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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Quality of Water Branch

THE GEOLOGICAL SURVEY SEDIMENT PROGRAM
IN CALIFORNIA

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The Geological Survey Sediment Program
in California

by E. Brown 1/

The activities of the Water Resources Division of the U. S. Geological Survey in the State of California arise from the responsibility placed on this agency by Congress for the determination and appraisal of the nation's water resources. The stream-sediment programs of the division are designed to carry out this broad responsibility and include systematic measurement of the sediment load carried by streams, studies of sources and movement of fluvial sediment, and research on the mechanics of fluvial-sediment movement. In order to effectively consummate these programs over the Nation, funds are appropriated by Congress and earmarked in part for what is termed the federal program and in part for the cooperative program to match on a 50-50 basis, offerings by State and local governments for the conduct of sediment investigations at the State or local level. The federal stream-sediment program is comprised of investigations in which the federal or national interest is predominant and, accordingly, the costs are borne entirely by the federal government. It is expected that some all-federal funds will be allocated in fiscal year 1958 to projects in California, but the amount is not as yet known.

In the cooperative programs, emphasis is given to the "long-term" systematic collection of sediment records as well as to the "short-term" project type of investigations in specific areas. The federal interest in such programs is usually concerned with (1) protecting the government's interest in federal developments, (2) interstate water problems, (3) national security and the general welfare.

For the 1958 fiscal year preliminary approval has been given to the allocation of \$25,000 in Federal funds for cooperative sediment investigations in California. This rather high percentage of the funds available for all programs throughout the nation is believed to indicate recognition by both Federal and State officials of the urgent need for sediment data for the State of California.

The lack of quantitative sediment data for the State is indicated by the fact that until the present time the only available sediment information has been a few scattered measurements by various agencies in "spot" areas. From December 1952 until March 1955 this District operated a daily sediment sampling station on the East Fork of the Russian River near Ukiah with funds provided by the U. S. Corps of Engineers. From September 1955 until June 1956 a limited sediment-sampling program was carried on by this office for a few streams in northwestern California from funds provided by the Geological Survey and the Bureau of Reclamation. This reconnaissance study was conducted to provide a minimum basis for discussion of the sediment characteristics of the streams in that area for a report by the Pacific Southwest Field Committee, U. S. Department of the Interior, on the natural resources of Northwestern California. Partly because of the extreme flood conditions of December 1955, but mainly because of insufficient funds, the sample coverage was too limited to allow computation of sediment loads for the period or to arrive at any definite conclusions regarding suspended-sediment loads.

Although the need for sediment data for California surface streams has been recognized for some time, the urgency of the situation became even more apparent with the development of the California Water Plan. Design and

construction features of this gigantic project for the full utilization of California's water resources required immediate knowledge of sediment characteristics in certain areas and eventual information on a great many others.

In July 1956, therefore, this district, in cooperation with the California Department of Water Resources, initiated a program of sediment investigations which is expected eventually to provide sediment data for all significant surface waters of the State. Funds provided for this first year of operation permitted the establishment and operation of five continuous record stations, eleven periodic or partial record stations, and the beginning of a study on reservoir sedimentation. During the 1958 fiscal year this program has been expanded to allow operation of some 10 continuous record stations and 20 partial record stations. These stations are given in table 1, which lists in down-stream order all sediment stations in operation at the present time.

The continuous record stations eventually will be divided into two groups designated as index (primary) stations and secondary stations. The index station designation will apply where long-term or essentially permanent operation may be desired to provide continuous records of sediment characteristics. The secondary station designation will apply to roving stations, operated for possibly 2 to 5 year intervals at each of several successive sites. At each site the records will be studied for correlation between water and sediment discharge and for correlation of monthly and annual loads with loads at key index stations. Stations will be moved to new sites as soon as reasonable correlations can be established.

It is intended that these continuous record stations be operated initially with daily or more frequent sampling during periods of storm or snow-melt runoff and with weekly or less frequent sampling during periods of low flow.

The periodic station designation applies to stations operated on the basis of only periodic or intermittent samples taken at irregular intervals. It is intended and expected that results of this sampling will give a reconnaissance idea of the variations in sediment concentration and discharge, the probable severity of the sediment problem at each site, and will be valuable as a guide to future planning for secondary or index stations.

Studies of the data from all types of stations will be made as currently as possible, and sampling frequency beyond the first year or two at a given station will be governed by the extent of observed variations and by the reliability of correlations that may be established. Records for the continuous record stations will be computed to show daily or monthly, and annual quantities of suspended sediment discharge.

Observations for computation of total sediment load rates will be made periodically at those stations on alluvial channels where appreciable amounts of sand size particles are available for movement by the streams. At some of these stations it may be feasible to make computations of approximate annual quantities of bed load, in addition to the measurement of suspended load, using recently developed techniques and formulae. In addition to records of the quantity and seasonal distribution of sediment discharge, records of the size distribution of sediment particles will be obtained for both suspended sediment and bed load.

Sedimentation surveys of reservoirs that have been in operation for several years offer a means of obtaining evaluations of long-term sediment yield rates for the basins above these reservoirs. Efficient use of this method is dependent on many variables, and it is felt that careful study and reconnaissance must precede such surveys to insure best results. Some of the supplementary data necessary to make such surveys of general value are: a good initial survey (preferably one that resulted in an accurate contour map), or a usable sedimentation survey made several years ago; records of operation of the reservoir showing fluctuations in stage and contents; records of inflow and outflow covering the period subsequent to the last survey. To be of maximum value, a sedimentation survey should include determinations of the particle sizes and specific weights of the deposited sediments throughout the reservoir. Thus, collection and analyses of samples of the deposited sediments will be an essential part of such surveys.

Reconnaissance and study of available data on several reservoirs in the Central Valley area were made during the 1957 fiscal year and actual surveys will be planned thereafter as funds and personnel can be made available.

In addition to the sediment investigation conducted in cooperation with the Department of Water Resources, additional measuring stations are being operated by this district to provide sediment data essential to the programs of other Federal agencies. For example, many of the stations requested by the Bureau of Reclamation during the 1956 fiscal year are still being supported by that agency. Funds provided by the Bureau allowed for the operation of 13 partial record stations during the 1957 fiscal year, and for 11 during 1958. These stations were selected to provide data in areas not covered by the State

program.

In order to obtain data essential to a current study of the San Francisco Bay Area, the U. S. Corps of Engineers during the 1957 fiscal year supported the operation of two continuous and 4 partial record stations on streams tributary to San Francisco Bay. This program also was continued during the 1958 fiscal year.

In summary, the sedimentation activities of this District during the 1957 fiscal year included, in addition to services performed for other agencies, the initiation of a comprehensive program in cooperation with the California Department of Water Resources. During the year a total of 7 continuous and 28 periodic sampling stations were placed in operation located chiefly in Northern California. These sediment activities have expanded to the extent that some 47 stations are now in operation. The location of these stations is shown in figure 1. It is expected that the cooperative program with the California Department of Water Resources will in time be expanded to provide the basic data and interpretive studies necessary for the sound appraisal of the sediment problems of California.

TABLE I
SEDIMENT STATIONS IN CALIFORNIA
IN OPERATION
June 1957 - July 1958

Ref. No.	Station	Supporting Agency	Type of Station
1	Sespe Creek near Fillmore, Calif.	USBR	Periodic
2	North Fork Mitilija Creek at Mitilija Hot Springs, Calif.	USBR	Periodic
3	Salsipuedes Creek near Lompoc, Calif.	USBR	Periodic
4	Cuyama River near Santa Maria, Calif.	USBR	Periodic
5	San Francisquito Creek at Stanford University, Calif.	USCE	Periodic
6	Guadalupe River at San Jose, Calif.	USCE	Periodic
7	Alameda Creek near Niles, Calif.	USCE	Continuous
8	Walnut Creek at Walnut Creek, Calif.	USCE	Periodic
9	San Joaquin River near Vernalis, Calif.	DWR	Continuous
10	Mokelumne River at Clements, Calif.	DWR	Periodic
11	Cosumnes River near Plymouth, Calif.	DWR	Periodic
12	Cosumnes River at Michigan Bar, Calif.	DWR	Periodic
13	Cosumnes River at McConnel, Calif.	DWR	Periodic
14	Pit River near Canby, Calif.	DWR	Periodic
15	Clear Creek at French Gulch, Calif.	USBR	Periodic
16	Cottonwood Creek near Cottonwood, Calif.	DWR	Periodic
17	Battle Creek near Cottonwood, Calif.	DWR	Periodic
18	Sacramento River at Red Bluff, Calif.	DWR	Continuous
19	Stony Creek at Black Butte Dam Site near Orland, Calif.	DWR	Periodic
20	Little Last Chance Creek near Vinton, Calif.	DWR	Periodic

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SEDIMENT STATIONS IN CALIFORNIA
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Continued

Ref. No.	Station	Supporting Agency	Type of Station
21	Big Grizzley Creek near Portola, Calif.	DWR	Periodic
22	Middle Fork Feather River below Sloat, Calif.	DWR	Periodic
23	Indian Creek near Crescent Mills, Calif.	DWR	Periodic
24	Feather River at Oroville, Calif.	DWR	Continuous
25	Middle Fork American River near Auburn, Calif.	DWR	Periodic
26	South Fork American River near Lotus, Calif.	DWR	Periodic
27	Sacramento River at Sacramento, Calif.	DWR	Continuous
28	North Fork Cache Creek near Lower Lake, Calif.	DWR	Periodic
29	Cache Creek at Yolo, Calif.	DWR	Periodic
30	Yolo Bypass near Sacramento, Calif.	DWR	Periodic & Continuous
31	Napa River near St. Helena, Calif.	USCE	Continuous
32	Sonoma Creek at Boyes Hot Springs, Calif.	USCE	Periodic
33	Eel River above Dos Rios, Calif.	DWR	Continuous
34	Middle Fork Eel River at Dos Rios, Calif.	DWR	Continuous
35	South Fork Eel River near Branscomb, Calif.	DWR	Periodic
36	South Fork Eel River near Miranda, Calif.	USBR	Periodic
37	Eel River at Scotia, Calif.	DWR	Continuous
38	Van Duzen River near Bridgeville, Calif.	USBR	Periodic
39	Showers Creek near Stapp Ranch near Mad River, Calif.	USBR	Periodic
40	Whitney Creek near Mad River, Calif.	USBR	Periodic

SEDIMENT STATIONS IN CALIFORNIA
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Continued

Ref. No.	Station	Supporting Agency	Type of Station
41 -	Mad River at Forest Glen, Calif.	DWR	Periodic
42	Mad River at Arcata, Calif.	DWR	Continuous
43	Shasta River near Yreka, Calif.	DWR	Periodic
44	Klamath River at Somesbar, Calif.	USBR	Periodic
45	Trinity River at Lewiston, Calif.	USBR	Periodic
46	South Fork Trinity River near Salyer, Calif.	DWR	Continuous
47	Trinity River at Hoopa, Calif.	DWR	Continuous

USBR: U. S. Bureau of Reclamation

USCE: U. S. Army, Corps of Engineers

DWR: California Department of Water Resources