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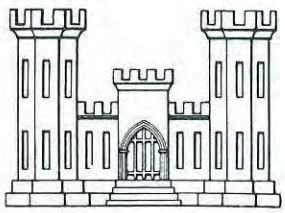
REPORT

ON

FLOODS OF DECEMBER 1955 AND JANUARY 1956

IN

NORTHERN CALIFORNIA COASTAL STREAMS



Prepared by
San Francisco District
Corps of Engineers, U.S. Army

June 1956

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REPORT

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FLOODS OF DECEMBER 1955

AND JANUARY 1956

IN

SAN FRANCISCO DISTRICT STREAMS

Prepared in the
Office of the District Engineer
San Francisco District
Corps of Engineers
U. S. Army
June 1956

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Report on Floods of December 1955
and January 1956
San Francisco District,
Corps of Engineers, U. S. Army

GENERAL

1. Authority. This report on the floods which occurred in the streams in the San Francisco District from the Oregon border to the Salinas River on 23 December 1955 has been prepared in compliance with instructions contained in paragraph 4223.05d of Orders and Regulations pertaining to collection of flood data.

2. Scope. It is intended that this report provide a complete, but brief, account of the December 1955 and January 1956 floods in the San Francisco District, including a general description of the basins, flood characteristics, rainfall associated with the floods, flood emergency activities of the Corps of Engineers, and the hydrologic, hydraulic, and damage data collected. Because of the severity of the floods, in many cases the greatest flood of record, and the extensive damages which they caused, the presentation of the flood data herein will be of great value in future flood-control investigations. During this same period, devastating floods occurred in the Sacramento and San Joaquin River Basins and their tributaries, and it is expected that a report on the resulting floods will be made by the Sacramento District within whose boundaries that area is located.

3. Description of streams. The storms which caused the floods of December 1955 covered southern Oregon, western Nevada, and central and northern California as far south as the upper reaches of the Salinas River. The affected stream basins are shown in the following tabulation, and are shown on Figure 1, which is a general map of the boundaries of the San Francisco District:

Streams North of San Francisco Draining into Pacific Ocean	Streams Draining into San Francisco Bay	Streams South of San Francisco Draining into Pacific Ocean
Smith River	Redwood Creek (Marin County)	San Gregorio Creek
Klamath River	Coyote Creek (Marin County)	Pescadero Creek
Trinity River	Corte Madera Creek	Scott Creek
Redwood Creek	San Rafael Creek	San Lorenzo River
Mad River	Novato Creek	Soquel Creek
Eel River	Petaluma Creek	Pajaro River
Mattole River	Tolay Creek	Salinas River
Noyo River		Carmel River
Big River		Big Sur River

Streams North of San Francisco Draining into Pacific Ocean	Streams Draining into San Francisco Bay	Streams South of San Francisco Draining into Pacific Ocean
Navarro River	Sonoma Creek	
Garcia River	Napa River	
Gualala River	Alhambra Creek	
Russian River	San Leandro Creek	
Walker Creek	San Lorenzo Creek	
Lagunitas Creek	Alameda Creek	
	Coyote Creek (Santa Clara County)	
	Guadalupe River	
	Campbell Creek	
	Stevens Creek	
	Redwood Creek (Santa Clara County)	
	Matadero Creek	
	San Francisquito Creek	
	San Mateo Creek	
	Colma Creek	

4. The rivers and creeks north of the San Francisco Bay area and the streams along the north coast drain the rugged, mountainous areas of the Coast Range Mountains which rise more than 8,000 feet above the level of the ocean. These streams flow, generally, in deep, narrow gorges for most of their course. Occasionally, the gorges widen to form valleys of various sizes and importance. Near the mouth, the rivers generally emerge from the mountain regions to meander across relatively flat and wide valleys or debris cones where most of the settlements and economic developments have taken place. It was in these areas that the impact of the December floods was the greatest. Streams that flow into San Francisco Bay and those south of San Francisco drain more relatively flat areas and pass through larger agricultural plains and greater areas of urban development.

5. Flood characteristics. Because of the steep gradients of the areas which they drain, floods on streams in the San Francisco District are characterized by their extremely rapid rise and almost as rapid recession. The time of peaking of the major rivers is about 8 to 18 hours, depending upon the size of the basin, after the start of the initial rise. The time of peaking for the smaller streams is appreciably less. Floods are of short duration, with the streams seldom being out of their banks for more than a day or two. Snow melt is seldom a large contributing factor toward runoff, the flood peaks being the result, primarily, of intense storm rainfall. Because of the rapidity with which flood peaks

rise and fall, there is little opportunity for effecting flood-control measures while the flood is in progress. Flood warnings, issued by the U. S. Weather Bureau, have been effective in keeping the loss of life, livestock, and equipment to a minimum.

6. Existing flood control works. The only Federal flood control project in the San Francisco District north of San Francisco is a local levee project, constructed in 1955 at Blue Lake, Humboldt County, on the Mad River under authority of Section 212 of the 1950 Flood Control Act. South of San Francisco, the only Federal flood control project is the Pajaro River levee system authorized by the Flood Control Act of December 1944 and completed in January 1949. Local interests have, from time to time, undertaken limited protective measures such as bank stabilization works and levees but in most instances the works are widely scattered and have not been fully effective because of small capacity or inadequate design. Construction by the San Francisco District of a flood control and water conservation reservoir on the East Fork of Russian River at Coyote Valley near Ukiah and bank protection works along the river from the dam to the mouth has been initiated. This reservoir is expected to be completed and in operation by the fall of 1958.

DESCRIPTION OF FLOODS OF DECEMBER 1955

7. Antecedent weather conditions. The climate of California is divided into definite wet and dry seasons. The rainy season usually starts in October and continues through May. October 1955 rainfall averaged about half of the monthly normal throughout the State. November rainfall was about average over most of central and northern California, except that in the north coastal areas and the northern portion of the San Francisco District precipitation was about one and one-half the monthly normal and snowfall had occurred in the mountainous areas. During the early part of December, relatively mild storms brought rain to most of the District, resulting in minor rises in streams north of San Francisco Bay. Total precipitation from 1 July through 14 December 1955 at selected U. S. Weather Bureau stations throughout the District is shown in Table 1.

Table 1

Antecedent Rainfall at Selected Stations
1 Sept - 14 Dec 1955

	Sept	Oct	Nov	1-14 Dec	Total	Normal for Period
Crescent City	3.24	7.66	9.89	6.14	26.93	23.23
Yreka	.77	.96	3.82	2.18	7.73	5.36
Orick Prairie Creek Park	2.78	4.78	11.41	7.34	26.31	21.93

Antecedent Rainfall at Selected Stations (Continued)

	Sept	Oct	Nov	1-14 Dec	Total	Normal for Period
Eureka	1.18	2.64	5.77	3.26	12.85	10.81
Ukiah	.41	.59	4.48	4.28	9.76	9.36
Santa Rosa	.45	.51	3.28	3.36	7.60	7.70
Napa State Hospital	.58	.07	2.32	2.73	5.70	6.00
San Francisco City	.02	.03	2.38	3.49	5.92	5.29
Livermore	.01	.67	1.31	1.64	3.63	3.72
Santa Cruz	.00	.05	3.74	6.93	10.72	7.02
Monterey	.00	.08	1.96	1.72	3.76	3.55
Salinas CAA, AP	T	T	1.61	1.97	3.58	3.18
Paso Robles	.00	.00	1.36	.74	2.10	3.20

8. Storms associated with the December 1955 floods. A type of weather pattern similar to those which existed during other notable flood-producing storms in northern and central California began to develop on 13 December when a high-pressure area developed over Alaska and western Canada blocking the movement of a deep storm center which was developing off of the Oregon coast. Light rain spread over northern California on 14 and 15 December. Most important, however, was the formation of a belt of warm moist air that extended from near the Hawaiian Islands to northern California, lying between the intense storm center to the north and a weak high-pressure system centered off the coast of lower California. By 19 December the general heavy precipitation pattern was well established. The belt of moist semi-tropical air flowing at high velocities at all levels onto the rain-inducing mountain barriers of the coastal ranges was fully developed. Maximum wind velocities aloft at times exceeded 80 miles per hour and these velocities extended to much lower elevations than is normal. Waves forming in the band of moist air, due to the conflict of surges of cold air out of the main storm center with the warm air, resulted in variations in the day-to-day rainfall intensity during the ensuing five days. Early on 23 December the last of these storms and the most intense in the series moved over the northern part of the State, causing very high winds. Subsequently, colder air began spreading over the northern part of the State, the heavy precipitation pattern was broken, and except for the passage of a cold-type storm on 26 and 27 December, the flood-producing rainfall was over. During the period between 19 and 23 December, wind velocities and, therefore, the volume of precipitable moisture, were exceptionally high at all levels. Freezing levels during the storms were much higher than normal, resulting in rainfall over mountainous areas where snow would normally have occurred.

9. New records for December monthly rainfall for central and northern California were established by these storms. The north coast drainage had over two and one-half times the normal rainfall, and the central coast drainage had over three times the normal. Most of the stations in the District recorded rain every day from 15 through 28 December. However, as can be seen on the representative mass curves on Figure 2, the day-to-day rainfall during the period varied as the areas affected by the series of the storms shifted from north to south. The first of two intense rainfall periods, on 18 and 19 December, centered in the Eel and Russian River basins with relatively light rainfall south of San Lorenzo River. The second intense rainfall period affected the streams north of San Francisco on 21 and 22 December and those streams south of San Francisco on 22 and 23 December as the flow of moist air shifted to the south. Rainfall subsequent to 23 December was due to the passage of a cold-type storm which produced less intense rainfall than the previous storms and thus did not add to the flood peaks but tended to sustain flows above critical stages. Daily rainfall amounts at representative stations in various basins during the storms are shown on Table 2, and a simplified isohyetal map of rainfall for the period 15 - 28 December is shown on Figure 3. The isohyets reflect the pronounced orographic character of the precipitation throughout the District with maximum amounts occurring on the windward mountain barriers and minimum amounts in the shadows of these barriers. Recorded maximum amounts for the period approached or exceeded forty inches in the Eel, Russian, and San Lorenzo River watersheds. Twenty-four hour maxima in excess of twelve inches were recorded at several stations.

Table 2

Rainfall at Selected Stations, Storms of 15-28 December 1955

	Super-vision	Time observed	Dec. 15	Dec. 16	Dec. 17	Dec. 18	Dec. 19	Dec. 20	Dec. 21	Dec. 22	Dec. 23	Dec. 24	Dec. 25	Dec. 26	Dec. 27	Dec. 28	Total
SMITH RIVER BASIN																	
Crescent City 7 ENE	USWB	8A	-	1.06	.36	1.69	2.68	.53	1.82	4.21	1.29	.37	.50	4.65	.82	.17	20.15
Gasquet Prairie Creek Lodge	Private	12N	.40	1.90	.10	5.00	2.10	3.40	6.45	3.65	1.60	.10	3.55	2.70	.85	.00	31.80
KLAMATH RIVER BASIN																	
Klamath	USWB	Midnight	.37	.60	1.75	1.68	.73	.98	2.74	1.60	.60	.01	1.54	1.35	.62	.00	14.57
Somesbar 1 W	USWB	8A	.00	.86	.19	2.05	.83	1.73	1.40	7.33	1.29	.14	.00	.20	1.65	.26	17.93
Yreka	USWB	8A	.00	.23	.13	.79	.29	.75	.76	3.75	.80	.02	.00	.16	.06	.00	7.74
Weaverville RS	USWB	8A	.00	.52	.37	2.18	2.11	.98	.80	3.80	1.25	T	.25	.38	.22	.02	12.88
REDWOOD CREEK BASIN																	
Orick Prairie Creek Park	USWB	5P	.25	.71	.41	2.36	1.39	.36	1.82	1.63	1.65	.28	.81	1.86	.88	.00	14.41
Orleans	USWB	6P	.39	.38	.88	1.52	1.95	.96	3.05	3.50	.99	.03	.08	.91	.77	.03	15.44
MAD RIVER BASIN																	
Mad River RS	USWB	8A	.03	1.01	1.69	2.51	3.11	1.78	3.51	4.04	2.22	.43	1.49	.62	.00	.00	22.44
Blue Lake Preston Ranch	Private	9P	.19	.91	2.10	.72	1.28	.78	4.95	5.57	1.20	.05	.25	1.50	.98	.00	20.48
EEL RIVER BASIN																	
Eureka WB City	USWB	6A	.00	.07	.17	1.68	.71	.92	.39	.99	1.49	.25	.01	.55	.73	.39	8.35
Scotia	USWB	8A	.00	.45	.38	2.10	3.04	1.30	1.80	5.39	1.43	.07	1.40	1.90	.34	.12	19.72
Ettersburg	Private	10A	.23	1.50	4.09	6.54	3.32	3.31	11.55	2.95	.20	1.30	2.35	.66	.17	.00	38.17
Covelo	USWB	Sunset	.25	.55	.92	1.36	2.63	.31	2.05	3.82	1.46	.00	.44	.55	.51	.00	14.85
Branscomb	Private	6P	.51	1.18	2.10	3.66	4.44	1.03	5.11	8.95	2.52	.06	1.32	1.45	.62	.04	32.99
RUSSIAN RIVER BASIN																	
Potter Valley PH	USWB	3P	.24	.57	.78	1.74	3.73	.52	1.50	5.84	1.80	.00	1.07	.68	.40	.01	18.88
Ukiah	USWB	4P	.25	.15	.38	1.87	3.85	.50	1.71	3.98	1.57	T	.80	.60	.33	.00	15.99
Hopland Largo Sta.	USWB	8A	.00	.35	.23	.46	4.93	1.96	.49	4.34	1.49	.04	.40	.97	.43	.23	16.32
Cazadero	USWB	5P	.45	*	3.52	.00	3.30	7.95	1.10	4.55	10.75	3.53	.15	.66	3.04	.06	39.06
Cobb	Private	8A	.00	.40	.35	1.11	12.31	8.64	2.47	8.52	4.60	.70	.40	2.13	1.39	.03	43.05

Table 2
(Continued)

Rainfall at Selected Stations, Storms of 15-28 December 1955

	Super-vision	Time observed	Dec. 15	Dec. 16	Dec. 17	Dec. 18	Dec. 19	Dec. 20	Dec. 21	Dec. 22	Dec. 23	Dec. 24	Dec. 25	Dec. 26	Dec. 27	Dec. 28	Total
NAPA RIVER BASIN																	
Saint Helena	USWB	6P	.15	.36	.33	1.93	5.76	.79	1.09	4.94	3.05	.02	.00	2.42	.13	.00	20.97
Napa State Hospital	USWB	8A	.00	.23	.38	.05	2.85	2.15	.19	3.45	1.65	1.07	.00	.86	.22	.00	13.10
SAN FRANCISCO BAY STREAMS																	
Kentfield	USWB	6:30P	.18	.39	.11	.85	5.75	.65	1.62	7.41	6.20	.02	.00	1.84	.11	.00	25.13
San Francisco City	USWB	Midnight	.11	.13	.04	.51	.87	.06	1.12	2.26	.83	.01	.04	1.10	.23	.00	7.31
Los Gatos	USWB	5P	.00	.00	.00	.87	6.22	1.89	.29	1.90	8.48	.52	.00	2.68	.07	.00	22.92
Hayward High School	Private	8A	.00	.12	.17	.03	1.13	.90	.12	1.22	2.90	.96	.00	.86	.84	.14	9.39
Livermore	USWB	8A	T	.03	.03	.01	.55	.68	.03	.75	3.26	1.93	.10	.72	.14	.08	8.31
SAN LORENZO RIVER BASIN																	
Santa Cruz	USWB	5P	.02	.04	.10	.00	1.50	.50	.95	3.57	4.39	.00	.00	1.68	.05	.00	12.80
Los Gatos 5 W (Lake McKenzie)	Private	8A	.00	.06	.00	.43	10.87	5.50	1.11	4.30	12.01	5.25	.00	3.16	.50	.10	43.29
PAJARO RIVER BASIN																	
Watsonville - Water Works	USWB	8A	.00	.02	.01	.01	1.13	1.09	.43	1.23	2.95	2.06	.00	.38	.28	.07	9.66
Corralitos 4 W	Private	8A	.00	.04	.00	.18	3.04	3.03	.54	3.80	7.80	2.95	.00	1.00	.35	.12	22.85
Hollister	USWB	6P	.00	.00	.00	.00	.28	.15	T	1.93	3.75	1.01	.00	.34	.02	.00	7.48
SALINAS RIVER BASIN																	
Salinas CAA AP	USWB	Midnight	T	T	T	.04	.44	.01	.03	1.19	2.34	.45	.02	.50	T	.00	5.02
Arroyo Seco	USWB	Midnight	.00	.00	.00	.22	1.45	.94	.00	4.16	4.40	.72	.15	1.02	.03	.00	13.09
Paso Robles	USWB	5P	.00	.00	.00	.00	.03	.63	.00	.15	2.67	2.21	.26	.40	.07	.05	6.47
Bryson	USWB	Midnight	.00	.00	.00	.21	.82	.94	.00	2.01	5.56	1.57	.30	1.44	.02	.00	12.87
BIG SUR-CARMEL RIVER BASIN																	
Big Sur State Park	USWB	8A	.00	.00	.00	.08	.39	3.30	.81	3.88	7.50	1.38	.00	1.43	.56	T	19.33
Los Padres Dam	Private	8A	.00	.00	.00	.00	1.10	1.47	.15	.51	5.39	2.98	.00	1.10	.34	.00	13.04

Notes: *Amount included in following measurement.
T - Trace

10. Comparison with other storms. Because of the number of factors which enter into the flood-producing potential, a direct comparison of storms is difficult. The period of rainfall which directly produced the great flood peaks of 22-24 December began on 21 December over the northern portion of the District and on 22 December over the southern portion and lasted from forty-eight to seventy-two hours. It is probable that the total rainfall amounts for this period have been approached or equaled during the time that rainfall records have been collected, at least in portions of the District. However, the antecedent rainfall prior to 15 December and the rainfall from the storms between 15 and 22 December saturated the watersheds so that conditions were extremely favorable for flood runoff. The smaller floods on rivers in the northern portion of the District which peaked on 19 and 20 December were still on the recession when the peaks due to the later rainfall occurred, thereby adding to the magnitude of the major peak discharges. This combination of favorable flood factors produced the record or near record discharges on larger drainage basins. Floods in the smaller basins were not as severe as might have been had the rainfall intensities been more critical. In general, this series of storms must be considered as one of the most severe that has occurred in recent times, and probably approached the flood-producing potential of the legendary storms of January 1862.

11. Flood magnitudes. As indicated in the previous paragraph, the storms of December resulted in record or near record discharges at gaging stations on most streams in the District. Peak discharges on the larger basins in the northern portion of the District probably were the greatest since 1862, and peak discharges on other streams equaled or approached historical maximums. The only stream in the San Francisco District (other than streams which were controlled or partially controlled by conservation reservoirs) which did not cause major damage was the Salinas River, where only minor damage was experienced in the flood plain areas. A compilation of flood peak discharges available at this time and comparison with previous gaged maximums are shown on Table 3. Selected representative hydrographs are shown on Figure 4. These preliminary data were furnished by the U. S. Geological Survey and are subject to revision.

Table 3

Peak Discharges at Selected Stream-gaging Stations
in Floods of December 1955 and Previous Record Floods

Location	Drainage area (sq. miles)	Peak discharge in c.f.s.			
		1955 Flood		Previous flood of record	
		Amount	Date	Amount	Date
Smith River Basin					
Smith River near Crescent City	613	165,000	22 Dec.	152,000	29 Oct. 1950
Klamath River Basin					
Klamath River near Klamath	12,100	425,000	22 Dec.	297,000	18 Jan. 1953
Klamath River at Somesbar	8,480	202,000	22 Dec.	137,000	18 Jan. 1953
Scott River near Fort Jones	662	38,500	22 Dec.	16,000	19 Jan. 1953
Redwood Creek Basin					
Redwood Creek at Orick	278	50,000	22 Dec.	50,000	18 Jan. 1953
Redwood Creek near Blue Lake	67.5	12,000	21 Dec.	8,310	23 Nov. 1953
Mad River Basin					
Mad River near Arcata	485	77,800	22 Dec.	75,000	17 Jan. 1953
Eel River Basin					
Van Duzen River near Bridgeville	214	43,500	22 Dec.	25,200	16 Jan. 1954
Eel River near Scotia	3,070	541,000	22 Dec.	345,000	11 Dec. 1937
South Fork Eel River near Miranda	547	173,000	22 Dec.	73,200	27 Dec. 1945
South Fork Eel River near Branscomb	43.8	20,100	22 Dec.	7,120	21 Jan. 1951
Eel River below Dos Rios	1,481	295,000	22 Dec.	96,400	9 Jan. 1953
Mattole River Basin					
Mattole River near Petrolia	240	90,400	21 Dec.	48,000	25 Jan. 1912
Russian River Basin					
Russian River near Guerneville	1,342	90,100	23 Dec.	88,400	28 Feb. 1940
Russian River near Healdsburg	791	70,000	22 Dec.	67,000	28 Feb. 1940
Russian River near Cloverdale	502	47,000	22 Dec.	33,300	17 Jan. 1954
Russian River near Hopland	362	48,000	22 Dec.	34,100	28 Feb. 1940
East Fork Russian River near Calpella	94.0	13,300	21 Dec.	11,300	21 Jan. 1951
Dry Creek near Cloverdale	88.3	17,600	22 Dec.	21,900	21 Jan. 1943

Table 3
(Continued)

Peak Discharges at Selected Stream-Gaging Stations
in Floods of December 1955 and Previous Record Floods

Location	Drainage area (sq. miles)	Peak discharge in c.f.s.			
		1955 Flood		Previous flood of record	
		Amount	Date	Amount	Date
Corte Madera Creek Basin					
Corte Madera Creek at Ross	18.3	3,650	22 Dec.	3,300	3 Dec. 1951
Napa River Basin					
Dry Creek near Napa	17.4	2,640	19 Dec.	2,380	6 Dec. 1952
Napa River near St. Helena	81.3	12,600	22 Dec.	11,800	6 Feb. 1942
San Lorenzo Creek Basin					
San Lorenzo Creek at Hayward	38.0	4,790	23 Dec.	3,440	27 Feb. 1940
Alameda Creek Basin					
Alameda Creek near Niles	633	21,000	23 Dec.	18,500	12 Jan. 1952
Guadalupe River Basin					
Guadalupe River at San Jose	131	5,740	23 Dec.	8,680	27 Feb. 1940
Alamitos Creek near Edenvale	350	4,140	23 Dec.	2,670	27 Feb. 1931
San Francisquito Creek Basin					
San Francisquito Creek at Stanford University	35.7	5,560	22 Dec.	3,650	18 Nov. 1950
San Lorenzo River Basin					
Branciforte Creek at Santa Cruz	18.5	8,100	22 Dec.	3,910	9 Feb. 1941
San Lorenzo River at Big Trees	110	30,400	23 Dec.	24,000	7 Dec. 1952
Soquel Creek Basin					
Soquel Creek at Soquel	40.4	15,800	23 Dec.	4,910	12,14 Jan. 52
Pajaro River Basin					
Pajaro River near Chittenden	1,188	24,000	24 Dec.	11,100	4 or 5 Apr. '41
San Benito River near Hollister	586	7,460	24 Dec.	5,490	15 Mar. 1941
Uvas Creek near Morgan Hill	30.2	10,300	23 Dec.	8,630	11 Dec 1937
Salinas River Basin					
Salinas River near Spreckels	4,231	22,000	25 Dec.	75,000	12 Feb. 1938
Nacimiento River near San Miguel	354	58,600	23 Dec.	53,100	15 Jan. 1952

Note: These data obtained from U. S. Geological Survey are preliminary and subject to revision.

12. Local conditions created by the floods. The northern California floods of December 1955, with the attendant discharges of record magnitudes, caused widespread destruction and damage to cities, communities, agricultural lands, military posts, State Parks, National Forests, Federal, State, and county property, industrial areas, highways, roads, bridges, railroads, public utilities, and transportation companies. A total of 19 persons lost their lives during the floods on streams in the San Francisco District. The total area flooded in the San Francisco District was approximately 156,200 acres of residential and agricultural lands. The resultant damages on most of the affected streams far exceeded those of any previously known flood. The communities of Klamath, Klamath Glen, Orick, Pepperwood, Weott, Myers Flat, Shively, Healdsburg, Cloverdale, Guerneville, urban areas around the Bay Area, Santa Cruz, Ben Lomond, and Soquel were hardest hit by floods on the various streams. Typical damages to urban and small communities are shown on Plates I and II. The destruction of homes, buildings, sawmills and other commercial establishments reached catastrophic proportions in some areas, particularly along the Klamath, Eel, and San Lorenzo Rivers. Evacuation of persons by military personnel, public agencies, and private persons from the flooded areas was carried on in an orderly manner. Evacuees were taken care of by the American Red Cross and Salvation Army, and private persons opened their homes to these people, many of whom had lost their entire possessions and homes. Typical rescue operations are shown on Plate III. Water supplies became contaminated, and health warnings were issued regarding proper precautions in the treatment of water for consumption. Sanitary disposal systems were rendered inoperative and precautions were taken by county health officers and sanitarians to prevent epidemics.

13. In the North Coastal Area the Smith, Klamath, Mad, and Eel Rivers reached the highest stages of record, and peak discharge maximums were exceeded. The greatest flows of record were observed in some areas on the Russian River. Most of the small streams in the San Francisco Bay Area overflowed their banks and caused floods in suburban areas, agricultural lands, and transportation routes. Record rainfall on the western slope of the coastal mountains in Santa Cruz County produced record flows in the San Lorenzo and Pajaro Rivers and in Soquel Creek. Damage to highways, county roads, and city streets reached record proportions. Highway U.S. 101 traverses or parallels most of the streams in Northern California that were flooded and sustained major damage from washouts, slips, and bridge failure at many points. Typical of major bridge losses were those at Martins Ferry over the Klamath River; the Trinity River bridge at Douglas City; the Hoopa Bridge over Willow Creek, a tributary of Trinity River; the bridge over the Russian River at Calpella; and two bridges over Dry Creek, a tributary of Russian River. Numerous State and county bridges were closed due to washout of bridge approaches. Highway U.S. 101, the main arterial north of San Francisco, was closed to traffic for a period of 10 days except for intermittent openings of certain reaches. About 30 December it was opened to convoys of light emergency vehicles, subject to numerous delays, and on 5 January it was opened to truck and bus traffic, still subject to delay.

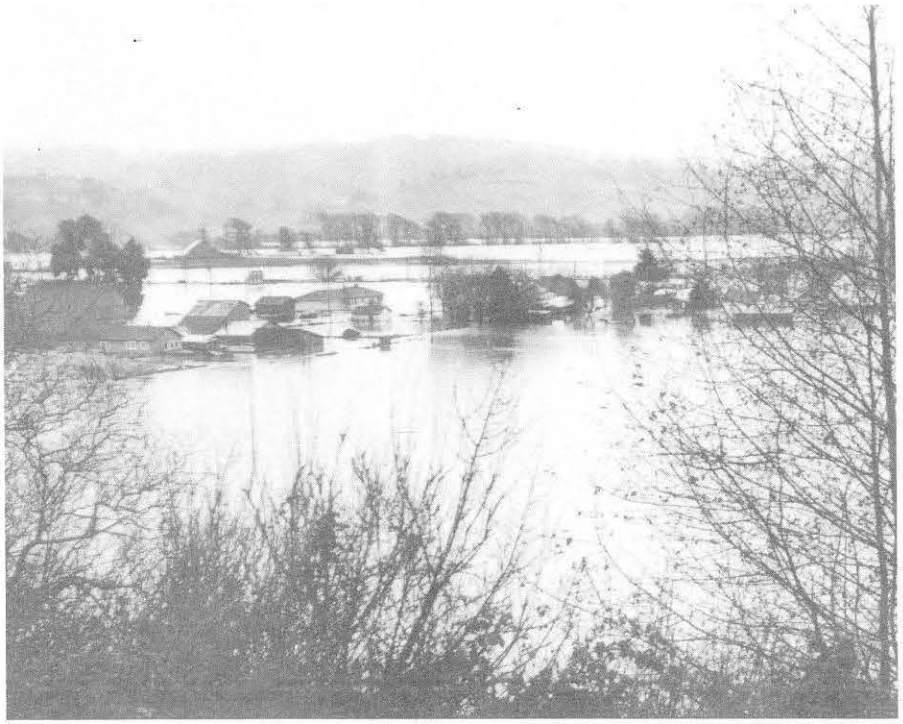
San Lorenzo River, City of Santa Cruz. Inundation and Destruction of Property on Left Bank of River near Branciforte Creek.

San Tomas Aquinas Creek, Santa Clara County. Inundation of Greenville Subdivision near Sunnyvale.

Green Vale Manor

TYPICAL URBAN DAMAGE

PLATE I



Eel River near Alton. Inundation of Small Community near Junction of Van Duzen River.

Eel River. Town of Pepperwood, One Week after Flood of 22 December 1955, Showing Heavy Deposit of Silt and Mud Extensive Building Damage

TYPICAL SMALL COMMUNITY DAMAGE

PLATE II

Eel River near Fortuna. California National Guard and Local Rescue Teams

Eel River near Alton. Evacuation of Local Residents by boat.

RESCUE OPERATIONS

PLATE III

Most county roads in the flood plains of the various basins were closed to traffic due to inundation which hampered evacuation of people and caused delays in emergency and rehabilitation efforts by Federal, State, and county agencies. Typical bridge damage is illustrated on Plate IV, and road closures are shown on Figure 5.

14. Damage to commercial establishments such as sawmills, wood products manufacturers, and food and dairy processing plants reached record proportions. Because of the unprecedented discharges and velocities of the various streams, in some cases whole communities were partially destroyed, particularly in the narrow river gorges of the Eel, Klamath, and San Lorenzo River basins. Typical damage to sawmills is shown on Plates V and VI.

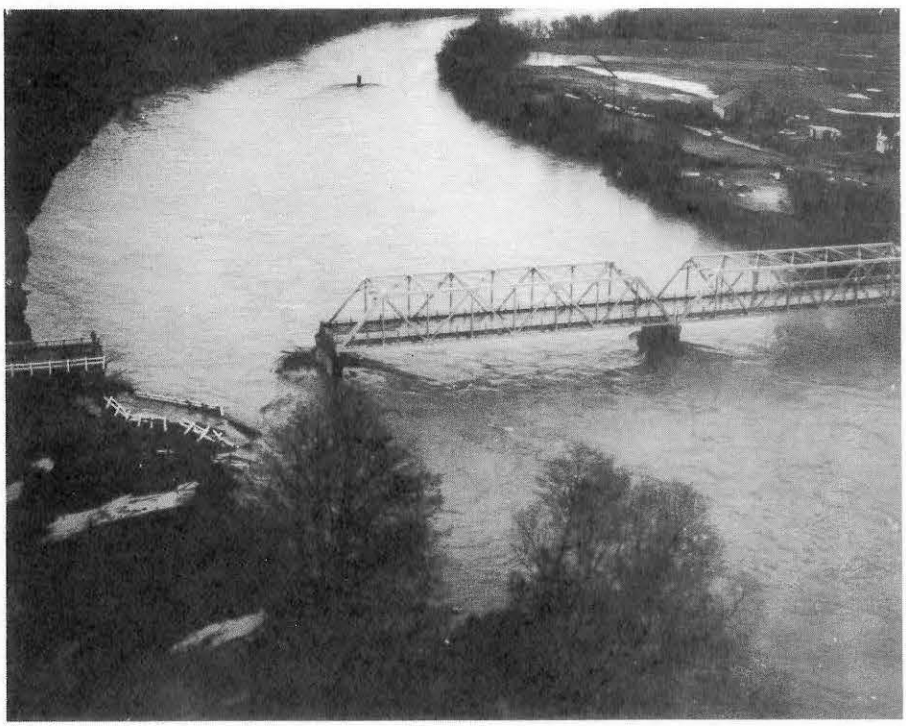
15. Telephone, telegraph, and teletype circuits were interrupted throughout most of the area. During and immediately following the flood, their only means of communication and dissemination of information was by radio. The circuits were partially restored by the end of December, but were so limited in capacity that only vital emergency messages could be put through, often with considerable delay.

16. Reports from public utility, transportation, and other public-service operators indicate that this flood and storm caused more damage to their facilities than any previous recorded storm.

17. The principal damages to agriculture were loss of land due to bank cutting and river meandering, deposition of sand and gravel over cultivated areas, topsoil erosion, and deposition of debris from trees, houses, and barns on cultivated lands. Local protection works such as levees and bank stabilization works were partially destroyed or failed completely. Over 2,500 animals, including approximately 1,300 cattle, and 1,200 head of sheep were drowned in the delta area of the Eel Basin. Damage to farm buildings, farm equipment, fences, and farm machinery was extensive. Because of the frequency at which minor flooding occurs in the delta regions, farmers have learned to cope with minor flooding by moving equipment and farm animals to raised barns for safety. Due to the magnitude of the December floods, however, these precautionary measures were inadequate as the barns and buildings were washed away with resulting loss of equipment and animals. Typical agricultural damage and animal loss are shown on Plates VII and VIII.

18. The Northwestern Pacific Railroad suffered numerous slides, washouts, and roadbed inundation damage from Healdsburg north to Eureka. Traffic was interrupted from the early stages of the flood until 6 February 1956 when operations were carried on during the daylight hours only. Full operation, except for passenger service, was restored on 15 March. This railroad is the principal means of transporting lumber products out of the area, and in addition to the physical damages, considerable indirect damage, both to the railroad and to the industries it serves, was caused by the inability of the railroad to operate. Typical railroad damage is shown on Plate IX.

North end of Douglas Memorial Bridge on U.S. Highway 101, Klamath River at Klamath



North end of U.S. Highway 101 Bridge over Mad River at Arcata.

TYPICAL BRIDGE DAMAGE

PLATE IV

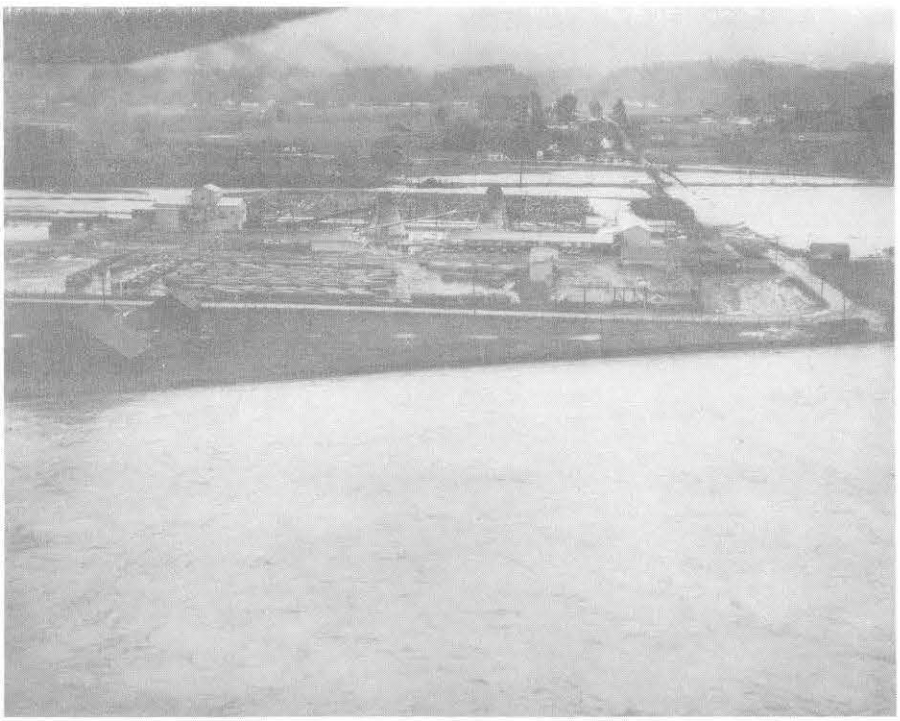
Klamath River at Klamath. Inundation and Destruction of Property of Lumber Mill on Right Bank.

Klamath River at Klamath. Inundation and Loss of Logs and Lumber at Mill on Left Bank.

TYPICAL INDUSTRIAL DAMAGE
Both photos, Klamath River at Klamath.

PLATE V

Eel River at Scotia. Inundation of Large Redwood Products Mill.



Eel River at Sandy Prairie near Fortuna. Inundation of Lumber Mill and Bank Cutting of Nearby Properties.

TYPICAL INDUSTRIAL DAMAGE

PLATE VI

Eel River near Mouth. Inundation and Debris Damage.

Eel River near Mouth. Closeup, Inundation of Farm Buildings.

TYPICAL AGRICULTURAL DAMAGE
Both photos Eel River near mouth.

PLATE VII

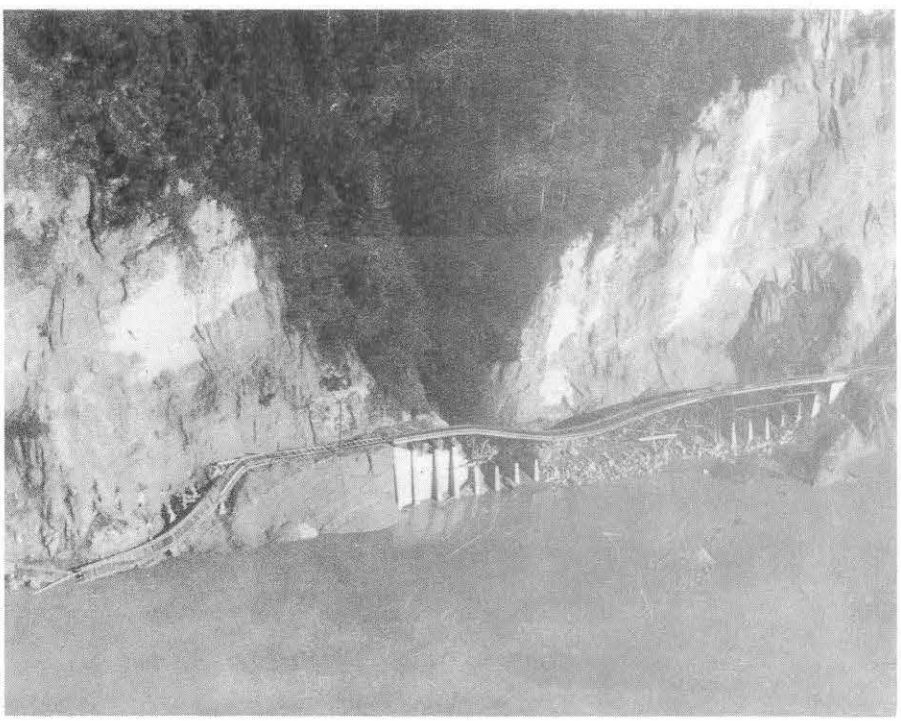
Eel River near Mouth. Building, Debris, and Sheet Erosion Damage

Eel River near Mouth. Losses to Dairy Herds

TYPICAL AGRICULTURAL DAMAGE

PLATE VIII

Sonoma Creek near Wingo, Sonoma County, showing inundation of track and right of way.



Eel River near Scotia. Wreckage of trestle on Scotia Bluffs. At Peak, water had been four feet over tracks.

TYPICAL RAILROAD DAMAGE

19. Damage to National Forests, and State and county parks exceeded those of any previous floods. Campsites, recreational facilities, administration buildings, and roads and bridges were damaged to such an extent that it is believed some of these recreational areas will not be open to the public this summer season. Many huge, irreplaceable redwood trees were washed away.

20. Hunter Liggett Military Reservation suffered considerable damage to roads, bridges, and training facilities, and at Hamilton Air Force Base, airplanes had to be evacuated to high ground because of flooded runways.

21. Loss of life. To ascertain the official death toll due to the December floods, the coroners offices of each of the counties in the San Francisco District were contacted. This check revealed that 19 persons lost their lives as a result of the floods. The following tabulation shows the deaths by county:

County	Lives lost
Del Norte	2
Humboldt	7
Sonoma	1
Marin	1
Santa Cruz	7
San Benito	1
Total	19

22. Activities of the Corps of Engineers. The first evidence that floods in the watershed areas along the north coast of California might develop came with the quantitative forecast on 17 December of moderate rains to occur on 18 December from the Bay Area, north. Quantitative forecasts on Sunday, 18 December 1955, were for increased rainfall over central and northern California. The Hydrology Section of the District office, after consultation with Chief, Flood Control Section, declared an "alert" in the afternoon of 18 December. The Eureka office of the U.S. Weather Bureau issued a livestock evacuation flood warning for the Eel River Delta. Late in the evening of 18 December, volunteer observers reported that several streams within the district had reached stages of bankfull or above. The quantitative forecast on the morning of 19 December called for additional heavy rains throughout central and northern California through 19 December. As a result, engineering personnel were dispatched to observe conditions on the streams north of San Francisco. The Eureka Weather Bureau Office forecast minor flooding to occur late on 19 December or early on 20 December on the Smith, Mad, Klamath, and Eel Rivers. The San Francisco Airport Weather Bureau Station issued a flood warning of between 36 and 40 feet on the Russian River at Guerneville on 20 December. The stage at which appreciable damage occurs at

Guerneville is 35.2 feet. Peaks from this storm occurred 20 December, and streams started to recede the same day. The quantitative forecast of 20 December called for light to moderate rain for 20 and 21 December. During this period, volunteer and engineering observers were reporting conditions from the field. The quantitative forecast by the U.S. Weather Bureau on 21 December forecast heavy rain through 21 and 22 December. A continuing state of "alert" for district personnel had existed since 18 December. On 22 December, additional heavy rains and storm warnings were forecast by the U.S. Weather Bureau through 23 December. Flood advisories were issued by the Eureka and San Francisco Weather Bureau offices for most of the streams in the San Francisco District. Rainfall equaling or exceeding forecasted amounts occurred throughout the District, and the small streams started to peak above flood stage on the morning of 22 December. Due to these conditions, the District Engineer ordered complete mobilization of District personnel and facilities for flood fighting and rescue operations at 0815 hours on 22 December. By late afternoon of 23 December, flood stages had developed in streams as far south as Watsonville on the Pajaro River and Corralitos Creek.

23. District forces functioned primarily through five regional (field) offices established at Crescent City, Eureka, Santa Rosa, San Francisco, and Santa Cruz, California. Flood fighting operations under Public Law 99, enacted by the 84th Congress, 28 June 1955, were conducted mainly in the Santa Cruz Area on the San Lorenzo and Pajaro Rivers and Corralitos Creek, where District personnel assisted and advised local people on measures to be taken in strengthening and patrolling levees. Similar operations had been under way in the Crescent City and Eureka areas as early as 21 December 1955. Rescue operations were also conducted at Geyserville on the Russian River on 22 and 23 December, in cooperation with local authorities and other Federal agencies, including the 30th Engineers (Sixth Army), U.S. Coast Guard, and U.S. Air Force. Rescue operations were conducted elsewhere in the District primarily by Civil Defense and local authorities under Civil Defense Disaster Plans. Assistance and equipment were furnished by the Sixth Army, U.S. Coast Guard, Marines, and Air Force at the request of Federal Civil Defense authorities. Contract work on flood fighting was initiated at Alviso, California, on 28 December in conjunction with local authorities to close levee breaks on Guadalupe River.

24. On 12 and 13 January 1956 additional storms deluged the coastal watersheds, and on 13 January, District forces were again alerted for flood fighting. Observers were dispatched from the field offices to points of possible flood danger. Contract flood fighting on the Russian River in the vicinity of Cloverdale, California, was initiated on 13 January to repair gaps in levees damaged during the December flood to prevent recurrence and extension of December damages to agricultural and residential properties in the Cloverdale Flood Control District. Coastal streams peaked on 15 January at lower stages than during the 22 - 24 December storms, and the flood alert was discontinued. The greater amount of damages from this storm were concentrated in Marin County streams.

25. On 19 and 21 February, flooding occurred on the Russian River which crested at about 40 feet at Guerneville on 23 February. The December crest at this station was 47.6 feet and the January crest was 35.5 feet. Low-lying areas were evacuated by local agencies in February. Additional damages along the major streams were negligible due to the short interval between this flood and the record floods in December.

26. Repair and restoration. Repair and restoration operations under Public Laws 875 and 99 were initiated immediately following subsidence of flood stages in all areas of the San Francisco District. Public Law 875 authorizes Federal assistance to States and local governments to accomplish channel clearing, debris removal, and other emergency channel work on unimproved streams. Work under this law, which is conducted at the request of the Federal Civil Defense Administration, was initiated following the Presidential major-disaster declaration of 23 December 1955. The Presidential proclamation was amended 27 February 1956 to include areas damaged by later floods. To date, the Federal Civil Defense Administration has approved 100 projects in the San Francisco District having an estimated cost of $1,600,000. Public Law 99 authorized Federal aid for flood fighting, flood emergency preparation, rescue operations, and repair and restoration of damaged flood control works. Under this law, 40 projects with an estimated cost of $1,500,000 are being accomplished in the San Francisco District. Under Section 14 of the Flood Control Act of 1946, which authorizes Federal construction of emergency bank protection works to prevent flood damage to highways, bridge approaches, and public works, provided not more than $50,000 shall be allotted for this purpose at any single locality for any one fiscal year, 4 projects with an estimated total cost of $120,000 have been authorized. Plate X illustrates a typical debris-, gravel-, and silt-filled channel which required emergency restoration under Public Law 875. On 6 January 1956 the District office ended 24-hour duty, and field offices were put on regular 8-hour duty. The individual field offices were demobilized thereafter as quickly as their functions could be advantageously assumed by the District office. Only the Eureka field office is in operation at this time.

DAMAGE SURVEYS

27. When the magnitude of the floods in the various basins of the San Francisco District became apparent, estimates of additional personnel required to staff the five regional offices were made. Because of the vast area to be covered and the imperative need for immediate rehabilitation, requests for temporary services of additional personnel were made by teletype to the various Districts throughout the Corps of Engineers. Of the seventy-five persons responding to the request, nineteen were assigned to the field, together with District personnel, to evaluate damages in the various disaster areas. Immediately after flood stages had receded, these flood damage evaluators also assisted the regional

Soquel Creek at Soquel. Large Debris Jam Which Caused Failure of Bridge.

Little Creek, Santa Cruz County. Heavy Debris Deposits on Highway.

TYPICAL DEBRIS DAMAGE

PLATE X

offices on inspections and processing of requests for emergency aid in the rehabilitation work under Public Laws 875 and 99. Eight temporary-duty employees were assigned to a unit comprised of four San Francisco District employees and five South Pacific Division employees established to prepare a special hydrologic study of the 15 - 28 December 1955 storm. The object of the study was the collection of basic hydrologic data and preparation of isohyetal maps covering the northern and central portions of California, the western portion of Nevada, and the extreme southern part of Oregon. The study titled "Part I, Storm Study, Storms of December 1955, Central and Northern California and Western Nevada," was completed and submitted on 17 April 1956. The remaining 48 temporary-duty employees were assigned to the various sections in the District office or the Regional offices for flood emergency work.

28. Following the initial survey and preliminary appraisal of flood damages, a program was prepared and put into operation for making a detailed comprehensive survey of flood damages on the rivers and streams in the San Francisco District. By this time, many of the highways and secondary roads were open to traffic so that previously isolated areas could be reached by car. The assistance of local newspapers and radio facilities was solicited for aid in the collection of data. A convass was made of private rainfall records in the area to supplement the information collected at the limited number of U. S. Weather Bureau Stations. The results of this canvass are tabulated in Table 2.

29. Complete coverage was given to urban areas where damages were unusually severe, such as at Klamath, Klamath Glen, Orick, Guerneville, and the city of Santa Cruz. Commercial and urban damages are based on estimates prepared by the industry, agency, or individual concerned, which were reviewed by Corps of Engineers' personnel to eliminate storm damage, to differentiate between direct and indirect damage, and to allocate by drainage area where this was not already determined. State and county agencies were contacted relative to direct damages to highway, county roads, and city streets, and to indirect damages resulting from traffic delays and rerouting. The indirect damage to highway traffic cannot be ascertained with a great degree of accuracy at this time because many roadblocks have not yet been cleared, rerouting of highway traffic and loss of revenue to truck and bus operators is continuing. To allocate indirect damage to the several basins along Highway U. S. 101, which parallels or traverses most of the flooded areas north of San Francisco, will entail a complicated study of highway counts, traffic costs, and revenues lost to business establishments along the route. For the purpose of this report these damages have been conservatively estimated at $350,000. Officials of public utility companies were interviewed for evaluation of losses to communications, power and related items. The losses from labor opportunity and tax losses were computed insofar as available from State and county officials.

30. Agricultural damages are based on a reconnaissance of the area to determine overflow limits, distribution of crops in various river basins as reported by agricultural advisors, and estimates of per-acre

damage to specific crops. Orchard damages are based on County Agricultural Advisors' estimates of tree losses that can be determined at this time. Total damage to orchards and crops cannot be ascertained fully until lost yield and further loss of trees from sour sap and other causes become apparent during harvest in the fall of this year or possibly next year. Bank-erosion damage was obtained on a sample coverage basis along with other agricultural losses. The true loss, however, will not be available until a detailed comparison is made of recent and previous aerial photographs. Other losses include the deposition of sand and gravel over cultivated areas, topsoil erosion (which the U. S. Soil Conservation Service estimates to have been 10,883,000 tons in the San Francisco District basins), and huge deposits of debris over cultivated areas from river overflow.

31. Estimate of damages. The total evaluated damages resulting from the December 1955 floods, as obtained from the surveys described above, amount to $67,970,000. A description of each basin and of the damage sustained is given in the paragraphs which follow. The basins have been grouped into 4 areas. Area 1 is comprised of all streams north of San Francisco Bay draining into the Pacific Ocean. Damages for this area are summarized in Table 73. Area 2 includes all streams draining into San Francisco Bay from the counties of Marin, Sonoma, Napa, Contra Costa, and Alameda, with the exception of the Alameda Creek Basin. These damages are summarized in Table 74. Area 3 includes all streams draining into San Francisco Bay from the counties of San Mateo, Santa Clara, and that portion of Alameda County in the Alameda Creek Basin. These damages are summarized in Table 75. Area 4 includes all streams south of San Francisco draining into the Pacific Ocean. Damages are summarized in Table 76. The San Francisco District flood damage totals for the four areas are summarized in Table 77.

32. Numerous photographs of the damage in all basins were taken or obtained from local sources. These, together with flood plain maps, recorded high water marks, damage appraisals and hydrologic and hydraulic data compiled, will constitute a permanent record on this flood for future use in investigations and studies. Damages that are not readily available, such as some types of agricultural damage, lost revenue to rental units, loss of taxes to Federal, State, county, and city governments, loss of business to non-wetted commercial establishments, highway stoppage and relocation, and final rehabilitation costs to the various relief agencies, Federal Civil Defense Administration, and others will be gathered later and issued as a supplement to this report. The full impact of the flood cannot be evaluated at this time due to unknown factors such as loss of labor in other coastal states from lack of lumber for construction, and the loss of tourist trade as the result of adverse publicity due to the storm. The latter is a very large factor in the economy of certain areas, particulary in the extreme northern part of California and in southern Oregon.

SMITH RIVER BASIN (Area 1)

33. Basin description. The Smith River rises in southern Oregon, flows in a southwesterly direction for approximately 50 miles, and empties into the Pacific Ocean in the vicinity of the town of Smith River. With the exception of a few small mountain valleys, the river flows through rugged mountain canyons until it emerges into the delta area in the vicinity of the Highway U. S. 101 bridge over the river seven miles above the mouth. It drains a fan-shaped area of 732 square miles, of which 613 square miles lie above the U. S. Geological Survey gaging station near Crescent City. The principal tributaries of the Smith River are the South Fork, North Fork, and Patrick Creek. Dominie, Rowdy, and Morrision Creeks, smaller tributaries in the delta area, contributed extensively to the flood damage.

34. Storm rainfall and stages. The storms of December 1955 in northern California produced a peak discharge of 165,000 cubic feet per second with a stage at the Smith River Gaging Station of 41.2 feet on 22 December. The previous maximum discharge of record (25 years) was 152,000 cubic feet per second with a stage of 39.5 feet on 29 October 1950 at the same location. It is probable that the December 1955 flood approached the historical flood of December 1851. The flood runoff during the period 18 - 23 December 1955 totaled more than 550,000 acre-feet above the gaging station.

35. It is estimated that 7,600 acres of pasture and other agricultural lands in the delta area were inundated to an average depth of about three feet by the Smith River and its tributaries, Dominie, Rowdy, and Morrison Creeks. Flood waters from the Smith River overflowed into Lake Earl Slough and raised the surface of Lake Earl. Due to the flat slope of the land adjacent to Lake Earl, 3,200 acres of land bordering the lake were flooded. Agricultural damage consisted, primarily, of scouring of pasturelands and of huge deposits of silt, gravel, and debris from timbering operations. Cattle loss was held to a minimum as a result of flood warnings issued by the United States Weather Bureau Office at Eureka, California. Bank cutting occurred on the right and left banks below Highway U. S. 101.

36. State and county highways and bridges were damaged considerably by slides and washouts. Commercial, logging, and tourist travel was disrupted at many points along the Redwood Highway (U. S. 101) in the various coastal stream basins and on other highways leading into the Smith River Basin for varying periods of time, and local travel was subject to controls and detours. The North Bank Road from the Dr. Fine Bridge on Highway U. S. 101 to Hiouchi bridge on Highway U. S. 199 was closed by inundation and slides at several locations for a number of days. Slides closed the county road from Mill Creek State Park to Crescent City for several days. Highway U. S. 199 to southern Oregon

points and Grants Pass was closed for a short period due to several slides. Farm and county roads in the delta area were inundated and considerably damaged, isolating some farms for a short period.

37. Industrial damage was greatest in the vicinity of the town of Smith River where lumber mills, inundated by Rowdy and Domine Creeks and isolated by road washouts, were forced to close for several days with resulting production losses to the mill and income losses to the employees.

38. There were no lives lost and no serious health problems developed.

39. District Office personnel made a flood damage survey during late December 1955 and January 1956, interviewing State, county, and local people to evaluate losses due to the storm and flood. Agricultural damage was obtained by interviewing approximately 30 percent of the farms in the flood plain and evaluating the remaining acreage on the ratio of the sampled area to the total acreage in the flood plain. High water marks for the December 1955 flood were established and leveled in.

40. The damages resulting from the December 1955 floods, both direct and indirect, totaled $468,500 for the Smith River Basin. The breakdown for these damages is shown in Table 4.

Table 4

Summary of Damages (Floods of December 1955)
Smith River Basin

Item	Damage
Agricultural	$ 45,900
Bank erosion	3,200
Inundation:	
Residential:	
Direct	7,700
Indirect	1,000
Non-residential:	
Direct	70,000
Indirect	4,700
Roads and bridges	336,000
Total	$468,500

KLAMATH RIVER BASIN (Area 1)

41. The Klamath River rises in south central Oregon from the waters contributed by Sprague and Williamson Rivers, which flow into Klamath Lake. From Klamath Lake the waters flow, via the Link River, to Lake Ewauna near Klamath Falls, and emerge from this lake as the Klamath River. Approximately two-thirds of the total drainage area of 15,900 square miles is in northwestern California. At the gaging station, above the town of Klamath, California, the river drains an area of 12,100 square miles. With the exception of about 25 miles in the upper region of the Klamath and some agricultural areas of the Williamson and Sprague Rivers and some of the major tributary streams, the Klamath River flows through rugged canyons until it reaches the Pacific Ocean. The principal tributaries of the Klamath River are the Shasta, Scott, Salmon, and Trinity Rivers.

42. In the early afternoon of 22 December 1955, the Klamath River reached a peak discharge of 425,000 cubic feet per second at the gaging station near Klamath. During the flood-flow period 19 - 25 December, over 2,500,000 acre-feet of runoff passed the gage. The previous recorded maximum discharge occurred in January of 1953 when peak flow was 297,000 cubic feet per second. It is believed that this December flood approached in magnitude the great flood of December 1861. New record peak discharges were established at all upstream gaging stations.

43. Due to bridge and road washouts and to the fact that communications were practically non-existant, access to the interior section of the Klamath River Basin was impossible during the flood and for long periods thereafter. Continued rains and subsequent slipouts of the highway and temporary by-pass detours made the trip impracticable. The interior highway has since been stabilized, and field parties are now evaluating the damages to the interior valley points. For the purpose of this report, estimates of damage to interior points were made from information made available from the various Federal, State, and county agency estimates.

44. Major damages occurred in the lower reaches of the basin, particularly in the vicinity of the town of Klamath and in Hoopa Valley. At Klamath, about 700 acres of agricultural lands were inundated in the delta area, and the town of Klamath and the community of Klamath Glen, some three miles upstream, were almost completely destroyed. The north approach of the Douglas Memorial Bridge, on Highway U. S. 101 over the Klamath River, was washed out, cutting off access to the town of Klamath from the south. Although this approach was replaced on an emergency basis, it was later lost again and traffic flow was interrupted until about Christmas when a temporary opening for emergency light traffic only was accomplished.

45. Six persons lost their lives as a direct result of the floods on Klamath River. All occurred in the lower portions of the Klamath River below Orleans, and all of the deaths have been authenticated by the Coroners of Humboldt and Del Norte Counties.

46. In the communities of Klamath and Klamath Glen there are few remaining whole buildings. Much of the economy of this area is based upon the production of lumber and lumber products, and several mills in the vicinity were completely inundated or demolished. Loss, both to equipment and through loss of logs and finished lumber stocks, was severe. Klamath Glen is the site of a number of homes for lumber-mill workers. In addition to the lumber industry, Klamath is a popular sport-fishing area, particularly in regard to salmon and steelhead. The town catered in the past to sport fishermen and had a number of auto courts, restaurants, and sporting goods stores, as well as the usual small business establishments which provide the necessities of life for the local inhabitants.

47. Upstream from the town of Klamath there are several tiny settlements, mainly for the convenience of sport fishermen, that are normally accessible only by boat or on poor secondary roads from Hoopa Valley. The first supplies to reach this area after the floods came in by boat on 29 December 1955. Damage in Hoopa Valley was mainly to the highway system, although several lumber mills were damaged. Hoopa Valley is traversed by the Trinity River just before that stream enters Klamath River. Upstream from the confluence with Trinity River, Klamath River flows past the California communities of Orleans, Somesbar, Happy Camp, Seiad Valley, and Hornbrook to its beginning at Lake Ewauna near Klamath Falls in Oregon. The major tributaries of Salmon River, Scott River and Shasta River enter the Klamath within this reach. There was scattered damage to residential and commercial properties along the river, but the major damage was to county and State roads and bridges, and to facilities of the U. S. Forest Service. In Scott Valley, on the Scott River, approximately 6,300 acres of agricultural land were inundated.

48. High water marks were established in the vicinity of Klamath and Klamath Glen.

49. Total damages, both direct and indirect, are estimated to have been $10,462,200 for the Klamath River and its tributaries. The breakdown of these damages is given in Table 5.

Table 5

Summary of Damages (Floods of December 1955)
Klamath River Basin

Item	Klamath River	Tributaries	Total
Agricultural:			
Direct	$ 40,200	$ 318,600	$ 358,800
Indirect	4,600	--	4,600
Bank erosion	109,000	--	109,000
Inundation:			
Non-residential:			
Direct	2,942,200	88,000	3,030,200
Indirect	1,290,000	--	1,290,000
Residential:			
Direct	662,200	27,000	689,200
Indirect	176,500	--	176,500
Roads and bridges	601,300	4,202,600	4,803,900
Total	$ 5,826,000	$ 4,636,200	$ 10,462,200

REDWOOD CREEK BASIN (Area 1)

50. Basin description. Redwood Creek drains an area of about 280 square miles of the Coast Range Mountains in Humboldt County. The basin is roughly rectangular in shape, extending about 56 miles along a northwest-southeast axis, and having a maximum width of about 8 miles. With the exception of the lower 4 or 5 miles, the stream flows through a narrow, deep canyon. The principal tributary is Prairie Creek, which meets the main stream a short distance upstream from the town of Orick. The watershed lies in an area of heavy precipitation, and runoff is extremely high, probably exceeding some 30 inches annually on the average. Orick, with an estimated population of 800, is the only important population center in the basin. The lumber industry and agriculture constitute the principal activities. Following the disasterous flood of January 1953, the Corps of Engineers, under authority of Section 14 of the 1946 Flood Control Act, constructed about 2,000 feet of riprap bank protection along the left bank of Redwood Creek both above and below the Highway U. S. 101 bridge at Orick. During that flood, severe erosion of the left bank along the bend in this area had threatened portions of the town, as well as the State highway bridge approach.

This riprap has effectively stabilized the bank and prevented further erosion from subsequent floods, including those of most recent occurrence.

51. Discharge and stages. Peak discharge at the U. S. Geological Survey gaging station at Orick (drainage basin 278 square miles), was 50,000 c.f.s. The peak stage of 28.95 feet m.s.l. occurred at 3:00 A.M., 22 December 1955. The discharge and stage were identical to those recorded for the January 1953 flood. It is probable that floods of this magnitude have occurred several times since the great floods of the winter of 1861-62. Although Prairie Creek did not contribute greatly to the December 1955 flood, it has been estimated that the greater discharge of Redwood Creek in 1955 made the total discharge below the confluence the same as that of 1953. Indications are that stages in some parts of the town were 3 inches higher than in 1953, but overland velocities were less.

52. Damages. Areas along Prairie Creek which had sustained damage during the 1953 flooding were not affected in the December 1955 flood. Of the 1,800 acres of flood plain, exclusive of water areas, approximately 910 acres of agricultural lands were inundated. This represents a reduction from the 1953 flood (1,170 acres) mainly because of lack of flooding along Prairie Creek. Inundation of non-agricultural facilities was about the same as in 1953. Although a lumber mill along Prairie Creek suffered no damage in this flood, one new mill built in Orick since 1953 was included in the recent flood plain. During late December and January, subsequent rises of Redwood Creek caused concern that additional damage might result. However, additional damage was light, although inundation reoccurred in some areas.

53. Headquarters were established in Orick to combine the activities of Civil Defense, Red Cross, and law enforcement. From these headquarters, aid in the form of food, shelter, and medical attention was supplied. Pure drinking water was also provided from tank trucks.

54. Preliminary estimates, obtained by the Red Cross from local Civil Defense forces, list the following damage classifications for the Orick area:

Unit	Degree of damage - No. of Units		
	Destroyed	Major	Minor
Dwellings	0	10	90
Business	0	5	25
Farm buildings (exclusive of dwellings)	0	0	0
Other buildings	0	0	0

55. The coroner's reports indicate that there were no authenticated deaths in the basin due to floods. Red Cross records, compiled on a preliminary basis, indicate that one person suffered minor injuries but did not require hospitalization.

56. A summary of damages for Redwood Creek is given in Table 6.

Table 6

Summary of Damages (Floods of December 1955)
Redwood Creek Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 64,900	$ 2,700	$ 67,600
Non-residential	144,300	162,400	306,700
Agricultural	44,900	3,700	48,600
Total Private	$ 254,100	$ 168,800	$ 422,900
Public			
Roads and bridges	$ 130,100	$ 0	$ 130,100
Utilities	7,500	0	7,500
Other public properties	7,700	0	7,700
Emergency aid	28,900	0	28,900
Total Public	$ 174,200	$ 0	$ 174,200
Total damage	$ 428,300	$ 168,800	$ 597,100

Note: Bank-erosion damage is not included. These damages will be determined at a later date from aerial photos as they become available.

MAD RIVER BASIN (Area 1)

57. Basin description. Mad River drains an area of about 485 square miles, above the U. S. Geological Survey gaging station near Arcata. It rises in the coastal range and flows through mountain canyons and small valleys for 92 miles until it emerges into the delta area in the vicinity of Blue Lake, 10 miles from the Pacific Ocean. The lower delta and valley areas are devoted primarily to agricultural and lumbering endeavors.

58. Discharges and stages. On 22 December 1955 the peak discharge at the gaging station was 77,800 c.f.s. with a gage datum stage of

27.30 feet. These exceeded the previous maximums of 75,000 c.f.s. discharge and 26.15 feet peak stage in January 1953. It is probable that other floods approaching this magnitude have occurred since the great floods of the winter of 1861-62.

59. Flood damage. During the flood of December 1955 the Mad River overflowed its banks and flooded approximately 6,300 acres. Included in this total were 4,500 acres of agricultural and industrial lands between Blue Lake and the Pacific Ocean. Highway U. S. 101 was inundated and the north approach to the bridge over Mad River was washed out, making it necessary to reroute traffic. Damage to agricultural lands from erosion, scour, siltation and debris deposits, and loss of dairy cattle was severe. Considerable damage occurred to sawmills and wood-products mills. Sweezey Dam, which impounds the domestic water supply for the city of Eureka, and the access road to the dam were seriously damaged from erosion. However, the dam was in no danger of failure. During the course of the flood, Mad River enlarged a minor cutoff channel to the extent that the main flow of the river now follows this new course. The effect has been to move the confluence of the Mad River and the North Fork of the Mad River about 0.4 miles upstream along the North Fork to create a sharp bend where the current flowed almost directly into a levee constructed by local interests.

60. Flood-protection works. In 1954-55 the Corps of Engineers, under authority of Section 212 of the 1950 Flood Control Act, constructed a 3,000-foot levee along the right bank of the North Fork of the Mad River to protect an industrial and agricultural area in the vicinity of Blue Lake. Continuing downstream to form an integral part of the Federal levee, local interests have constructed a levee to protect a lumber mill. It is against this lower section constructed by local interests that the direct current of the Mad River now flows. During the height of the flood, surface water was flowing at levee crest and in some depressed portions of the levee a row of sandbags was placed to prevent overtopping. The riverward face of the downstream end of the levee was eroded and, subsequently, riprap was placed to prevent future failure from this cause. Inspection following the floods established that the work constructed by the Corps of Engineers had suffered no appreciable damage even though stages in the North Fork of the Mad River had approached design flood stages.

61. Damage survey. Following the preliminary reconnaissance, a comprehensive flood damage appraisal was accomplished. Based on reports from the Humboldt County Coroner, it was established that no lives had been lost due to the floods. The Red Cross reported that seven persons had been injured seriously enough to require hospitalization. Damages from the December 1955 floods are summarized in Table 7.

Table 7

Summary of Damages (Floods of December 1955)
Mad River Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 3,600	$ 500	$ 4,100
Non-Residential	130,600	71,200	201,800
Agricultural	285,500	0	285,500
Flood-protection works	26,300	0	26,300
Total Private	$ 446,000	$ 71,700	$ 517,700
Public			
Transportation	$ 0	$ 4,500	$ 4,500
Roads and bridges	354,300	0	354,300
Utilities	215,500	0	215,500
Other public properties	9,800	0	9,800
Emergency aid	221,300	0	221,300
Total Public	$ 800,900	$ 4,500	$ 805,400
Total damage	$1,246,900	$ 76,200	$ 1,323,100

EEL RIVER (Area 1)

62. Basin description. Eel River and its tributaries drain a sparsely settled mountainous area of approximately 3,630 square miles situated in the Coast Range easterly from Cape Mendocino on the northern California coast. The river flows in a northwesterly direction from its source and discharges into the Pacific Ocean about ten miles southerly from the entrance to Humboldt Bay. The river has four principal tributaries; namely, Middle Fork, North Fork, and Van Duzen Rivers from the east, and South Fork from the west. Extensive flooding generally occurs only in the three principal agricultural areas of the basin. These are the Eel River delta, Round Valley, and Little Lake Valley. However, during the December 1955 floods, because of unprecedented flood discharges, many small communities along the river received damage for the first time in their recorded histories. It is estimated that 43,000 acres of agricultural, urban, and industrial property were flooded.

63. Discharges and stages. From the records of the U. S. Geological Survey water stage recorder at Scotia, it was learned that the river rise started about noon of 17 December and reached a minor peak stage

at 2:00 A.M. on 20 December. Following this minor peak, the stage receded until noon on 21 December when the river again started to rise. This rise continued until the flood peak reached a gage height of 62.2 feet at 4 P.M. on 22 December. This stage height is 7 feet higher than the highest previously recorded peak stage in December 1937. The only possible greater peak may have occurred in the flood of 1862, about which little is known. The preliminary estimate of discharge for the December 1955 flood was 541,000 c.f.s. as compared with an estimated 345,000 c.f.s. for the 1937 flood. Between 18 - 24 December 1955, a total flow of 2,400,000 acre-feet of water passed the Scotia gage. New record peak discharges were established at all upstream gaging stations by the flood. Flood warnings for evacuation of farm animals in the delta area are issued by the Eureka Office of the U. S. Weather Bureau. These warnings are based on the predicted river stage at Fernbridge. For that purpose, the Weather Bureau maintains a network of official hydrologic reporting stations throughout the area. The first stock evacuation warning was issued by the Weather Bureau on the morning of 18 December for a stage of 15.0 feet at Fernbridge on the evening of 18 December. Advisory warnings were issued periodically during the flood period. The peak stage recorded at Fernbridge was 31.1 feet m.s.l. late in the afternoon of 22 December. The previous maximum stage at this gage, 29.8 feet m.s.l., was recorded on 11 December 1937. Following the peak, the stage continued to drop and, except in some exceptionally low areas, the river returned to its banks by noon of 25 December. Subsequent to the main flood, lesser rises occurred on 5 and 15 January 1956, reflooding some of the lowland areas near the mouth of the river. Of these two rises, the one on 15 January was greater and reached a peak stage at Scotia of 42.3 feet and of 22.0 feet at Fernbridge, 2.0 feet above the stage where damage starts. However, due to the previous flood additional damage was relatively light with the exception of bank erosion.

64. Flood damage. Agricultural damage in the delta region was catastrophic. In addition to severe damage to farm homes, out-buildings and farm machinery, entire herds of valuable dairy stock, developed over many years of breeding, were lost. A tabulation of stock loss, as compiled by the Humboldt County Agricultural Commissioner, is presented in Table 8.

Table 8

Stock Loss, Eel River Basin

General area	Number of head lost				
	Cattle	Hogs	Horses	Sheep	Chickens
Loleta-North Delta	244	3		3	
Ferndale-South Delta	633	1		201	
Metropolitan-Scotia	141	2		20	35
Shively-Holmes, Elinor, Pepperwood, and South	249	1	1	135	700
Camp Grant-Main Fork				375	
Totals	1,267	7	1	734	735

Because of continued heavy post-flood discharges, bank erosion was accelerated at all critical bends of the river, primarily at Sandy Prairie where some 25 acres of agricultural land were lost during the flood. Bank erosion in this area is reported on in a San Francisco District report entitled "Review of Reports on Eel River, California, for Flood Control, with Reference to Sandy Prairie Area, Fortuna, California," dated 2 April 1956.

65. Damage to commercial and residential property in the communities along the river, many of which had never previously been flooded, was the worst in history, particularly in the communities of Stafford, Elinor, Pepperwood, Shively, Bull Creek, South Fork, McCann, Weott, Meyers Flat, and Phillipsville. Table 9, although incomplete, indicates the distribution-density of damage in these areas.

Table 9

Building Units Damaged or Destroyed
(Floods of December 1955)
in Eel River Basin, Humboldt County

Area	Dwellings			Business			Farm buildings			Other buildings		
	D	M	m	D	M	m	D	M	m	D	M	m
Fernbridge-Mouth	25	50	160				50	150	350			
Fortuna-Scotia	10	9	159	1		1						
Stafford-Elinor	11	23	15	2							6	6
Pepperwood-Dyerville	50	32	39		20	10			40		43	1
Dyerville-Eel Rock	6	2	14								1	
Bull Creek	32	10	20									
Weott	24	16	5	27	4	1						
Meyers Flat	115	6	2		5	10						
Miranda-Garberville	9	41	21	2	2							
Totals	282	189	435	32	31	22	50	150	390		50	7

Legend: D - Destroyed; M - Major damage; m - minor damage.
Other buildings include public buildings, non-farm storage buildings, etc.

66. A considerable portion of the building damage was caused by high velocity flow coupled with a large amount of heavy debris. The force of the flow and the heavy debris eroded out building supports, swept the buildings from their foundations, and destroyed them. Commercial and industrial losses resulted from damage to buildings, equipment, and stocks, and from loss of business. The major portion of loss under this category was suffered by the lumber industry.

67. Highways and bridges of the State and counties suffered extensive damage from flood and storm as did the Northwestern Pacific Railroad and power and telephone companies. Numerous slides, washouts, and trestle losses throughout most of Mendocino and Humboldt Counties closed the railroad until 6 February. From that date until 15 March the railroad operated during daylight hours only and limited traffic to the movement of freight. Since 15 March, freight has been moved night and day with passenger traffic limited to daylight hours, and this schedule is in force as of the date of this report.

68. Widespread loss of pole lines and associated equipment was sustained by the utility companies that provide services for this area. A number of communities and rural areas were without power for a prolonged period. The cleanup work was hampered thereby since water, which is normally obtained by pumping, was not readily available for the removal of mud and washing of premises. Communication lines and equipment were washed away and destroyed by slides over a large portion of the area. Long-distance trunk lines were inoperative for periods ranging from one to two weeks except for intermittent opening for emergency calls.

69. The main north-south highway, U. S. 101, was closed in numerous places by washouts, slides, and damaged bridges. This highway was closed to all through traffic between Fortuna and Willits until 30 December, although some reaches were opened to local essential traffic prior to this date. On about 1 January 1956, through traffic of light emergency vehicles were convoyed through during daylight hours. About 5 January, trucks and busses again started operating, but all traffic was subject to numerous delays. County roads and bridges were extensively damaged, and many areas were isolated. One of these areas was the south side of the Eel River delta in which the town of Ferndale is located. This community and those of Petrolia and Honeydew on the Mattole River were isolated until the end of December by loss of the south bridge abutment at Fernbridge and loss of roads and bridges on the routes out of Rio Dell and Dyerville. The community of Shively was isolated by slides and washouts of the county road on the right bank of Eel River. Larrabee was cut off by washout of the low-level bridge from Holmes. Access was difficult, due to heavy mud on the roads, to several of the communities along the main branch of the Eel River upstream from Dyerville. The road to Bull Creek from Dyerville was made impassable because of numerous heavy slides, extensive washouts, loss of bridges, and fallen timber. Convoys of two or more jeeps (to provide mutual assistance in the event of bog-downs) or other four-wheel-drive vehicles were getting into some areas to provide food and medical aid, to evacuate, and to restore vital utilities. With the exception of certain isolated areas, county roads were opened to emergency traffic by early January 1956.

70. In addition to public property losses to road systems, utilities, and railroads, considerable damage was sustained by the California State Division of Beaches and Parks to State Parks and campgrounds located in the redwood groves along the South Fork of Eel River. Most of these areas are adjacent to the riverbanks in order to obtain the maximum recreational benefits consistent with low summer streamflow. Loss of a large stand of prime timber, because of erosion in the Bull Creek State Park area, accounted for about 30 percent of the total losses to the State Park system. Damage to roads and facilities of the U. S. Forest Service occurred along Eel River in both the Six Rivers and Mendocino National Forests. There are no Federal flood-control projects in Eel River Basin. However, a number of levees and bank revetment works have been constructed by private individuals or local groups and by the State of California for specific local problems.

71. Loss of life. According to the Humboldt County Coroner's report, two persons lost their lives as a direct result of the floods in Eel River Basin. A resident of Fortuna was drowned in the vicinity of Waddington on 20 December, and a resident of Pepperwood lost his life in that vicinity 23 December. In addition to the lives lost, the Red Cross reported that 27 persons were injured, 4 seriously enough to require hospitalization.

72. Damage summary. A summary of flood damages in the Eel River Basin has been compiled from the results of the comprehensive damage survey accomplished by District Office and temporary-duty personnel and from information provided by various agencies of the Federal, State, county, and municipal governments, relief and charitable agencies, and similar organizations. These damages are summarized in Table 10.

Table 10

Summary of Damages (Floods of December 1955)

Eel River Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 2,729,300	$ 30,100	$ 2,759,400
Non-residential	3,533,700	1,127,000	4,660,700
Agricultural	3,575,900	6,700	3,582,600
Total Private	$ 9,838,900	$1,163,800	$ 11,002,700
Public			
Transportation	$ 2,050,000	$ 507,600	$ 2,557,600
Roads and bridges	4,192,700	0	4,192,700
Utilities	870,400	0	870,400
Other public properties	1,432,000	30,000	1,462,000
Emergency aid	2,131,100	0	2,131,100
Total Public	$ 10,676,200	$ 537,600	$ 11,213,800
Total damage	$ 20,515,100	$1,701,400	$ 22,216,500

MATTOLE RIVER BASIN (Area 1)

73. Basin description. The Mattole River drains an area of 294 square miles lying generally between the west watershed boundary of the Eel River and the Pacific Ocean. The headwaters rise near the Pacific Coastline in Mendocino County near the Humboldt County line, and the river flows in a northwesterly direction through Humboldt County to the Pacific Ocean near Petrolia. The basin contains very little urban development. Most of the population is concentrated in three small communities, Petrolia, Honeydew, and Ettersburg, with an aggregate population of about 200 according to the 1950 census. The Mattole River has long been popular as a sport-fishing area. In addition, agricultural pursuits, mainly sheep raising, are carried on. The demand for lumber to supply the west-coast building boom since the close of the last war has increased lumbering operations in the area.

74. Storm rainfall and stages. Precipitation is relatively heavy over most of the basin, with an average annual rainfall of nearly 80 inches at the Weather Bureau rain gage, "Upper Mattole." The flood peak at the U. S. Geological Survey gage near Petrolia, from a drainage area of 240 square miles, occurred 21 December with a discharge of

90,400 c.f.s. at a stage of 29.6 feet (gage datum). This peak far exceeded the previous recorded maximum of 48,000 c.f.s. in January 1912.

75. Agricultural losses consisted mainly of silting of pasture, loss of livestock, and damage to fences. According to best estimates, approximately 400 sheep were lost in the floods of December 1955. Losses to the lumber industry were partly to facilities and stocks of logs and finished lumber, and partly to the loss of business because of inability to move finished lumber out over the severely damaged roads.

76. Loss of life was limited to one resident of Petrolia who was drowned on 22 December according to official reports of the Humboldt County Coroner's office.

77. Little is known of the early phases of the flood since the area was inaccessible to most forms of transportation until early January. By that time, the road was open to light emergency traffic via Ferndale and Centerville Beach, with travel conditions slow and hazardous. An alternate route, via Bull Creek to Dyerville, remained closed until early in March 1956 due to extensive damage in the Bull Creek Flats area. The estimated flood plain extended over approximately 1,200 acres, of which 400 acres are in agricultural areas.

78. Flood damages, obtained from a comprehensive field survey and data obtained from county and State sources, are shown in Table 11.

Table 11

Summary of Damages (Flood of December 1955)

Mattole River Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 3,700	$ 0	$ 3,700
Non-residential	96,700	28,200	124,900
Agricultural	57,400	0	57,400
Total Private	$ 157,800	$ 28,200	$ 186,000
Public			
Roads and bridges	$ 439,000	$ 0	$ 439,000
Utilities	5,000	0	5,000
Other public properties	2,700	0	2,700
Emergency aid	0	50,000	50,000
Total Public	$ 446,700	$ 50,000	$ 496,700
Total damage	$ 604,500	$ 78,200	$ 682,700

NOYO RIVER BASIN (Area 1)

79. Basin description. The Noyo River rises in the Coast Range Mountains about 4 miles west of the city of Willits in Mendocino County, California, and flows westerly to the Pacific Ocean at Fort Bragg. Fort Bragg is the only city of any size in this region and has a population (1950 census) of 3,826. The main economy of the area is based on lumbering and manufacture of lumber products, and these activities are concentrated at Fort Bragg. Several commercial fisheries are also located on Noyo Harbor. The area is served by California State Highway Sign Route 1, along the Pacific Coast north and south of Fort Bragg, and by a county road connecting with Willits. In addition, a small narrow-gauge railroad of the California Western Railroad and Navigation Company runs between Fort Bragg and Willits. Fort Bragg has an airport at which regularly scheduled flights of Southwest Airways provide passenger and air-express service.

80. Discharge and stages. A stream-gaging station was installed in recent years by the U. S. Geological Syrvey about 4 miles upstream from the mouth of the river. On 22 December 1955, the peak discharge at this station for 105 square miles of drainage area above the gage was 27,600 c.f.s., with a stage of 25.69 (gage datum). The previous maximum discharge of 16,000 c.f.s. with a stage of 24.56 (gage datum), was recorded during December 1951. No records are available prior to that date, but is is probable that discharge approaching that of the December 1955 storms has occurred several times since the major floods in northwestern California during the winter of 1861-62.

81. Flood damages to agricultural, residential, and non-residential private properties, as well as to public properties, were negligible throughout the basin. Most of the river channel is in steep canyons with few improvements within the flood plain. The area adjacent to the river near the mouth is mainly occupied by the fishing industry and harbor facilities. Some silting in the navigable channel has been reported during the past several years.

82. Noyo Harbor. The Corps of Engineers has constructed an entrance channel to the river, 10 feet deep and 100 feet wide, protected by parallel jetties, and a channel in the river of like depth and 150 feet wide for a distance of five-eighths of a mile upstream. During the floods, serious shoaling occurred in the dredged area and the jetties were slightly damaged.

MISCELLANEOUS COASTAL STREAMS (Area 1)

83. Basin descriptions. Streams in this category are those small streams outside of the watersheds of the major rivers which drain the westerly slopes of the Coast Ranges directly to the Pacific Ocean or

to Humboldt Bay. In order, south from Redwood Creek to north of the Big River watershed at Mendocino, some of the larger of these streams include: Maple Creek at Big Lagoon, Little River near Crannel, Jacoby and Freshwater Creeks between Arcata and Eureka, Elk River and Salmon Creek between Eureka and Loleta, Bear River between Eel and Mattole Rivers, Usal Creek opposite Cummings on the Eel River, Cottoneva Creek at Rockport, and Tenmile River about 8 miles north of Fort Bragg. In addition to these larger streams, there are numerous small creeks with drainage areas generally less than 10 square miles.

84. Flood damage. Because of the remoteness and sparse settlement of most of this coastal area, damage was confined primarily to roads and bridges in the Humboldt County portion of the coastline in the area south of Humboldt Bay. Direct damage to county roads and bridges, by floods on these streams, totaled $409,500. No reports of damage to scattered homes, farms, or commercial facilities, other than roads and bridges, were available from responsible sources, and it is believed that damage to these improvements, if it existed, was minor. No loss of life or injury was reported, and no expenditures were made by Civil Defense, Red Cross, or Salvation Army organizations.

RUSSIAN RIVER BASIN (Area 1)

85. Basin description. The Russian River drains an area of 1,485 square miles. Approximately two-thirds of the area is situated in Sonoma County, approximately one-third is in Mendocino County, and several small areas comprising less than 1 percent of the total lie in Lake County. The drainage basin, lying between adjoining ridges of the Coast Range Mountains, is about 80 miles long and from 10 to 30 miles with with its major axis roughly parallel to the California Coast. The total length of the river is about 110 miles. The principal tributaries to the Russian River are Dry Creek, Mark West Creek, East Fork, Forsythe Creek, Feliz Creek, Pieta Creek, Big Sulphur Creek, Maacama Creek, Green Valley Creek, and Austin Creek. Dry Creek drains an area of 218 square miles situated in the west central portion of the drainage basin. Mark West Creek, with its tributaries, Santa Rosa Creek, Windsor Creek, and the Laguna De Santa Rosa drains an area of 255 square miles located in the southeast portion of the drainage basin.

86. The Russian River drainage basin is primarily an agricultural area. It is one of the major wine-grape growing regions of California. The production of hops, field and orchard crops, and the raising of sheep, cattle, and poultry comprise the principal agricultural activity of the area. Major industries include wineries, processing plants for fruit and animal products, mining, lumbering, and manufacture of timber products. The lower portion of the river from the mouth to above Healdsburg is devoted primarily to summer homes and resort areas catering to vacationists during the summer and fall months.

87. Discharge and stages. As a result of the continued high intensity rainfall during the two-week period beginning about 15 December 1955, the Russian River peaked on two occasions. The first peak at Guerneville occurred 20 December with a stage of 39.0 feet, about 8.5 feet above flood stage. This first peak stage resulted in general flooding along the Russian River with damage to agricultural, commercial, residential, and public property and utilities. Highways and railways were flooded, with resultant transportation tie-ups. One death occurred when a rancher attempting salvage of equipment on his ranch slipped from a wading horse and was drowned. The river again rose to flood stages on 22 December and 23 December exceeding previous maxima on all of the stream-gaging stations in the Russian River watershed. The peak discharge of 22 December, on the East Fork near Calpella, of 13,300 cubic feet per second at a stage of 15.06 feet (gage datum) from a drainage basin of 94 square miles, compares with 11,300 cubic feet per second at a stage of 13.7 feet (gage datum) recorded in January 1951. The estimated peak discharge near Guerneville of 90,100 cubic feet per second at a stage of 47.6 feet (gage datum) on 23 December 1955, from a drainage basin of 1,342 square miles, compares with 88,400 cubic feet per second at a stage of 46.87 feet (gage datum) recorded in February 1940. The total runoff between 18 - 24 December at the Guerneville gaging station was in excess of 750,000 acre-feet. It is probable that this flood was among the greatest to occur since the floods of the 1861-62 winter season.

88. Flood conditions. As in most major disasters, communications with the several communities along the basin were disrupted, hampering the dissemination of flood information and warnings along the river. When it became apparent that the several small towns and resort areas along the lower Russian River would be inundated, local Civil Defense authorities declared a state of emergency at 12:00 midnight 21 December 1955 and an orderly evacuation of the areas most likely to be inundated was started. Where possible, furniture, personal effects, and equipment were moved to higher ground. From the magnitude of the eventual flood, this evacuation and preventive work of moving belongings saved many hundreds of thousands of dollars and possibly many lives.

89. When the full impact of the flood along the entire river was felt, evacuation of persons was carried out by rescue teams from all branches of the Armed Services, the National Guard, and Coast Guard, together with local law enforcement personnel and private individuals. Equipment such as helicopters, Army ducks, jeeps, swamp buggies, radio equipment, rubber rafts, amtracks, and private craft were used during the day and night rescuing people from tops of houses, from islands and other places in the raging torrent that afforded a place of sanctuary against the flood. Civil Defense organizations, the American Red Cross, and the Salvation Army worked side by side with the Armed Services and local people in affording succor to the homeless people of the flooded areas. The task of rescue and rehabilitation was complicated

by the washout of many of the highways and, in many cases, the complete destruction of bridges. Guerneville and adjacent summer-home areas were completely cut off by the flood from outside aid except by helicopter. Doctors and Red Cross nurses stemmed a possible epidemic of dysentary that broke out in one of the small residential areas of the lower Russian River. Radio newscasts and pamphlets were issued by health officers as to the use of water, care of food, and health preservation. Flooding was general along the Russian River and all of its tributaries and rescues were accomplished on several tributaries as well as on the Russian River.

90. Flood damage. In general, the main damage from flooding in the upper basin and along Dry Creek was to agricultural property. Riverbank erosion washed away many local bank-protection works and many acres of highly developed farm cropland. Approximately 30,000 acres of agricultural land was flooded. Huge log jams from accumulated orchard trimmings and timber cuttings jammed the bridges crossing many streams, with resulting failure and washout in several cases of vital stream crossings. In addition to the agricultural damage in the upper basin of the Russian River, many residential and commercial areas were hard hit, with homes, sawmills, wineries, and food-processing plants bearing the brunt of the major physical damage. The lower basin is devoted primarily to summer homes and resort property. In the reach from Mirabel Park to the river mouth, these summer homes and resort areas are immediately adjacent to the river to receive the fullest pleasure and benefit from the many beaches and swimming, sunning, and boating opportunities. It is in these areas that the overflow of the river, with its attendant swift velocity, ravaged the residential and resort areas, inundating homes, resorts, and attendant commercial endeavors to their roofs and washing others from their foundations, to float downstream to ultimate destruction against trees or bridges.

91. A statistical breakdown of the residential, resort, farm, and small business structures damaged or destroyed, and a resume of the number of persons rescued or evacuated by the various agencies follows:

Persons rescued from positions of immediate peril (lives saved)	109
Persons rescued from positions not in immediate peril	96
Evacuated under guidance of Civil Defense, Redwood Township	600
Evacuated under guidance of Civil Defense, Healdsburg Township	156
Total saved or evacuated	961

Dwellings, destroyed	45
Dwellings, major damage	127
Dwellings, minor damage	312
Farm buildings, major damage	4
Farm buildings, minor damage	9
Rental cabins, destroyed	150
Small business buildings, major damage	25
Small business buildings, minor damage	210
Small business buildings, affected by flood	120
Total number structures affected by flood	1,002

92. Practically all major county roads were closed to traffic due to inundation from the flood or slides from the unprecedented rains. The Northwestern Pacific Railroad, which parallels the flood plain from Healdsburg to Ukiah, was out of operation for approximately two weeks due to track washout in several places.

93. Immediately after the December flood, personnel of the San Francisco District interviewed local authorities, State and County officials, and local residents to ascertain the damage to their properties. Residential and commercial damage was evaluated by nearly a 100-percent coverage of the area. Damage to agricultural property was evaluated by a 50-60 percent coverage of the area. High-water marks were established and are in the process of being levelled in.

94. Damages resulting from the December 1955 floods, amounting to $5,017,200, are summarized in Table 12.

Table 12

Summary of Damages (Floods of December 1955)
Russian River Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 864,300	$ 131,700	$ 996,000
Non-residential	1,411,500	201,000	1,612,500
Agricultural	830,400	30,900	861,300
Total Private	$ 3,106,200	$ 363,600	$3,469,800
Public			
Roads and bridges	$ 767,700	$ 0	$ 767,700
Railroad	55,000	297,100	352,100
Emergency aid	427,600	0	427,600
Total Public	$ 1,250,300	$ 297,100	$1,547,400
Total damage	$ 4,356,500	$ 660,700	$5,017,200

95. February 1956 flood. Continued heavy rains during the month of February resulted in a third flood alert, issued by the local Civil Defense authorities 20 February, based on a U. S. Weather Bureau perdicted peak stage of 30-32 feet (flood stage 29.0 feet). Civil Defense flood warnings and the recent memory of the disastrous December floods activated local residents and business people to salvage attempts and precautions such as moving equipment, furniture, and stored merchandise to places of safety. The river peaked 23 February at a stage of 40.0 feet (gage datum). During the emergency, some people had to be evacuated from the low-lying portion of the flood plain. The Red Cross provided care for some of the residents. The local emergency was discontinued by the Civil Defense authorities at 6:00 A.M., 23 February. Local salvage attempts resulted in the saving of many thousands of dollars. An approximate flood damage of $100,000 was estimated by local Civil Defense Agencies for this flood.

CORTE MADERA CREEK BASIN (Area 2)

96. Basin description. Corte Madera Creek is located in southern Marin County and empties into San Francisco Bay 8 miles north of the Golden Gate. The basin is approximately 8 miles long and from 3 to 4 miles wide with an elevation range from sea level at the mouth to 2,600 feet on Mount Tamalpais in the headwaters. The basin area is approximately 25 square miles, mostly mountainous and hilly. It has a central valley partly composed of wide, low-lying partially reclaimed tidal flats in the 2-mile reach adjacent to the creek immediately above the mouth and below College Avenue in Kentfield, thence becoming narrower and steeper to its head in the mountains. The population of the area is increasing rapidly, with a present total of 23,600 (1954 estimate) living in 5 incorporated towns and an unknown number living in unincorporated communities, the largest of which is Kentfield. This compares with a total population of 19,000 for the 5 incorporated towns in 1950, and a total estimated population of 12,000 for the entire valley in 1940. Most of the area is occupied by small cities and suburban communities. Heavy industry in the upper basin is non-existent. The Northwestern Pacific Railroad and Highway U. S. 101 cross the marshlands near the mouth of the creek. College of Marin is located in the lower portion of the basin. Marin Municipal Water District has a small storage reservoir (Phoenix Lake) on Ross Creek, a tributary of Corte Madera Creek. Tamalpais State Park occupies a small area in the headwaters. Sanitary sewer facilities are provided through a local sanitary district and water supply is provided by the Marin Municipal Water District. Agriculture is considered a minor factor in the economy of the basin.

97. Flooded areas. Flooding was intermittent in the upper reaches of the basin, with a light streat overflow starting and ending in a 3-block reach in Fairfax. A second overflow area in a residential district just above the Nokomis Avenue Bridge in San Anselmo, extended through the main business section of San Anselmo, and ended one block downstream from Bolinas Avenue in the town of Ross, a total distance of 1 mile and average width of slightly less than a block. A third overflow area started 500 feet below the fire station in Ross and continued to the tidal flats below College Avenue in Kentfield. Some flooding occurred in residential sections in the reclaimed areas below College Avenue and included College Park, Greenbrae, and Heather Gardens. A small business area in the lower basin on Paradise Drive, east of Highway U. S. 101, in the town of Corte Madera was flooded by flow from local drains. The area flooded was 1,086 acres, of which 175 acres were developed land and 910 acres were marshland or newly reclaimed marshland in the low flat area between College Avenue and Highway U. S. 101. With minor exceptions, flooding in the Fairfax area was much less severe than on previous occasions. From Nokomis Street in San Anselmo to Highway U. S. 101 crossing, flooding was generally reported to be the most severe and the water the highest within the experience of local residents.

98. Damages. Residents of low-lying areas and business people located in areas subject to frequent flooding have learned by experience to take certain preventive action during times when floods threaten. Fire departments and local government groups warn residents of flood threats when streams are high and inundation is expected. As a result, during the December 1955 storms, automobiles were moved to high ground, low-lying buildings were emptied of valuables, rugs and low furniture were raised in homes known to be subject to flooding, and business places barricaded doors and windows and moved stock up from lower shelves. These actions helped minimize flood damage. The floods of December 1955 so far exceeded previously remembered flooding that the preventive actions were not always adequate. Homes in areas never before flooded and new residents suffered relatively higher damage than those who had experienced previous damage. Without such precautions as were taken, the direct business losses in the San Anselmo business district could easily have tripled the $20,500 reported, and the residential losses in Kentifield and the Granton Park, Poplar Street, and Kent Avenue districts of Ross could conceivably have been 40 percent on more higher than the $82,500 reported for those districts. Flood damages for the Corte Madera Creek Basin are summarized in Table 13.

Table 13

Summary of Damages (Floods of December 1955)
Corte Madera Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 94,800	$ 5,300	$ 100,100
Non-residential	33,600	14,700	48,300
Public utilities	26,000	-	26,000
Roads and bridges	82,600	-	82,600
Totals	$ 237,000	$ 20,000	$ 257,000

NOVATO CREEK BASIN (Area 2)

99. Basin description. Novato Creek drains 41 square miles in Marin County, adjacent to the northwesterly extremity of San Pablo Bay. The basin is 12 miles long and averages 3½ miles in width. Novato Creek rises in the northwesterly portion of the basin, flows westerly and southwesterly about 3 miles, thence in a general southeasterly direction through the middle of the basin to its outlet in San Pablo Bay. The watershed is composed of a hilly and mountainous section bordering the sides and upstream end of the creek and comprising about two-thirds of the total area; a small valley section of about 8 square miles, adjacent to the town of Novato; and a low level section, about 5 square miles in extent, composed principally of reclaimed marshlands abutting San Pablo Bay. An additional reclaimed area, 4 square miles in extent, borders the lower 3 miles of Novato Creek Basin on the south. The population of the area is primarily suburban or rural. The town of Novato, with a population of 3,500 in 1950, is the principal community in the basin. Rafael Village and Hamilton Air Force Base are important unincorporated centers of population.

100. Damages. Except for the populated areas, most of the land is devoted to agriculture, with grazing in the mountainous areas and hay and grain production the principal crops in the valleys and reclaimed land regions. Flooding occurred in a relatively small area in the town of Novato where yards were inundated and water entered garages and the cabins of a motel. Most of the agricultural land below Highway U. S. 101 was inundated. The total area flooded is estimated to be 4,080 acres of urban and agricultural property. Damage was relatively light in the Novato area due to the fact that

water did not quite reach the floor level of any of the homes in the flood area. At the peak of flooding, water spilled into an open area of low reclaimed marshland of approximately 200 acres along and adjacent to the upstream side of Highway U. S. 101 and south of Novato Creek levee. Flooded runways at Hamilton Field caused the evacuation of airplanes to high ground. The North Marin County Water District has a water conservation reservoir in the upper basin with a storage capacity of 4,500 acre-feet. While this reservoir is operated for water conservation only, water did not start to spill over the Novato Dam until 10:15 P.M., 22 December, while peak flooding in Novato occurred between 6:45 and 7:00 A.M., 22 December, more than 15 hours earlier. It would appear, therefore, that the storage in Novato Dam prevented considerably greater flooding in the vicinity of Novato. Flood damages for the Novato Creek Basin are tabulated in Table 14.

Table 14

Summary of Damages (Floods of December 1955)
Novato Creek Basin

Item	Estimated Damage		
	Direct	Indirect	Total
Residential	$ 1,200	$ 1,200	$ 2,400
Non-residential	5,000	700	5,700
Agricultural	119,000	4,500	123,500
Public property	1,000	-	1,000
Government property	-	60,000	60,000
Roads and bridges	1,500	-	1,500
Total	$ 127,700	$ 66,400	194,100

PETALUMA CREEK BASIN (Area 2)

101. Basin description. Petaluma Creek drains an area of 146 square miles, of which 75 percent is in southern Sonoma County and 25 percent is in northern Marin County. The basin is approximately 19 miles long and averages 8 miles in width. Petaluma Creek begins at the junction of Lichau and Haggin Creek below Pengrove. The stream flows southwesterly for about 1 mile, thence in a general southeasterly direction about 18 miles to drain into San Pablo Bay. Practically all of the valley section is devoted to agriculture with poultry

culture the principal industry, especially in the northern part of the basin. Other areas are devoted to hay, forage, grain, and truck crops. Petaluma, with an estimated 1954 population of 12,500, is the principal city in the basin. Other communities in the basin or partly in the basin are Pengrove and Cotati. Industry is light and is related mainly to agriculture.

102. Flooded area. Local flooding occurred in the easterly portion of the city of Petaluma with relatively light damage. Flooding in the upper basin was relatively small compared with previous floods. Scattered flooding occurred below Petaluma in the reclaimed marshland area, with resulting damage to farm equipment, crops, and deposition of objectionable material over the planted fields. Flood damages for the Petaluma Creek Basin are tabulated in Table 15.

Table 15

Summary of Damages (Floods of December 1955)
Petaluma Creek Basin

Item	Estimated Damage		
	Direct	Indirect	Total
Residential	$ 100	$ 100	$ 200
Agricultural	37,600	1,100	38,700
Roads and bridges	16,500	-	16,500
Totals	$ 54,200	$ 1,200	$ 55,400

SAN RAFAEL CREEK BASIN (Area 2)

103. Basin description. San Rafael Creek rises in the northwesterly portion of the basin, flows southeasterly for two miles and then easterly to its outlet in San Francisco Bay. In its upper reaches it flows in a small, natural, open channel. As it passes through the city of San Rafael, it flows through numerous culverts. The lower 1.5 miles of the stream is an improved navigable channel with the head of navigation at Irwin Street in San Rafael. The triangular-shaped basin has an area of approximately 8 square miles. The upland portion of the basin is devoted primarily to residential and retail business uses. The extremely mountainous areas remain more or less undeveloped. The partly reclaimed marshlands are being used and developed primarily for business, wholesale, warehousing, and light manufacturing. There is a residential fringe around the edge of much of this reclaimed land.

One large school and an airport are also located in this area, and the main line of the Northwestern Pacific Railroad crosses the lower portion of it. San Rafael, the incorporate limits of which include most of the basin, had an estimated population of 16,000 in 1954, and is rapidly growing in importance as the retail and wholesale distributing center of Marin County which had an estimated population of 100,000 in 1954.

104. Flooding. The principal December flooding in San Rafael started where San Rafael Creek was partly forced out of its channel at the First and D Street culvert. Street and yard flooding continued from there to B Street, where flooding became more severe and water levels reached or exceeded the floors of some business places and warehouses in the general area bounded by Third Street on the north, Francisco Boulevard on the east, Woodland and Bret Avenue on the south, and B Street on the west. Street flooding also occurred in a small area in the vicnity of the County Hospital on Fourth Street at Grand Avenue. The total area flooded amounted to 428 acres.

105. Flood damages. Flood damage occurred primarily in the reclaimed marshland area and its fringe, located west of Francisco Boulevard. Because of the accessibility of water, rail, and highway carriers, this area has been attractive to light industry such as wholesale and retail dealers. Most of the non-residential damage occurred in this area when stocks of merchandise were lost and some building damage occurred. Damages in the San Rafael Creek Basin are tabulated in Table 16.

Table 16

Summary of Damages (Floods of December 1955)
San Rafael Creek Basin

Item	Estimated damages		
	Direct	Indirect	Total
Residential	$ 1,500	$ 100	$ 1,600
Non-residential	112,700	12,700	125,400
Emergency repair	1,000	-	1,000
Totals	$ 115,200	$ 12,800	$ 128,000

SONOMA CREEK AND TOLAY CREEK BASINS (Area 2)

106. Basin description. Sonoma Creek rises at the head of Sonoma Valley in the Coast Range Mountains, about seven miles southeast of the city of Santa Rosa and flows through the central section of Sonoma Valley in a southerly direction to drain into San Pablo Bay, an arm of San Francisco Bay. The basin is roughly rectangular in shape, about 22 miles long and averaging 7 miles in width, with an area of 154 square miles. Tolay Creek drains the more westerly portion of Sonoma Valley and flows southerly to drain into San Pablo Bay. Tolay Creek has an individual entrance to San Pablo Bay but is also interconnected with the mouth of Sonoma Creek by tideland sloughs. Sonoma Valley is primarily an agricultural area devoted to the production of hay, grain, fruit, grapes, cattle, and dairy products. The population of Sonoma County was estimated to be 126,400 in 1955. The main population center, the city of Sonoma, exceeds 2,500. A group of smaller communities, Glen Ellen, Kenwood, Eldridge, Boyes Springs, El Verano, Vineburg, and Schellville, dot the valley floor adjacent to Sonoma Creek. The remaining area is rural and is sparsely settled.

107. Flooding. Flooding occurred in discontinuous reaches along the entire length of Sonoma Creek. Near Glen Ellen, a slide along the right bank has been in progress, intermittently, for several years. The heavy storm rains and flood flows in the stream aggravated the unstable slide until it nearly closed the channel. The flow in the restricted channel gained sufficient velocity to scour and undermine the left creek bank, causing serious erosion to a small agricultural area and damage to residences. Minor bank overflow started 2 miles south of Sonoma. At this point, overflow on the right bank emptied into Fowler Creek and the left bank emptied into Schell Creek, which creeks are tributary to Sonoma Creek farther downstream. Major overflow started just north of the Schellville Highway junction. Flooding became general on both banks from Schellville south to Wingo, a distance of $2\frac{1}{2}$ miles. Flooding on the left bank ended at Wingo, but continued on the right bank for another $2\frac{1}{2}$ miles to its junction with East Branch from Tolay Creek. From the East Branch junction to the mouth of Sonoma Creek, a distance of 1.1 miles, flow was confined within levees. Flooding from Tolay Creek, except for its unreclaimed marsh area and seepage into Tubbs Island, was minor. The total area flooded in the two creek basins was approximately 6,300 acres exclusive of the unreclaimed marsh area between levees. High water of the late 1920's exceeded the December 1955 high water by about 0.3 foot at a point 0.8 mile above the Highway 37 bridge west of Schellville. In the general area below the bridge, the 1955 flood was reported to have been the worst in the memory of local residents.

108. Flood damage. Damage in the area above Schellville was confined primarily to small agricultural areas, residential and commercial property, and roads and bridges. In the area below Schellville, damage to agricultural lands was extensive, primarily from total loss of seeded crops, damage to farm equipment, stored crops, farm roads, and excessive erosion of some of the levees. Most of the agricultural damage from Tolay Creek occurred in the lower area of the reclaimed marshlands where the two creeks have a common flood plain. Agricultural damage from Tolay Creek was similar in nature to that from Sonoma Creek in this area. Flood damages from Sonoma and Tolay Creeks are summarized in Table 17.

Table 17

Summary of Damages (Floods of December 1955)
Sonoma and Tolay Creek Basins

Item	Damage		
	Direct	Indirect	Total
Sonoma Creek			
Agriculture	$ 323,800	-	$ 323,800
Residential	40,200	-	40,200
Non-residential	35,800	-	35,800
Railroad	40,000	$ 33,500	73,500
Roads and bridges	9,500	-	9,500
Emergency aid	10,000	-	10,000
Total Sonoma Creek	$ 459,300	$ 33,500	$ 492,800
Tolay Creek			
Agriculture	$ 11,500	-	$ 11,500
Total both basins	$ 470,800	$ 33,500	$ 504,300

ARROYO CORTE MADERA DEL PRESIDIO BASIN (Area 2)

109. Basin description. The Arroyo Corte Madera Del Presidio Creek Basin is located in the southeasterly portion of Marin County with its headwaters rising on the slopes of Mount Tamalpais. The creek flows through steeply mountainous regions in the upper basin until it reaches the relatively flat, highly urbanized area in the lower reaches near its mouth, where it drains into Richardson Bay, an arm of San Francisco Bay. The basin is roughly rectangular in

shape, approximately 4 miles long and 1½ miles wide. Mill Valley, with a population 8,500 in 1955, is the principal incorportated town in the area. Mount Tamalpais State Park is located in the headwater area. The basin is devoted primarily to suburban development and industry.

110. Flooded area. Flooding occurred in scattered street and yard areas in the town of Mill Valley. In the vicinity of Camino Alto, 63 acres upstream and 144 acres of marshland and partially reclaimed land downstream were flooded.

111. Flood damage. Damage was confined primarily to the Mill Valley area where water entered some stores and flooded them to shallow depths. The resulting sales losses were relatively large due to the interruption and loss of holiday sales. Residential area damage was light, with flooding limited primarily to garages, yards, and streets. The damages for the basin are summarized in Table 18.

Table 18

Summary of Damages (Floods of December 1955)
Arroyo Corte Madera Del Presidio Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 3,200	$ 100	$ 3,300
Non-residential	11,400	7,000	18,400
Totals	$ 14,600	$ 7,100	$ 21,700

MILLER CREEK BASIN (Area 2)

112. Basin description. Miller Creek is located in eastern Marin County about 6 miles south of Novato and drains an area of approximately 10 square miles. It rises in an area mountainous in character and then flows through a narrow valley to enter a reclaimed marshland adjacent to San Pablo Bay. The population is primarily rural, but rapid expansion of new subdivisions is taking place. With the exception of the new subdivisions now under construction, most of the land is devoted to agricultural endeavors, with grazing in the mountainous area, field crops in the valley section, and hay and grain crops in the reclaimed marshlands. Highway U. S. 101 and the Northwestern Pacific Railroad traverse the flood plain in the lower reaches of the basin adjacent to the reclaimed marshlands.

113. Flooding and flood damage. Flooding was confined to the reclaimed area on the left bank between the Northwestern Pacific Railroad tracks and San Pablo Bay south of Hamilton Field. Approximately 770 acres of grain and hay land were flooded when a levee in the vicinity of the Northwestern Pacific track was eroded, resulting in agricultural damages estimated to be $21,600 direct and $1,500 indirect, for a total of $23,100.

LAGUNITAS CREEK BASIN (Area 2)

114. Basin description. Lagunitas Creek drains a coastal basin in western Marin County. It empties into the south end of Tomales Bay at a point 28 miles northwest of the Golden Gate. The basin is very mountainous, with relatively narrow valleys or canyons along the main stems of Lagunitas Creek and several of the tributaries. The creek flows through low reclaimed marshland in the 1.4-mile reach above its mouth. Olema Creek, a tributary, flows through a mile-long southeasterly extension of the marsh area, which also has been partially reclaimed. Marin Municipal Water District has 4 storage reservoirs in the basin for domestic water supply. There are numerous small reservoirs or stock ponds, from 1 to 2 acres in area, in the basin. The range in elevation is from sea level at the mouth to 2,600 feet on Mount Tamalpais in the headwater area. The land use is primarily agricultural, with grazing in the mountain upland, and hay, grain, and truck crops in the valleys and marshlands. There are no heavy industries. The population, which is primarily rural, is concentrated in the communities of Woodacre, San Geronimo, Forest Knolls, Lagunitas, Point Reyes Station, Olema, and Nicasio.

115. Flooding and damages. Flooding occurred in the agricultural area west of Point Reyes Station when levee failures allowed 315 acres of pastureland to be flooded, resulting in damage to crops and farm equipment and deposits of gravel and other objectionable material. An additional area of 502 acres of unleveed agricultural land was flooded in the area. Roads and highways were damaged to a considerable extent by slipouts and erosion of road fill. Residential damage occurred from inundation in the southwesterly portion of the town of Point Reyes Station. Damage for Lagunitas Creek basin is summarized in Table 19.

Table 19

Summary of Damages (Floods of December 1955)
Lagunitas Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 3,500	-	$ 3,500
Non-residential	300	-	300
Agricultural	15,200	-	15,200
Protection works	10,000	-	10,000
Roads and bridges	120,000	-	120,000
Total	$ 149,100	-	$ 149,100

GALLINAS CREEK BASIN (Area 2)

116. Basin description. Gallinas Creek drains an area of about 4 square miles located in central Marin County about 2 miles north of San Rafael along Highway U. S. 101. The drainage basin is comprised of low rolling hills that are rapidly being developed as unincorporated population centers such as Terra Linda, California Meadows, and Santa Venetia.

117. Flood damage. In the reclaimed former marshlands in the vicinity of Santa Venetia, flooding occurred in urban streets and to a very limited extent to commercial and residential property. Very limited flooding also occurred in San Rafael Meadows to commercial property. A total of about 316 acres of limited urban and marshland areas was flooded. In Santa Margarita Valley adjacent to the Terra Linda tract, a concrete-lined drainage channel was eroded away to such an extent that repairs are estimated to cost $100,000, and smaller upper drains were damaged to the extent of $4,000. In this area, damage to uncompleted streets from erosion is estimated to be $17,100. Damages in the Gallinas Creek Basin are tabulated in Table 20.

Table 20

Summary of Damages (Floods of December 1955)
Gallinas Creek Basin

Item	Damage		
	Direct	Indirect	Total
Channel	$ 104,000	-	$ 104,000
Streets	17,100	-	17,100
Total	$ 121,100	-	$ 121,100

NAPA RIVER BASIN (Area 2)

118. Basin description. Napa River rises on the south slope of Mt. St. Helena at the boundary of Lake and Napa Counties, and flows southeasterly to Napa, thence southerly to discharge into Mare Island Strait, an arm of Carquinez Strait. Its total length is about 50 miles. Its drainage area of 417 square miles lies between those of Russian River and Sonoma Creek on the west and those of Putah Creek and the small streams draining into Carquinez Strait and Suisun Bay on the east. All of the river lies in Napa County with the exception of the southern 3.4 miles which lie in Solano County. Of the total drainage area, 260 square miles are classified as mountain and foothill and 157 are valley and mesa. At Suscol, river mile 10.8, there is a natural topographic constriction in the basin which limits the flood plain to a width of about 2,000 feet at 10-foot elevation, U.S.G.S., and about 2,750 feet at 20-foot elevation, U.S.G.S. Below Suscol, the river flows through a typical delta area, and below the Southern Pacific Railroad crossing at Brazos, river mile 8, it flows through numerous interconnected channels and sloughs, some of which merge with those of the Sonoma Creek delta on the west. The actual line of demarcation between the two basins is uncertain. In the delta area the lands vary in elevation from a few feet above to a few feet below mean sea level.

119. The tributaries of Napa above the city of Napa are Conn Creek, Rector Creek, and Milliken Creek on the east and Dry and Napa Creeks on the west. Below Napa, the tributaries are smaller but Cayento Creek (Tulucay Creek) and Suscol Creek on the east and Carneros Creek on the west caused considerable damage in the December 1955 flood.

120. The population of Napa County, a small portion of which is east of the Napa River Basin, was 46,603 on 1 April 1950, according to the U. S. Census, and was estimated to have increased to 57,200 by 1 July 1955, an increase of about 23%. The small portion of Solano County included in the Napa River Basin contains the basin's largest city, Vallejo. The population of Solano County as a whole increased from 104,833 on 1 April 1950 to an estimated 124,400 on 1 July 1955, a gain of about 19%, while the city of Vallejo increased from 26,038 to an estimated 36,000, or an increase of about 38%.

121. The estimated population as of 1954 and assessed valuation as of 1950 are listed below for the principal cities in the Napa River Basin:

City	Estimated Population (1954)	Assessed Valuation (1950)
Napa County:		
Calistoga	1,418	$ 2,036,000
St. Helena	2,390	2,861,000
Napa	15,290	12,832,000
Solano County:		
Vallejo	36,000	15,662,000

The assessed valuation of property in Napa County outside of the cities listed above was $23,545,000 in 1950, or a total assessed valuation of $41,274,000 for Napa County and $56,936,000 for the Napa River Basin.

122. A large part of the economy of the Napa River Basin is related to the production and processing of agricultural products, consisting principally of fruit, nut, field, and truck crops, and animal production. The production of agricultural crops in Napa County in 1954 amounted to $15,608,000. A summary of crops flooded in the December 1955 flood is given below:

Crop	Flooded area (acres)		
	South of Napa	North of Napa	Total
Oats, barley, grain, or ready to seed	1,368	188	1,556
Pasture:			
Voluntary, temporary, and permanent	1,472	704	2,176
Prunes, walnuts, vines	0	302	302
Berries	0	2	2
Flower seed	0	1	1
Other	160	479	639
Totals	3,000	1,676	4,676

Numerous wineries and fruit-drying and packing plants located in the basin north of the city of Napa were apparently outside of the flood plain. Scattered throughout the basin, but principally in the city of Napa and south to Vallejo, are various industrial establishments such as fruit-processing plants, tanneries, factories producing

clothing, boxes, brick, tile, concrete building blocks, scientific instruments, and steel pipe. Almost the entire area south of the Southern Pacific Railroad to San Pablo Bay and west of Napa River to the Sonoma County line is owned by Leslie Salt Company who also own a large area east of the river. Several resorts and a number of houses are located on or inside the levee. At Vallejo, the principal activity centers around the Mare Island Naval Shipyard located across Mare Island Strait from Vallejo.

123. Flood control improvements. The principal storate reservoirs in the basin are Conn Valley, of 30,500 acre-foot capacity, on Conn Creek; Rector, of about 4,500 acre-foot capacity, on Rector Creek; and Milliken, of 2,000 acre-foot capacity, on Milliken Creek. Conn Valley and Milliken are owned by the city of Napa and Rector is owned by the State of California. In addition, there are several small stock-water reservoirs on Cayento Creek and its tributaries and numerous stock-water dams throughout the basin both above and below Napa. Numerous private levees have been constructed along the river. Above Napa they are, in general, of rather light section and are somewhat discontinuous. Below Napa the properties are protected by very substantial private levees, but these are of insufficient height in many places to prevent overtopping with high water equal to that of December 1955 and January 1956.

124. Federal projects. Under authority of Congressional acts of 30 August 1935 and 24 July 1946, the Corps of Engineers has constructed a river and harbor project on the Napa River, which provides a dredged channel 100 feet wide and 15 feet deep from Mare Island causeway to Asylum Slough; thence 75 feet wide and 10 feet deep to Third Street in the city of Napa. The project was completed in 1950 except for dikes and revetments authorized for construction if required. An inactive flood control project, adopted by the Flood Control Act of 22 December 1944, provides for construction of an earth-fill dam on Conn Creek and channel clearing and bank protection works where needed in certain reaches of the Napa River. No work has been done on the project since, subsequent to authorization of the project, local interests constructed a reservoir for domestic water supply at the Conn Creek damsite.

125. Stage and discharge. The December 1955 storm produced very heavy rainfall from 18 - 20 December and again on 22 - 24 December. The Napa River at the St. Helena gage peaked at 5 A.M., 22 December, at 12,600 c.f.s. The peak at the Lincoln Avenue Bridge in Napa (under construction) occurred at 10:30 A.M. the same day, 22 December, at elevation 20.5 feet, U.S.G.S. According to the office of the City Engineer at Napa, Conn Valley Reservoir was 13.5 feet below the spillway on 16 December and rose to spillway level at 1:00 A.M., 22 December. Storage below spillway level prior to spilling

was 9,700 acre-feet. On 23 December the peak discharge from the spillway, with water level in the reservoir 3.7 feet above spillway crest, was 3,700 c.f.s. It was estimated that 17,000 acre-feet went over the spillway in the first week of discharge. High water at the Oak Knoll Gage north of Napa was 22.5 feet. High water in Napa on Third Street at Dewoody was 15.92 feet U.S.G.S., and just below the highway bridge on Imola Avenue it was 8.27 feet U.S.G.S. The tide gage at the Mare Island Naval Shipyard, based on M.L.L.W. datum, showed high-tide readings of 7.3 feet at 7:20 A.M., 22 December; 8.5 feet at 8:00 A.M., 23 December, and 8.7 feet at 10:15 A.M., 26 December 1955. Since mean sea level is about 2.90 feet above the datum of this gage, the above readings, reduced to mean sea level, would be 4.4 feet, 5.6 feet, and 5.8 feet, respectively. Dry Creek, which enters Napa River above the Oak Knoll Gage, peaked on 19 December and again on 22 December at somewhat lower stage. The discharge on 19 December was 2,640 c.f.s. The high tides during the flood period contributed materially to the flood stage from the mouth of the river to above Napa.

126. Comparison with previous floods. In the area from about the mouth of Dry Creek to the upper part of the basin near Calistoga, farmers who have lived in the area as long as 15 years uniformly stated that the December flood was the highest in their experience. Farmers living in this area from 21 to 58 years stated that the flood was either the highest or one of the highest of their experience. Where figures are given, the flood is usually stated to be from 1 to 2 feet higher than previous floods. High-water marks on the upper side of the highway bridge over Dry Creek indicate that the floods of December 1952 and February 1950 were about 1.2 feet and 2.8 feet, respectively, higher than the flood of 19 December 1955. In the flooded area below the mouth of Dry Creek, extending through the city of Napa, all information is to the effect that high water was one foot or more below high water in 1940. However, from about Suscol to the mouth of the river, six farmers who have lived in this area from 10 to 82 years stated that the December flood was the highest in their experience.

127. Depth and duration of flooding. From the upper portion of the basin to a short distance below St. Helena, flooded areas were relatively small and somewhat discontinuous. From about one mile below St. Helena to the Oak Knoll Gage the flooded area was continuous and in some cases it was over one mile in width. Flooding resulted from the river overflowing its banks and overtopping or going around levees which were discontinuous. Flooding in this area was up to depth of 7 feet and remained on some areas for periods up to 8 weeks. From Oak Knoll Gage to Trancas Road, about 2 miles north of Napa, flooding was confined to a relatively narrow, discontinuous strip along the river. In this area flooding up to 12 foot depths was reported and the duration was 3 to 4 days. Below Trancas Road Bridge

the flooding, in general, occurred on both sides of the river and the flood plain was over one mile wide in some places. In the lower part of Napa City north of Fist Street, the water was over 4 feet deep in places. Napa Creek overflowed its banks due to debris jams at Behrens Street Bridge and flooded an area of 14 city blocks. Depth of flooding was relatively shallow except for property on the streambanks, where basements were flooded below ground level. Duration of flooding from Napa Creek was 2 days and from Napa River, in the city area, 3 days. From Trancas Road south to San Pablo Bay the flood covered large agricultural areas up to depths of 4 feet, which, due to continued rainfall, remained flooded for periods up to 26 days. The total area flooded in the Napa River Basin was 12,580 acres. Within the city of Napa and subdivisions just outside its boundaries to the northeast, about 382 acres were flooded, 43 acres of which were attributable to Napa Creek. Of the total acres flooded, 9,000 acres were north of Suscol and 3,580 acres were south of Suscol.

128. Flood damage. Almost complete coverage was obtained in field evaluations of the damages incurred from flooding where damages were unusually severe such as residential, urban, and industrial areas. Evaluation of damage to agricultural areas was based on reconnaisance to determine the overflow area and sample coverage of the area.

129. Commercial losses. Losses were obtained for 81 commercial establishments within Napa River Basin which incurred direct damages of $99,400 and indirect damages of $58,200, a total of $157,600. Total observed damage represents about 98% of the total estimated damages of $161,000, of which $101,100 was direct and $60,000 was indirect. The distribution of these losses by location is presented in the table below. Direct damages were largely made up of damage to stocks, buildings, machinery and equipment, furnishings, and grounds. Indirect damages were principally loss of business. Damage to commercial establishments are summarized in Table 21.

Table 21

Summary of Damage to Commercial Establishments
Napa River Basin

Item	No. of units observed	Damage		
		Direct	Indirect	Total
Above Suscol:				
City of Napa and vicinity	51	$ 50,400	$ 45,800	$ 96,200
City of Napa (from Napa Creek)	18	13,700	2,800	16,500
Subtotal City of Napa and vicinity	69	$ 64,100	$ 48,600	$112,700
Valley north of Napa	1	$ 500	$ 0	$ 500
Cayento Creek	3	19,900	2,700	22,600
Steel mills south of Napa	1	5,500	6,500	12,000
Total above Suscol	74	$ 90,000	$ 57,800	$147,800
Below Suscol:				
Cuttings Wharf area	2	$ 1,900	$ 0	$ 1,900
Vallejo	5	9,200	2,200	11,400
Total below Suscol	7	$ 11,100	$ 2,200	$ 13,300
Total Napa River Basin	81	$101,100	$ 60,000	$161,100

130. Residential losses. Losses were obtained for 130 residences within Napa River Basin which incurred direct damages of $34,000 and indirect damages of $1,700, a total of $35,700. Total observed damage represents about 70% of total estimated damages of $51,100, of which $48,500 was direct and $2,600 was indirect. The distribution of these losses by location is presented in the table below. Direct damages were principally to buildings, household furnishings, and personal belongings, and included labor for cleanup work. Damage caused by Napa Creek also included damage to private protection works, grounds, and improvements. Indirect damages were largely the cost of evacuation and reoccupation, with some cost for emergency protective measures. Napa River residential damages are summarized in Table 22.

Table 22

Summary of Residential Damages
Napa River Basin

Item	No. of units observed	Damage		
		Direct	Indirect	Total
City of Napa and vicinity	89	$ 30,700	$ 2,000	$ 32,700
City of Napa (from Napa Creek)	36	14,600	400	15,000
Total City of Napa and vicinity	125	$ 45,300	$ 2,400	$ 47,700
Valley north of Napa	4	3,200	100	3,300
Total above Suscol	129	$ 48,500	$ 2,500	$ 51,000
Below Suscol	1	0	100	$ 100
Total Napa River Basin	130	$ 48,500	$ 2,600	$ 51,100

131. Agricultural damage. Losses to agricultural lands and improvements were obtained by District Office personnel with the cooperation of the Napa County Agricultural Commissioner. From field investigation by personnel of both offices, damage appraisals were made on 70 percent of the farms in the flood plain and 86 percent of the total damages. It was found that the principal damage was to newly planted grain or hay crops, pasture, orchards, fences, and levees. Crop damage is estimated to be 55 percent of the total agricultural damage. Stock loss was held to a minimum due to evacuation of stock animals to places of safety; 13 head of cattle and 9 calves are reported to have been lost. Sampled damages were $123,900 and expanded damages were $143,300, of which $91,700 was above Suscol. Estimates of agricultural damages are subject to later revision due to the fact that farmers could not accurately estimate damages to crops planted last fall or to orchards which were submerged for a considerable length of time. Agricultural losses from this flood will be reevaluated during the harvest period in cooperation with the County Agricultural Commissioner and results will be included in a supplement to this report.

132. Roads, bridges, and city streets. Damages to roads, bridges, and city streets amounted to $136,800, all direct. Of this amount, $134,800 was to county roads and State highways, including the damage done by the discharge from Conn Valley spillway, and $2,000 was damage from erosion of culverts and city streets in Napa.

133. Water and sewage systems. The only material damage under this heading was to the sewage system in Napa. This system also receives storm water, and it is estimated that the cost of clearing the pipelines of sand, silt, and gravel washed into them during the flood was $15,500.

134. Transportation and public utilities. The only transportation company which suffered material damages in this area was the Napa Transit Comapny which operates chartered busses out of Napa. Damage amounting to $4,000 occurred to busses, supplies, and shop equipment. The Southern Pacific Railroad damages were negligible in this area. The Pacific Telephone and Telegraph Company and Western Union suffered no damage, and damage to the Pacific Gas and Electric property was negligible.

135. U. S. Coast and Geodetic Survey. The U. S. Coast and Geodetic Survey gaging station near St. Helena was damaged to the extent of $1,200.

136. Public buildings. As far as has been determined, there was no flood damage to public buildings in the Napa River Basin caused by Napa River or any of its principal tributaries; however, local runoff damaged the State Hospital grounds and installations at Imola.

137. Private levees. Damage occurred to private levees above and below Napa. Above Napa, the damage to levees consisted primarily of overtopping and large gaps being eroded through the structure. Below Napa, damage was confined generally to overtopping, and most erosion occurred on the landside from the high velocity of water running down the levee slope. The total damage to private levees is estimated to be $40,000.

138. Public health and safety. In the area flooded by both Napa Creek and Napa River in the city of Napa and vicinity, there were numerous instances in which flood water backed up the sewage outlets and flooded homes. There were also some instances of wells being flooded and polluted with contaminated water. One woman ascribed her rather long illness to drinking from a well which was thus contaminated. It was also noted that, especially in the houses in the area where the flood water had remained for several days, there were numerous cases of illness, particularly among children. Some were ill with colds, probably brought on or accentuated by the damp condition of the homes, and some may have become ill from drinking polluted water or eating contaminated food. No allowance has been made in this damage estimate for the effect of the flood upon the health of the people. As far as known, there were no deaths caused by the flood.

139. Rescue and evacuation activities. The Civil Defense Administration evacuated approximately 300 people from the flooded area within and to the northeast of Napa. In general, people received some short warning, but in a few cases they did not know of the flood until it entered their houses or business properties. There are an unusually large number of boats in Napa for a city of this size, and this fact greatly aided the evacuation of people from their houses. Those evacuated were quartered with friends, in churches, or in hotels. Flood damages for the Napa River Basin are tabulated in Table 23.

Table 23

Summary of Damages (Floods of December 1955)
Napa River Basin

Item	Damage		
	Direct	Indirect	Total
Commercial	$ 101,100	$ 60,000	$ 161,100
Residential	48,500	2,600	51,100
Agricultural	172,300	-	172,300
Roads and bridges	136,800	-	136,800
Public utilities	19,500	-	19,500
Federal property	1,200	-	1,200
Total	$ 479,400	$ 62,600	$ 542,000

SAN LORENZO CREEK BASIN (Area 2)

140. Basin description. San Lorenzo Creek rises in the hills east of the city of Hayward in Alameda County, flows westerly for approximately 10 miles, and empties into San Francisco Bay in the vicinity of the town of San Lorenzo. About nine-tenths of the area drained by the creek is hill country and the remaining one-tenth is the flat lowland by the bay. The drainage area is fan-shaped and comprises 45 square miles. The principal tributaries are Cull and Crow Creeks from the north and Palomares Creek from the south.

141. Flood discharge. The estimated peak discharge on San Lorenzo Creek at Hayward on 23 December, from a drainage area of 38 square miles, was about 4,800 c.f.s., which exceeded the previous maximum of 3,440 c.f.s. recorded in February 1940. The December 1955 flood has probably been exceeded several times since January 1862.

142. Damage. The inundation of agricultural land by San Lorenzo Creek and its tributaries was minor in extent. In the upper basin, farm property damage from stream erosion was appreciable. Bank cutting occurred on Crow Creek, Cull Creek, and Palomares Creek, endangering and destroying property. Several bridges were damaged or destroyed, isolating some farms for a few days until bridges could be repaired or replaced. Traffic was slightly impaired in the city of Hayward due to flooding of San Lorenzo Creek. Road and highway damage from flooding was negligible. The bulk of the flood damage was residential. It is

estimated that approximately 200 homes were damaged; 130 by flooding and 70 by bank cutting. The total area flooded was about 750 acres, all of which was in the city of Hayward. The average depth was about $2\frac{1}{2}$ feet and the maximum depth, 6 feet. Bank erosion occurred in Hayward, San Lorenzo, and in the unincorporated areas along San Lorenzo Creek. Contributing causes of the flooding and bank erosion was the large quantity of runoff and the uprooted trees and debris in the creek which formed debris jams. These obstructions in the stream caused scouring of banks just upstream from the obstructions and general flooding both upstream and downstream of the debris jams. Non-residential damage occurred in Hayward, San Lorenzo, and in Crow Canyon. Most of this damage was caused by erosion and bank caving. Included in non-residential damage is the cost of restoring flood control works by the city, county, State, and Federal governments. No public utility damage resulted from flooding or bank cutting by San Lorenzo Creek. There were no lives lost and no serious health problems developed.

143. District Office personnel conducted a flood damage survey, interviewing State, county, and local people to evaluate losses due to the flood. Agricultural damage was obtained by investigating approximately half of the farms and evaluating the remaining ones on the basis of those sampled. High-water marks for the 22 December 1955 flood were established and will be leveled in to mean sea level datum.

144. The damage resulting from the 22 December 1955 flood for the San Lorenzo Creek Basin totals $930,300. The breakdown of these damages is shown in Table 24.

Table 24

Summary of Damages (Floods of December 1955)
San Lorenzo Creek Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 329,400	$ 6,300	$ 335,700
Non-residential	114,800	-	114,800
Agricultural	56,800	-	56,800
Restoration (F.C.D.A.)	81,000	-	81,000
Total Private	$ 582,000	$ 6,300	$ 588,300
Public			
Roads and bridges	$ 250,000	-	$ 250,000
Railroads	neg.	-	neg.
Public utilities	neg.	-	neg.
Federal, State and County flood control works	92,000	-	92,000
Total Public	$ 342,000	-	$ 342,000
Total damage	$ 924,000	$ 6,300	$ 930,300

ALAMEDA CREEK BASIN (Area 2)

145. Basin description. Alameda Creek rises in the Diablo Range in Santa Clara County, flows northerly and westerly for approximately 41 miles, and empties into San Francisco Bay in the vicinity of the town of Alvarado. The drainage area below the outlying mountains consists of two major valleys, Livermore Valley and the Alvarado-Niles Valley, connected by a 6-mile canyon between Niles and Sunol through which Alamada Creek flows. The watershed is roughly rectangular in shape, approximately 45 miles long and 15 miles wide, with its major axis running northwesterly. The drainage area of the basin is 696 square miles. The principal tributaries of Alameda Creek are the Arroyo del Valle, Arroyo de la Laguna, and Calaveras Creek.

146. Flood discharge. The estimated peak discharge of 21,000 c.f.s. on Alameda Creek near Niles on 23 December, from a drainage area of 633 square miles, exceeded the previous maximum of 18,500 c.f.s. recorded in January 1952. Since discharge from the drainage area above Calaveras Dam was completely controlled, it is believed that the December 1955 flood was among the greatest, if not the greatest, flood since January 1862.

147. Flood damage. It is estimated that 15,232 acres of pasture and other agricultural land in the Livermore Valley and Alvarado-Niles Valley were inundated to an average depth of about 2 feet by Alameda Creek and its tributaries, Arroyo del Valle, Arroyo de la Laguna, and the Arroyo Mocho. Flood waters from Alameda Creek overflowed into large gravel pits near Centerville, filling them till they overflowed and threatened the town of Centerville. Percolation pits at Niles were filled and overflowed when a levee failed. Agricultural damage consisted mostly of silt deposits, scouring, and, in some cases, complete destruction of pasturelands by erosion and deposition of gravel. Large amounts of unharvested cauliflower were rendered unfit for marketing by flooding and silting. The loss to livestock was negligible. Bank cutting occurred on the left bank of the Arroyo del Valle in Pleasanton below the Southern Pacific Railroad bridge, and below the Division Street bridge. State and county highways and roads were damaged considerably by slides and erosion. No major highway bridges were washed out. Commercial and tourist travel was disrupted or completely stopped at several points for periods from 1 to 12 days. Contributing factors to the flooding were the limited capacity of Alameda Creek and some tributaries due to large quantities of brush and growth in the creek, and inadequate levees which were overtopped in some places or which failed without overtopping in other places. Gopher holes were the cause of levee failure in many cases.

148. Traffic on State Highway 17 was closed from Alvarado to Decoto Road for one day by inundation. The Niles Canyon Road, a State road, was closed by slides and washouts at a few points for a

period of 12 days. Stonybrook Road was closed by washouts for several days. Kilcare Road was damaged by erosion from Sinbad Creek. Arroyo Road to the Veterans Hospital was damaged in several places, isolating the hospital for 12 hours. State and county road crews working under adverse conditions reestablished through traffic by repairing Niles Canyon Road, Arroyo Road, and other damaged roads. Heavy trucking over Niles Canyon Road was restricted for several days until final repairs were completed. Flooding of farm roads and county roads in Alvarado isolated farms for a short period.

149. Residential damage was greatest in Niles. When the Shinn Percolation Pit levee failed and the pit was overflowed, a residential section, Valle Serra, was inundated to an average depth of 3 feet. Because residents had no warning, the damage sustained in this area was the maximum that could be expected from inundation of that depth. The storm drains for this area empty into the percolation pit. When the levee failed, the water from Alameda Creek filled the percolation pit, backed up through the storm drains, and came out of the catch basins. Water also came through the low point at the east side of the area. Though the area was flooded for only one day, the damage was extensive. Hardwood floors were warped so badly that they had to be completely replaced. Rugs and upholstered furniture were damaged beyond economical repair. Walls were cracked and in some cases the foundations were damaged. Of 236 homes in the Valle Serra tract, about 155 suffered some flood damage. Those that had no direct flood damage suffered a depreciation in value by virtue of being in the flooded area. This loss was not included in the flood damage survey. Flooding in Alvarado to an average depth of $1\frac{1}{2}$ feet did little residential damage as the people were warned and, in some cases, evacuated by the Alameda County Sheriff's Department.

150. The bulk of industrial (non-residential) damage was suffered in the Niles area. A steel mill had over $1,000,000 direct damages and $300,000 indirect losses as a result of 4 feet of flooding. In the same area, a tile manufacturer lost $130,000 from flood damages as a result of 3 feet of inundation. In the Alvarado area, a concrete pipe manufacturer had $20,000 direct damage and $80,000 indirect losses from about one foot of flooding. These three manufactueres alone accounted for over $1\frac{1}{2}$ million dollars in direct and indirect flood damages. This amount represents over 36 percent of the total of all flood damages in the Alameda Creek Basin. Railroad damage was sustained by the Southern Pacific Company in the Alvarado-Newark section, and by the Northwestern Pacific Railroad in the Niles Canyon section.

151. Public utility damage was sustained by the San Francisco Water Department, whose pipeline, bridges, aqueduct, dam, and land were damaged. Interruption of public utility services in the Alameda Creek Basin was negligible.

152. There were no lives lost and no serious health problems developed.

153. District Office personnel conducted a flood damage survey, interviewing State, county and local people to evaluate losses due to the storm and flood. Agricultural damage was obtained by investigating approximately 60 percent of the farms in the flood plain and evaluating the remaining acreage on the ratio of the sampled area to the total acreage in the flood plain. High-water marks for the December 1955 flood were established and will be leveled in to mean sea level datum. The damages resulting from the 22 December 1955 flood for the Alameda Creek Basin total $4,124,600. The breakdown for these damages is shown in Table 25.

Table 25

Summary of Damages (Floods of December 1955)
Alameda Creek Basin

Item	Damage		
	Direct	Indirect	Total
Private			
Residential	$ 428,400	$ 19,000	$ 447,400
Non-residential	1,778,000	602,000	2,380,000
Agricultural	880,000	-	880,000
Bank erosion*	(63,000)	-	(63,000)
Flood-control works (Federal and county funds)	106,900	-	106,900
Total Private	$ 3,193,300	$ 621,000	$ 3,814,300
Public			
Roads and bridges	$ 180,000	$ -	$ 180,000
Railroads	84,000	20,000	104,000
Public utilities	17,400	-	17,400
Federal, State, and county	8,900	-	8,900
Total Public	$ 290,300	$ 20,000	$ 310,300
Total damage	$ 3,483,600	$ 641,000	$ 4,124,600

*This damage is included in residential and agricultural totals.

MISCELLANEOUS BASINS IN CONTRA COSTA COUNTY (Area 2)

154. Rodeo Creek drains a relatively small area southeast of the town of Rodeo on the south shore of San Pablo Bay near Carquinez Strait. During the storm of December 1955, this creek overflowed its banks at the pedestrian bridge at Second Street and at the next street upstream. Water flowed along Second and adjacent streets and came up to the doorways of several business places but in most cases was prevented from entering by sandbagging. Some of the homes along the creek bank had water in their cellars but none in their homes. In general, there was little damage. It is estimated that the cost of flood fighting and cleanup amounted to $1,000. Damage to commercial and residential property was negligible. There was an estimated damage of $1,000 to county roads. The total damage from Rodeo Creek Basin was $2,000.

155. Wildcat Creek drains a relatively long narrow area immediately south of San Pablo Creek and runs through the towns of San Pablo and North Richmond to discharge into San Pablo Bay north of the Standard Oil Refinery. The creek overflowed its banks at the Verdi School in North Richmond but there was no water in the school building and no expense except for the purchase of sandbags. Water also overtopped the levees downstream from the school in small quantity near the P. Pippo property with little or no damage. At the end of Gertrude Avenue, where Wildcat Creek enters a slough leading to San Pablo Bay, water overflowed an area occupied by a number of "Arks." Water came over walkways and entered some sheds up to a depth of one-half foot adjacent to the "Arks." Total flood damage from this creek is estimated to be $1,000 to private property, principally in damage prevention and cleanup work, and $2,000 to county roads. Total damage from Wildcat Creek was $3,000.

156. Unnamed creek north of San Pablo Creek, of very limited drainage area, runs through the northern portion of the town of San Pablo and skirts an industrial installation at Rheem on the Santa Fe Railroad to discharge into San Pablo Bay about three-fourths mile north of San Pablo Creek. The creek left its banks just east of the eastern boundary of the town of San Pablo and flowed southwest through El Portal School grounds causing damage to equipment and expense of cleanup. The flow then continued to the west to the State Highway and then north to rejoin the stream channel. About halfway between the highway and Rheem it overflowed its banks, flooding a considerable area, including the grounds of the Bay View School, and causing damage. Downstream from the school, water overflowed the area in the vicinity of 13th Street, flowed around 10 to 15 homes, damaged property in garages, and deposited silt over the area. The flooded area extended downstream to the American Standard Products Factory at Rheem causing damage to structures, raw material, and finished products. Total damages for the basin are estimated to be $21,500, itemized as follows: residential direct, $1,000; non-residential direct, $18,500; public works and schools, $2,000. $100 was expended by the National Guard for flood emergency work.

157. Alhambra, Pinole, and San Pablo Creeks. Flooding and flood damages were negligible within cities on these creeks, but damage to county roads by Alhambra and San Pablo Creeks and their tributaries was extensive, causing an estimated $18,100 on Alhambra Creek and $87,200 on San Pablo Creek. High-water marks have been established on these creeks and will be leveled in for future reference. The estimated damages for the small creeks in Contra Costa County are summarized in Table 26.

Table 26

Summary of Damages (Floods of December 1955)
Small Creeks in Contra Costa County

Item	Damage		
	Direct	Indirect	Total
Residential	$ 4,100	$ -	$ 4,100
Non-residential	18,500	1,000	19,500
Public buildings	2,000	-	2,000
Roads and bridges	108,300	-	108,300
Total	$ 132,900	$ 1,000	$ 133,900

COLMA CREEK BASIN (Area 3)

158. Basin description. Colma Creek has its source in the hilly regions southwest of Daly City, and flows in a generally southeasterly direction to empty into San Francisco Bay in a low marshy area near the industrial section of South San Francisco. The basin is approximately 15 square miles in extent, and the topography varies from hilly in the upper reaches to low and flat in the lower reaches. It is thickly populated and contains portions of the city of South San Francisco and a number of suburban developments. In the upper portion of the basin, a considerable number of large cemeteries are located. The low-lying area near the mouth of the creek contains many warehouses and light manufacturing enterprises. A branch line of the Southern Pacific Railway parallels the creek for the greater portion of its length, and Highway U. S. 101 traverses the center of the basin for several miles. The Bayshore Freeway, an alternate of Highway U. S. 101, crosses the area near the outlet into San Francisco Bay.

159. Storm rainfall. Meteorological records of the area indicate that during the storm period 15 - 28 December 1955, the heaviest rainfall occurred during the periods 18 through 20 December and 22 through 24 December. Unofficial precipitation stations in and near the basin recorded the following amounts of rain:

Station	Precipitation, inches	
	18 - 20 Dec. 1955	22 - 24 Dec. 1955
Lake Merced	2.12	4.69
San Bruno	3.03	6.22

No records are available of flood crests or discharges on Colma Creek. In the opinion of local inhabitants, the heights reached in the December 1955 flood did not greatly exceed past floods.

160. Flooded areas. Damage in the low-lying areas in South San Francisco which were inundated was primarily to city streets.

161. Description of flood damage and summary of losses. The only reported costs were those occasioned by removal of silt from the stream channel and from streets and sewers. The Corps of Engineers, U. S. Army, expended $43,200 for removing silt from the stream channel and the city of South San Francisco expended $8,400 for cleaning and flushing streets and sewers. The damages for the Colma Creek Basin are summarized below:

Table 27

Summary of Damages (Floods of December 1955)
Colma Creek Basin

Item	Damage		
	Direct	Indirect	Total
Roads and bridges	$ 8,400	$ -	$ 8,400
Emergency aid	43,200	-	43,200
Total	$ 51,600	-	$ 51,600

SAN BRUNO CREEK BASIN (Area 3)

162. Basin description. The headwaters of San Bruno Creek are in the hilly region to the west of the city of San Bruno. The creek meanders in a general northeasterly direction to the outskirts of the city of San Bruno where it goes underground into a man-made channel, to emerge in a low marshy area near the San Francisco Bay. The basin, approximately 3 square miles in extent, is thickly populated and contains the major portion of the city of San Bruno. It is traversed by Highway

U. S. 101 and a branch of the Southern Pacific Railroad. The elevation of the basin varies from 500 feet in the upper reaches to sea level at the mouth.

163. Storm rainfall. The storm period on San Bruno began 15 December and extended to 28 December 1955, with the heaviest rainfall occurring on 18 through 20 December and 22 through 24 December. Rainfall stations recorded the following precipitation for these periods:

Station	Precipitation, inches	
	18 - 20 Dec. 1955	22 - 24 Dec. 1955
San Bruno	3.03	6.22
San Francisco Airport	2.07	4.81

No records of stages or discharges are available on San Bruno Creek.

164. Description of flood damages and summary of losses. The only reported costs due to flood damages on this creek were for removal of extremely heavy accumulations of silt from the stream channel and from the streets and sewage system of the city. The Corps of Engineers, U. S. Army, expended $16,000 and the city of San Bruno $23,000 for this work. Damages are summarized in Table 28.

Table 28

Summary of Damages (Floods of December 1955)
San Bruno Creek Basin

Item	Damage		
	Direct	Indirect	Total
Roads and bridges	$ 23,000	$ -	$ 23,000
Emergency aid	16,000	-	16,000
Total	$ 39,000	-	$ 39,000

COASTAL STREAM BASINS - SAN MATEO COUNTY (Area 3)

165. Description. A number of streams, having their origin high in the Santa Cruz Mountains in the area extending from the southern boundary of San Mateo County northward to the San Andreas Lake region,

overflowed their banks in the December 1955 flood. The principal streams upon which appreciable damages occurred are Pilarcitos Creek, San Gregorio Creek, Tunitas Creek, and Pescadero Creek. Pilarcitos Creek, the northernmost of the streams, rises in the region slightly south and west of San Andreas Lake, from whence it flows in a general southeasterly direction for approximately 7 miles and then turns sharply southwest to empty into the Pacific Ocean at Halfmoon Bay. San Gregorio Creek has its source near the town of La Honda and flows almost due west to the Pacific Ocean. Tunitas Creek has its origin high in the Santa Cruz Mountains southwest of the city of Burlingame. It flows in a general southwesterly direction and empties into the Pacific Ocean about 2½ miles north of San Gregorio. Pescadero Creek, near the southern boundary of San Mateo County, originates in the area near the extreme southeast corner of San Mateo County and flows generally northeast to the Pacific Ocean in the vicinity of the town of Pescadero. The basins of these streams, containing, respectively, 28.8, 53.0, 7.5, and 46.2 square miles of area, are mountainous except for the coastal plains near their mouths. Banks are steep and well defined and generally heavily wooded, especially in the upper areas.

166. Storm rainfall and stages. Unofficial rainfall reports indicate that the most intensive precipitation prior to the flood occurred during the periods 19 and 20 December and 22 to 24 December 1955. Following is a tabulation of unofficial rainfall stations and recordings in each basin, with the exception of Tunitas Creek for which no records are available (the nearest station is in the San Gregorio Creek Basin at the Eastman Estate, Woodside):

Station	Precipitation, inches	
	19 - 20 Dec. 1955	22 - 24 Dec. 1955
Pilarcitos Creek Basin		
San Andreas Reservoir	3.25	8.20
Pilarcitos Reservoir	4.10	11.62
Upper Crystal Springs Reservoir	2.25	5.76
San Gregorio Creek Basin		
Crystal Springs Cottage	2.02	4.78
Eastman Estate, Woodside	3.53	8.46
Searsville Lake	3.69	9.19
La Honda	4.65	6.97
San Gregorio	3.58	7.01
Pescadero Creek Basin		
Portola Redwoods State Park	8.32	11.26
La Honda	4.65	6.97

The maximum recorded discharge of 9,420 c.f.s. on Pescadero Creek, which occurred at 2 A.M. on 23 December 1955, exceeded the previous peak of 3,440 c.f.s. recorded 7 December 1952. No records are available on the other creeks, but inhabitants of the basins of all three streams assert that stages reached in the December 1955 flood exceeded anything in their memories.

167. Flooded areas. Estimates of the flooded areas were derived by detailed reconnaissance in the field, and the extent of the flood plains was delineated on the best available maps. The estimated gross areas flooded as a result of the December 1955 flood are given below:

Stream	Area Flooded, Acres
Pilarcitos Creek	29
San Gregorio Creek	159
Tunitas Creek	10
Pescadero Creek	654

168. Evacuations and persons displaced. Information received from the American Red Cross, Salvation Army, local city officials, and local inhabitants indicates that about 10 families were evacuated in the Pescadero area.

169. Pilarcitos Creek damage. Reported losses in this section were entirely agricultural in nature and consisted principally of damages to artichoke crops and erosion of farmland. Estimated damages were $23,300 direct and $3,100 indirect, or a total of $26,400, which are summarized in Table 29.

Table 29

Summary of Damages (Floods of December 1955)
Pilarcitos Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 23,300	$ 3,100	$ 26,400

170. San Gregorio Creek damage. Damages along San Gregorio Creek were principally agricultural and totaled $50,500, of which $48,500 was direct and $2,000 indirect. Removal of slides, repair of roads, and

clean-up of debris was accomplished at a cost of $14,700. The San Gregorio Creek Basin damages are summarized in Table 30.

Table 30

Summary of Damages (Floods of December 1955)
San Gregorio Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 48,500	$ 2,000	$ 50,500
Roads and bridges	14,700	-	14,700
Total	$ 63,200	$ 2,000	$ 65,200

171. Tunitas Creek damage. The heavy rainfall and rapid runoff from the steep slopes washed many trees and accumulations of debris into the stream where they lodged at numerous small bridges over the channel, causing undercutting of the banks and resulting in numerous slides and cave-ins along the roads and at bridge approaches. Removal of slides and repair of damage to bridges and roads cost the State of California and San Mateo County an estimated $58,300. Tunitas Creek Basin damages are summarized in Table 31.

Table 31

Summary of Damages (Floods of December 1955)
Tunitas Creek Basin

Item	Damage		
	Direct	Indirect	Total
Highways, roads, and bridges	$ 58,300	-	$ 58,300

172. Pescadero Creek damage. The major damage in the basin was to vegetable crops, principally artichokes, broccoli, and lettuce, when an estimated 430 acres of farmland were flooded. Erosion of topsoil, deposition of silt and debris, and cutting away of creek banks, all of which was direct damage, resulted in an estimated loss of $174,000. Approximately 15 homes in the town of Pescadero were flooded to a depth

of about one-half foot. Estimated residential damages were $13,600 direct, and $400 indirect, for a total of $14,000. Commerical damage was limited to a parts department in a local garage and filling station and was estimated to be $3,600, of which $2,400 was considered direct and $1,200 indirect. Repair and rehabilitation of county roads along Pescadero Creek and tributaries and replacement of a 60-foot timber bridge on Pescadero Road was estimated to cost $43,600. The Corps of Engineers, U. S. Army, expended about $72,000 in removing log jams and clearing stream channels. The American Red Cross expended an estimated $27,700 in the evacuation, maintenance, and rehabilitation of flood victims. Total estimated expenditures for emergency aid were $99,700, and are summarized in Table 32.

Table 32

Summary of Damages (Floods of December 1955)
Pescadero Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 174,000	$ -	$ 174,000
Residential	13,600	400	14,000
Commercial	2,400	1,200	3,600
Highways, roads, and bridges	43,600	-	43,600
Emergency aid	27,700	72,000	99,700
Total	$ 261,300	$ 73,600	$ 334,900

173. Total damage, coastal stream basins. The total damage for coastal streams in San Mateo County are summarized in Table 33.

Table 33

Summary of Damages (Floods of December 1955)
Coastal Stream Basins - San Mateo County

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 245,800	$ 5,100	$ 250,900
Residential	13,600	400	14,000
Commercial	2,400	1,200	3,600
Highways, roads, and bridges	116,600	-	116,600
Emergency aid	99,700	-	99,700
Total	$ 478,100	$ 6,700	$ 484,800

SAN MATEO CREEK BASIN (Area 3)

174. Basin description. San Mateo Creek drains an area of approximately 34 square miles in central San Mateo County, extending from Skyline Boulevard on the easterly side of lower Crystal Springs Lake to San Francisco Bay, and discharges into the bay at a point approximately 13 miles south of the southern limits of the city and county of San Francisco. San Mateo Creek rises in the western part of the basin and flows easterly until controlled at Skyline Boulevard by a water supply dam for the city of San Francisco, known as Crystal Springs Dam. Approximately 30 square miles of the drainage basin lie above the Crystal Springs Reservoir. The downstream portion of the creek meanders through the city of San Mateo to marshlands adjoining Lower San Francisco Bay. The stream is contained by levees in the lower reach from Bayshore Highway to the San Mateo-Hayward Bridge Highway where the stream passes through highway culverts into the tidal marsh of Lower San Francisco Bay, with the outlet controlled by tide gates.

175. Storm rainfall and stages. During the storm period 15 - 28 December 1955, rainfall reports indicate the most intense rainfall occurred during the period 18 - 20 December and 22 - 24 December 1955. The following rainfall was recorded in the area:

	Precipitation, inches	
Station	18 - 20 Dec. 1955	22 - 24 Dec. 1955
San Mateo	1.60	5.86
Lower Crystal Springs	2.35	5.53
Pilarcitos Reservoir	4.24	11.62

During either the night of 23 December or the morning of 24 December 1955, San Mateo Creek overflowed its left bank where the levee ties into the Bayshore Highway-San Mateo Bridge cloverleaf, which is lower than the general height of the levee system downstream. The levee system downstream of Bayshore contained the stream flow except at culverts under the San Mateo-Hayward Bridge Highway, at which point the highway is lower than the levee system.

176. Description of the flood. San Mateo Creek flowed at approximately bankfull capacity at Highway U. S. 101, causing the storm drainage system for Mills Memorial Hospital to be ineffective, thus backing storm water into the lower floors. In the vicinity of Bayshore Highway, the creek overflowed its banks inundating the main approach to the San Mateo-Hayward Bridge Highway and depositing silt and debris throughout the general area. Overflow water meandered through the north

shoreview area, accumulating in a low residential area for a period of time until the local storm sewer system, which pumps into San Francisco Bay, could accommodate the additional inflow. The creek also overflowed the San Mateo-Hayward Highway where the stream passes under the highway. This, combined with the aforementioned overflow, resulted in closure of the San Mateo-Hayward Highway for a period of 12 to 15 hours. During the night of 23 December and the morning of 24 December, the levee on the right bank adjacent to residential property became saturated, allowing large quantities of water to seep through and inundate the surrounding area to an approximate depth of 3 feet above the gutter line, causing extensive damage to a residential area where construction was slab-on-grade. The main factors contributing to the overflow and prolonged high stage of the creek were a series of seasonal high tides and an inadequate outlet structure under the highway. The outlet structure has since been replaced by a larger structure. The damages are summarized in Table 34.

Table 34

Summary of Damages (Floods of December 1955)
San Mateo Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 26,700	$ 2,500	$ 29,200
Non-residential	3,400	-	3,400
Total	$ 30,100	$ 2,500	$ 32,600

SAN FRANCISQUITO CREEK BASIN (Area 3)

177. Basin description. The San Francisquito Creek drainage basin is an area of approximately 40 square miles, extending from Skyline Boulevard on the ridge of the Santa Cruz Mountains to San Francisco Bay. The creek enters the bay at a point approximately 25 miles south of the southern limits of the city and county of San Francisco. Approximately 85 percent of the drainage area and its tributaries lies in San Mateo County, draining the Woodside and Portola Valleys and adjacent mountain region. The remaining 15 percent lies in Santa Clara County. For a considerable distance in its lower reaches, this stream forms the boundary between San Mateo and Santa Clara Counties. To the south is the city of Palo Alto, and to the north is the city of Menlo Park, the town of Atherton, and the unincorporated area of East Palo Alto.

Tributary streams include West Union Creek, Corte di Madera Creek, Bear Creek, and Los Trancos Creek. San Francisquito Creek rises in the western part of the basin and passes through Searsville Lake, which is also fed by Corte Madera Creek and Corte di Madera Creek. The narrow outlet portion of the drainage basin is along the crest and southerly slope of a comparatively extensive alluvial cone, which extends from the foot of the hills (approximate elevation 150) to the marshlands adjoining the bay. The general ground level slopes away from the stream. Consequently, when San Francisquito Creek overflows, the flood waters augment the flood flow of the lower portion of Matadero Creek on the south.

178. Storm rainfall and stages. During the storm period 15 - 28 December 1955, rainfall reports indicate the most intense rainfall occurred during the period 18 - 20 December and 22 - 24 December 1955. The following rainfall was recorded in the area:

Station	Precipitation, inches 18 - 20 Dec. 1955	22 - 24 Dec. 1955
Searsville Lake	3.69	9.19
Skylonda	6.64	12.41
Stanford University	1.86	5.71
Eastman Estate-Woodside	3.53	8.46
Woodside	5.72	7.80
Schilling	4.54	10.23
Palo Alto City Hall	1.85	4.73

Shortly after 6:00 P.M., 22 December 1955, a heavy tropical storm, accompanied by near hurricane winds and torrential rainfall, struck the entire watershed of the streams that flow through Palo Alto. The water in San Francisquito Creek rose rapidly after 7:00 P.M., and by 9:45 P.M. was approximately 1 foot below the highway pavement at Bayshore Highway. As the stream continued to rise and the velocity increased, it undercut the stream banks and, together with the high winds, caused many large trees to fall into the channel. The peak discharge occurred at approximately 1:30 A.M., 23 December 1955, in the vicinity of Middlefield Road. The peak discharge recorded at midnight, 22 December, at the Stanford University gaging station, 5,560 cubic feet per second from a drainage area of 35.7 square miles above the gaging station, exceeded the previous maximum of 3,650 cubic feet per second recorded in November 1950. It is believed that the December 1955 flood is among the greatest that have occurred on San Francisquito Creek since January 1862.

179. Evacuation and persons displaced. Based on information obtained from the city of Palo Alto and that compiled during flood damage surveys, it is estimated that more than 1,000 persons were displaced as a result of the flood. The Red Cross and affiliates established facilities to care for the evacuees in the Jordon Junior High School, and many more found refuge with friends and relatives in the local areas.

180. Description of the flood. Sometime between 11:00 P.M. and 11:30 P.M. on 22 December, a log jam at the Bayshore Highway Bridge caused the stream to overflow the south bank above Bayshore Highway. This water flowed south, parallel to Bayshore Highway and into the city streets, thus into the Greer Park Subdivision where the water reached a maximum height of more than 3 feet above the floors of the houses. Upstream at the Pope-Chaucer Street Bridge another log jam occurred at approximately the same time causing water to overflow the right bank and flow into the city of Palo Alto. At approximately 12:45 A.M., 23 December, the stream was still rising, resulting in overflow of the leveed bank approximately 400 feet upstream of Bayshore Highway. Overflow also occurred in the unleveed section approximately 2,000 feet upstream of Bayshore Highway. The total area flooded included 1,171 acres of residential and commercial property and 69 acres of agricultural property, for a total of 1,240 acres. Peak discharge was observed at approximately 1:30 A.M., 23 December, at which time the creek overflowed its banks from Middlefield Road for a distance of approximately 1 mile downstream, with overflow traveling down the streets. This extreme peak was maintained for approximately an hour, after which the stream began to fall gradually and had returned to its banks by 4:00 A.M. During the period 11:30 P.M., 22 December, to 3:30 A.M., 23 December, the overflow water flowed over Bayshore Highway approximately 10 inches deep near the creek, and 3 inches deep near Matadero Creek to the south. The overflow water from the creek traveling by various routes accumulated against Bayshore Highway and the Matadero-Seale Canal levees, resulting in a water surface higher than the levees of Seale Canal. The overflow fortunately washed out the levees downstream allowing the flood water in Greer Park to flow into Seale Canal, thence into the Matadero-Adobe Creek flood basin. Downstream from Bayshore Highway the overflow water covered portions of the golf course and subsequently moved into the airport area when the drainage pumps were unable to handle the volume. Supplemental pumps were installed and several days of pumping were required to eliminate the overflow water in the airport area. The receding flood waters revealed that the banks of the creek had been eroded and the channel enlarged 30 to 40 percent.

181. Summary of losses. The most concentrated damages were sustained in commercial and residential areas, comprising an area of approximately 1,171 acres, with a maximum inundation of approximately $3\frac{1}{2}$ feet above floor levels occurring in Greer Park. Damages are summarized in Table 35.

Table 35

Summary of Damages (Floods of December 1955)
San Francisquito Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 1,449,800	$ 66,700	$ 1,516,500
Non-residential	117,100	8,500	125,600
Highways, roads, and bridges	31,400	-	31,400
Emergency aid	220,500	-	220,500
Total	$ 1,818,800	$ 75,200	$ 1,894,000

MATADERO CREEK BASIN (Area 3)

182. Basin description. Matadero Creek drains approximately 8 square miles of mountainous area and 6 square miles of valley land in northern Santa Clara County from approximately one mile above Atascadero Road to the Matadero-Adobe Creek flood basin. Matadero Creek and its tributary streams, including Los Robles Creek on the south and Frenchman's Creek, locally known as Dartmouth Canal, drain the central portion of the Stanford University Campus, the Stanford Industrial Research area, and the adjacent foothills. The creek meanders through the city of Palo Alto collecting inflow from the city's storm drainage system.

183. Storm rainfall and stages. During the storm period 15 - 28 December 1955, rainfall reports indicate the most intense period of rainfall occurred during the period 18 - 20 December and 22 - 24 December 1955. The rainfall in this basin was similar to that recorded for the San Francisquito Creek drainage basin. The peak discharge recorded by the U.S.G.S. was 854 cubic feet per second. It is believed that the December 1955 flood is among the greatest of record.

184. Description of the flood. Between 11:00 P.M. and midnight 22 December 1955, culverts in the vicinity of the Stanford University Campus and the western city limits of Palo Alto poured water into the city streets, flooding Highway U. S. 101 and inundating the Mayfield School. The total area flooded was 102 acres of residential and commercial property. Overflow waters did little damage in homes. A materials company suffered damage to motors and pumps. Debris-laden

overflow waters poured through a large warehouse area, depositing tons of silt and debris. The overflow rejoined the creek in the vicinity of the Southern Pacific Railroad. At its crest, the flood water was 3 inches above the Bayshore Highway pavement. The receding flood waters revealed that creek banks had been eroded and degradation of the channel bottom had resulted in the channel being enlarged by 20 to 30 percent.

185. Summary of losses. The major portion of the damages sustained were to the commercial area and to city streets as a result of silt and debris deposits. Damages are summarized in Table 36.

Table 36

Summary of Damages (Floods of December 1955)
Matadero Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 9,700	$ 200	$ 9,900
Non-residential	19,300	1,500	20,800
Bank erosion	13,000	-	13,000
Emergency aid	24,400	-	24,400
Total	$ 66,400	$ 1,700	$ 68,100

ADOBE CREEK BASIN (Area 3)

186. Basin descripition. Adobe Creek drains an area of approximately 9 square miles in northern Santa Clara County from Monte Bello Ridge and Page Mill Road in the Santa Cruz Mountains to the Matadero-Adobe flood basin. The creek meanders through Green Meadow Tract, Fairmeadow Tract, and Mayview Homesites in the southeastern section of the city of Palo Alto, and collects the inflow from the storm drainage systems of the subdivisions bordering the creek.

187. Storm rainfall and stages. During the storm period 15 - 28 December 1955, rainfall reports indicate the most intense period of rainfall occurred during the period 18 - 20 December and 22 - 24 December 1955. Rainfall in this basin was similar to that recorded for the San Francisquito Creek drainage basin. To date, the peak discharge for this storm has not been reported. It is believed, however, that the December 1955 runoff is among the greatest of record.

188. Description of the flood. Between 11:00 P.M. and midnight 22 December 1955, culverts were overflowed due to their inability to pass discharges for a storm of this magnitude, thus causing the flood waters to overflow Highway U. S. 101 with resultant flooding of 73 acres of residential property and 45 acres of agricultural land, for a total flood plain of 118 acres. The accumulated water impounded behind Highway U. S. 101 resulted in the major portion of the damages sustained in this area. Serious bank erosion and the cutting of a new channel in the foothill area above elevation 200 resulted in large damages claimed for a limited number of residences.

189. Summary of losses. The major portion of the damage sustained was to residences and was attributable to bank erosion and the formation of a new stream channel. Damages are summarized in Table 37.

Table 37

Summary of Damages (Flood of December 1955)

Adobe Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 15,000	$ -	$ 15,000
Residential	70,500	400	70,900
Non-residential	900	-	900
Total	$ 86,400	$ 400	$ 86,800

PERMANENTE CREEK BASIN (Area 3)

190. Basin description. Permanente Creek originates high in the Santa Cruz Mountains between Saratoga and Los Altos. It drains an area of approximately 16 square miles and the basin topography varies from mountainous in the upper reaches to flatlands in the lower reaches of the stream. Its course is generally in a northward direction, meandering through the city of Mountain View and emptying into San Francisco Bay almost due north of Mountain View. In its middle and lower reaches the basin is densely settled, containing portions of the cities of Los Altos and Mountain View, and a number of suburban developments. Agricultural areas are intensively farmed and include a large number of apricot, prune, and pear orchards. The basin is adequately served by Federal, State, and County highways and a branch railroad line of the Southern Pacific Company.

191. Storm rainfall and stages. During the storm period 15 - 28 December 1955, records indicate the heaviest rainfall occurred during the periods 18 - 20 December and 22 - 24 December 1955. The following precipitation was recorded in the area:

Station	Precipitation, inches 18 - 20 Dec. 1955	22 - 24 Dec. 1955
Los Altos - Rexworthy	3.74	5.62
Stanford University	1.86	5.71
Palo Alto City Hall	1.85	4.73

192. Recorded gage heights or discharges are not available on Permanente Creek, but long-time residents of the area assert that the December 1955 flood was the highest they had ever witnessed. The heavy rainfall and rapid uncontrolled runoff from the mountains, uprooted and washed out many trees and accumulations of debris which were carried downstream where they became lodged at culverts and other restricted points, blocking the channel and causing the creek to overflow its banks. A number of culverts and bridges in the city of Mountain View were extensively damaged by undercutting and scouring out of the approaches.

193. Flooded areas. A detailed reconnaissance of the area revealed an estimated 770 acres inundated, most of it in the lower reaches of the stream.

194. Evacuations and persons displaced. Residential damage from Permanente Creek waters was minor as far as monetary damages were concerned. However, a number of families residing in the lowland areas had to be evacuated, fed, and housed during the flood period. About 100 persons were evacuated from this area and maintained for periods up to two weeks.

195. Flood damages and summary of flood losses. The greatest reported damages were to agriculture, principally in the lower reaches of the stream. Damage to cauliflower, broccoli, stock feed, and loss of livestock and heavy erosion of land along the channel amounted to $67,300, of which $38,500 is considered direct and $28,800 indirect. Residential losses, almost all of which occurred in the city of Mountain View, were light, amounting to only $4,700. Damages were caused by local overflow due to blocking of culverts by debris. The principal commercial loss was suffered by a salt company which reported extensive losses due to infiltration of salt beds by creek waters. Damage to restaurants, motels, and shops in Mountain View

brought the total estimated damage to $24,200, of which $22,800 is direct and $1,400 indirect losses. Repair and rehabilitation of culverts, bridges, and streets, cleaning of debris and silt from sewers, and miscellaneous repairs to city property damaged by flood waters, will cost the city of Mountain View an estimated $43,300. The American Red Cross spent an estimated $3,000 for the evacuation, care, and rehabilitation of flood victims in the Permanente Creek Basin. The damages are summarized in Table 38.

Table 38

Summary of Damages (Floods of December 1955)
Permanente Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 38,500	$ 28,800	$ 67,300
Residential	3,800	900	4,700
Non-residential	62,300	5,200	67,500
Emergency aid	3,000	-	3,000
Total	$ 107,600	$ 34,900	$ 142,500

STEVENS CREEK BASIN (Area 3)

196. Basin description. Stevens Creek originates high in the Santa Cruz Mountains west of the town of Saratoga and drains an area of approximately 24.6 square miles, of which 6.6 square miles lie above the Stevens Creek Reservoir. This reservoir has a storage capacity of 3,955 acre-feet and is located about 1½ miles southwest of Monte Vista. From the reservoir, the creek flows almost due north, passing east of the city of Mountain View and west of Moffet Field Naval Air Station to empty into San Francisco Bay via the Matadero-Adobe Creek flood basin and Mayfield Slough. Topography of the basin varies from mountainous in the upper reaches to flat in the lower reaches.

197. Storm rainfall and stages. Records of the storm of 15 - 28 December indicate that the most intensive periods of rainfall occurred during the periods 18 - 20 December and 22 - 24 December 1955. Rainfall reported for the area during these periods is given below:

Station	Precipitation, inches 18 - 20 Dec. 1955	22 - 24 Dec. 1955
Stevens Creek Reservoir	7.09	10.58
Black Mountain	10.66	11.85
Portola Redwoods State Park	8.93	11.26
Los Altos - Rexworthy	3.74	5.62

The crest of 8.25 feet reached at 4:00 P.M., 23 December, on the Cupertino gage, was the highest stage attained by this stream during the period of record (1930 to date), exceeding the previous record of 7.05 feet established 28 February 1940. The extremely heavy rains, coupled with rapid runoff, and the inadequate drainage system in the basin, would undoubtedly have resulted in much greater damage had it not been for the control exercised by the Stevens Creek Reservoir in the headwaters of the stream. Interviews with local inhabitants who experienced flood damage indicated that the principal factors causing overflow were inadequacy of existing culverts and the clogging of drains and constricted openings by large accumulations of orchard cuttings, debris, and trash thrown into the stream. Numerous citizens claimed they spent hours pulling debris from the stream, in order to let the water out, only to have to repeat the task a few hours later.

198. Flooded areas. It has been estimated that approximately 1,325 acres, most of it in the area adjacent to the mouth of the stream, were inundated by the waters of Stevens Creek. The extent and location of flooded areas were estimated by reconnaissance of the territory and defined on the best maps available. Numerous high-water marks were established along the stream, and their locations and descriptions recorded. The estimated gross area flooded is given below:

Reach	Area (acres)
San Francisco Bay to Bayshore Freeway	1,026
El Camino Real to Southern Pacific Railroad	219
Southern Pacific Railroad to Reservoir	80
	1,325

199. Flood damages and summary of losses. The principal losses recorded in the Stevens Creek Basin were to agriculture, mainly in the lower reaches of the stream. The heaviest recorded loss was to a livestock company which lost 447 hogs and was unable to operate for approximately 5 months. Estimated losses in livestock, feed, and loss

of business to this company were $76,300. Units of the California National Guard were successful in removing the major portion of the livestock in this area by means of amphibious vehicles. Other agricultural losses in the lower reaches and to orchards in the reaches above El Camino Real Highway account for a total loss of $239,800, of which $116,700 is considered direct and $123,100 indirect. Nearly all residential losses were in the city of Mountain View and were due to local overflow caused by clogged culverts. A few families left their homes for one or two days, but none required evacuation or assistance from the American Red Cross or other agencies. Total estimated residential damages were $20,100. Approximately $7,000 of this sum represents losses due to heavy erosion of stream banks in residential areas between Fremont Avenue and Stevens Creek Road. The chief commercial losses were suffered by a salt company which reported damages of approximately $41,900 due to overflow of salt beds by waters from Stevens Creek. Total non-residential losses attributed to Stevens Creek were $43,100, of which $42,500 were considered direct and $600 indirect. Replacement of 4 bridges, repair of 2 sections of the Mountain View-Stevens Creek Road, and general repair and cleanup of culverts, roads, and bridges damaged by waters of Stevens Creek cost an estimated $91,900. Total damages are summarized in Table 39.

Table 39

Summary of Damages (Floods of December 1955)
Stevens Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 116,700	$ 123,100	$ 239,800
Residential	19,200	900	20,100
Non-residential	42,500	600	43,100
Highways, roads, and bridges	91,900	-	91,900
Total	$ 270,300	$ 124,600	$ 394,900

GUADALUPE RIVER BASIN (Area 3)

200. Basin description. Guadalupe River rises high in the Santa Cruz Mountains between Los Gatos and New Almaden and flows in a general northerly and westerly direction through central Santa Clara County

to empty into San Francisco Bay at the city of Alviso. Principal tributaries are Alamitos Creek, Los Gatos Creek, and Saratoga Creek. Saratoga Creek, which joins Guadalupe River in the tidal area of Alviso Slough, has two main branches -- San Tomas Aquinas and Calabazas Creeks. The river and its tributaries drain a total area of approximately 365 square miles. The drainage area of Guadalupe River Basin is approximately 219 square miles and varies from mountainous terrain in the upper reaches to low flatlands in the lower reaches. Guadalupe Reservoir, with a storage capacity of 3,460 acre-feet, is located on the headwaters of this river.

201. Storm rainfall and stages. The peak discharge of Guadalupe River at San Jose was 5,740 c.f.s. on 23 December 1955, which did not exceed the previous maximum discharge of 8,680 c.f.s. recorded in February 1940. However, the December 1955 flood at San Jose would undoubtedly have surpassed all previous records and caused much greater damage had it not been for the control exercised by new conservation reservoirs. Continuous and heavy rainfall, occurring over a period of several days prior to the flood, loosened and scoured out large trees and accumulations of debris which floated downstream and became lodged at bridges and culverts, obstructing the channel and causing severe local flooding. Erosing and undercutting of the banks and adjacent lands also contributed to the flood hazard by aggradation of the channel. Records of the storm of 15 - 28 December 1955 indicate that the most intensive precipitation occurred during the periods 18 - 20 December 22 - 24 December 1955. Rainfall reported for the Guadalupe River area during these periods are given below:

	Precipitation, inches	
Station	18 - 20 Dec. 1955	22 - 24 Dec. 1955
Santa Clara University	3.01	4.18
Toyon Avenue	1.55	3.80
Alviso - Leslie Salt Co.	.46	2.79
Saratoga Summit	14.42	19.45
Los Altos - Rexworthy	3.74	5.62
Lexington Dam	9.35	12.47
Guadalupe Reservoir	8.65	8.63
Los Gatos	16.80	21.56
Almaden Reservoir	8.92	11.99

202. Flooded areas. The estimated gross areas inundated in the Guadalupe River Basin during the December 1955 flood are as follows:

Stream	Acres Flooded: Reach	Acres Flooded: Total
Guadalupe River, Main Stem		5,260
Mouth to Brokaw Road	5,050	
Broakaw Road to Hillsdale Avenue	10	
Hillsdale Avenue to Robertsville	200	
Guadalupe River Tributaries:		
Alamitos Creek		770
Mouth to Twin Creeks	770	
Los Gatos Creek		190
Mouth to Vasona Reservoir	0	
Vasona Reservoir to Lexington Reservoir	190	
Saratoga Creek, Main Stem		4,210
Mouth to Bayshore Freeway	2,690	
Bayshore Freeway to El Camino Real	1,100	
El Camino Real to Stevens Creek Road	60	
Stevens Creek Road to Saratoga	360	
Saratoga Creek Tributaries:		
Calabazas Creek		440
Mouth to El Camino Real	350	
El Camino Real to foothills	90	
San Tomas Aquinas		1,770
Mouth to Bayshore	760	
Bayshore to El Camino	80	
El Camino to Stevens Creek Road	110	
Stevens Creek Road to foothills	820	
Subtotal Guadalupe River Tributaries	7,380	
Total Guadalupe River Basin		12,640

203. Loss of life. No loss of life was reported in the Guadalupe River Basin due to the December 1955 flood.

204. Evacuations and persons displaced. From data obtained from FCDA, American Red Cross, local fire and police departments, churches, and local inhabitants, it is estimated that approximately 200 families were evacuated from Alviso and Agnew. Evacuations were for periods ranging from one day to two weeks. No families were permanently displaced as no homes were destroyed by flood waters.

205. Flood damages and summary of losses. The most concentrated losses were suffered within the city of Alviso, where practically the entire town was under water at depths up to 5 feet. There were 21 commercial establishments, 6 industrial plants, 3 churches, and 171 residences inundated, with services discontinued for periods varying from several days to more than a month. Owners of warehouses and commercial buildings in the area report loss of tenants and inability to secure new ones due to the flood hazard. Considerable damage to streets and sewers was reported. Flood-damage surveys attained 100 percent coverage. Total estimated flood damage for the city is $244,500.

206. Agriculture. Approximately 4,160 acres devoted to agriculture were flooded along the main channel. Principal damage to agricultural products was to pears and cauliflower. A number of farmers in the area lost livestock and stock feed. Approximately 1,300 feet of levee was damaged sufficiently to require repair. Total estimated agricultural losses were $246,600, all direct.

207. Commercial. Urban commercial properties in reaches reporting flood damages along the main stem are almost all located in the city of Alviso. Two large warehouses devoted to storage purposes, an oil extracting company, a number of taverns, night clubs, and grocery stores were damaged in amounts varying from slight to exceedingly severe. The only other damage to commercial establishments on the main stream was in San Jose where a local canning company reported minor damages to one of their storage buildings. No rural commercial losses were reported. Estimated total commercial damages attributable to the main stream were $182,900, of which $150,200 is direct and $32,700 is indirect.

208. Residential. The only residential damages reported along the main stem were in the city of Alviso where approximately the entire town was inundated. Although no homes were completely destroyed, almost all reported damage. The majority of a number of house trailers in the town prior to the flood were removed in time to prevent serious damage. Estimated residential damages from the main stem were $53,700 direct and $2,300 indirect, for a total of $56,000.

209. Utilities and communications. No serious damage to facilities or properties was reported by the utilities and communication interests in this area.

210. State property. The State Hospital at Agnew reported damages to roads, grounds, and fences totaling $10,000.

211. Highways, roads and bridges. Damages to State and county roads, bridges, and highways along the main channel amounted to approximately $81,400, of which $53,000 was allotted to repair of the Almaden Road Bridge, $25,000 for two major washouts on Almaden Road, and the remaining $3,400 for minor repairs and washouts within the area.

212. City property. All damage to muncipal property along the main channel occurred in the cities of Alviso and San Jose. Damages consisted of emergency repairs of sewers and pavements, removal of debris and slides from streets, bridges, and the streambed, and protection of flood-control facilities. Estimated municipal damage at San Jose was $55,100, of which $39,100 is direct and $16,000 indirect. Alviso reported $30,000 direct and $5,000 indirect damage, for a total of $35,000. Total estimated municipal damages were $69,100 direct and $21,000 indirect, or $90,100, attributable to the main stream.

213. Railroads. The Southern Pacific Railroad Company reported damage to roadbed fills and miscellaneous property at Alviso and temporary suspension of service for 2 days. Damages were estimated at $15,500 direct and $10,700 indirect, or a total of $26,200.

214. Emergency aid. The Corps of Engineers, U. S. Army, gave emergency assistance in the form of sandbagging levee breaks, channel clearing, removal of debris, and levee restoration on the Guadalupe River to the extent of $47,800. National Guard expenditures amounted to $4,500 and included pay of personnel engaged in flood-emergency work, subsistence, and equipment supplies. The American Red Cross spent $8,000 for relief and rehabilitation of flood victims in this area. Total emergency aid amounted to $60,300. Damages for the Guadalupe River, main stem, are summarized in Table 40.

Table 40

Summary of Damages (Floods of December 1955)
Guadalupe River Basin, Main Stream

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 246,600	$ -	$ 246,600
Residential	53,700	2,300	56,000
Non-residential	227,300	55,700	283,000
Highways, roads, and bridges	81,400	-	81,400
Railroads	15,500	10,700	26,200
Emergency aid	60,300	-	60,300
Total	$ 684,800	$ 68,700	$ 753,500

215. Alamitos Creek, the second largest tributary of Guadalupe River, has its source south of New Almaden, and drains an area of about 35 square miles. Its course is generally northwesterly to its junction with Guadalupe River about 2 miles south of the city of San Jose. Calero Reservoir with a capacity of 9,213 acre-feet and Almaden Reservoir with a capacity of 1,972 acre-feet are located on the headwaters of Alamitos Creek. Average precipitation in this area was 10.31 inches in the 4-day storm period preceding the flood. Agricultural damages on 770 acres inundated amounted to $108,500 and consisted primarily of erosion of topsoil and deposition of silt and debris in orchard areas. Damages to homes and grounds in the town of New Almaden amounted to $31,100, of which $30,100 was direct and $1,000 was indirect. Very heavy erosion of lands along the creek was suffered by property owners. Trees, stone and concrete retaining walls, barbecue pits, fences, and garden furniture were washed away and demolished. The most severe damage to urban commercial property was incurred by the New Almaden Museum, which suffered losses totaling $8,600. Two taverns and a dinner club had considerable damage to their grounds and gardens. Total urban commercial damages were estimated to be $11,500, of which $10,100 was direct and $1,400 was indirect. Rural commercial damage was severe. At a summer resort downstream from the town of New Almaden, over 100 picnic tables, 30 barbecue pits, and other articles were destroyed. Extensive clearing and rehabilitation was necessary for the large modern swimming pool and filter house located on the property. Upstream, above the Almaden Reservoir, in the small settlement of Twin Creeks, three privately owned bridges were washed out. Two houses at a summer resort were damaged severely and

a considerable amount of damage was inflicted to the grounds and furnishings. Total rural commercial damages were estimated to be $40,100, of which $38,600 was direct and $1,500 indirect. Damage to highways, roads, and bridges consisted of the cost of repair and rehabilitation of Alamitos Creek Bridge and repair and replacement of county roads washed out in this area, amounting to $11,600, all direct. The total damage attributable to Alamitos Creek is summarized in Table 41.

Table 41

Summary of Damages (Floods of December 1955)
Alamitos Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 108,500	$ -	$ 108,500
Residential	30,100	1,000	31,100
Non-residential	48,700	2,900	51,600
Highways, roads, and bridges	11,600	-	11,600
Total	$ 198,900	$ 3,900	$ 202,800

216. Los Gatos Creek, the main tributary to the Guadalupe River system, has its origin south and east of the city of Los Gatos, and drains an area of approximately 60 square miles in Santa Clara County. It flows in a general northeasterly direction to its junction with Guadalupe River in the city of San Jose. Lexington Reservoir, with a storage capacity of 25,100 acre-feet, is located on Los Gatos Creek about 1½ miles south of the city of Los Gatos. Slightly downstream from Los Gatos is Vasona Reservoir with a capacity of 750 acre-feet. Another small reservoir, Austrian Reservoir, capacity unknown, is located about 6½ miles above Lexington Dam. The average precipitation in this area in the 4-day storm period prior to the flood was 10.66 inches. No agricultural damages were reported in the Los Gatos Creek Basin. Damage to residences in Los Gatos was minor. No buildings were inundated as a result of overflow of the creek itself. A storm drain leading into a tributary of the creek clogged with debris and overflowed, putting four feet of water into two basement apartments. Total residential damage was estimated at $6,600, of which $6,100 was direct and $500 was indirect. The only commercial damage reported in the city of Los Gatos was to a theater. The damage, amounting to $300, was caused by overflow from a storm drain located in the rear

of the theater which clogged with debris. The county road system in the valley sustained damages from slides and washouts in the amount of $162,700, all of it direct. Existing drains were inadequate to handle the rapid runoff from the mountains. Costs to the city of Los Gatos for clearance of debris and emergency repairs to roads, bridges, culverts, and other public facilities resulted in $4,000 direct and $1,600 indirect damages, for a total of $5,600. Total damages for the Los Gatos Creek Basin are summarized in Table 42.

Table 42

Summary of Damages (Floods of December 1955)
Los Gatos Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ -	$ -	$ -
Residential	6,100	500	6,600
Non-residential	4,300	1,600	5,900
Highways, roads, and bridges	162,700	-	162,700
Total	$ 173,100	$ 2,100	$ 175,200

217. Saratoga Creek has its headwaters near the town of Saratoga and flows generally north and east through Santa Clara County, crosses Highway U. S. 101 west of the city of Santa Clara, and thence flows almost due north to a junction with Guadalupe River at the city of Alviso. The drainage area is approximately 16.5 square miles in extent and varies from mountainous terrain in the headwaters area to flat lowlands in the lower reaches. Approximately 12.5 inches of rain fell in the 4-day storm period preceding the flood. Estimated agricultural damages to farm lands, buildings, crops, stock, and equipment amounted to $503,100, all direct. Approximately 4,190 acres were inundated. The most intensive residential damage from flood waters of Saratoga Creek occurred in the town of Saratoga. Overflow of the creek caused heavy erosion to grounds along the stream; in some cases as much as four feet of topsoil was washed away. An ornamental Japanese garden, erected at considerable expense, was totally destroyed, along with a number of fruit and other trees. A valuable collection of flower bulbs was lost by another property owner. A contributory factor in the overflow of the creek was the presence of some huge stock piles of gravel in a quarry just above town. Heavy rains washed this gravel down into the streambed, raising it several feet. Large trees and other debris

collected at the Saratoga-Sunnyvale Road Bridge also adding to the overflow condition. A number of homes in the city of Santa Clara were also inundated. Total damage to residential homes and property was estimated at $111,300, of which $106,700 was direct and $4,600 was indirect. Greatest individual loss to commercial property was that of a restaurant and motel in the city of Santa Clara. Losses to the building and contents were approximately $20,000. Also severely damaged were picnic grounds at Saratoga which sustained estimated damages of approximately $10,000. A number of shops and motels in the city of Santa Clara were also damaged, bringing the total estimated commercial damages to $100,600, of which $93,800 was direct and $6,800 was indirect. Repair and rehabilitation costs of State and county roads and highways is estimated at $138,300. Of this figure, $116,000 was for the removal of slides, restoration of roadway surface and drainage, and replacement of protection walls and culverts on State Highway No. 9 between Saratoga and Saratoga Gap. Expenditures for emergency flood measures and rehabilitation of streets, sewers, and other properties of the city of Santa Clara were estimated to be $33,200, of which $28,600 was direct and $4,600 indirect damages. Based upon information received from the American Red Cross, the California National Guard, and local city officials, it is estimated that $2,400 was spent for evacuation, relief, and rehabilitation of flood victims. The total damage sustained in the Saratoga Creek Basin is summarized in Table 43.

Table 43

Summary of Damages (Floods of December 1955)
Saratoga Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 503,100	$ -	$ 503,100
Residential	106,700	4,600	111,300
Non-residential	122,400	11,400	133,800
Highways, roads, and bridges	138,300	-	138,300
Emergency aid	2,400	-	2,400
Total	$ 872,900	$ 16,000	$ 888,900

218. San Tomas Aquinas Creek originates a short distance northwest of the town of Los Gatos. It flows generally north to its confluence with Saratoga Creek approximately $\frac{1}{2}$ mile north of Bayshore Highway, which it crosses approximately 1 mile southwest of the town

of Agnew. This stream drains an area of approximately 20 square miles in Santa Clara County, most of which is flat to gently rolling terrain. Precipitation amounted to approximately 13 inches in the 4-day storm period preceding the flood. Approximately 1,500 acres of agricultural land was inundated as a result of overflow of San Tomas Aquinas Creek. Principal damage resulted from erosion of orchard land. Agricultural damages were estimated to be $101,100, all of which are considered direct losses. Residential damages were relatively minor. Greatest losses were reported in Bowers Subdivision in the city of Santa Clara where estimated damages amounted to $24,200. The town of San Tomas suffered losses estimated at $13,400. Losses in the city of Campbell were about $6,800. Additional minor damage totaling about $600 was reported by the city of Santa Clara and the town of Agnew. Total residential damage was $54,000, of which $50,400 was direct and $3,600 was indirect. Minor commercial damages to service stations, grocery stores, and shops totaled $4,900, of which $4,500 was direct and $400 was indirect. Repair and rehabilitation costs of streets, sewers, culverts, drains and public facilities in the cities of Santa Clara and Sunnyvale are estimated at $37,400, of which $35,400 were direct damages and $2,000 were indirect. Expenditures for clearing of debris and slides from, and repair to, the State and county road systems amounted to $17,600, all direct damage. Heavy erosion of banks and levees occurred on this stream, especially in the area between Bayshore Highway and Homestead Road. Damages from bank erosion in this area are estimated at $17,300. Based upon information received from the American Red Cross, city officials, police and fire department personnel, and local inhabitants, it is estimated that $3,000 was expended in direct relief emergency aid as a result of flooding. Damages attributable to San Tomas Aquinas Creek are summarized in Table 44.

Table 44

Summary of Damages (Floods of December 1955)

San Tomas Aquinas Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 101,100	$ -	$ 101,100
Residential	50,400	3,600	54,000
Non-residential	39,900	2,400	42,300
Highways, roads and bridges	17,600	-	17,600
Bank cutting	17,300	-	17,300
Emergency aid	3,000	-	3,000
Total	$ 229,300	$ 6,000	$ 235,300

219. Calabazas Creek has its source high in the Santa Cruz Mountains west and north of the town of Saratoga. It flows in a general northeasterly direction, crosses Highway U. S. 101 near the western boundary of the city of Santa Clara, thence flows due north for approximately $\frac{1}{4}$ mile where it turns sharply eastward 7/10 mile from its junction with Saratoga Creek. The drainage basin encompasses approximately 15 square miles of area in Santa Clara County and its topography varies from mountainous in the upper reaches to gently sloping in the lower reaches. Rainfall during the storm period prior to the flood averaged 12.5 inches. No agricultural damages were reported in the Calabazas watershed. Residential damages attributable to Calabazas Creek were relatively severe, especially in the Greenvale Subdivision of the city of Sunnyvale. Damages varying from minor to severe were reported in this section, with 166 homes inundated up to depths of 3 feet. The major cause of the overflow, according to local inhabitants, was the blocking of the stream channel under the Southern Pacific Railroad Bridge by excessive debris. Damages to homes and properties in this and other areas along the creek were estimated at $231,400, of which $215,900 was direct and $15,500 was indirect damage. Direct damages requiring repair and rehabilitation of county roads and highways are estimated to be $14,100. Cleanup of streets and sewers, and repair and rehabilitation of streets, sewers, culverts, and drains in the cities of Sunnyvale and Santa Clara was estimated to have resulted in damages of $48,800, of which $41,200 was direct damage and $7,600 was indirect. The American Red Cross and the California National Guard are estimated to have spent $10,300 in direct emergency relief in the evacuation, maintenance, and rehabilitation of flood victims in the Sunnyvale-Santa Clara Area. Damages attributable to Calabazas Creek are summarized in Table 45.

Table 45

Summary of Damages (Floods of December 1955)

Calabazas Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ -	$ -	$ -
Residential	215,900	15,500	231,400
Non-residential	41,200	7,600	48,800
Highways, roads, and bridges	14,100	-	14,100
Emergency aid	10,300	-	10,300
Total	$ 281,500	$ 23,100	$ 304,600

220. Total damages in the basins of Guadalupe River and its tributaries are summarized in Table 46.

Table 46

Summary of Damages (Floods of December 1955)
Guadalupe River Basin and Tributaries

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 959,300	$ -	$ 959,300
Residential	462,900	27,500	490,400
Non-residential	483,800	81,600	565,400
Highways, roads, and bridges	425,700	-	425,700
Railroads	15,500	10,700	26,200
Bank cutting	17,300	-	17,300
Emergency aid	76,000	-	76,000
Total	$ 2,440,500	$ 119,800	$ 2,560,300

COYOTE CREEK BASIN (Area 3)

221. Basin description. This streamoriginates in the mountainous area north and east of the city of Gilroy, in the Mount Hamilton Range. The drainage area is 239 square miles according to data from the U. S. Geological Survey. However, this figure includes only the area above the Julian Street Gage in the city of San Jose. Total drainage for Coyote Creek and its tributaries is approximately 394 square miles. In general, Coyote Creek flows in a northwesterly direction, traversing practically the entire length of Santa Clara County and entering the lower end of San Francisco Bay approximately 8 miles northwest of the town of Milpitas. Coyote Reservoir, capacity 24,560 acre-feet, is located on the upper reaches of Coyote Creek near the town of San Martin in southern Santa Clara County. Anderson Reservoir, storage capacity 75,000 acre-feet, is located a few miles downstream near the town of Madrone. Topography of the basin is chiefly hilly to mountainous except for low flat areas near the creek mouth. Principal tributaries of Coyote Creek are Las Animas Creek, San Felipe Creek, Canada de los Osos, Silver Creek, Penitencia Creek, and Fisher Creek.

222. Storm rainfall and stages. During the storm period 15 - 24 December 1955, records indicate that the heaviest rainfall occurred during the periods 18 - 20 December and 22 - 24 December. Recorded rainfall for these periods is given below:

Station	Precipitation, inches 18 - 20 Dec. 1955	22 - 24 Dec. 1955
Mount Hamilton	2.95	11.23
O'Connell Ranch	4.20	6.29
Besson	3.97	13.86
Oak Flat Ranch	3.62	6.56
Anderson Dam	3.88	6.32

Coyote Creek discharge above the Leroy Anderson Dam was fully controlled by conservation reservoirs. Below the dam, the discharge was of minor importance. Heavy rains and overflows washed trees, cuttings, and other debris into the stream channels. This drift accumulated at constricted points in the channels, blocking the flow and causing severe local flooding.

223. Areas flooded. The gross acreage inundated by the December 1955 flood in the Coyote Creek Basin was as follows:

Stream	Acres Flooded Reach	Total
Coyote Creek, Main Stem		
Mouth to East Shore Freeway	532	532
Coyote Creek Tributaries:		
Penitencia Creek		
Mouth to Calaveras Road	402	
Silver Creek		
Mouth to Tully Road	888	
Fisher Creek		
Mouth to Willow Spring Canyon	480	
Subtotal Coyote Creek Tributaries		1,770
Total Coyote Creek Basin		2,302

224. Flood damages and summary of losses. Flood damages in Coyote Creek Basin were relatively minor. All damages reported were agricultural in nature, consisting of soil erosion and deposition of debris and silt over orchards and farmlands. Flood damage surveys were made on a basis of 50 to 75 percent coverage.

225. Coyote Creek, main stem. The only damages reported on the main stem of Coyote Creek were in the low flatlands near the mouth and consisted principally of damage to pastureland from deposition of silt. Some damage to private flood-protection works was also noted. Approximately 532 acres were inundated and losses were estimated at $59,300, all direct damage, as indicated in Table 47.

Table 47

Summary of Damages (Floods of December 1955)
Coyote Creek Basin, Main Stem

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 59,300	$ -	$ 59,300

226. Penitencia Creek, one of the main tributaries of the Coyote Creek system, rises in the foothills of the Santa Cruz Mountains south and east of the city of Milpitas in Santa Clara County. Its general course is northwesterly to its junction with Coyote Creek. The greater part of the basin consists of flat to gently sloping areas with only a small portion of the upstream section of mountainous character. Ponding of creek waters in the Milpitas area inundated approximately 402 acres and resulted in considerable damage to fruit trees, principally apricot. Losses of wheat, oats, and barley were also reported. Ponding was caused by inability of existing drainage facilities to handle the runoff. Agricultural damages were estimated at $56,300, all direct. Road damages, as a result of State and county expenditures for emergency measures, rehabilitation of retaining walls, and repair of damage caused by minor slides and washouts totaled $6,000. Total damages attributable to Penitencia Creek are summarized in Table 48.

Table 48

Summary of Damages (Floods of December 1955)

Penitencia Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 56,300	$ -	$ 56,300
Highways, roads, and bridges	6,000	-	6,000
Total	$ 62,300	$ -	$ 62,300

227. Silver Creek has its origin in the Mount Hamilton region of the Diablo Range approximately 7 miles southeast of the city of San Jose. Its course is almost parallel to Coyote Creek throughout its entire length. Junction with Coyote Creek is effected about 3/4-mile norhtwest of the interesection of Santa Clara Street and Bayshore Highway in the outskirts of San Jose. Approximately 890 acres were inundated. Agricultural damages were minor and consisted chiefly of damage to pastureland from erosion of topsoil. Estimated agricultural losses amounted to $28,500 direct damage. The only flood damage to roads in Silver Creek Basin was a reported item of $100 for clearing of culverts. Total damages attributable to Silver Creek are summarized in Table 49.

Table 49

Summary of Damages (Floods of December 1955)

Silver Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 28,500	$ -	$ 28,500
Highways, roads, and bridges	100	-	100
Total	$ 28,600	$ -	$ 28,600

228. Fisher Creek, a small mountain stream, rises in the region just north and west of the town of Morgan Hill, Santa Clara County. Its course is northwesterly and it joins Coyote Creek slightly northwest of the town of Coyote. Approximately 480 acres were inundated. The only damages reported from the Fisher Creek Basin were agricultural in nature and amounted to $98,800 direct damage. Principal damages were to fruit trees, principally apricot, and to vegetable truck farms. Total damages attributable to Fisher Creek are given in Table 50.

Table 50

Summary of Damages (Floods of December 1955)
Fisher Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 98,800	$ -	$ 98,800

229. Total damages in the basins of Coyote Creek and its tributaries are summarized in Table 51.

Table 51

Summary of Damages (Floods of December 1955)
Coyote Creek Basin and Tributaries

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 242,900	$ -	$ 242,900
Highways, roads, and bridges	6,100	-	6,100
Total	$ 249,000	$ -	$ 249,000

MISCELLANEOUS SMALL STREAMS - ALAMEDA COUNTY

230. Description. Mission, Morrison, and Toroges Creeks, three small streams in Alameda County, have their origins in the mountainous area just east of the town of Irvington. Near Irvington, Mission and Morrison Creeks combine into one stream which flows almost due south to empty into the Coyote Creek slough area near its mouth. Toroges Creek also empties into the slough area near the mouth of Coyote Creek.

231. Flooded areas. Approximately 506 acres of farmland were flooded by overflow from these three streams. Of this total, 304 acres are estimated to have been attributable to Mission Creek, 195 acres to Morrison Creek, and 7 acres to Toroges Creek.

232. Flood damages. Overflow from these creeks caused minor agricultural damage to farmlands from bank erosion and deposition of silt and debris on pasturelands. Total damages were estimated to be $17,500, all direct. The amount of damage attributable to each stream is shown in Table 52.

Table 52

Summary of Damages (Floods of December 1955)
Miscellaneous Small Streams - Alameda County

Item	Damage		
	Direct	Indirect	Total
Agricultural:			
Mission Creek	$ 1,100	$ -	$ 1,100
Morrison Creek	14,700	-	14,700
Toroges Creek	1,700	-	1,700
Total	$ 17,500	$ -	$ 17,500

SCOTT CREEK BASIN (Area 4)

233. Basin description. Scott Creek is a small coastal stream emptying into the Pacific Ocean 1½ miles north of Davenport Landing in Santa Cruz County. Scott Creek extends approximately 8 miles inland into the Ben Lomond mountains and drains an area of about 30 square miles of mountainous country. Major tributaries of Scott Creek are the Big, Mill, and Little Creeks. The basin development is concentrated along Swanton Road in the lower 3 miles of the basin.

234. Flooded areas. The Scott Creek flood plain is also situated in the lower 3 miles of the basin, where an area of approximately 650 acres, of which 350 acres is timber-pasture and tideland marsh and about 300 acres is cropland, is subject to flooding.

235. Storm rainfall and stages. During the five-day period ending midnight 24 December 1955, heavy rains fell over the Scott Creek watershed. The unofficial rainfall reports indicate that nearly 13 inches fell during the first 3 days and 13 inches fell on the last 2 days for a total of nearly 26 inches during the 5-day period. The first overflow on Scott Creek occurred at 8 P.M. on 22 December 1955, cresting just before midnight and receding to about bankfull within an hour after the crest. On Little Creek, a tributary of Scott Creek, large landslides impounded the flood flows until approximately 4 A.M. on 23 December when the confined waters broke through, carrying boulders and heavy timber, and in its wake flooded the area at the confluence of Little and Scott Creeks, including several homes near the mouth of Little Creek. Several homes and farm buildings were destroyed and a woman perished when her house was destroyed by the overflow of Little Creek. Scott Creek rose to near record heights during the late afternoon of 24 December and again on 25 December. The highest water in the lower basin of Scott Creek during these overflows averaged 5-6 feet over bankfull stages, inundating a gross area of about 450 acres, of which 250 acres are timber-pasture and 200 acres are cropland.

236. Agricultural and commercial damages. The major crop losses were 5 acres of strawberries destroyed and 9 acres which sustained 50 percent loss due to silting-in of the plants, and scour and erosion on 15 acres of land prepared for planting strawberries. The last cutting, or harvest, on 15 acres of broccoli and 22 acres of sprouts were destroyed by the overflow. Idle croplands sustained severe scour on 6 acres and heavy gravel deposits on 42 acres. The entire cropland area in the lower Scott Creek Basin is owned by one operator. Crop losses totaled $73,000, land damages $30,000, and loss of 4 farmhouses and other farm equipment $19,300. Approximately 25 acres of timber-pasture land were severely scoured, causing an estimated loss of $700. Minor damage to fences and private roads and bridges is estimated at $1,000. Farm workers' automobiles and trucks were flooded, resulting

in a loss of $9,200. A sawmill and logging camp sustained a loss of $6,500.

237. Roads and bridges. The county road and bridges in the vicinity of Little Creek sustained damages of $4,000 to road fill with an additonal $500 in damage resulting from traffic interruption due to heavy debris deposits on the roadway just above Little Creek. There were no reported damages to utilities and communications in this basin.

238. Emergency aid. Channel restoration, removal of log jams and debris were accomplished on Little Creek by the Corps of Engineers under authorization of the Federal Civil Defense Administration at a cost of $43,600.

239. Flood damage survey coverage in Scott Creek Basin was 100 percent of the cropland, highway, and rural commercial damages and 15 percent of the timber-pasture damage area. The estimated flood damages in the Scott Creek Basin as a result of the December 1955 floods are summarized in Table 53.

Table 53

Summary of Damages (Floods of December 1955)
Scott Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural:			
Crop	$ 65,800	$ 7,200	$ 73,000
Lands	27,000	3,000	30,000
Farm buildings and equipment, etc.	29,000	1,200	30,200
Total Agricultural	$ 121,800	$ 11,400	$ 133,200
Non-residential	$ 5,000	$ 1,500	$ 6,500
Highways, roads, and bridges	4,000	500	4,500
Emergency aid	43,600	-	43,600
Total damage	$ 174,400	$ 13,400	$ 187,800

SAN LORENZO RIVER BASIN (Area 4)

240. Basin description. San Lorenzo River Basin, located in central Santa Cruz County, drains into Monterey Bay at the city of Santa Cruz. The basin extends approximately 20 miles in a northerly direction from the river mouth into the coastal mountains, and has a drainage area of approximately 137 square miles, nearly all mountainous. The lower 3 miles of the river flow through the city of Santa Cruz. A principal tributary, Branciforte Creek, has its confluence with San Lorenzo River in the heart of the city. The city of Santa Cruz encompasses an area of 12 square miles, of which about one square mile is situated in the flood plains of San Lorenzo River and Branciforte Creek. It is the county seat and principal trading center of the county and a major resort and tourist center of the State. Approximately 7 percent of the basin land area above the city of Santa Cruz is developed. Its principal utilization is as a resort area for both summer and permanent homes which, for the most part, are located along the main river and major tributary stream channels. The principal centers of population in this area above Santa Cruz are the towns of Felton and Ben Lomond, approximately 9 and 12 miles, respectively, above the mouth of San Lorenzo River. The only large area in the basin devoted to agriculture is along the left bank of San Lorenzo River partly within, and extending about one-half mile above, the northern city limits of Santa Cruz.

241. Storm rainfall and stages. During the storm period 15 - 28 December 1955, a total of 32.50 and 12.80 inches of rainfall was recorded by the Boulder Creek-B and Santa Cruz stations, respectively. The most intensive rainfall occurred during a four-day period, 21 - 24 December 1955, when the following rainfall amounts were reported:

Station	Precipitation, inches 21 - 24 Dec. 1955
Santa Cruz	8.90
Live Oak (Adjacent basin)	7.11
Empire Grade	16.60
Boulder Creek	18.27
Ben Lomond	14.98
Felton	14.91
Cave Gulch	15.05
Davenport (Adjacent basin)	6.70
Aptos (Adjacent basin)	9.85

The greatest rainfall in any 24-hour period occurred from 7:30 A.M., 22 December, to 7:30 A.M., 23 December 1955, when the station at Boulder Creek-B recorded 9.11 inches.

242. In the central part of the basin, known as the Ben Lomond area, San Lorenzo River exceeded bankfull stage during the early morning of 22 December and crested about 1:00 A.M. on 23 December 1955, remaining above bankfull until about noon on 25 December 1955. According to statements of Santa Cruz city officials, the duration of the flood in the city of Santa Cruz was 11 hours, starting at 8:00 P.M. on 22 December and ending at 7:00 A.M. on 23 December 1955, with the estimated crest time being 4:45 A.M. on 23 December 1955. Discharge was estimated by the City Engineer to have been 40,000 second-feet at the State Route No. 1 by-pass bridge site. U.S.G.S. stream gages on San Lorenzo River at Big Trees and at north edge of Santa Cruz and on Branciforte Creek near Market Street Bridge recorded the following maximum stages:

Station	Date	Time	Peak Stage	Peak Discharge
Big Trees	23 Dec.	1:30 A.M.	22.55	30,400
Santa Cruz	23 Dec.	2:00 A.M.	23.10	30,400
Branciforte Creek	22 Dec.	11:00 P.M.	22.04	8,100

The 23 December 1955 flood on the San Lorenzo exceeded the previous maximum flood of 1940 by about 2.5 feet in the lower basin and approximately 3 to 3½ feet in the vicinity of Boulder Creek. Local reports indicate previous maximum stages of record were exceeded along Kings, Boulder, Two Bar, Bear, and Zayante Creeks in the upper basin. Overflow occurred from the headwaters to the mouth, resulting in the maximum flood of record. The heavy rains and overflows loosened and scoured out large trees, and floated them downstream where they became lodged at channel and valley points of constriction, impounding the high velocity channel flow and causing extremely severe local flooding. The numerous log jams and other channel obstructions diverted the high velocity flows, causing the streams to change from their normal alignment and undercut and scour out numerous bridges, road fills, channel dams, and private developments. The river overflowed its banks in the lower part of Santa Cruz about 7:30 P.M. on 22 December. By 9:00 P.M. flood waters reached Front Street and by 11:00 P.M. had attained a depth of 2 feet in the vicinity of the intersection of River and Water Streets. Near the flood crest, water reached a depth of 4 feet along Pacific Avenue and about 6.5 feet in the 100 block on Front Street. The duration of the flood in the business district was approximately 11½ hours and was considerably longer in the low-lying areas. In the main business district the December 1955 flood exceeded the previous maximum flood of record by 2.5 feet, while at the Southern Pacific Railroad Bridge at the mouth of San Lorenzo River it was below the maximum flood of record, February 1940, by about 1.1 feet.

243. Flooded areas. The flood plains of San Lorenzo River and its tributaries were estimated by detailed reconnaissance of the area and delineated on the best maps available. During reconnaissance of the flooded areas, numerous high-water marks were established, with location and description prepared for future reference. The estimated gross acreage in the San Lorenzo River Basin inundated during the December flood is summarized below:

Stream	Acres Flooded Reach	Total
San Lorenzo River, Main Stem:		
Mouth to upper limits, City of Santa Cruz	410	
Upper limits, City of Santa Cruz, to Mt. Hermon Highway at Felton	676	
Mt. Hermon Highway at Felton to Highway No. 9 at Ben Lomond	94	
Highway No. 9 at Ben Lomond to Highway No. 9 at Boulder Creek	16	
Highway No. 9 at Boulder Creek to Riverside Grove	79	
Subtotal San Lorenzo River-main stem		1,275
San Lorenzo River Tributaries:		
Kings Creek		
Mouth to Wallace Johnson Ranch	90	
Boulder Creek		
Mouth to Boulder Creek Airport	100	
Two Bar Creek		
Mouth to mile 3.0	50	
Bear Creek		
Mouth to mile 3.0	109	
Newell Creek		
Mouth to mile 1.5	80	
Branciforte Creek Basin:		
Branciforte Creek Main Stem		
Mouth to north city limits, Santa Cruz	74	
Santa Cruz city limits to Granite Creek Road	185	

Stream	Acres Flooded: Reach	Acres Flooded: Total
East Fork Branciforte Creek		
Mouth to Happy Valley School	72	
Happy Valley Creek		
Mouth to mile 1.5	26	
Granite Creek		
Mouth to mile 1.0	25	
Redwood Canyon Creek		
Mouth to mile 0.5	6	
Glen Canyon Creek		
Mouth to mile 0.25	3	
Zayante Creek		
Mouth to confluence with Lompico Creek	80	
Subtotal San Lorenzo River Tributaries		900
Total San Lorenzo River Basin		2,175

The area inundated in the city of Santa Cruz was delineated on city maps by the City Engineer and verified by the Corps of Engineers during flood-damage surveys. The estimated total area flooded was 410 acres, or 107 city blocks of business, warehouse, industrial, and residential property.

244. Loss of life, rescue, and evacuation operations. Despite storm and flood warnings issued by local radio, a considerable part of the population was unaware of the danger of the impending flood. In addition, people in the area subject to flooding were reluctant to believe the flood waters could reach such proportions. These and other factors contributed to the fact that 7 persons lost their lives during the 22 - 23 December 1955 flood in the San Lorenzo River Basin. Five were in the city of Santa Cruz and 2 were near Mt. Hermon in the Zayante Creek Basin.

245. Based on information obtained from the Federal Civil Defense Administration, American Red Cross, local fire and police departments, Salvation Army, news services, and data compiled during flood damage surveys, it is estimated that 2,830 persons were displaced by the floods, of which about 2,440 were in the city of Santa Cruz, 30 at Felton,

52 at Ben Lomond, and 300 in settlements such as Gold Gulch, Paradise Park, Wildwood, and Riverside Grove. The total assisted evacuations by boats, high-wheeled vehicles, helicopters, etc., numbered approximately 775, of which about 600 were in the city of Santa Cruz. The largest proportion of the rescues were accomplished by amphibious trucks (DUKWS) manned by Army troops from Fort Ord. Salvation Army teams rescued about 100 persons in Santa Cruz and the U. S. Forestry Service rescued 10 persons at Felton. Many more were rescued by their neighbors and friends in local areas. In the city of Santa Cruz, a state of emergency was in force at about 9:00 P.M., 22 December. The police and fire departments, Sheriff, Red Cross, Civil Defense, and service reserve units were called into action, with headquarters in the City Hall. Rescue and evacuation operations had been started earlier by the Salvation Army and volunteers who had evacuated about 100 persons by 9:30 P.M. These forces were joined or taken over by larger numbers as the night wore on and by 5:00 A.M. on 23 December a rescue team of 15 men and officers from Fort Ord, using 4 amphibious trucks (DUKWS) and a helicopter, arrived to assist the local forces. By 2:00 P.M. on 23 December some 600 persons had been rescued, and approximately 2,440 persons evacuated from the city of Santa Cruz. In additon to flood warnings broadcast over the local radio station, warnings were telephoned until these facilities were flooded out about 10:00 P.M., 22 December. A power substation on Blaine Street flooded out at 12:32 A.M. 23 December, throwing a majority of the city into total darkness. All street bridges across San Lorenzo River were closed severing the city into two parts, which resulted in disruption of effective police and fire protection. Only through effective and timely rescues was the loss of life held to five within the city of Santa Cruz. Verified deaths due to the flood were furnished by the County Coroner's office. In the town of Felton, rescue teams of local people and the U. S. Forest Service evacuated 22 persons. In the town of Ben Lomond, approximately 20 people were evacuated by the Ben Lomond Fire Department, and 30 displaced persons were cared for by the Red Cross.

246. Flood damage surveys. The flood damage survey of the basin was made during the period 14 January - 25 February 1956. Each individual business establishment owner or operator was interviewed to determine direct and indirect damages. Insofar as practicable, the business and commercial activity of the inundated area was surveyed on a 100 percent basis. Likewise, all other facilities, services of Governmental agencies, utilities, communications, transportation, etc., were surveyed on a 100 percent basis. In the residential areas, the survey was made on a minimum 25 percent sample coverage of each individual city block. However, all properties were observed and counted, due to the great variations in types and classes of residential properties. Agricultural damages were likewise surveyed on an approximate

25 percent coverage. Estimates of direct and indirect losses were obtained from utility, communication, and transportation companies, as well as various departments of Federal, State, county, and city governmental units.

247. Flood damages and summary of losses. Total flood damages for the San Lorenzo River Basin were estimated to be $8,700,900, of which $7,514,600 were direct and $1,186,300 were indirect. Of these amounts $6,498,700 direct damages and $1,130,900 indirect damages were suffered by the city of Santa Cruz. In view of the extent of the damage, the basin has been divided into the following reaches to facilitate the summarization of damages:

City of Santa Cruz
Santa Cruz to and including Felton
Felton to Riverside Grove
Kings Creek
Boulder Creek
Two Bar Creek
Bear Creek
Zayante Creek
Branciforte Creek

248. City of Santa Cruz. Overflow from San Lorenzo River commenced about 7:30 P.M. on 22 December and by 23 December had inundated the downtown area of the city to a maximum depth of slightly over 6 feet. Buildings were undermined, grounds and storage yards scoured and covered with debris, and buildings, equipment, and merchandise covered with mud and silt. The high velocity debris-laden flows battered and destroyed numerous buildings. The types and numbers of the damaged property are indicated below:

Type	Number
Commercial	650
Residential	609
Post Office	1
Other public buildings	9
Churches, schools, and libraries	6
Transportation services	8
Utilities	2
Communication services	2
Water plant	1
	1,288

In addition, there were 85 business and professional establishments located on second-floor levels which experienced no direct flooding, but which were isolated for a period of 2-3 days, making a total of 735 commercial establishments and a grand total of 1,373 businesses affected in the city of Santa Cruz. Nine business establishments were destroyed and approximately 200 residences were destroyed or so severely damaged that they were no longer suitable for occupancy and were condemned by the local authorities. Other properties were put out of business or service for from five to 30 days. In addition to damage to private property, Federal, State, county, and city property was severely damaged, both to structures and equipment. Transportation facilities such as city bus lines, intercity busses, and railroads were shut down for a period up to 7 days, due to huge amounts of silt and debris clogging the city streets and to flooding of facilities. Public utilities suffered severe damage to plant and equipment when a substation was flooded causing a blackout of power and lights throughout the city. Communications were cut off when the new telephone exchange was flooded and telephone lines were destroyed. Removal of huge log jams and channel restoration was accomplished by the Corps of Engineers under authorization of the Federal Civil Defense Administration. Total damages to the city of Santa Cruz are summarized in Table 54.

Table 54

Summary of Damages (Floods of December 1955)

City of Santa Cruz, California

Item	Damage		
	Direct	Indirect	Total
Residential	$ 786,500	$ 69,600	$ 856,100
Non-residential:			
Commercial	4,515,100	941,600	5,456,700
Churches and schools	7,800	100	7,900
Federal property	6,100	200	6,300
County property	165,800	-	165,800
City property	366,600	-	366,600
Transportation	18,900	10,200	29,100
Utilities	111,900	11,000	122,900
Communications	250,200	25,500	275,700
State tax revenue	-	54,500	54,500
City tax revenue	-	18,200	18,200
Highways, roads, and bridges	70,000	-	70,000
Emergency aid	199,800	-	199,800
Total	$ 6,498,700	$1,130,900	$ 7,629,600

249. Santa Cruz to and including Felton. San Lorenzo River overflowed its banks along the entire length of this reach, with the exception of the few narrow uninhabited gorges, causing severe damage to the many summer homes and resort areas. Extensive damage occurred to rural commercial properties at Sycamore Grove, Griffin Redwood Grove, Felton Grove, and the more populated area in the vicinity of Felton. Agricultural damage occurred when 250 acres of orchard and 65 acres of cropland were inundated resulting in loss of fruit trees, erosion of topsoil, deposition of huge amounts of gravel and debris, and losses of farm buildings, fences, and agricultural equipment. Nine homes were completely destroyed in this area and 174 more summer homes or permanent residences were so severely damaged that future occupancy is questionable. Furniture and personal belongings in most cases were a complete loss due to the depth of inundation and the smashing effect of the high velocity. Public property damage was confined primarily to Henry Cowell State Park where recreational facilities and prize redwood trees were lost. County roads and private roads were severely eroded and many private bridges across the river were washed out, isolating residents for several days. The Southern Pacific Railroad parallels the river in this reach and was inundated at the Ebbis Tunnel, interrupting service for 25 days. The resulting estimated damages for this reach are summarized in Table 55.

Table 55

Summary of Damages (Floods of December 1955)
San Lorenzo River - Santa Cruz to and Including Felton

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 136,000	$ 11,300	$ 147,300
Residential	368,900	27,200	396,100
Non-residential	64,500	1,000	65,500
Highways, roads, and bridges	3,500	500	4,000
Railroads	7,000	800	7,800
Emergency aid	2,500	-	2,500
Total	$ 582,400	$ 40,800	$ 623,200

250. Felton to Riverside Grove. In this reach some 13 acres of non-contiguous cropland, all idle, were flooded. These small units, principally garden tracts, suffered topsoil erosion and loss of land by channel changes. Principal residential damage occurred in the vallage of Ben Lomond and the rural settlement of Riverside Grove where 16 residences were flooded and 12 additional residential properties sustained damage to yards and bank protection works along the channel. Water supply lines were severed at several river crossings and power and telephone lines sustained minor damage. Downstream from State Highway No. 9 Bridge, 39 commercial establishments were flooded, with overflows ranging in depth from just a few inches to 9 feet. Farther downstream, a boys' camp was damaged to the extent of almost total destruction. State Highway No. 9 in the vicinity of Wildwood Grove sustained minor damages due to undercutting of road fill. The small bridge at the county road crossing at Riverside Grove sustained a washout with replacement cost estimated to be $5,000. Damages for this reach are summarized in Table 56.

Table 56

Summary of Damages (Floods of December 1955)
San Lorenzo River, Main Stem, from Felton to Riverside Grove

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 6,600	$ -	$ 6,600
Residential	38,600	1,500	40,100
Non-residential	73,700	3,700	77,400
Highways, roads, and bridges	6,500	-	6,500
Emergency aid	2,700	-	2,700
Total	$ 128,100	$ 5,200	$ 133,300

251. Kings Creek. Flooding by Kings Creek in the upper San Lorenzo Basin resulted in relatively severe erosion and scour of 10 acres of orchard, 20 acres of idle cropland, and 60 acres of pasture and timber. Power and telephone lines sustained washouts of poles at several points. The county road system in the valley suffered washouts of 3 bridges and a number of sections of road fills. The Corps of Engineers, U. S. Army, under authorization of the Federal Civil Defense Administration, removed log jams at several places along the valley at a cost of $8,500, in an effort to reduce or remove local flood hazards. Damages for this reach are summarized in Table 57.

Table 57

Summary of Damages (Floods of December 1955)

Kings Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 5,700	$ -	$ 5,700
Non-residential	3,000	-	3,000
Highways, roads, and bridges	102,000	3,000	105,000
Emergency aid	8,500	-	8,500
Total	$ 119,200	$ 3,000	$ 122,200

252. Boulder Creek Basin, in the upper San Lorenzo River Basin, sustained scour and erosion damage to channel banks and timber-pasture areas. Minor damages were experienced by private farm roads and bridges. Three cabin camps in the vicinity of State Highway No. 44 crossing suffered damages due to inundation and also sustained damage to roads, bridges, and small channel dams. Three summer homes were flooded and several others lost sections of retaining walls adjacent to the creek channels. Power and telephone facilities sustained minor damage. Damages due to undercutting of bridge approach fills were experienced to a minor extent to both State and county roads in this vicinity. Damages for Boulder Creek are summarized in Table 58.

Table 58

Summary of Damages (Floods of December 1955)

Boulder Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 5,000	$ -	$ 5,000
Residential	3,500	-	3,500
Non-residential	3,000	500	3,500
Highways, roads, and bridges	500	-	500
Emergency aid	500	-	500
Total	$ 12,500	$ 500	$ 13,000

253. Two Bar Creek, in the upper San Lorenzo River Basin, sustained severe scouring of channel banks and timber-pasture areas. Minor damages were experienced by private farm roads and bridges. Two cabins were washed away due to undercutting of stream banks and three summer homes were damaged by overflows and deposition of debris around the buildings. The county road in this valley sustained numerous washouts of road fills. Damages for Two Bar Creek are summarized in Table 59.

Table 59

Summary of Damages (Floods of December 1955)
Two Bar Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 2,000	$ -	$ 2,000
Residential	600	-	600
Non-residential	700	-	700
Highways, roads, and bridges	20,100	-	20,100
Total	$ 23,400	$ -	$ 23,400

254. Bear Creek Basin, in the upper central San Lorenzo River Basin, suffered agricultural damage due to flooding of 10 acres of timber-pastureland and severe erosion of several ranch roads. In the lower 2 miles of the basin, three summer homes sustained direct damage of $2,000. Power poles in the area were knocked over by heavy debris. The county highway in the valley experienced slides and slipouts due to undercutting of the road fill. Damages for Bear Creek Basin are summarized in Table 60.

Table 60

Summary of Damages (Floods of December 1955)
Bear Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 2,000	$ -	$ 2,000
Residential	1,500	-	1,500
Non-residential	200	-	200
Highways, roads, and bridges	21,500	-	21,500
Total	$ 25,200	$ -	$ 25,200

255. Zayante Creek Basin, in the lower central San Lorenzo River Basin, experienced limited agricultural damage from erosion and scour of timber-pasturelands and the loss of several orchard trees. Commercial damages were confined to Mount Hermon properties and consisted of loss of one road bridge, 3 footbridges, and short sections of sidewalks. Damage to lawns and boathouses was also reported. Two lives were lost when the road bridge washed out while a truck was enroute crossing. Zayante Creek is highly developed in the lower reaches, with 50-60 residential properties located on the high banks of the creek. In this area the creek exceeded bankfull stage by 5-7 feet, entering the lower levels of 6 homes, with resultant flooding of basements and garages. Considerable damage was done to retaining walls and backyards. Minor damages occurred to power facilities, primarily line poles knocked over by debris. The small irrigation dam in this reach sustained scour damage at abutments and damage to ditches due to excessive flows entering the distribution system. County roads sustained damages when the roadbed was scoured out by overflows along Zayante Creek. Along Bean Creek, a small tributary of Zayante Creek, the estimated road and bridge damages are $21,000. Damages for Zayante Creek Basin are summarized in Table 61.

Table 61

Summary of Damages (Floods of December 1955)
Zayante Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 1,000	$ -	$ 1,000
Residential	3,500	-	3,500
Non-residential	22,500	-	22,500
Highways, roads, and bridges	49,400	-	49,400
Emergency aid	2,400	-	2,400
Total	$ 78,800	$ -	$ 78,800

256. Branciforte Creek, in the lower San Lorenzo River Basin, joins the San Lorenzo River within the city of Santa Cruz, California. Estimates of flood damage described herein are above and outside the city limits of Santa Cruz. Agricultural damages consist of erosion of fields; loss of land due to channel changes; washing out of orchard trees, fences, private roads, and bridges. Considerable damage was experienced by several commercial concerns as a result of sidehill

run-off, but insofar as it could be determined, only one commercial establishment sustained damages from the overflows of Glen Canyon Creek. Storm damage was so extensive to this establishment that the business has failed to reopen. Residential damages are the result of 10 homes being inundated and 67 others sustaining damages to yards, fences and private roads and bridges. Damages to power and telephone facilities consisted of loosened poles due to debris piling up around them during the overflows. County roads sustained relatively minor damages in this basin. A small bridge washed out on Ocean Street extension and numerous road fills and road shoulders were damaged by local overflows. Emergency aid in the form of removal of numerous log jams was accomplished by the Corps of Engineers. Damages in Branciforte Creek Basin are summarized in Table 62.

Table 62

Summary of Damages (Floods of December 1955)
Branciforte Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 1,500	$ 500	$ 2,000
Residential	26,300	4,900	31,200
Non-residential	2,200	500	2,700
Highways, roads, and bridges	300	-	300
Emergency aid	16,000	-	16,000
Total	$ 46,300	$ 5,900	$ 52,200

257. San Lorenzo River Basin. The damages for the entire San Lorenzo River Basin and its tributaries are summarized in Table 63.

Table 63

Summary of Damages (Floods of December 1955)

San Lorenzo River Basin and Tributaries

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 159,800	$ 11,800	$ 171,600
Residential	1,291,700	106,600	1,398,300
Non-residential	5,549,900	1,063,600	6,613,500
Highways, roads, and bridges	273,800	3,500	277,300
Railroads	7,000	800	7,800
Emergency aid	232,400	-	232,400
Total	$ 7,514,600	$1,186,300	$ 8,700,900

APTOS CREEK BASIN (Area 4)

258. Basin description. Aptos Creek, in south-central Santa Cruz County, is a small coastal stream emptying into the Pacific Ocean via Monterey Bay. Aptos Creek and its principal tributary, Valencia Creek, join together just south of the village of Aptos. The drainage basin extends about 7 miles inland into the coastal mountains. In general, only the southern or lower 2 miles of the flood plain have developments that are subject to flooding.

259. Storm rainfall. During the four-day period ending 22 December 1955, heavy rains, averaging between 8 and 9 inches, fell over the basin causing Aptos and Valencia Creeks to slightly exceed bankfull stages at several points in the lower basin.

260. Flood damages. Agricultural damages were primarily due to scour and erosion of first shelf lowlands planted to pasture, a few orchard crops, and idle croplands. Approximately 140 acres were inundated, of which 20 acres were cropland. Non-crop agricultural damages were generally very minor, consisting of eroded private roads and washed out culverts. County roads and bridges experienced relatively heavy damages at the Valencia Road crossing where a culvert and road fill washed out due to a log jam. The bridge on Aptos Creek just below the confluence of Aptos and Valencia Creeks sustained a washout of cribbing endangering the bridge structure. Four homes along

Moosehead Drive, downstream from the village of Aptos, experienced flooding. The Southern Pacific Railroad sustained minor damage due to undermining of the roadbed at Aptos, which resulted in a 7-day interruption of rail service on the Santa Cruz-Watsonville line. Indirect damages were assigned to the city of Santa Cruz, California. The local telephone and telegraph company sustained minor damages due to the undermining of facilities in the flood plain. Damages for this basin are summarized in Table 64.

Table 64

Summary of Damages (Floods of December 1955)

Aptos Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 6,700	$ 1,000	$ 7,700
Residential	6,400	-	6,400
Non-residential	500	-	500
Highways, roads, and bridges	27,700	900	28,600
Railroads	2,100	-	2,100
Emergency aid	16,300	-	16,300
Total	$ 59,700	$ 1,900	$ 61,600

SOQUEL CREEK BASIN (Area 4)

261. Basin description. Soquel Creek is a small coastal stream emptying into Monterey Bay at Capitola, California. Soquel Creek watershed extends north from Capitola some 10 miles into the coastal mountains in central Santa Cruz County. Soquel, California, population 1,200, is situated on Soquel Creek about $1\frac{1}{4}$ miles above the mouth. The business district and a portion of the residential district lies along both banks of Soquel Creek just north of the Santa Cruz-Watsonville Freeway, State Highway No. 1. The accessible portions of the basin are fairly well developed, containing numerous small hillside dairy and chicken ranches, and many permanent and summer residences.

262. Storm rainfall and stages. During the four-day period ending midnight 22 December 1955, heavy rains fell over the Soquel Creek watershed. Unofficial rainfall reports indicate amounts varying from nearly 11 inches in the upper basin to approximately 8 inches in the lower basin occurred during this period. Continued heavy rains occurred on 23, 24, and 25 December. Crest stage on the U.S.G.S. gage in the vicinity of Bridge Street in Soquel was 22.33 feet at 2:15 A.M. on 23 December 1955. Soquel residents reported water entered their homes at approximately 12:30 A.M., crested about 2:30 A.M., and receded out of their homes at approximately 2:45 A.M. on 23 December 1955.

263. Flooded areas. The Soquel Creek flood plain is limited to the lower four miles of the basin and is generally very narrow in the upper basin and widens out to approximately 1,000 feet in the lower basin. The flood of 23 December 1955 inundated an area of 125 acres in Soquel Creek Basin. On Hinckley Creek, above the confluence with Soquel Creek, flood flows exceeded bankfull by approximately 6 feet. Downstream from this point along Soquel Creek the overflows averaged 5 feet in depth, except where local log jams increased depths to over 6 feet. As the flood flows progressed down the valley to the village of Soquel, the effect of valley storage reduced the overflow depths to 2-3 feet. The first flood at Soquel occurred as a result of a log jam on Bates Creek at the Glen Haven Road Bridge about 10 P.M. on 22 December, inundating several homes near the confluence of Bates and Soquel Creeks. Within approximately one hour a log jam formed at the Soquel Drive Bridge in the heart of the village, impounding the rapidly flowing Soquel Creek and forcing the water over both banks, primarily along the left bank. The area inundated comprises some 8 city blocks containing nearly the entire business district, public buildings, churches, and the most densely populated residential district.

264. Evacuations and persons displaced. In the village of Soquel the flood caused displacement of approximately 350 persons, of which 25 to 30 were rescued from flooded homes. In the village of Capitola some 35 persons were forced to evacuate as a safety measure. Insofar as is known, there were no lives lost as a result of the flood.

265. Flood damages. The high velocity flood flows caused channel scour and severe bank erosion, resulting in the loss of 5 acres of cropland. Overbank flows scoured topsoil from an estimated 10 acres and deposited gravel and debris on an additional 19 acres. Other than cultivated pastures and orchards, the land was idle at the time of the flood. Approximately 16 acres of orchards were damaged by scouring and erosion. Non-crop agricultural damages were to fencing, farm buildings, irrigation pump installations, and farm roads and bridges. The major damage to State and county highways was to the Soquel Drive Bridge and the undercutting of fills along Old San Jose Road, north of Soquel.

In rural areas 13 summer and permanent homes were damaged. Within the village of Soquel the high velocity overbank flows carried heavy timber and debris which battered many buildings and totally destroyed dozens. Gravel, mud, and debris lodged in and around the flooded properties. Between the more structurally sound buildings the high velocity flows scoured out large areas and undermined many buildings. Damages are summarized in Table 65.

Table 65

Summary of Damages (Floods of December 1955)
Soquel Creek Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 14,000	$ 4,000	$ 18,000
Residential	121,300	14,800	136,100
Non-residential	388,900	39,900	428,800
Highways, roads, and bridges	148,600	6,300	154,900
Emergency aid	93,300	-	93,300
Total	$ 766,100	$ 65,000	$ 831,100

PAJARO RIVER BASIN (Area 4)

266. Basin description. The Pajaro River and its tributaries which includes Carnadero Creek, Llagas Creek, Santa Ana Creek, San Benito River, and Corralitos Creek lies in Santa Clara, San Benito, Monterey, and Santa Clara Counties. Watsonville, the second largest city in Santa Cruz County with a population estimated at 12,800 in 1954, lies on the southern boundary of the county, in the heart of the rich agricultural Pajaro Valley. The city of Watsonville proper is located on the right bank of the Pajaro River about 6 miles from the mouth and just downstream from the confluence of Pajaro River and Corralitos Creek. Watsonville Junction is located across the river in Monterey County. Gilroy, with a population estimated at 5,200 in 1956, is located in southern Santa Clara County, 29 miles south of San Jose on Highway U. S. 101. The city of Gilroy is situated in the flood plain of Santa Clara Valley.

267. Storm rainfall and stages. During the storm period 16 - 28 December 1955, the rainfall station at the Watsonville Water Works recorded a total of 9.66, with the heaviest amounts occurring during a 3-day period, 22 - 24 December, when there was a total of 6.25 inches reported. On 22 December 1955, Eureka Canyon, the upper reach of Corralitos Creek, received 3.90 inches. Unofficial rainfall reports indicate the upper Corralitos and Carnedero-Uvas Creeks had a total rainfall of about 9-11 inches during the 3-day period, 22 - 24 December 1955. The upper Pajaro River received, during the same 3-day period, a total of 10.77 inches at San Juan Bautista; 6.28 inches at Hollister; with generally lesser amounts in the upper San Benito River Basin. Based on the best available data, the heavy rainfall in the lower Pajaro River Basin caused the Corralitos-Salsipuedes Creeks to crest about noon on 23 December 1955 and the Pajaro River crested at 2:00 P.M. on 23 December 1955, at a stage of 33.4, just 0.6 foot below the top of the levee protection. In the vicinity of Gilroy 12.9 inches of precipitation was reported during the period 22 - 23 December 1955, causing Uvas-Carnadero Creeks to overflow.

268. Flooded areas. Large scale flooding occurred in the Santa Clara Valley at the confluence of the tributary streams, and resulted primarily from backwater effect created by the restricted Pajaro channel in the Chittenden Pass reach. Since the topography in this area is relatively flat and the channel capacity of the Pajaro limited to low discharges, water was virtually pooled over an area of 7,900 acres of agricultural land. Carnadero Creek is an exception to the backwater effect flooding. Flooding along this creek was from headwater flow which scoured lands and channel banks. Flood flows of Carnadero Creek southwest of Gilroy eroded sections of the city levee by undercutting the levee structure, however, no overflows resulted from the levee failures. South of Gilroy, Carnadero Creek overtopped the left bank just upstream from the new Porter Road Bridge and inundated a considerable agricultural area. Flooding in the Miller Slough area is primarily due to poor drainage on the relatively flat land in and adjacent to Gilroy, where an area of about 16 city blocks was inundated by surface water ponding as a result of exceeding the Miller Slough channel storage area. Along Corralitos Creek considerable bank damage occurred, however, overflow was limited to flooding of only 4 acres near the lower reaches of the stream. Both Watsonville and Watsonville Junction are protected by levees along both banks of the Pajaro River and a short section of levee along the right bank of Corralitos Creek. The inundation of the city of Watsonville and Watsonville Junction was prevented by the flood fight activities of some 400 volunteers, National Guard, troops from Fort Ord, Santa Cruz and Monterey County forces, and the forces of the city of Watsonville, under the coordination of the Corps of Engineers. Five levee breaks, two on the south and three on the north side of Salsipuedes Creek were contained as were the localized scoured and undercut sections of the main levee along Pajaro River. There was considerable agricultural damage along the Pajaro

River from its confluence with San Benito River to the levees east of Watsonville. In the area from the hills to the ocean, protected by levees, Pajaro River did not flood. Although levees were breached in several places, they were breached from caving banks and not overtopping. Water did not flow from the river through any damaged levees. All standing water outside the levees resulted from ponding rain water. Subsequent to the completion of the levee project in the Watsonville area in about 1941 by the Corps of Engineers, the local interests have not constructed or provided effective means of removal of the interior drainage and seepage waters. Thus, when concurrent high river stages and rainfall occurs, there is considerable ponding of surface runoff behind the levees for several days in the developed areas of Watsonville.

269. Evacuations and persons displaced. As a precautionary measure, some 972 persons were evacuated from the protected areas of Watsonville and housed in emergency mass shelters for about 2 days. No loss of life was reported in the urban area of Watsonville. Overflows in the city of Gilroy forced about 225 persons to evacuate their homes for a period of about 2 days on 23 and 24 December 1955. Approximately 86 evacuees were cared for on 23 December and 70 on 24 December by the Red Cross mass shelter in the Veterans Memorial Building. Evacuation was accomplished by personnel, vehicles, and equipment of the local unit of the National Guard.

270. Flood damage. Interviews with owners and operators of farms in this area revealed that great losses have been sustained from flooding and prolonged inundation of garlic fields and fields which had been prepared and fertilized for the planting of lettuce. There was extensive damage to roadways, bridges, tenant houses, and mechanical equipment in these agricultural areas. One of the greatest losses, however, will result from diminished returns due to the inability of the operators to enter the saturated fields for renovation and replanting. Flooding along Carnadero Creek scoured lands and channel banks with resulting loss of lands and crops. There was also damage to rural homes and to highway bridges. Along Corralitos Creek from the town of Corralitos to Green Valley Road crossing damages resulted from loss of land due to undermining and caving banks. Loss of land and apple trees constitute the greatest loss in this reach. Along the Pajaro River from its confluence with San Benito River to the levees east of Watsonville damages were principally loss of lands, erosion of lands, and loss of or silting of orchards. In Watsonville 29 blocks of city streets, adjacent parking areas, and sidewalks flooded to a maximum depth of nearly 2 feet due to ponding of surface runoff. Considerable interruption of business as well as moving of stock took place in the commercial establishments. There were 243 residences isolated for 2-3 days, however, only 3 sustained losses due to water entering the residence proper. Considerable expense was required of the county for emergency flood fight work.

The city of Watsonville sustained more than $75,000 damage to streets, sewers, water supply lines, and expenditures for emergency work. Local communication facilities suffered $55,000 in damages in and around Watsonville. Transporation damages were very minor, other than interruption of traffic. Damages for Pajaro River Basin are summarized in Table 66.

Table 66

Summary of Damages (Floods of December 1955)

Pajaro River Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 1,279,000	$ 746,000	$ 2,025,000
Residential	251,000	12,100	263,100
Non-residential	50,500	5,000	55,500
Highways, roads, and bridges	270,200	-	270,200
Emergency aid	647,700	-	647,700
Total	$ 2,498,400	$ 763,100	$ 3,261,500

CARMEL RIVER BASIN (Area 4)

271. Basin description. Carmel River, located in western Monterey County, is a coastal stream emptying into the Pacific Ocean at the city of Carmel. The basin extends some 25 miles southeast into the coastal mountains.

272. Storm rainfall. During the storm period 17 - 28 December 1955, the Lambert Ranch rainfall station recorded a total of 12.28 inches. The most intense rainfall period was the 4-day period 21 - 24 December 1955 when a total of 9.78 inches was recorded. The greatest 24-hour rainfall was 4.10 inches on 23 December 1955.

273. Flooded areas. The Carmel River exceeded bankfull at State Highway No. 1 by 3½ feet, at the Robinson Road crossing by approximately 2 feet, and upstream at Carmel Valley settlement by about 2½ feet, inundating approximately 450 acres, of which about 200 acres were cropland in the reach from the mouth to Carmel Valley village.

274. Flood damages. In the lower basin flood plain, on the right bank just below State Highway No. 1 Bridge, a new housing development has been constructed in the area subject to inundation. This residential development is known as the Mission Subdivision and as of this date there are 101 residences ranging in value from $12,000 to $18,000. Construction is continuing on residential properties and a shopping center. The entire development is situated on the first shelf lowlands and is protected by a short section of levee about 2,500 feet long extended from the highway bridge approach fill downstream along the high banks of the Carmel River. The levee averages about 6 feet high, top width of 4-6 feet, side slopes 1 on 1½ feet. The December flood on the Carmel River was within 1½ feet of the top and required considerable emergency flood fight activity by local volunteers, county forces and troops from Fort Ord. On the opposite bank there is a large farm area planted to artichokes which were in part flooded by the December flood. This farmer has a dragline which he has used to remove bars in the mouth of the Carmel River each time a flood occurs to prevent or reduce floods on his fields. Just downstream from the Mission Subdivision is the Mission Ranch which experienced minor flooding on several paved tennis courts, three cabins, stable and riding horse pens. On the riverbank opposite the Mission Ranch is the sewage disposal plant for the city of Carmel. This facility was above levels of the December flood and sustained only minor damage to access roads and some scour around pipeline crossings. About 3 miles above the mouth several acres of orchards were flooded and low fields in river bends were eroded. Several houses, yards, and orchards were flooded just below the Schult Road crossing. The principal damage was scour of fields and uprooting of several fruit trees. In the vicinity of the Robinson Ranch road crossing, 4 homes located on the left bank were flooded to depths of 1 to 1½ feet, yards were eroded, fences washed out, and roadways badly torn up. Upstream from this crossing a crusher-plant on the right bank lost a part of the gravel stockpile. Between the Robinson Ranch Road Bridge and the village of Carmel Valley, several cabins were reported damaged by river overflow scouring out around foundations and washing out private road and footbridges. Damages for Carmel River Basin are summarized in Table 67.

Table 67

Summary of Damages (Floods of December 1955)

Carmel River Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 39,600	$ 3,000	$ 42,600
Residential	9,500	-	9,500
Non-residential	4,000	300	4,300
Highways, roads, and bridges	500	-	500
Emergency aid	1,500	-	1,500
Total	$ 55,100	3,300	$ 58,400

BIG SUR RIVER BASIN (Area 4)

275. Basin description. Big Sur River in west central Monterey County is about 24 highway miles south of Carmel, California. State Highway No. 1 traverses the lower 5 miles of the river valley between the mouth and Pfeifer State Park. Along this reach is situated the only known development in the basin.

276. Storm rainfall. During the storm period 18 - 27 December 1955, the rainfall station at the Big Sur State Park recorded 19.33 inches of rainfall, with heaviest amounts occurring on 22 and 23 December 1955, when a total of 11.46 inches was reported.

277. Flood damages. The heavy rains caused the Big Sur River to slightly exceed bankfull stage from the state park to the mouth. However, according to the U. S. Forest Ranger stationed at the Big Sur State Park , the minor flooding caused no damage of consequence and none could be observed by the reconnaissance team.

SALINAS RIVER BASIN (Area 4)

278. Basin description. The Salinas River Basin is located in Monterey, San Luis Obispo, San Benito, and Kern Counties, in the coastal area of central California. The watershed extends approximately 170 miles northwesterly-southeasterly and is approximately 40 miles wide at its greatest width. Salinas, Paso Robles, and King City are the largest urban centers.

279. Flood damages. Although flows exceeded normal annual stages, landowners and operators along the Salinas River reported little flooding of improved or cultivated lands. The only agricultural damage of consequence was the loss of one field of broccoli and one of celery, a total of 24 acres, lying on the left bank at the State Highway 117 crossing, near Salinas. Hunter Liggett Military Reservation suffered damage to training facilities, headquarters area, and roads and bridges from tributary streams. The road from the reservation to the coast was closed to traffic for several days. Damage to facilities is estimated to be $29,900 and road and bridge damage is $96,500. Damages for Salinas River Basin are summarized in Table 68.

Table 68

Summary of Damages (Floods of December 1955)
Salinas River Basin

Item	Damage		
	Direct	Indirect	Total
Agricultural	$ 10,000	$ -	$ 10,000
Non-residential	29,900	-	29,900
Highways, roads, and bridges	96,500	-	96,500
Total	$ 136,400	$ -	$ 136,400

DESCRIPTION OF FLOODS OF JANUARY 1956

280. General. A widespread general storm affecting most of the San Francisco District occurred from 14 to 16 January 1956. The rainfall from this storm was not particularly severe but due to the saturated conditions existing on most watersheds, moderate floods occurred on several of the streams throughout the District. Due to the much greater peak discharges in the December floods, damages incurred were relatively small. An exception to the aforementioned conditions occurred in portions of the San Francisco Bay area. Exceptionally heavy rains occurred in portions of Marin County for short durations on the afternoon of 14 January causing severe local flooding on the small basins in the western and southern portions of the county. Indicative of the severeity of the local rainfall in the southern portion of Marin County are the 24-hour rainfall records of 3.22 inches in San Francisco and 5.84 inches at Muir Woods on 14 January.

281. Area description. Marin County is located on the peninsula north of the Golden Gate between the Pacific Ocean on the west and San Francisco Bay on the east. The county has an area of 521 square miles, is 49 miles long and varies from 6 to 13 miles width. It is divided by a central mountainous ridge running in a northwesterly by southeasterly direction. It ranges in elevation from below sea level in the low reclaimed bayshore marshlands to 2,600 feet above sea level on Mount Tamalpais near the southerly end of the county. Most of the streams are short with steep slopes in the upper reaches of their watersheds. Those streams draining into San Francisco Bay and Lagunitas Creek on the western slope generally pass through low flat, partially reclaimed marshlands at their mouths. The streams affected by the January storms are Stinson Creek, Redwood Creek and Tennessee Valley Creek draining into the Pacific Ocean on the southwestern tip of the peninsula, and Coyote Creek and San Rafael Creek draining into San Francisco Bay on the southeastern tip of the peninsula.

282. Population. The greater majority of the estimated 100,000 population live on the east side of the central dividing ridge in incorporated cities and towns.

283. Industry. There are numerous military and naval reservations and other installations, including Hamilton Air Force Base in the southeastern half of the county. Agricultural production totaled $11,900,000 in 1954, of which $9,200,000 was from dairy products. Numerous industrial plants engaged in light industry and boat building are situated on the bayside of the peninsula. There are numerous recreational areas, yacht harbors, and fishing resorts in the area.

284. Storms. Flooding occurred three times during the winter period, twice by excessive rainfall (December 1955 and January 1956)

and once from tidal flooding in January 1956. The 19 - 24 December 1955 flood was caused primarily from excessive rains in the central and northern portions of the county. The 14 January 1956 inundation was caused by heavy rains, mainly in the southern and western tip of the county. On 26 January 1956 high tides caused flooding in the San Rafael tidal area.

285. Flooded areas. Flood conditions for each of the major basins of the county are reviewed in the following paragraphs. In addition to the major drainage areas, minor flooding and damage occurred in several small communities. While damage from this storm was light, the rapid population growth and subdivision expension in Marin County places these areas in a position where future damage could be heavy. These communities are described below.

286. Belvedere. Street flooding occurred on the mainland side of Belvedere Lagoon. Limited residential and several acres of low lying ground were affected. At Point San Pedro semi-reclaimed marshland and lowland on the north side of the road from San Rafael to Point San Pedro were flooded. The total area submerged was 254 acres. Flooding was of short duration and caused little damage.

287. Marin City. Marin City is located two miles north of the Golden Gate Bridge on the eastern side of the peninsula. Flooding was confined to the streets during the December 1955 and January 1956 storms with only negligible damage occurring.

STINSON CREEK BASIN

288. Basin description. Stinson Beach is a small resort town on the Pacific Coast, 8 miles north of the Golden Gate. Stinson Creek flows through the town and along State Highway No. 1 and empties into the southeast end of Bolinas Lagoon. The basin area is slightly more than 1 square mile, and it is steeply mountainous with a maximum elevation of about 2,000 feet. The flooded area is occupied by a small community and a part of Stinson Beach State Park. It is mainly a recreational area with summer homes, rental cabins, motels, small business establishments and a few permanent residences.

289. Flood damages. Flooding was limited to 27 acres in the resort area just above the mouth of the stream. During the high stages of the flood, course gravel and sand completely filled the channel above State Highway No. 1 and blocked the road with large deposits of boulders, gravel and sand. Many residential yards in the resort area were covered with one-half to three feet of silt. Major damage in the area is associated with removal of this debris from channels, roadways, and residential and commercial properties. Damage estimates were made by nearly 100 percent coverage of the area and are summarized in Table 69.

Table 69

Summary of Damages (Floods of January 1956)
Stinson Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 8,100	$ -	$ 8,100
Non-residential	6,400	-	6,400
Emergency aid	14,000	-	14,000
Highways, roads, and bridges	1,000	-	1,000
Total	$ 29,500	$ -	$ 29,500

REDWOOD CREEK BASIN

290. Basin description. Redwood Creek, located in southern Marin County, has headwaters on the slope of Mount Tamalpais and empties into the Pacific Ocean 4 miles north of Point Bonita at the entrance to San Francisco Bay. The basin is 5 miles long and has an average width of 1-3/4 miles. It is steeply mountainous except for a three-mile narrow winding valley in the lower central portion of the basin. Elevations range from mean sea level to 2,600 feet on Mount Tamalpais in the headwaters. Muir Woods National Monument, which is a primitive redwood forest area and a portion of Mount Tamalpais State Park, is located in the upper part of the watershed. A small resort area is located at Muir Beach at the mouth of Redwood Creek. The balance of the basin is devoted primarily to agricultural uses.

291. Flood damages. Flooding occurred primarily in the low valley area one-half mile upstream from the mouth of the creek. Several residences and resort cabins suffered inundation of first floors and several other residences had water within a few inches of the first floor. The main damage in this vicinity was to the highway, which suffered washouts, slides, road culvert damage, road shoulder damage, and deposition of debris. Damage in Muir Woods National Monument was confined to camp facilities, trails, and footbridges. Damage estimates are summarized in Table 70.

Table 70

Summary of Damages (Floods of January 1956)
Redwood Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 1,200	$ -	$ 1,200
Non-residential	6,200	-	6,200
Highways, roads, and bridges	45,400	-	45,400
Total	$ 52,800	$ -	$ 52,800

TENNESSEE VALLEY CREEK BASIN

292. Basin description. Tennessee Valley is a small basin in southern Marin County that empties into the Pacific Ocean 2 miles north of the entrance to San Francisco Bay. Part of Fort Cronkhite Military Reservation extends into the lower portion of the basin. Local residents reported little or no damage. Some bank erosion occurred along the stream. Culverts and a small footbridge were washed out. The valley is sparsely settled and is used primarily for grazing and other agricultural purposes. The total damage is estimated not to exceed $1,000.

COYOTE CREEK BASIN

293. Basin description. Coyote Creek is located in the southern part of Marin County about 4 miles north of the entrance to San Francisco Bay. The creek drains into Richardson Bay which is an arm of San Francisco Bay. The basin is fan-shaped with steeply mountainous sides descending to a small valley with rolling hills. The population of the area is primarily suburban or rural and of the 600 residences in the basin, about 250 are located in the area flooded during January 1956. In addition to the present homes, a large subdivision has been planned for near future construction in this flood area.

294. Flood damages. Most of the flooding that occurred in the suburban area was caused by inadequate channel capacities. Overflow from stream channels flooded streets and residences to depths of two feet in a few of the residences located in the filled tidal flats.

The flood plain contains 90 acres of reclaimed and developed land, and 55 acres of marshland. Many residences were evacuated voluntarily with the assistance of local public agencies. Greater damage was averted by salvage efforts such as raising furniture and removing floor coverings. Structural damage was light due to the slab concrete construction of most of the homes. Damages were evaluated on nearly 100 percent coverage of the area. The resulting damages for the January 1956 floods are summarized in Table 71. A higher flood peak than the one in January occurred in this area 7 December 1955 in the northern portion of the flood plain, however, due to the short duration, damages were relatively light.

Table 71

Summary of Damages (Floods of January 1956)

Coyote Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 75,900	$ 7,100	$ 83,000
Non-residential	800	-	800
Emergency aid	200	-	200
Total	$ 76,900	$ 7,100	$ 84,000

SAN RAFAEL CREEK BASIN

295. Tidal Flood. During the high tide of 26 January 1956, flooding occurred in the city of San Rafael along Francisco Boulevard in the low partially unprotected tidal area adjacent to San Rafael Creek downstream from Irwin Street. Flooding was not as extensive at the County Hospital on Fourth Street and Grand Avenue in the city of San Rafael as during the December floods. The area most severely flooded was the San Rafael business area on Harbor Street and Francisco Boulevard just northeast of Highway U. S. 101. Flooding was caused exclusively from high tides. Flooding occurred when tidal flows came over the banks of the canal west and north of Canal Street. Damages from tidal flooding are summarized in Table 72.

Table 72

Summary of Damages (Floods of January 1956)
San Rafael Creek Basin

Item	Damage		
	Direct	Indirect	Total
Residential	$ 2,000	$ -	$ 2,000
Non-residential	24,200	2,200	26,600
Total	$ 26,200	$ 2,200	$ 28,600

Table 73

Summary of Damages, Floods of December 1955
Area I

	Smith River	Klamath River and Tributaries	Redwood Creek	Mad River	Eel River and Tributaries	Mattole River	Miscl. Coastal Streams	Russian River and Tributaries	Total Area I
AGRICULTURE									
Direct	$ 45,900	$ 358,800	$ 44,900	$ 285,500	$ 3,575,900	$ 57,400	$ -	$ 830,400	$ 5,198,800
Indirect	-	4,600	3,700	-	6,700	-	-	30,900	45,900
Bank cutting	3,200	109,000	-	-	-	-	-	-	112,200
Flood protection works	-	-	-	26,300	-	-	-	-	26,300
INUNDATION									
Residential									
Direct	7,700	689,200	64,900	3,600	2,729,300	3,700	-	864,300	4,362,700
Indirect	1,000	176,500	2,700	500	30,100	-	-	131,700	342,500
Non-residential									
Direct	70,000	3,030,200	159,500	355,900	5,836,100	104,400	-	1,411,500	10,967,600
Indirect	4,700	1,290,000	162,400	71,200	1,157,000	28,200	-	201,000	2,914,500
STATE & COUNTY ROADS & BRIDGES									
Direct	336,000	4,803,900	130,100	354,300	4,192,700	439,000	409,500	767,700	11,433,200
Indirect	-	-	-	4,500	-	-	-	-	4,500

Table 73
(Continued)

Summary of Damages, Floods of December 1955
Area I

	Smith River	Klamath River and Tributaries	Redwood Creek	Mad River	Eel River and Tributaries	Mattole River	Miscl. Coastal Streams	Russian River and Tributaries	Total Area I
RAILROAD									
Direct	$ -	$ -	$ -	$ -	$ 2,050,000	$ -	$ -	$ 55,000	$ 2,105,000
Indirect	-	-	-	-	507,600	-	-	297,100	804,700
TOTALS, INUNDATION									
Direct	413,700	8,523,300	354,500	713,800	14,808,100	547,100	409,500	3,098,500	28,868,500
Indirect	5,700	1,466,500	165,100	76,200	1,694,700	28,200	-	629,800	4,066,200
AGRICULTURE(All)	49,100	472,400	48,600	311,800	3,582,600	57,400	-	861,300	5,382,200
GRAND TOTALS									
Direct	462,800	8,991,100	399,400	1,025,600	18,384,000	604,500	409,500	3,928,900	34,205,800
Indirect	5,700	1,471,100	168,800	76,200	1,701,400	28,200	-	660,700	4,112,100
SUBTOTAL	$468,500	$10,462,200	$568,200	$1,101,800	$20,085,400	$632,700	$409,500	$ 4,589,600	$38,317,900
EMERGENCY AID	-	-	28,900	221,300	2,131,100	50,000	-	427,600	2,858,900
TOTAL	$468,500	$10,462,200	$597,100	$1,323,100	$22,216,500	$682,700	$409,500	$ 5,017,200	$41,176,800

Area I includes all streams north of San Francisco Bay draining into the Pacific Ocean.

Table 74

Summary of Damages, Floods of December 1955
Area II

	Corte Madera Creek	Novato Creek	Petaluma Creek	San Rafael Creek	Sonoma Creek	Misc. small basins north side of bay	Napa River	San Lorenzo Creek	Alameda Creek	Misc. small basins east side of bay	Total Area II
AGRICULTURE											
Direct	$ -	$119,000	$37,600	$ -	$323,800	$ 48,200	$143,300	$ 56,800	$ 880,000	$ -	$1,608,800
Indirect	-	4,500	1,100	-	-	1,500	-	-	-	-	7,100
Bank cutting	-	-	-	-	-	-	29,000	-	-	-	29,000
Flood protection works	-	-	-	-	-	114,000	-	92,000	106,900	-	312,900
INUNDATION											
Residential											
Direct	94,800	1,200	100	1,500	40,200	6,700	48,500	329,400	428,400	4,100	954,900
Indirect	5,300	1,200	100	100	-	100	2,600	6,300	19,000	-	34,700
Non-residential											
Direct	59,600	6,000	-	113,700	35,800	11,700	121,800	114,800	1,804,300	20,500	2,288,200
Indirect	14,700	60,700	-	12,700	-	7,000	60,000	-	602,000	1,000	758,100
STATE & COUNTY ROADS & BRIDGES											
Direct	82,600	1,500	16,500	-	9,500	137,100	136,800	250,000	180,000	108,300	922,300
Indirect	-	-	-	-	-	-	-	-	-	-	-

Table 74
(Continued)

Summary of Damages, Floods of December 1955
Area II

	Corte Madera Creek	Novato Creek	Peta-luma Creek	San Rafael Creek	Sonoma Creek	Misc. small basins north side of bay	Napa River	San Lorenzo Creek	Alameda Creek	Misc. small basins east side of bay	Total Area II
RAILROADS											
Direct	$ -	$ -	$ -	$ -	$ 40,000	$ -	$ -	$ -	$ 84,000	$ -	$ 124,000
Indirect	-	-	-	-	33,500	-	-	-	20,000	-	53,500
TOTALS, INUNDATION											
Direct	237,000	8,700	16,600	115,200	125,500	155,500	307,100	694,200	2,496,700	132,900	4,289,400
Indirect	20,000	61,900	100	12,800	33,500	7,100	62,600	6,300	641,000	1,000	846,300
AGRICULTURE(All)	-	123,500	38,700	-	323,800	163,800	172,300	148,800	986,900	-	1,957,800
GRAND TOTALS											
Direct	237,000	127,700	54,200	115,200	449,300	317,800	479,400	843,000	3,483,600	132,900	6,240,100
Indirect	20,000	66,400	1,200	12,800	33,500	8,600	62,600	6,300	641,000	1,000	853,400
SUBTOTAL	$257,000	$194,100	$55,400	$128,000	$482,800	$ 326,400	$542,000	$849,300	$4,124,600	$ 133,900	$7,093,500
EMERGENCY AID	-	-	-	-	10,000	-	-	81,000	-	-	91,000
TOTAL	$257,000	$194,100	$55,400	$128,000	$492,800	$ 326,400	$542,000	$930,300	$4,124,600	$ 133,900	$7,184,500

Area II includes the area that drains into San Francisco Bay in the counties of Marin, Sonoma, Napa, Contra Costa, and Alameda, with the exception of Coyote Creek Basin.

Miscellaneous small basins north side of bay include; Tolay Creek, Arroyo Corte Madera Del Presidio, Lagunitas Creek, Miller Creek, and Gallinas Creek.

Table 75

Summary of Damages, Floods of December 1955
Area III

	Colma Creek	San Bruno Creek	Coastal Streams	San Mateo Creek	San Francisquito Creek	Matadero Creek	Adobe Creek	Permanente Creek	Stevens Creek	Guadalupe River and Tributaries	Coyote Creek and Tributaries	Misc. small streams Alameda County	Total Area III
AGRICULTURE													
Direct	$ -	$ -	$245,800	$ -	$ -	$ -	$15,000	$28,500	$116,700	$ 959,300	$242,900	$17,500	$1,635,700
Indirect	-	-	5,100	-	-	-	-	28,500	123,100	-	-	-	157,000
Bank cutting	-	-	-	-	-	13,000	-	-	-	17,300	-	-	30,300
Flood protection works	-	-	-	-	-	-	-	-	-	-	-	-	-
INUNDATION													
Residential													
Direct	-	-	13,600	26,700	1,449,800	9,700	70,500	3,800	19,200	462,900	-	-	2,056,200
Indirect	-	-	400	2,500	66,700	200	400	900	900	27,500	-	-	99,500
Non-residential													
Direct	-	-	2,400	3,400	117,100	19,300	900	62,300	42,500	483,800	-	-	731,700
Indirect	-	-	1,200	-	8,500	1,500	-	5,200	600	81,600	-	-	98,600
STATE & COUNTY ROADS & BRIDGES													
Direct	8,400	23,000	116,600	-	31,400	-	-	-	91,900	425,700	6,100	-	703,100
Indirect	-	-	-	-	-	-	-	-	-	-	-	-	-
RAILROADS													
Direct	-	-	-	-	-	-	-	-	-	15,500	-	-	15,500
Indirect	-	-	-	-	-	-	-	-	-	10,700	-	-	10,700

Table 75
(Continued)

Summary of Damages, Floods of December 1955
Area III

	Colma Creek	San Bruno Creek	Coastal Streams	San Mateo Creek	San Francisquito Creek	Matadero Creek	Adobe Creek	Permanente Creek	Stevens Creek	Guadalupe River and Tributaries	Coyote Creek and Tributaries	Misc. small streams Alameda County	
TOTALS, INUNDATION													
Direct	8,400	23,000	132,600	30,100	1,598,300	29,000	71,400	66,100	153,600	1,387,900	6,100	-	3,506,500
Indirect	-	-	1,600	2,500	75,200	1,700	400	6,100	1,500	119,800	-	-	208,800
AGRICULTURE (All)	-	-	250,900	-	-	13,000	15,000	67,300	239,800	976,600	242,900	17,500	1,823,000
GRAND TOTALS													
Direct	8,400	23,000	378,400	30,100	1,598,300	42,000	86,400	104,600	270,300	2,364,500	249,000	17,500	5,172,500
Indirect	-	-	6,700	2,500	75,200	1,700	400	34,900	124,600	119,800	-	-	365,800
SUBTOTAL	$ 8,400	$23,000	$385,100	$32,600	$1,673,500	$43,700	$86,800	$139,500	$394,900	$2,484,300	$249,000	$17,500	$5,538,300
EMERGENCY AID	43,200	16,000	99,700	-	220,500	24,400	-	3,000	-	76,000	-	-	482,800
TOTAL	$51,600	$39,000	$484,800	$32,600	$1,894,000	$68,100	$86,800	$142,500	$394,900	$2,560,300	$249,000	$17,500	$6,021,100

Area III includes the area that drains into San Francisco Bay in the counties of San Mateo, Santa Clara, and that portion of Alameda County in the Coyote Creek basih.

Table 76

Summary of Damages, Floods of December 1955
AREA IV

	San Lorenzo River and Tributaries	Soquel Creek	Pajaro River and Tributaries	Scott Creek	Aptos Creek	Carmel River	Salinas River	Total Area IV
AGRICULTURE								
Direct	$ 159,800	$ 14,000	$1,279,000	$ 121,800	$ 6,700	$ 39,600	$ 10,000	$ 1,630,900
Indirect	11,800	4,000	746,000	11,400	1,000	3,000	-	777,200
Bank cutting	-	-	-	-	-	-	-	-
Flood-protection works	-	-	-	-	-	-	-	-
INUNDATION								
Residential								
Direct	1,229,400	121,300	251,000	-	6,400	9,500	-	1,617,600
Indirect	103,200	14,800	12,100	-	-	-	-	130,100
Non-residential								
Direct	5,612,200	388,900	50,500	5,000	500	4,000	29,900	6,091,000
Indirect	1,067,000	39,900	5,000	1,500	-	300	-	1,113,700
STATE AND COUNTY ROADS AND BRIDGES								
Direct	273,800	148,600	270,200	4,000	27,700	500	96,500	821,300
Indirect	3,500	6,300	-	500	900	-	-	11,200

Table 76
(Continued)

Summary of Damages, Floods of December 1955
AREA IV

	San Lorenzo River and Tributaries	Soquel Creek	Pajaro River and Tributaries	Scott Creek	Aptos Creek	Carmel River	Salinas River	Total Area IV
RAILROADS								
Direct	$ 7,000	$ -	$ -	$ -	$ 2,100	$ -	$ -	$ 9,100
Indirect	800	-	-	-	-	-	-	800
TOTALS, INUNDATION								
Direct	7,122,400	658,800	571,700	9,000	36,700	14,000	126,400	8,539,000
Indirect	1,174,500	61,000	17,100	2,000	900	300	-	1,255,800
AGRICULTURE (All)	171,600	18,000	2,025,000	133,200	7,700	42,600	10,000	2,408,100
GRAND TOTALS								
Direct	7,282,200	672,800	1,850,700	130,800	43,400	53,600	136,400	10,169,900
Indirect	1,186,300	65,000	763,100	13,400	1,900	3,300	-	2,033,000
SUBTOTAL	$8,468,500	$ 737,800	$2,613,800	$ 144,200	$ 45,300	$ 56,900	$136,400	$12,202,900
EMERGENCY AID	232,400	93,300	647,700	43,600	16,300	1,500	-	1,034,800
TOTAL	$8,700,900	$ 831,100	$3,261,500	$ 187,800	$ 61,600	$ 58,400	$136,400	$13,237,700

Area IV includes all the streams south of San Francisco draining into the Pacific Ocean.

Table 77

Summary of Damages, Floods of December 1955
San Francisco District, Totals

	Area I	Area II	Area III	Area IV	San Francisco District totals
AGRICULTURE					
Direct	$ 5,198,800	$1,608,800	$1,635,700	$ 1,630,900	$10,074,200
Indirect	45,900	7,100	157,000	777,200	987,200
Bank cutting	112,200	29,000	30,300	-	171,500
Flood-protection works	26,300	312,900	-	-	339,200
INUNDATION					
Residential					
Direct	4,362,700	954,900	2,056,200	1,617,600	8,991,400
Indirect	342,500	34,700	99,500	130,100	606,800
Non-residential					
Direct	10,967,600	2,288,200	731,700	6,091,000	20,078,500
Indirect	2,914,500	758,100	98,600	1,113,700	4,884,900
STATE AND COUNTY ROADS AND BRIDGES					
Direct	11,433,200	922,300	703,100	821,300	13,879,900
Indirect	4,500	-	-	11,200	15,700
RAILROADS					
Direct	2,105,000	124,000	15,500	9,100	2,253,600
Indirect	804,700	53,500	10,700	800	869,700
TOTALS, INUNDATION					
Direct	28,868,500	4,289,400	3,506,500	8,539,000	45,203,400
Indirect	4,066,200	846,300	208,800	1,255,800	6,377,100
AGRICULTURE (All)	5,383,200	1,957,800	1,823,000	2,408,100	11,572,100
GRAND TOTALS					
Direct	34,205,800	6,240,100	5,172,500	10,169,900	55,788,300
Indirect	4,112,100	853,400	365,800	2,033,000	7,364,300
SUBTOTAL	$38,317,900	$7,093,500	$5,538,300	$12,202,900	$63,152,600
EMERGENCY AID	2,858,900	91,000	482,800	1,034,800	4,467,500
TOTAL	$41,176,800	$7,184,500	$6,021,100	$13,237,700	$67,620,100
Indirect damages to U.S. Highway 101					350,000
GRAND TOTAL					$67,970,100

Table 78

Summary of Damages (Floods of January 1956)
Marin County Basins

Item	Stinson Beach	Redwood Creek	Tennessee Valley	Coyote Creek	Total
Residential:					
Direct	$ 8,100	$ 1,200	$ -	$ 75,900	$ 85,200
Indirect	-	-	-	7,100	7,100
Non-residential:					
Direct	6,400	6,200	1,000	800	14,400
Highways, roads, and bridges	1,000	45,400	-	-	46,400
Emergency aid	14,000	-	-	200	14,200
Total	$ 29,500	$ 52,800	$ 1,000	$ 84,000	$ 167,300

REPORT ON
FLOODS OF DECEMBER 1955
AND JANUARY 1956 IN THE
SAN FRANCISCO DISTRICT
STREAMS AFFECTED
BY FLOODING

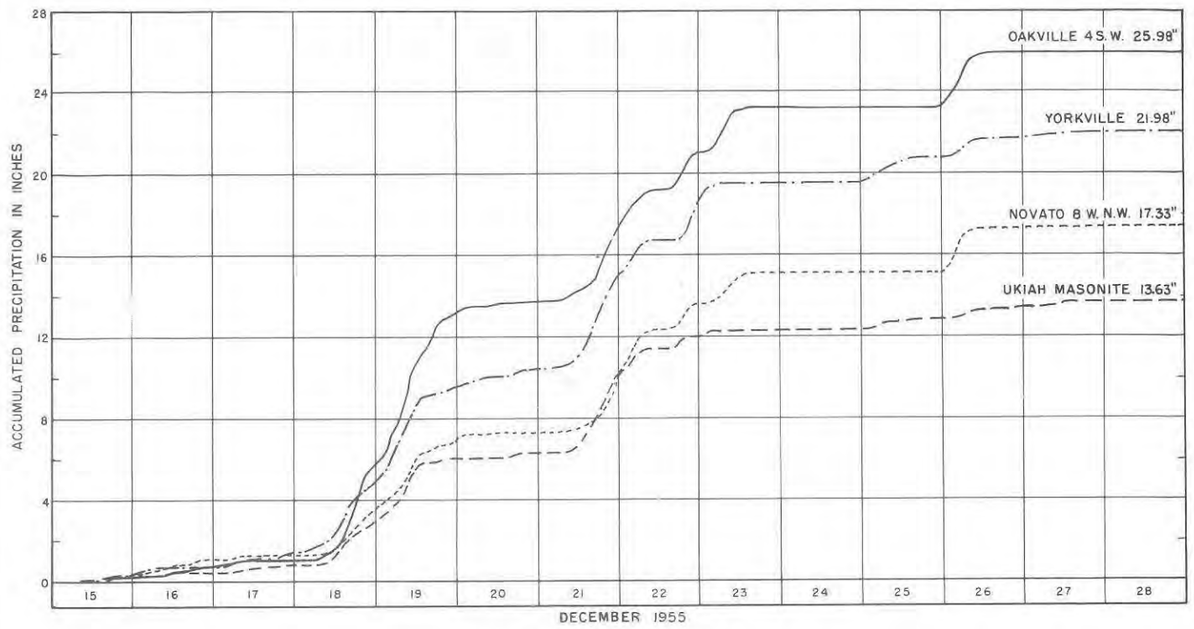
IN 5 SHEETS — SHEET 1

SCALE IN MILES
50 0 50

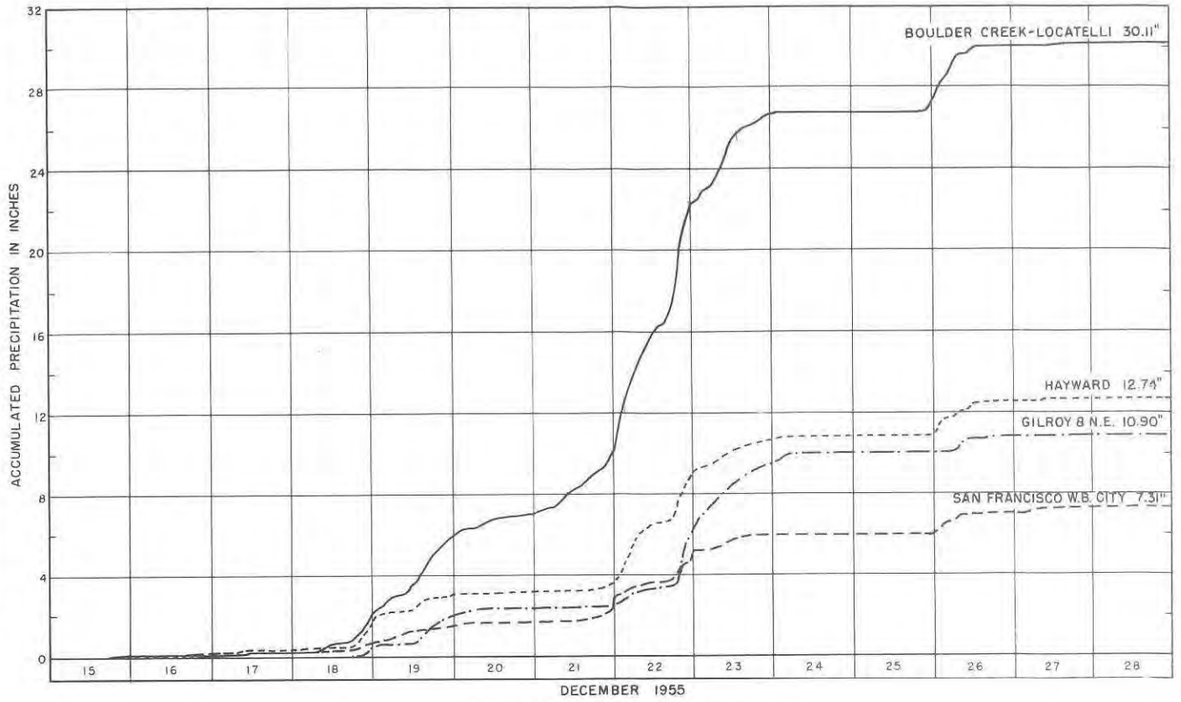
SAN FRANCISCO DISTRICT
CORPS OF ENGINEERS, U.S. ARMY

TRACED: J.B. — TO ACCOMPANY REPORT — FILE NO.
CHECKED: H.S. — DATED JUNE 1956 — 49-53-1

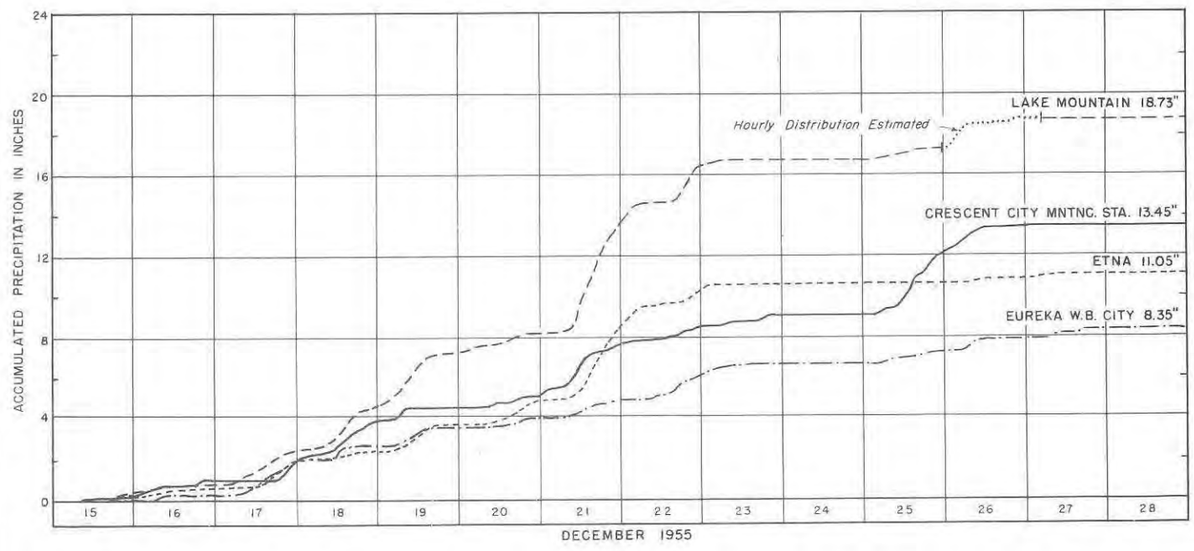
FIG. 1



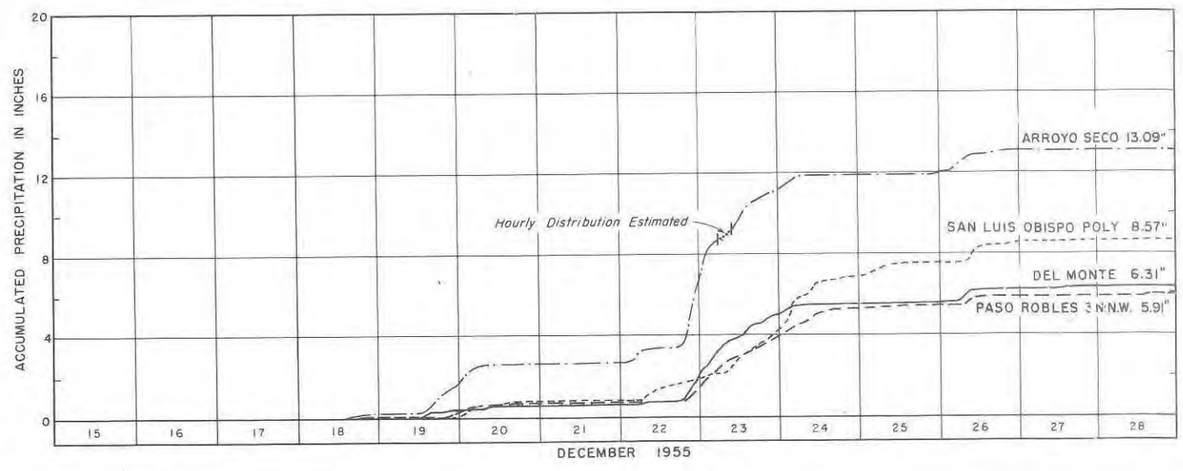
NORTH CENTRAL AREA



SOUTH CENTRAL AREA



NORTHERN AREA



SOUTHERN AREA

REPORT ON
FLOODS OF DECEMBER 1955
AND JANUARY 1956 IN THE
SAN FRANCISCO DISTRICT

MASS RAINFALL CURVES

STORMS OF 15-28 DEC. 1955

IN 5 SHEETS SHEET NO. 4

CORPS OF ENGINEERS, U.S. ARMY, SAN FRANCISCO, CALIF.
APRIL , 1956

DRAWN: M.H.T
TRACED: D.F.
CHECKED: I.H.S.

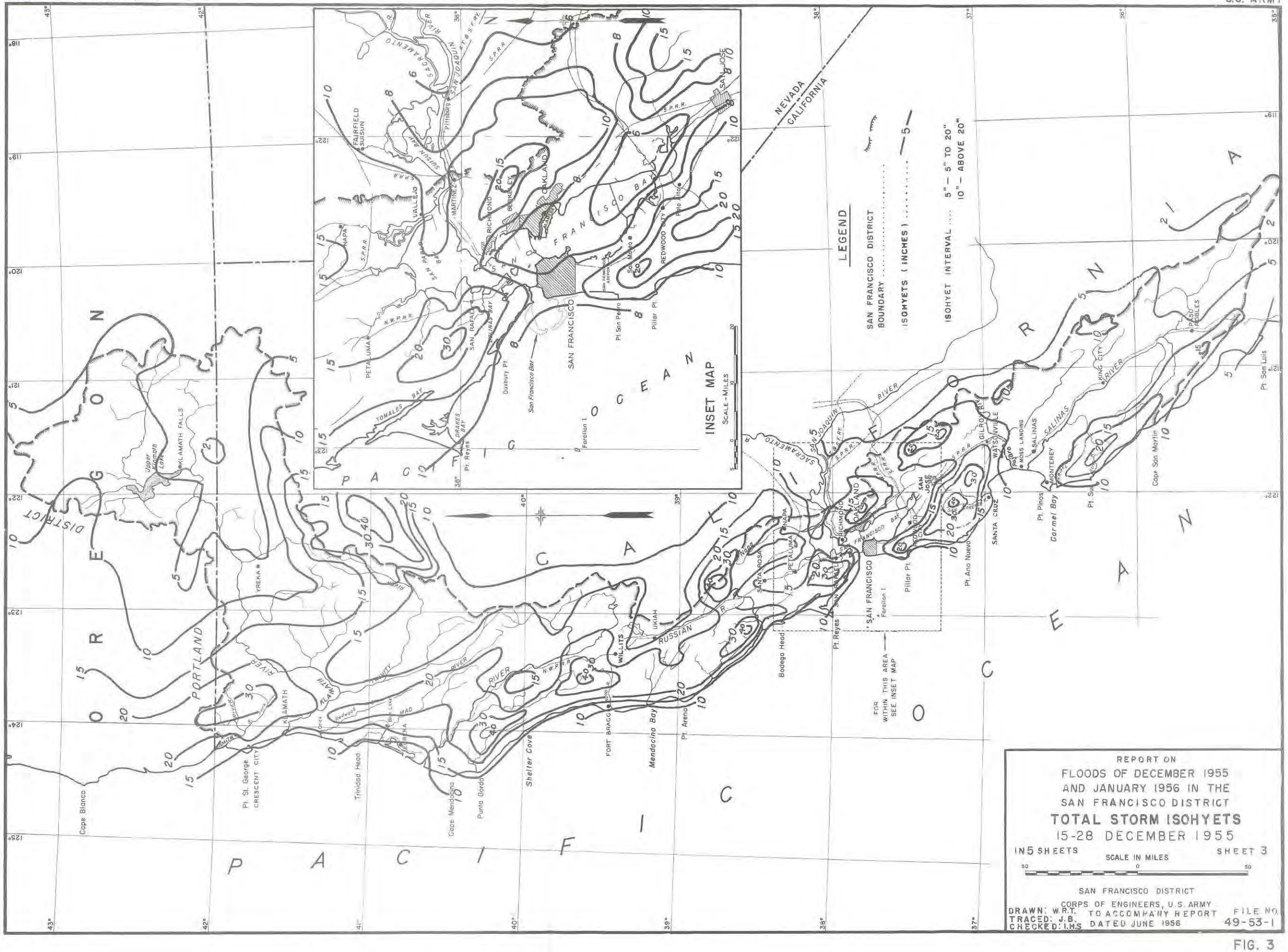
TO ACCOMPANY REPORT
DATED JUNE 1956

FILE NO.
49-53-1

FIG. 2

CORPS OF ENGINEERS

U.S. ARMY



REPORT ON
FLOODS OF DECEMBER 1955
AND JANUARY 1956 IN THE
SAN FRANCISCO DISTRICT

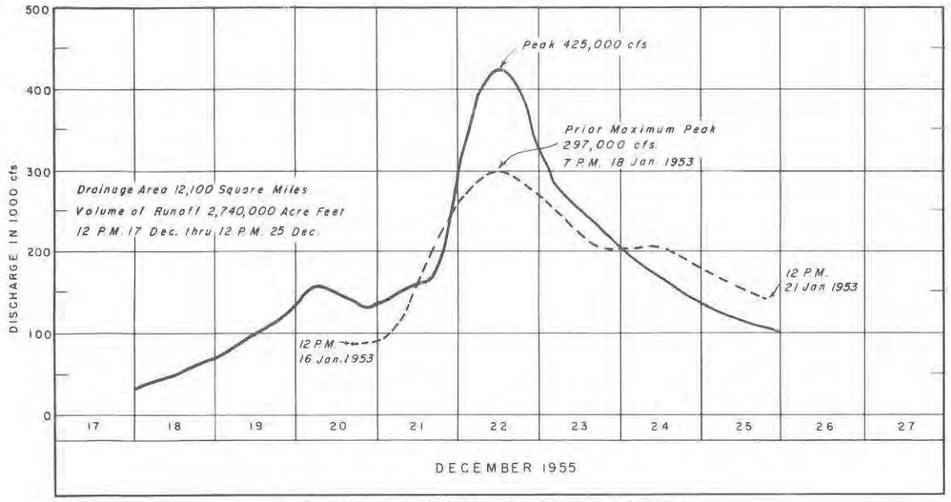
TOTAL STORM ISOHYETS
15-28 DECEMBER 1955

IN 5 SHEETS — SHEET 3

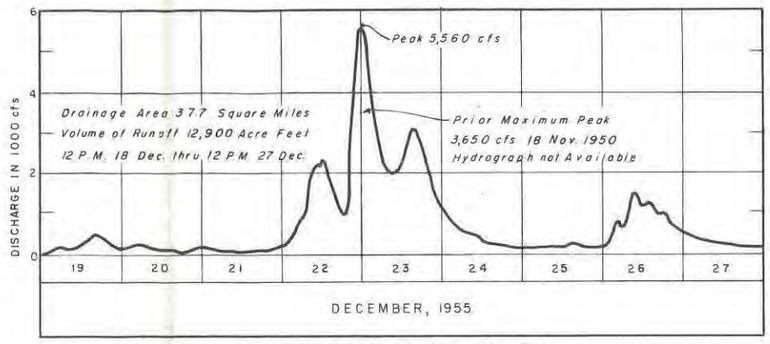
SCALE IN MILES 50 0 50

SAN FRANCISCO DISTRICT
CORPS OF ENGINEERS, U.S. ARMY
DRAWN: W.R.T.
TRACED: J.B.
CHECKED: I.H.S.
TO ACCOMPANY REPORT
DATED JUNE 1956
FILE NO. 49-53-1

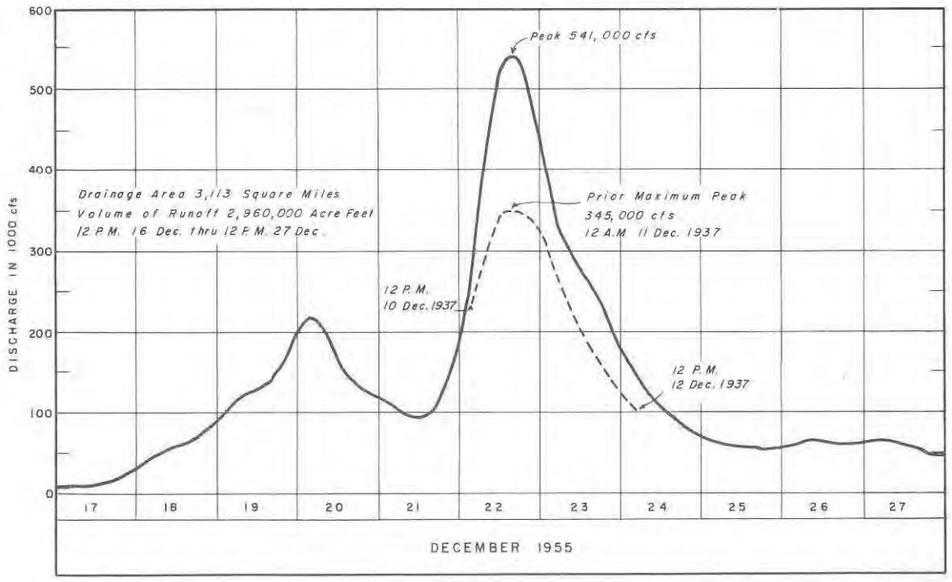
FIG. 3



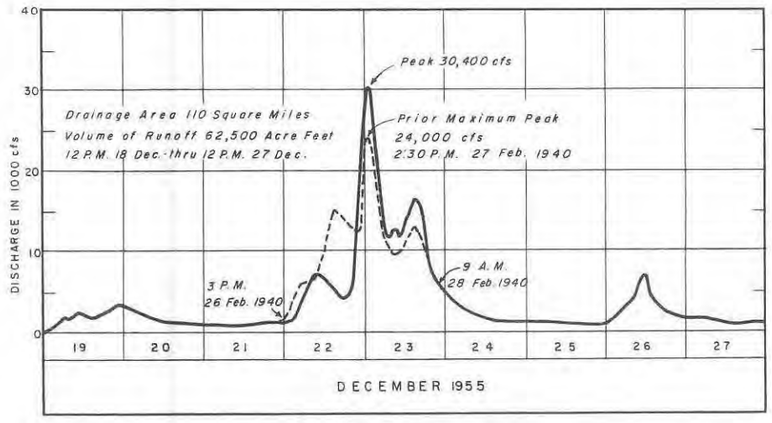
KLAMATH RIVER NEAR KLAMATH



SAN FRANCISQUITO CREEK
AT STANFORD UNIVERSITY

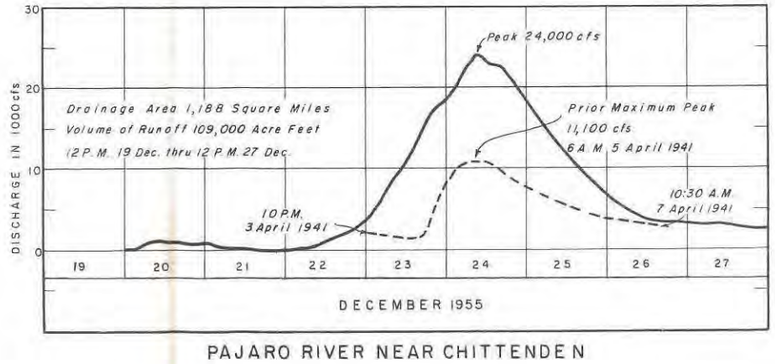


EEL RIVER AT SCOTIA

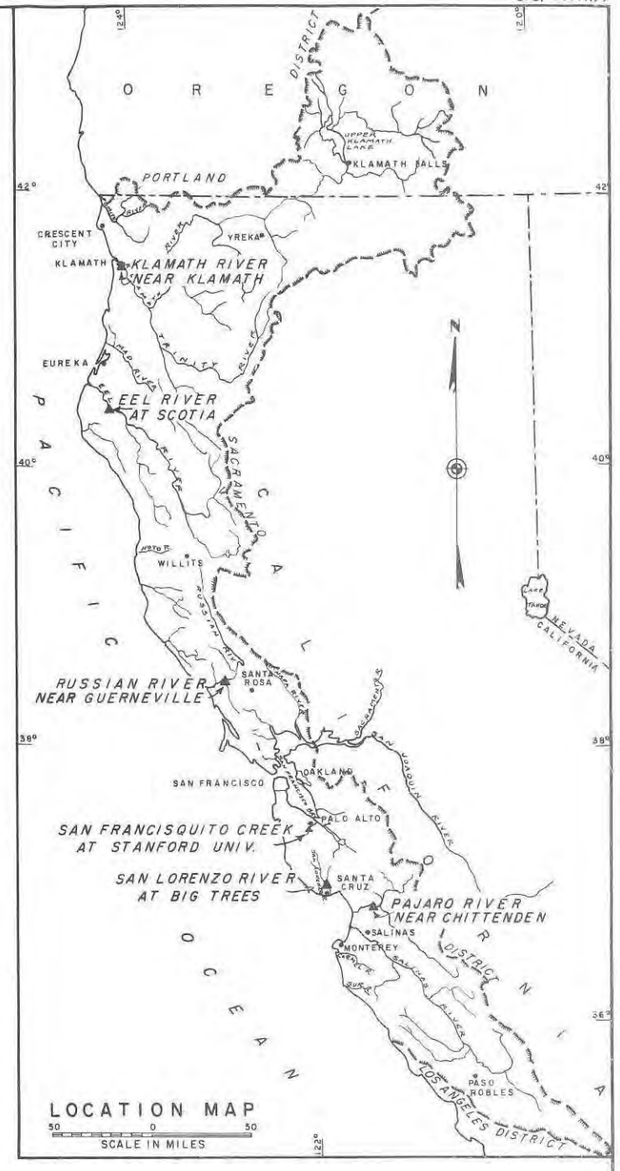


SAN LORENZO RIVER AT BIG TREES

RUSSIAN RIVER NEAR GUERNEVILLE



PAJARO RIVER NEAR CHITTENDEN



NOTE.
Hydrographs of December 1955 floods are preliminary and subject to revision.

REPORT ON
FLOODS OF DECEMBER 1955
AND JANUARY 1956 IN THE
SAN FRANCISCO DISTRICT

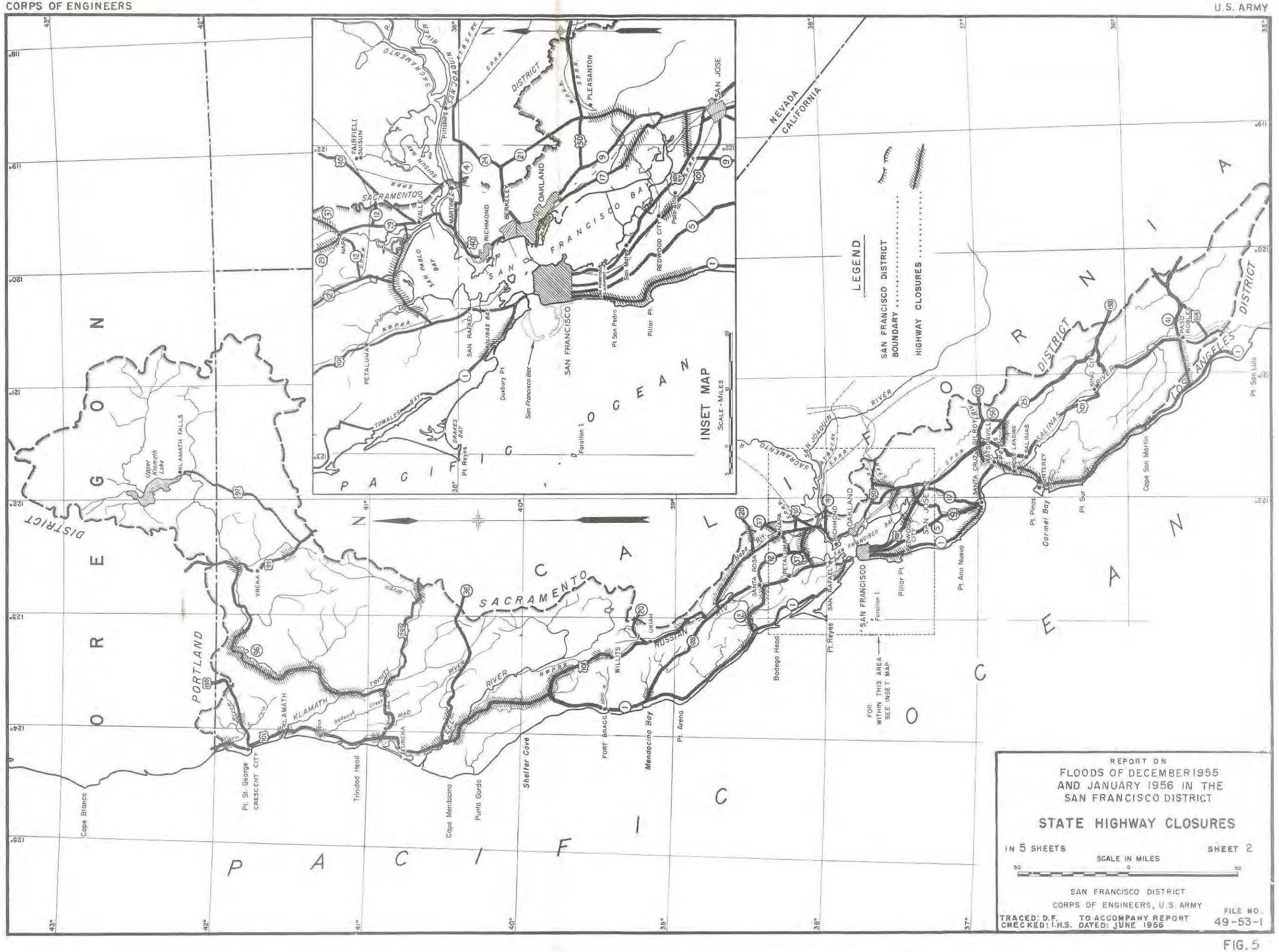
HYDROGRAPHS
FOR SELECTED STREAMS

IN 5 SHEETS — SHEET NO. 5
CORPS OF ENGINEERS, U.S. ARMY, SAN FRANCISCO, CALIF.
APRIL, 1956
DRAWN: M.T.
TRACED: J.B.
CHECKED: I.H.S.
TO ACCOMPANY REPORT
DATED: JUNE, 1956
FILE NO. 49-53-1

FIG. 4

CORPS OF ENGINEERS

U.S. ARMY



REPORT ON
FLOODS OF DECEMBER 1955
AND JANUARY 1956 IN THE
SAN FRANCISCO DISTRICT

STATE HIGHWAY CLOSURES

IN 5 SHEETS — SHEET 2

SCALE IN MILES

50 0 50

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

TRACED: D.F. TO ACCOMPANY REPORT
CHECKED: I.H.S. DATED: JUNE 1956

FILE NO. 49-53-1

FIG. 5

DATE SUBJECT

DATE JOB NO. SHEET NO. O.F

1955 Damages

Calipso & Tributaries (including Mantua)

$ 2,560,300 ✓

Stevens Creek	344,400 ✓
Pamo	142,500 ✓
above	86,800 ✓
mentadero	68,100 ✓
San Francisquito	1,894,000 ✓
	$ 5,146,600 ✓

Coyote Creek	59,300 ✓
Permanente	62,300 ✓
Silver	28,600 ✓
Fisher	98,800 ✓
	$ 249,000 ✓

5,146,600

Total (Guad, San Francisquito & Coyote) → $ 5,395,600 ✓

...ram Report of Flood of Dec 1955 & Jan 1956
... Mantua Calif. Coastal Streams
Prepared by S.E. Dent, Corps of Engineers U.S. Army
June 1956