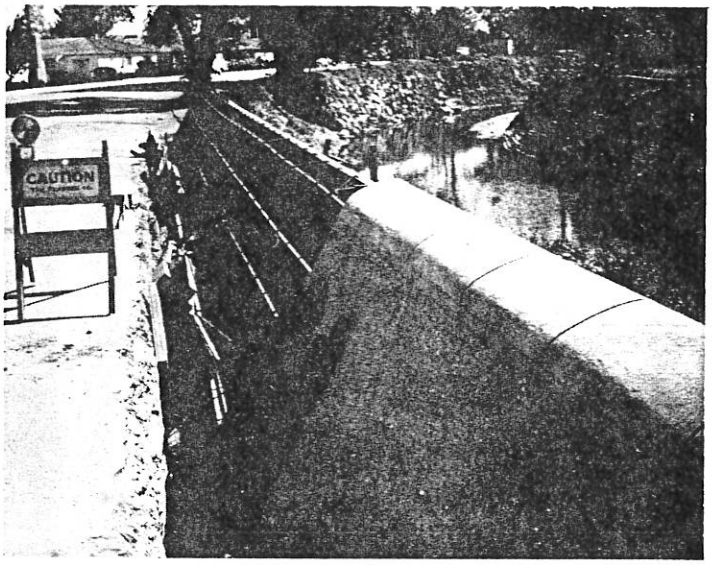


PHOTOGRAPH 2 - FLOOD OF DECEMBER 1955 RIVER MILE 2.9

PHOTOGRAPH 3 - FLOOD OF APRIL 1958 RIVER MILE 1.6

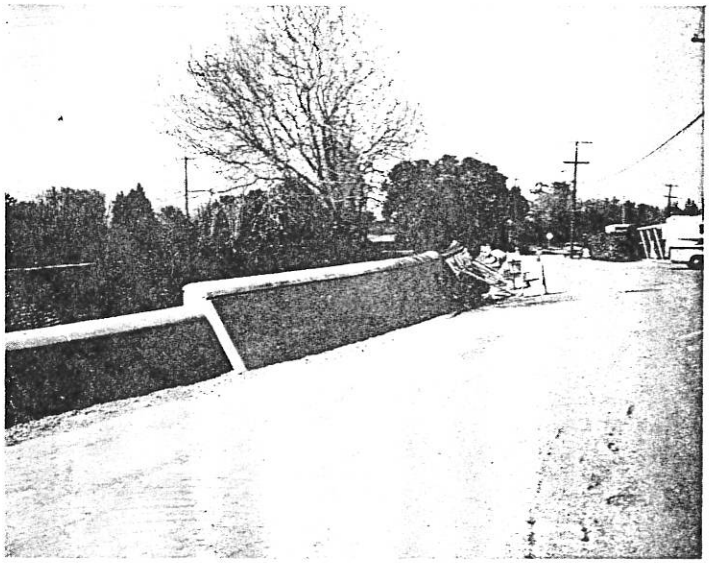


PHOTOGRAPH 4 - FLOOD OF APRIL 1958 LEVEE OVERFLOW AT RIVER MILE 1.3

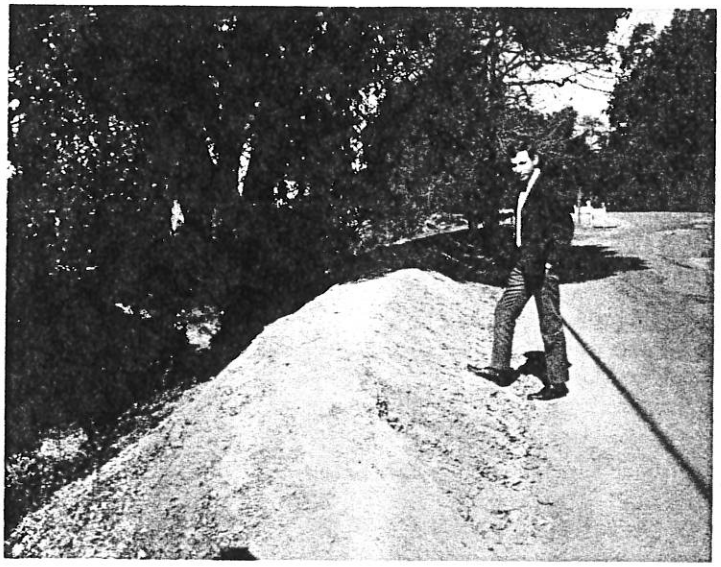


PHOTOGRAPH 5

GRAVITY FLOODWALLS CONSTRUCTED BY
LOCAL INTERESTS
NOTE SACKCRETE LINING ON RIGHT BANK



PHOTOGRAPH 6



PHOTOGRAPH 7

EARTH BERM CONSTRUCTED BY
LOCAL INTERESTS