ANALYSIS OF STREAMFLOW CHARACTERISTICS FOR STREAMS ON THE ISLAND OF TUTUILA, AMERICAN SAMOA
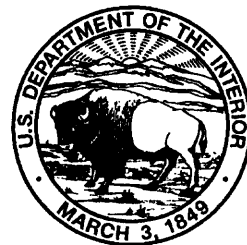
By Michael F. Wong

Prepared in cooperation with the

GOVERNMENT OF AMERICAN SAMOA

ENVIRONMENTAL PROTECTION AGENCY,

and AMERICAN SAMOA POWER AUTHORITY

Honolulu, Hawaii
1996

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Gordon P. Eaton, Director

CONTENTS

FIGURES

PLATE

TABLES

Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
foot per mile (ft/mi)	0.1894	meter per kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic foot per second per square mile (ft^3/s)	0.01093	cubic meter per second per square kilometer
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
inch per year (in/yr)	2.54	centimeter per year

EXPLANATION OF TERMS

Base-flow--That part of streamflow derived from ground water.

Cubic foot per second (ft³/s)--The rate of discharge representing a volume of 1 cubic foot of water passing a given point during 1 second.

Daily record station--A particular site where gage height measurements are made only once per day.

Drainage area--An area from which streamflow is carried away by a single drainage system. Also called drainage basin.

Continuous-record stream-gaging station--A particular site on a stream where systematic, continuous observations of gage heights, which are subsequently converted to discharge, are obtained.

Index station--A long-term gaging station whose streamflow characteristics are used to estimate characteristics at short-term or low-flow partial-record gaging stations.

Low-flow--The minimum stream discharge that occurs within a given time period.

Low-flow partial-record station--A station where eight or more base-flow discharge measurements are made, typically during a 3 to 4 year period, to determine low-flow characteristics.

Miscellaneous site--A site where discharge measurements have been made as part of studies that were not restricted just to the determination of low-flow characteristics.

Peak flow--The highest instantaneous stream discharge that occurs within a given time period. Used interchangeably with peak discharge.

Recurrence interval--The average interval of time within which a given discharge magnitude will be equaled or exceeded once. Implies no regularity in the time of recurrence. The inverse of recurrence interval can be thought of as the probability of a discharge magnitude being equaled or exceeded in a given year. In the case of low-flow discharges, the recurrence interval is the average interval of time within which the given discharge magnitude is less than or equaled.

Residuals--The difference between the observed and computed values.

Station numbers--Continuous-gaging and low-flow partial-record stations are given eight digit numbers for identification purposes. In this report these numbers are presented as four digit abbreviations such as 9060, where the complete number for this stations is 16906000. The two left (16) and two right (00) digits of this and all other station numbers have been omitted in the text of this report for brevity because they are common to all station numbers.

Analysis of Streamflow Characteristics for Streams on the Island of Tutuila, American Samoa

By Michael F. Wong

Abstract

Several methods for estimating streamflow characteristics for low and peak flows for streams on Tutuila, American Samoa are presented. These methods, derived from frequency, flow-duration, and regression analyses, allow the user to compute estimates for the 7-day low flow with 2-year and 10-year recurrence intervals; the median flow; the mean flow; and the 2-, 5-, 10-, 25-, 50, and 100-year peak flood flows at gaged and ungaged streams. In addition, frequency techniques using the log-Pearson type III distribution were also used to compute for gaged sites the 1-, 7-, 14-, 30-, 60-, 90-, 120-, and 183-day low flows with 2-, 5-, 10-, and 20-year recurrence intervals; the 1-, 7-, 15-, 30-day high flows with 2-, 5-, 10-, and 25-year recurrence intervals; and the 2-, 5-, 10-, 25-, 50-, 100-year peak flows. The regression equations and estimated streamflow characteristics are based on streamflow data collected from 1958 through 1990 at 11 continuous-record gaging stations with 9 to 32 years of record, 75 low-flow partial-record stations, and 49 miscellaneous sites.

Low-flow regression analysis using the base-flow index basin characteristic provided results with standard errors of estimate ranging from 13.3 to 43.8 percent. These standard errors are comparable to the average values at the low-flow partial-record stations. Regional analysis, using the method of residuals, divided Tutuila into two hydrologic regions which correspond to differences in geology. Peak-flow regression equations had coefficients of determination ranging from 0.60 to 0.66 and standard errors of estimate ranging from 44.0 to 47.4 percent. The large standard errors result

from the large variability of flood peaks compared with drainage area. The geology of Tutuila also affects the magnitude of observed flood peaks.

INTRODUCTION

The U.S. Geological Survey (USGS) in cooperation with the Government of American Samoa began a systematic stream-gaging program on the island of Tutuila in 1957. Matsuoka (1978) summarized this network of continuous- and partial-record stream-gaging stations. Since 1960, villages and urban centers, located on the flatlands of the island, have become increasingly crowded as Tutuila's population increased from 20,000 in 1960 to 47,000 in 1990 (U.S. Department of Commerce, 1992). The increasing population and development has placed a strain on the water resources of Tutuila. Therefore, this study was undertaken in cooperation with the American Samoa Environmental Protection Agency and the American Samoa Power Authority to provide updated information regarding streamflow characteristics. This information is needed to develop streamflow and drainage standards, to provide water-budget calculations, and to locate potential hydropower and reservoir sites.

Purpose and Scope

The purpose of this report is to provide updated streamflow characteristics at gaged and low-flow partial-record sites and to describe methods that can be used to estimate streamflow characteristics at miscellaneous and ungaged sites. Streamflow characteristics computed at sites with continuous-record gages include the 1-, 7-, 14-, 30-, 60-, 90-, 120-, and 183-day low flows with 2-, 5-, 10-, and 20-year recurrence intervals; the 1-, 7-, 15-, 30-day high flows with 2-, 5-, 10-, and 25-year recurrence intervals; the mean flow; flow dura-

tion; and the 2-, 5-, 10-, 25-, 50-, 100-year peak flows. At low-flow partial-record, miscellaneous, and ungaged sites, the streamflow characteristics evaluated include the 7-day low-flow with 2-year and 10-year recurrence intervals; the median flow; mean flow; and 2-, 5-, 10-, 25-, 50-, 100-year peak flows. Uncertainties in these streamflow characteristics are also evaluated.

This report expands on the work of Matsuoka (1978) who analyzed streamflow characteristics at gaged and low-flow partial-record sites. In the present study, 14 years of additional data are included, low and peak-flow characteristics were regionalized, and updated statistical techniques were applied. Streamflow data collected at 11 continuous-record stream-gaging stations, 75 low-flow partial-record stations, and 49 miscellaneous sites on Tutuila from 1957 through 1990, are used in the analysis. From 1957 through 1958, the USGS operated six daily record stations on Tutuila. These stations are treated as low-flow partial-record stations in this report and are counted in the 75 low-flow partial-record stations. With the exception of a few miscellaneous sites and data from the 1989 and 1990 water years, all data used were published in USGS annual data reports (see Nakahara and others, 1990, as an example) or in Water-Supply Papers (U.S. Geological Survey, 1962, 1971, 1977).

Description of the Study Area

The island of Tutuila lies in the Pacific Ocean at about latitude 14°S and longitude 17°W (plate 1). Tutuila has an area of 53 mi^2 and is the third largest island in the Samoan island chain. Tutuila is the center of government, commerce, and population for the U.S. territory of American Samoa.

Like the other Samoan islands, Tutuila was created by volcanic action and shaped by erosional forces. Four centers of volcanic activity created Tutuila about one million years ago. These centers are, from east to west, the two smaller volcanoes of Olomoana and Alofau, the central Pago Volcano, and the Taputapu Volcano, whose rocks overlap those of the Pago Volcano (Stearns, 1944). Short-lived eruptions, about 12,000 years ago at the summit and south side of Taputapu Volcano, created the Tafuna-Leone plain and blanketed the Taputapu summit with a layer of permeable cinders (P.R. Eyre and G.P.L. Walker, USGS, written commun., 1993). These later eruptions changed the surface runoff characteristics of the Taputapu Volcano. Floods

on Tutuila usually are generated in upland areas, where rainfall is high, slopes are steep, and rocks have low permeability; however, the domed summit area of Taputapu, with its blanket of permeable cinders, generates little direct runoff (P.R. Eyre and G.P.L. Walker, USGS, written commun., 1993). The headwaters of streams that radiate from the Taputapu summit are fed by springs that issue from the cinders, resulting in greater sustained base flows than from the other volcanic regions on the island.

The climate of Tutuila is tropical, with uniform temperatures and high humidity throughout the year. Mean annual temperature at the Pago Pago International Airport is 80°F. Mean daily temperature during the year varies from about 78° to 82°F. Most rain falls during the typhoon season from October through April and lower amounts of rain fall in the dry season, from May through September. A compilation of 212 annual peak discharges and dates of occurrence show that 65.5 percent of the annual peaks occur during the wet season (fig. 1). Orographic effects associated with the steep mountain slopes cause rainfall to range from 94 in/yr at the shoreline to 250 in/yr at the 1,610 ft elevation above Pago Pago Harbor (P.R. Eyre and G.P.L. Walker, USGS, written commun., 1993). Average annual rainfall over the entire island is estimated to be about 150 in/yr (P.R. Eyre and G.P.L. Walker, USGS, written commun., 1993). Rainfall is primarily generated by southeasterly tradewinds bringing moist sea air over the steep mountain slopes or by cyclonic rain associated with ocean storms. Periods of low rainfall, when rainfall at the airport is less than 90 percent of the annual average, recur at roughly 3 to 4 year intervals (P.R. Eyre and G.P.L. Walker, USGS, written commun., 1993). Rainfall was 63 percent of the annual average in 1974, the driest year of record, and 134 percent in 1981, the wettest year of record (National Oceanic and Atmospheric Administration, 1957-88).

Flashy streamflow is characteristic of the small steep-sided drainage basins of the island, whose headwaters meet along the east-west trending central mountain summit of the island (plate 1). Flood hydrographs are steep and of short duration. The rising limb of a typical hydrograph from a gaged stream on Tutuila usually lasts about 1 hour and the recession for about a day to a day and a half. Gaged drainage basins range in area from 0.1 to 1 mi^2. Most streams on Tutuila are perennial; however, base flows are low and sometimes highly variable (Matsuoka, 1978).
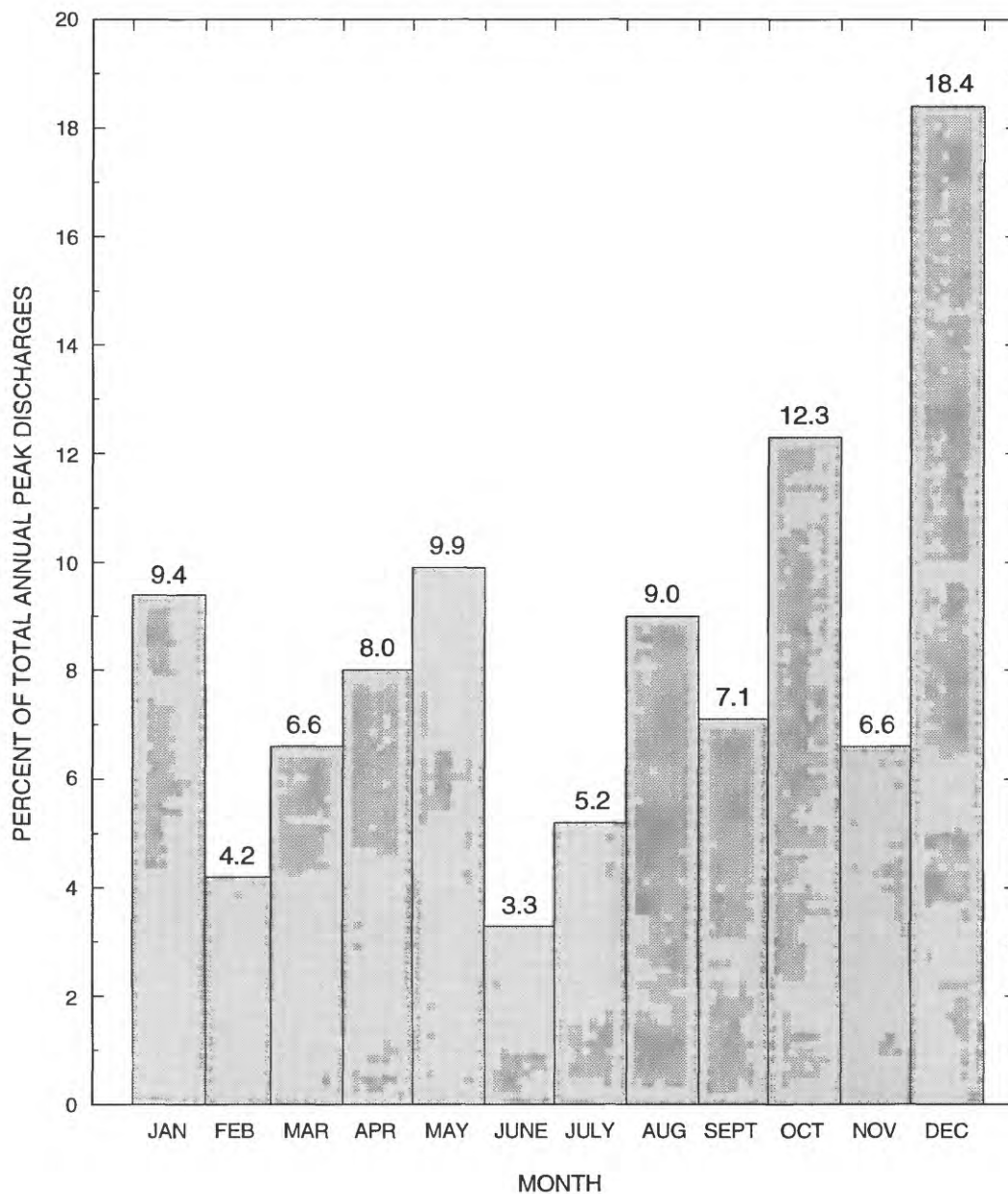
Figure 1. Monthly occurrence of annual peak discharges for the period of record through 1990 for 11 continuous-record stream-gaging stations on Tutuila, American Samoa.

Previous Investigations

A study of streamflow characteristics on Tutuila was done by Matsuoka (1978). Matsuoka provided low- and high-flow frequency data and flow-duration curves for 6 continuous-record stations using 18 years of record, from 1959 through 1977, and peak-flow frequency curves for 5 streams with 15 years of continuous streamflow data collected between 1958 and 1973. The low- and high-flow frequency analyses and flow-duration curves were updated through 1977 because of the 1974 drought. All frequency curves were calculated using the log-Pearson type III distribution with station skew coefficients. Matsuoka (1978) also estimated, using regression analysis, the 7-day 2-year and 10-year low flows for 45 of 72 low-flow partial-record stations.

Water-supply studies that discuss low or base flows on Tutuila include Austin, Smith and Associates (1963), R.H. Dale (written commun., 1970), Government of American Samoa (1975), U.S. Army Engineer District, Honolulu (1977, 1978a, 1978b), and M & E Pacific (1987). The U.S. Army Engineer District, Honolulu (1978b) presented flow-duration curves for six USGS-gaged streams and a "composite" flow-duration curve for regionalization purposes. The U.S. Army Corps of Engineers also conducted some flood hazard studies for a number of streams (Department of the Army, 1976a, 1976b, 1977a, 1977b, 1977c). These studies presented frequency curves computed using methods in Beard (1962) and based on peak-flow data from eight USGS stream-gaging stations. Flood plains for the 100-year flood are discussed briefly in U.S. Army Engineer District, Honolulu (1977).

Acknowledgements

The author gratefully acknowledges the late Folasa Tiumalu, Department of Public Works, Government of American Samoa, the late Falani "Frank" Taotoai, and Asomuamua "John" Ito of the American Samoa Power Authority for their dedicated service in the collection of streamflow data for the USGS.

ANALYSIS OF STREAMFLOW CHARACTERISTICS

This section describes the analytical methods used to determine streamflow characteristics and the results from applying these methods. These methods are frequency analysis, flow-duration and mean flow analysis, and regression analysis. The use of each method was dependent on the location and type of site and the quality and quantity of data available. Discussions of streamflow characteristics, the available data, and the computation of streamflow characteristics by the various methods are presented. It is assumed that readers have a familiarity with basic statistical procedures and with statistical methods in hydrology as discussed by Riggs (1968a, 1968b, 1973).

Explanation of Streamflow Characteristics

Natural streamflow is highly variable and dependent on the geology, climate, and topography of a given region. Streamflow characteristics are quantitative measures of the magnitude, variability, and extremes of instantaneous, daily, monthly, and yearly means of streamflow (Riggs, 1985). Most streamflow characteristics are usually categorized as either low- or high-flow characteristics.

Low-flow characteristics include the 7-day 2- and 10-year low flows, the median flow, and the mean flow. The 7-day 2- or 10-year low flow is the discharge at the 2- or 10-year recurrence interval measured from a frequency curve developed for a gaging station using the lowest mean discharge for 7 consecutive days for each year. The minimum mean discharge for 7 consecutive days within a given year will equal or fall below the 7-day 2- or 10-year low flow on average once every 2 or 10 years. In any given year, the probability of this happening is one-half (50 percent) for 2-year recurrence intervals and one-tenth (10 percent) for 10-year recurrence intervals. This same general definition applies to the 1-, 7-, 14-, 30-, 60-, 90-, 120-, and 183-day low flows with 2-, 5-, 10-, and 20-year recurrence intervals. The 7-day 2-year low-flow value usually represents the normal low flow that would be expected each year. The 7-day 10-year low-flow value represents a measure of extreme low-flow conditions commonly associated with droughts. Riggs (1985) mentions that the severity of a seasonal drought can be expressed by the recur-

rence interval associated with the minimum 30-day mean low flow at a gaging station. The 7-day 10-year low flow is also used as a design flow for water-quality management by many states in the United States. The median flow represents the flow that is equaled or exceeded 50 percent of the time at a given stream site. The median is estimated from a flow-duration curve. A flow-duration curve is a cumulative frequency curve that shows the percentage of time that a daily mean flow equals or exceeds a given discharge (Searcy, 1959). The median flow is used in hydropower studies as an index of power potential with storage (Searcy, 1959). The median flow is also used to regulate streamflow allocation in the State of Hawaii. The mean flow is the mean of all daily recorded streamflows at a gaged site. The mean flow represents the long-term average flow that would be observed at a given site. The mean flow has been used in the calculation of streamflow resources for water-budget and ground-water recharge studies.

High-flow characteristics include the instantaneous peak flows with 2-, 5-, 10-, 25-, 50, and 100-year recurrence intervals and the 1-, 7-, 15-, 30-day high flows with 2-, 5-, 10-, and 25-year recurrence intervals. Instantaneous peak flows with recurrence intervals of 2-, 5-, 10-, 25-, 50-, and 100-years are peak-flow discharges expected to be equalled or exceeded once on average every 2, 5, 10, 25, 50, and 100 years, respectively. The 30-day high flow with a 10-year recurrence interval is the average discharge for a 30-consecutive-day period expected to be equalled or exceeded once on average every 10 years. This same general definition applies to the 1-, 7-, and 15-day high-flow values. Peak flows are used in the design of bridges, culverts, and other structures to prevent flood damages. The Federal Emergency Management Agency (FEMA) uses the 100-year peak flood to estimate the extent of flood plains for flood insurance studies. Peak flows, along with the consecutive-day high and low flows, also are used in the design and management of dams and reservoirs.

Frequency Analysis

In a frequency analysis, a theoretical frequency distribution is assumed for the population of streamflow events and the statistical parameters of this distribution are computed from the collected streamflow data. The resulting frequency curve relates the magnitude of a streamflow event to the frequency of occurrence

(Riggs, 1968b). Frequency analysis was conducted on annual series of low-flow, high-flow and peak-flow characteristics for the continuous-record stream-gaging stations on Tutuila. The proper interpretation of frequency curves requires that the data set used consist of homogeneous and independent streamflow events. Thus, the use of annual series.

Low-Flow Frequency Analysis

For low-flow frequency analysis, an annual series of low flows were calculated by climatic year (April 1 through March 31). The climatic year was used to ensure that the entire low-flow cycle (usually May through September) was maintained as a continuous period within a given year. The annual series of 1-, 7-, 14-, 30-, 60-, 90-, 120-, and 183-day low flows were determined as the lowest mean discharge for that number of consecutive days within each climatic year of record as shown in figure 2. Proper analysis of low-flow frequency data requires that a representative sample of the type of streamflow data involved be available. Given the 3 to 4 year cycle of wet and dry years on Tutuila (P.R. Eyre and G.P.L. Walker, USGS, written commun., 1993), a minimum of 9 to 12 years of streamflow data are required to provide a representative sample. Of the 11 stream-gaging stations on Tutuila, only 7 had at least 9 continuous climatic years of record. For these 7 stations, the low-flow frequency characteristics were determined using the log-Pearson type III distribution with graphical adjustment for fit if necessary (Riggs, 1972).

The log-Pearson type III is a three-parameter distribution. These parameters are the mean, standard deviation, and coefficient of skew computed from the logarithms of the annual series of low-flow data by the method of moments. As a result, these parameters are also called moments (the mean is the first moment, the standard deviation is the second moment) (Kite, 1977). USGS computer program A193 in ANNIE (Lumb and others, 1990) was used to compute the frequency curves. Examples of frequency curves are shown in figure 3.

Results of the low-flow frequency analysis are given in table 1 (at end of report). For two stations, 9060 and 9480, diversions were significant enough to prevent using their entire data sets for frequency analysis. A significant diversion is one where the streamflow diverted has a noticeable effect on the observed streamflow
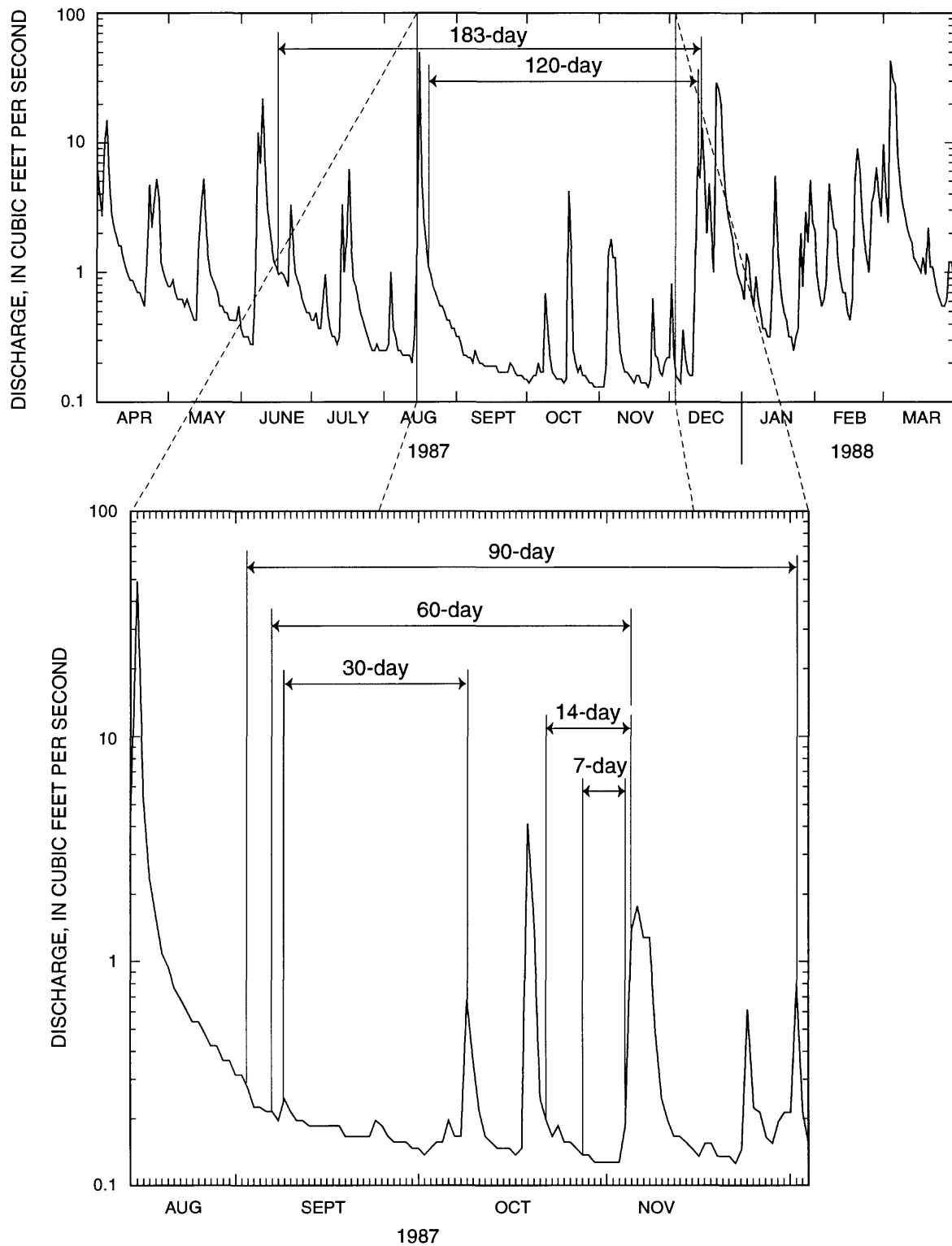
Figure 2. Hydrograph of daily discharge of Pago Stream at Afono (station 9120), for 1988 climatic year, showing annual low-flow periods for various numbers of consecutive days, Tutuilla, American Samoa.
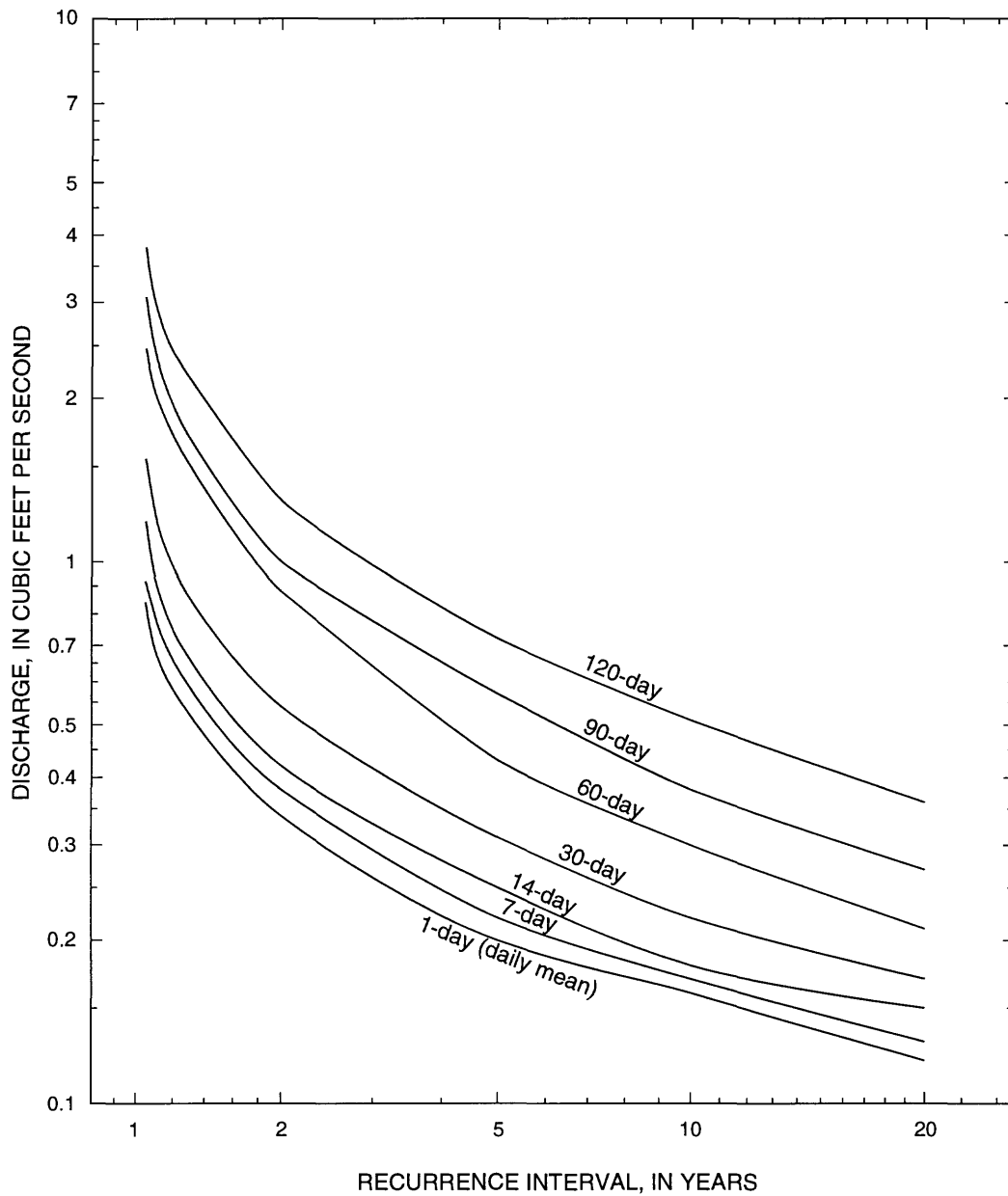
Figure 3. N-day low-flow frequency curves for Pago Stream at Afono (station 9120) for the period of record through 1990, Tutuila, American Samoa.

compared to the streamflow prior to the diversion. For station 9060, the average annual median flows were reduced by 30 percent from pre-diversion flows; at station 9480, the reduction was 48 percent. Since the proper interpretation of frequency curves requires homogeneous data sets, only one data set could be used, either the pre- or the post-diversion data set. At station 9060, the post-diversion data set was too short to provide a good representation. At station 9480, only the 17 climatic years of post-diversion data were used to compute the frequency curves. For the four stations (9060, 9315, 9335, and 9442) with insufficient data for low-flow frequency analysis, low-flow characteristics were estimated by the station-to-station regression procedures described below. Locations of continuous-record stream-gaging stations are shown in plate 1.

Accuracy of the 7-day 2- and 10-year low flows at continuous-record stream-gaging stations was determined by the method developed by Hardison and Moss (1972). This method computes standard error as a function of the standard deviation of the logarithms of the annual low flows, the coefficient of skew of the same annual series, the recurrence interval, and the number of years of record at the gaging station. This method could also be used to compute accuracies for the other low-flow and high-flow frequency values. Only the accuracies for the 7-day 2- and 10-year low flows are given in table 1.

High-Flow and Peak-Flow Frequency Analysis

A high-flow frequency analysis is similar to low-flow frequency analysis but uses the available high-flow data instead of low-flow data. The log-Pearson type III frequency distribution was used with the annual series of 1-, 7-, 15-, and 30-day high flows. The annual series of 1-, 7-, 15-, and 30-day high flows were determined as the highest mean discharge in the year for that number of consecutive days. For high- and peak-flow analyses, the year used is the water year (October 1 through September 30). High-flow frequency characteristics were calculated for the 10 continuous-record stream-gaging stations with 9 or more water years (October 1 to September 30) of record (table 1). No high-flow characteristics were computed for station 9442, which had only 8 years of daily flow record. USGS computer program A193 in ANNIE (Lumb and others, 1990) was used to compute the high-flow frequency curves as well.

For peak-flow frequency analysis, the log-Pearson type III distribution was applied to the annual series of

instantaneous peak discharges following procedures outlined in Bulletin 17B (Interagency Advisory Committee on Water Data, 1982). Bulletin 17B procedures recommend the skew coefficient at each gaging station be weighted with a generalized skew, which is determined from long-term records from several gaging stations. Because the skew coefficient is sensitive to the magnitude of rare events such as large floods, the station skew for a short-term record is generally a poor estimate of the population skew. The use of a generalized skew provides for an improved skew estimate at short-term stations. No previous value of generalized skew exists for Tutuila, so one was calculated by taking the arithmetic mean of skew values, as discussed in Bulletin 17B (Interagency Advisory Committee on Water Data, 1982), from the four long-term continuous-record stream-gaging stations having more than 30 years of record. To calculate the generalized skew, the station skew coefficients were multiplied by a bias-correction factor of $(1 + 8.5/N)$, where N is the number of years of record. This bias-correction factor was proposed by Hazen (1930, p. 46) and used by Hardison (1974) to compensate for the low bias exhibited by skew coefficients of data from records of finite length. Hazen's (1930) correction factor was chosen over others (for example, that of Tasker and Stedinger, 1986) because its applicability is not limited by the range of skew values or record lengths. After the bias adjustment, the mean skew for the four long-term stations (9120, 9205, 9310, and 9480) was determined to be -0.4 with a variance of 0.291.

Flood-frequency curves were estimated using the -0.4 generalized skew in USGS program J407, which uses Bulletin 17B guidelines and is located in WAT-STORE (Kirby, 1979) and in ANNIE (Lumb and others, 1990). Table 2 gives the peak-flow statistics from the logarithms of the annual floods and the magnitude and frequency of floods at the 11 continuous gaging stations on Tutuila with recurrence intervals of 2-, 5-, 10-, 25-, 50-, and 100-years. Accuracy of high-flow estimates are dependent on the same factors as low-flow frequency estimates. Accuracy of peak-flow estimates also are dependent on the same factors as low-flow frequency estimates with the addition of the correlation between the mean and standard deviation of the annual series of peak discharges. Accuracies for the high-flow and peak-flow estimates are not provided in this report, but can be computed by the methods in Hardison and Moss (1972) and Hardison (1969, 1971).

Table 2. Peak-flow statistics and estimates for selected recurrence intervals and maximum observed flood discharges at 11 continuous-record stream-gaging stations on Tutuila, American Samoa

[Peak-flow statistics computed from the logarithms of annual floods by Bulletin 17B (Interagency Advisory Committee on Water Data, 1982) procedures; std, standard deviation; skew, coefficient of skew; first line of peak flow estimates is from gaged record, second line is estimate from regression equation; *, station has less than 10 years of record; ft³/s, cubic feet per second; --, no regression value computed, drainage area out of range]

| Station number | Peak-flow statistics (log 10 units) | | | Peak-flow estimates, in cubic feet per second, at given recurrence interval, in years: line 1, gaged record; line 2, equation | | | | | | Maximum observed flood | | Channel slope (ft/mi) | Basin altitude (ft) |
	mean	std	skew	2	5	10	25	50	100	Water year	Dis-charge (ft³/s)		
9060	2.512	0.255	-0.238	332 / *150*	535 / *232*	678 / *289*	863 / *367*	1,000 / *428*	1,150 / *492*	1963	804	930	610
9120	2.720	0.219	-0.469	546 / *584*	809 / *872*	972 / *1,050*	1,160 / *1,250*	1,300 / *1,390*	1,420 / *1,530*	1969	1,350	1,190	670
9175	2.286	0.213	-0.305	198 / *198*	293 / *304*	355 / *376*	431 / *471*	486 / *544*	540 / *620*	1970	390	1,320	660
9205	2.412	0.181	-0.394	265 / *--*	369 / *--*	432 / *--*	505 / *--*	555 / *--*	603 / *--*	1972	498	800	720
9310	2.475	0.227	-0.543	313 / *207*	467 / *318*	562 / *393*	672 / *492*	746 / *567*	816 / *645*	1980	815	790	400
9315*	2.516	0.216	-0.499	342 / *287*	503 / *437*	602 / *535*	717 / *660*	796 / *752*	870 / *845*	1980	635	990	970
9335*	2.421	0.152	-0.314	268 / *277*	355 / *422*	406 / *517*	467 / *639*	508 / *729*	547 / *820*	1985	400	1,100	1,000
9442	2.785	0.293	-0.439	640 / *785*	1,080 / *1,160*	1,390 / *1,390*	1,780 / *1,640*	2,070 / *1,800*	2,350 / *1,960*	1975	1,640	1,370	900
9480	2.354	0.200	0.028	226 / *217*	333 / *333*	409 / *411*	509 / *513*	587 / *590*	667 / *670*	1985	535	1,310	800
9600	1.880	0.233	0.057	75 / *159*	119 / *246*	151 / *306*	196 / *388*	232 / *451*	270 / *518*	1970	232	580	800
9639	1.760	0.294	0.132	57 / *86*	101 / *135*	138 / *171*	194 / *222*	243 / *264*	298 / *310*	1981	234	1,150	430

Flow-Duration Analysis and Mean Flow

Flow-duration analysis uses all the daily mean discharges for complete water years for the entire period of record to compute a flow-duration curve. A flow-duration curve indicates the percentage of time that a given discharge is equalled or exceeded. Examples of flow-duration curves are shown in figure 4. The median flow is the flow equalled or exceeded 50 percent of the time. Flow-duration curves were computed by the method in Searcy (1959) and results are tabulated for all 11 stream-gaging stations in table 1. For two stations, 9060 and 9480, the low-flow data were affected by diversions so that flow-duration curves are given for both the pre- and post-diversion time periods. USGS computer program A969 in WATSTORE was used to compute the flow-duration curves (Meeks, 1975).

Flow-duration curves imply no frequency of events and comparisons of flow-duration values between gaging stations require that the duration curves be computed from discharge data covering the same time period. Included with the flow-duration data in table 1 is an index of variability. This index is computed from the flow-duration curve (Searcy, 1959) and may be used to explain ground-water effects on streamflow. A high value of variability indicates a steep slope of the flow-duration curve, high variability of streamflow, and low ground-water storage (Searcy, 1959; Friel and others, 1989). A low value of variability indicates a greater ground-water storage capacity, which maintains higher sustained streamflow during dry periods (Friel and others, 1989). The index of variability for the 11 continuous-gaging stations ranged from 0.265 to 1.04 (table 1).

The mean flow is the average of all the daily discharges recorded at a given station for the period of record. Mean flow values are given at all gaging stations for the period of record through 1990 (table 1), except for stations 9060 and 9480. Because of the upstream diversions of streamflow at these stations only the mean flow discharges from the post-diversion period are given. The large differences between median and mean streamflow characteristics observed for streams on Tutuila can be attributed to the flashy nature of the streams.

The mean and median values are computed without error for a given period of record. Accuracies of the true, or long-term, value of the mean and median flows were estimated by equations in Kendall and Stuart

(1963). The accuracies given in table 1 for the mean and median are those for the true or long-term value of the mean and median.

Regression Analysis

Because streamflow records are collected at only a few of the many sites where information is needed, streamflow characteristics commonly are estimated at low-flow partial-record, miscellaneous, and ungaged sites using information obtained from gaged sites. Regression analysis is a tool allowing the transfer of data from one site to another. Regression analysis is used to describe a relation using either streamflow measurements or basin characteristics. From this relation, streamflow characteristics can be transferred. In this report, regression analysis was used to transfer low-flow characteristics from a gaged site to other gaged sites, low-flow partial-record sites, and some miscellaneous sites and to relate selected streamflow characteristics to basin characteristics so that the selected streamflow characteristics can be transferred to low-flow partial-record, miscellaneous, and ungaged sites.

Station-to-Station

Station-to-station regression analysis was used to transfer low-flow characteristics from continuous-record index stations to sites with 8 or more base-flow measurements. These sites can include continuous-record, low-flow partial-record, and miscellaneous sites. The relation between data at sites with base-flow measurements and mean daily flow at index stations was determined by one of two different methods: the moments approach or graphical regression. The selection of method was dependent on the number of measurements available and the strength of the linear relation, as determined by the correlation coefficient, between the site and its index station. The correlation coefficient measures the degree of linear relation between two variables and varies from -1 to 1, with values close to -1 and 1 indicating strong linear relationships. The negative sign indicates an inverse relation. For sites with 10 or more base-flow measurements, a correlation coefficient greater than 0.70, and a linear relation, the moments method was used. At sites with fewer than 10 measurements and/or sites with non-linear relations, the graphical regression, also called graphical correlation, method was used. Sites with data that correlated poorly with data from index stations (correlation coefficient
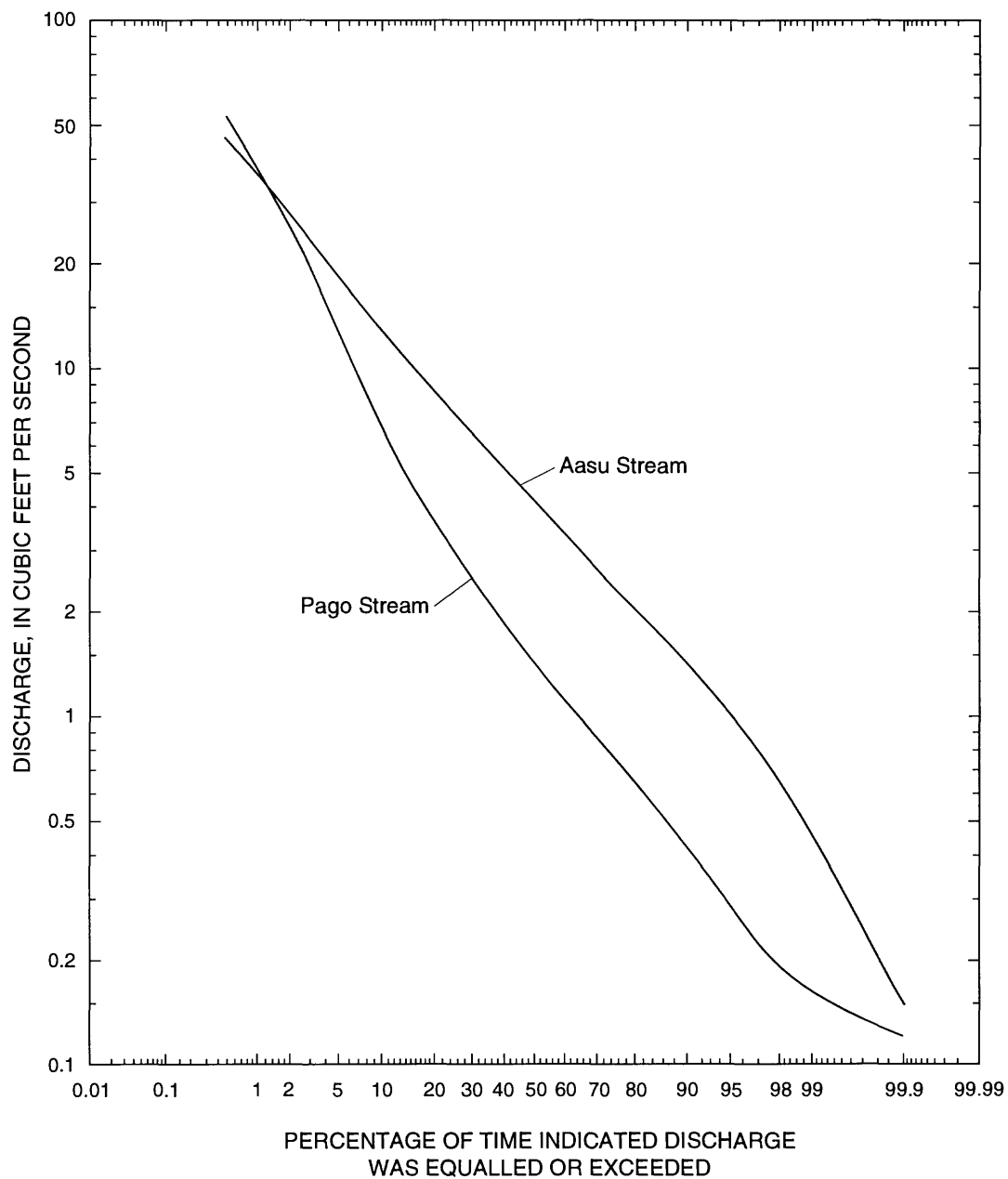
Figure 4. Flow-duration curves showing the percentage of time a given flow was equalled or exceeded at Pago Stream at Afono (station 9120) and at Aasu Stream at Aasu (station 9205), for water years 1960–90, Tutuila, American Samoa.

less than 0.50) and/or seven or fewer measurements were treated as miscellaneous sites. All discharge data were normalized by logarithmic (base 10) transformation before analysis (Searcy, 1960). The logarithmic transformation commonly creates a linear relation among streamflow data. The index station with concurrent daily discharges having the highest correlation coefficient with the base-flow measurements for a site, regardless of method, was selected as the index station for that particular site.

Some low-flow partial-record stations have measurements that include surface runoff. In some cases surface runoff was occurring at the index station on the days when discharge measurements were made at the low-flow partial-record stations. Only base-flow data were used to determine the relation in either the moments approach or the graphical correlation method. Therefore, streamflow measurements which included surface runoff were not used in the low-flow analysis.

Of the seven continuous-record gaging stations with computed low-flow frequency curves, only five had periods of record long enough to cover the dates of the base-flow measurements at the remaining four continuous-record stations, the low-flow partial-record stations, and the miscellaneous sites. The five gaging stations (9120, 9205, 9310, 9480, and 9600) were used as index stations in the analysis. Two different sets of low-flow characteristics from station 9480 were used for transferring. When most of the base-flow measurements at the partial-record and miscellaneous sites were made during the pre-diversion time period at station 9480, then low-flow characteristics computed for the pre-diversion base-flow period were used. When most of the base-flow measurements were made during the post-diversion time period at station 9480, the post-diversion characteristics were used.

Moments approach.--The moments approach is a mathematical method that transfers the parameters of a frequency curve (the moments) from an index station to a site with base-flow measurements. This method is discussed in detail by Stedinger and Thomas (1985) and briefly explained here. Because the moments approach is a mathematical method, a large number of base-flow measurements and a high correlation coefficient are needed to provide reliable results. The moments approach uses ordinary least-squares regression analysis to describe the relation between the index station and the site with base-flow measurements. The site with

base-flow measurements is assumed to have the same coefficient of skew as the index station and the other moments (mean and standard deviation) are then transferred using the regression line. A frequency curve is then created at the site with base-flow measurements using the transferred moments. The 7-day 2-year and 10-year low flows are calculated from this curve. For sites where this approach was used, the median and mean flows were transferred using the same regression line. The moments approach can be used with one or two index stations and provides results comparable to estimates computed by frequency analysis when applied to data from continuous-record gaging stations on Tutuila.

The regression equation used in the moments approach simply relates the streamflow measurements at the continuous-record, low-flow partial-record, or miscellaneous site to the daily mean streamflow at the index station and has the form:

$$LogQ = Loga + b_1 LogX_1 + b_2 LogX_2, \qquad (1)$$

where:

$Log\,Q$ = logarithm of streamflow at site with
base-flow measurements,

$Log\,X_1$, $Log\,X_2$ = logarithm of daily mean streamflow
at index stations,

a = the regression constant, and

b_1, b_2 = the regression coefficients.

The moments also in logarithmic format are then transferred using equation 1. For the mean and median streamflow characteristics, the regression equations were untransformed from logarithms, and have the form:

$$Q = a \left(X_1^{b_1} \right) \left(X_2^{b_2} \right) (\text{BCF}), \qquad (2)$$

where:

Q = streamflow at site with base-flow
measurements,

X_1, X_2 = streamflow at index stations,

a = the regression constant,

b_1, b_2 = the regression coefficients or
exponents of the streamflow
characteristics at the index stations,
and

BCF = the bias-correction factor.

The bias-correction factor is used to correct for re-

transformation bias that results when the logarithmic transformation is used (Miller, 1984). In this study the bias-correction factor was determined by the "smearing estimate" (Duan, 1983). Bias-correction factors were applied to the regression constants when determining the mean streamflow characteristics. Median streamflow estimates were not corrected because no bias was shown when moments approach was applied using data from continuous-streamflow stations. Bias-correction factors for the 45 low-flow partial-record sites using the moments approach ranged from 1.012 to 1.333 and had an average of 1.082.

Graphical regression.--The graphical regression or graphical correlation method is discussed in detail by Searcy (1960) and also by Hardison and Moss (1972). This method consists of plotting the base-flow measurements for the continuous-record station, low-flow partial-record station, or miscellaneous site against the concurrent daily discharges for the index station on logarithmic graph paper. A line which best fits the given data is then drawn through the data. This is the line of relation. Low-flow characteristics are then transferred from the index station to the site with base-flow measurements by using the line of relation and the low-flow characteristics for the index station. An example of this procedure is provided in figure 5.

Low-flow estimates.--Estimates of the 7-day 2- and 10-year low flows at the 4 continuous-record stations (9060, 9315, 9335, 9442) using station-to-station methods are given in table 1 (at end of report). At some of these continuous-record stations, daily mean flows or annual 7-day low-flow values were used in place of base-flow measurements in the above methods. Estimates of the 7-day 2- and 10-year low flows, median flows, and mean flows for 73 of the 75 low-flow partial-record stations are given in table 3 (at end of report). Locations of low-flow partial-record sites are shown in plate 1. The two partial-record stations without estimates for low-flow characteristics were daily record stations 9500 and 9505 (old) which measured a municipal diversion and have been excluded from further analysis. Only 4 of the 49 miscellaneous sites had eight or more discharge measurements. These sites (2, 43, 44, and 46) had low-flow characteristics estimated by the methods described above and are presented in table 4 (at end of report). The remaining miscellaneous sites had low-flow characteristics estimated by using the regional regression equations discussed in the section of the report on "Regional regression analysis."

Accuracy of the low-flow characteristics for continuous-record stations, low-flow partial-record stations, and miscellaneous sites were computed using methods summarized by Stedinger and Thomas (1985) and Hardison and Moss (1972). The method by Stedinger and Thomas (1985) is a modification to the method by Hardison and Moss (1972) and applies only to sites where the low-flow characteristics were computed by the moments approach. Accuracy estimated using either method is dependent on the number of base-flow measure-ments at the site, the variance of these measurements, the magnitude of the 7-day 2- or 10-year estimate relative to the base-flow measure-ments, and the standard error of the 7-day 2- or 10-year low flow at the index station.

Regional Regression Analysis

Regional regression analysis relates the streamflow characteristics to measurable basin characteristics. The resulting regression equation can then be used to estimate streamflow characteristics at any site using the basin characteristics from that site.

The ordinary least-squares estimator used in traditional regression analysis, such as that applied in using the moments approach, assumes that the errors (residuals) are random, uncorrelated, normally distributed, and have equal standard deviations (Draper and Smith, 1981). Therefore, all stations used in the regression analysis are given equal weight. However, these conditions are not always met with regional hydrologic data because streamflow records at gaged sites used in the regression analysis are of different record lengths. In addition, cross-correlation of concurrent flows among nearby gaged sites can exist especially when using low-flow characteristics from partial-record stations. To solve these problems, Stedinger and Tasker (1985) developed a generalized least-squares estimator that accounts for cross-correlation among sites as well as for unequal record length. The generalized least-squares estimators assign each station a different regression weight and therefore improve model accuracy. Where the ordinary least-squares assumptions were violated it has been shown that generalized least-squares estimators are appropriate for certain situations and provide reduced standard errors of estimate for the regression equations (Stedinger and Tasker, 1985).
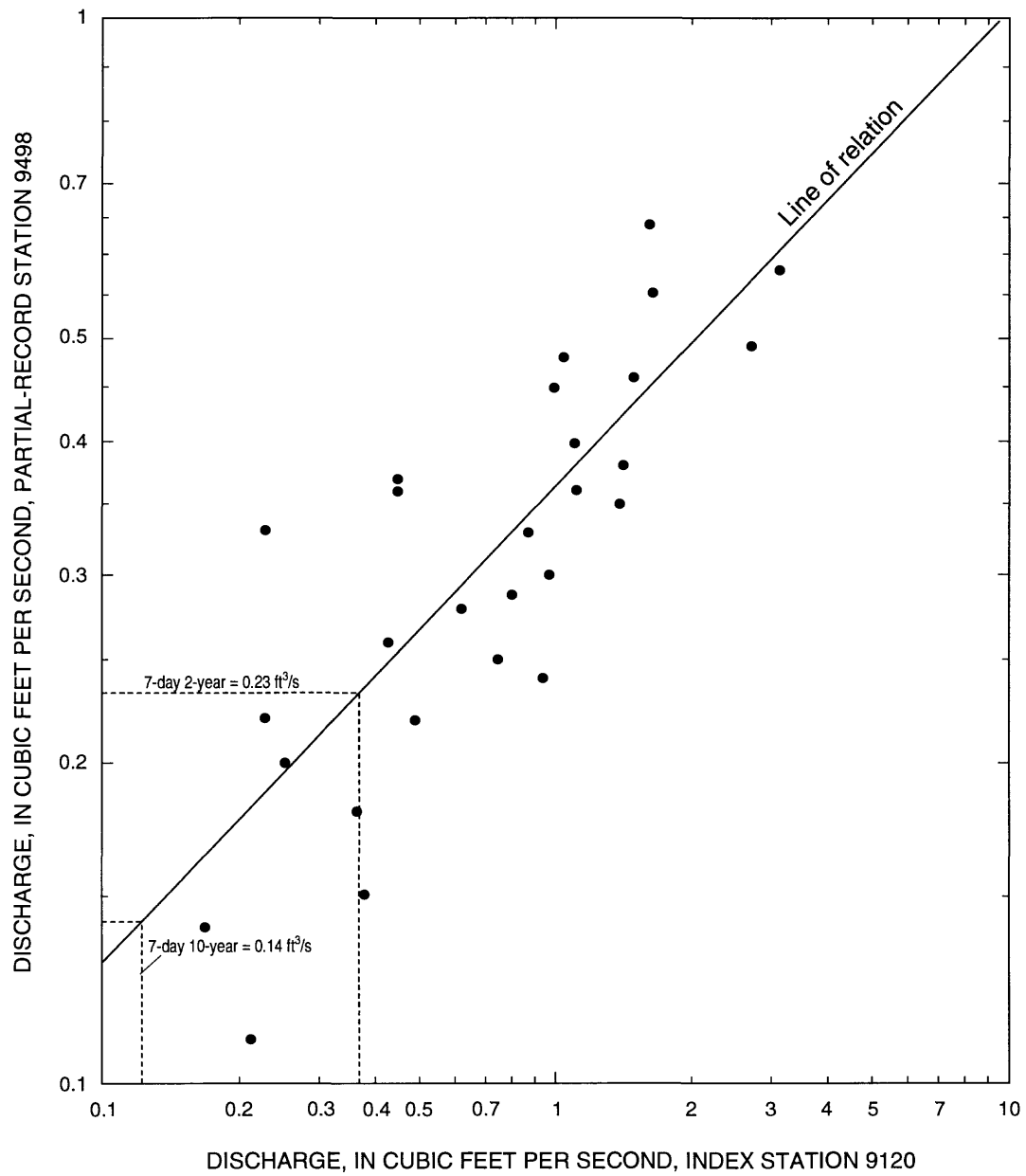
Figure 5. Graphical method of estimating low-flow characteristics at sites with eight or more base-flow measurements, Tutuila, American Samoa.

For the regression analysis in this study, the 7-day 2- and 10-year low flows, the median flow, the mean flow, and the peak flood estimates for the 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals were the dependent variables and the drainage-basin characteristics were the independent variables. For the low-flow characteristics, regression analysis was done using the base-flow index basin characteristic to compute equations that are applicable for sites with some base-flow data and without the base-flow index variable to produce equations for ungaged sites. Data for sites having significant upstream diversions were excluded, leaving 81 out of 88 stations and miscellaneous sites available for regression analysis (table 5). Data for the regional regression analysis were also transformed using the common (base 10) logarithm. This transformation was based on examination of the streamflow, basin, and climatic characteristics and results from previous studies (Thomas and Benson, 1970) which have shown that the logarithmically transformed variables are linearly related.

After transforming the variables, the first step of the regional regression analysis was to determine the significant independent variables for each of the streamflow characteristics. This was done by using correlation and stepwise regression procedures. Correlation was used to calculate the degree of correlation between the dependent and independent variables, and between all pairs of independent variables. Because high correlation between two independent variables tends to reduce the statistical significance of each variable involved in regression analysis, only the more significant and reliable one was retained.

The stepwise regression procedure was used to determine the most statistically significant independent variables. In this procedure, variables are added or deleted one at a time into the regression model according to their level of significance for entry and retention (Draper and Smith, 1981). In this study, an entry and retention significance level of 0.05 (5 percent) was used in the stepwise regression F-test to limit the number of variables. Also, the use of the 5-percent significance level generally limited the final regression equations to two or three variables. The stepwise procedure was run for each streamflow variable using data for the entire island and for each of the individual regions that were later identified.

In choosing variables and regions, a study of the standard error of estimate in percent (%SE) and the co-

efficient of determination (R^2) was done on the stepwise regression results. The %SE is the measure of model error and lack of fit of the regression equation and the R^2 is the fraction of the total variability of the observed dependent variables explained by the independent variables. For multiple regression analysis the R^2 is adjusted for lost degrees of freedom caused by multiple independent variables (Draper and Smith, 1981). In general, use of statistically significant predictor variables minimized the %SE and maximized R^2. The chosen variables were then used to develop the regression equations. The resulting regression equations have the form:

$$Q = a \left(X_1^{b_1} \right) \left(X_2^{b_2} \right) ... \left(X_n^{b_n} \right) (BCF), \qquad (3)$$

where:

Q = streamflow characteristic (dependent variable),

$X_1, X_2,...X_n$ = basin and/or climatic characteristics (independent variables),

a = the regression constant,

$b_1, b_2,...b_n$ = the regression coefficients or exponents of the basin and/or climatic characteristics, and

BCF = the bias-correction factor.

The bias-correction factor is the same as explained under equation 2. Bias-correction factors were applied to the regression constants for the equations in tables 6 through 9. Bias-correction factors for the equations in tables 6 through 9 ranged from 1.024 to 1.490, with an average of 1.138. Bias-correction factors were not used in the peak-flow equations in table 10 because of the small data base.

The generalized least-squares estimator in the GLSNET program (Tasker and Stedinger, 1989) in ANNIE (Lumb and others, 1990) was then used to compute the final regression equations. The final regression equations were checked to ensure that all independent variables were statistically significant, the coefficients of the independent variables were hydrologically reasonable, correlation between independent variables was not significant, the standard error was minimized, the coefficient of determination was maximized, overly influential observations were not present, and that residual variances were constant.

Table 5. Summary of data for continuous-record gaging stations, partial-record stations, and miscellaneous sites used in regional regression analysis, Tutuila, American Samoa

[7Q2, 7-day, 2-year low flow; 7Q10, 7-day 10-year low flow; ft³/s, cubic feet per second; DA, drainage area; GA, gage altitude; CL, main channel length; DD, drainage density; BR, basin relief; BS, basin slope; BFI, base-flow index; mi², square mile; ft, feet; ft/mi, feet per mile; ft³/s/mi², cubic foot per second per square mile]

Station	7Q2 (ft³/s)	7Q10 (ft³/s)	Mean flow (ft³/s)	Median flow (ft³/s)	DA (mi²)	GA (ft)	CL (mi)	DD (1/mi)	BR (ft)	BS (ft/mi)	BFI (ft³/s/ mi²)	Region (plate 1)
9000	0.01	<0.01	0.05	0.02	0.06	180	0.46	5.83	590	3,440	0.17	1
9010	0.08	0.04	0.35	0.18	0.09	160	0.63	5.89	680	4,000	1.11	1
9020	0.02	0.01	0.08	0.04	0.03	150	0.31	7.67	410	3,140	1.00	1
9025	0.07	0.03	0.36	0.25	0.12	40	0.73	7.25	800	5,800	0.71	1
9030	0.02	<0.01	0.13	0.07	0.06	120	0.43	9.50	430	4,080	0.50	1
9040	0.01	<0.01	0.07	0.03	0.05	140	0.24	3.60	640	2,300	0.21	1
9050	0.03	0.01	0.29	0.11	0.09	220	0.65	6.00	470	2,820	0.22	1
9060[b]	0.02	<0.01	0.33	0.08	0.18	190	0.59	6.67	690	4,600	0.17	[a]1
9070	0.02	0.01	0.11	0.07	0.06	75	0.33	2.50	510	1,280	0.36	1
9080	0.01	<0.01	0.18	0.07	0.08	230	0.49	6.88	550	3,780	0.13	1
9095	0.19	0.08	0.83	0.43	0.47	20	0.80	4.96	1,080	5,360	0.36	1
9100	0.02	<0.01	0.22	0.12	0.01	290	0.11	4.00	350	1,400	2.15	1
9110	0.07	0.03	0.42	0.28	0.10	70	0.46	7.80	880	6,864	0.60	1
9120[b]	0.38	0.17	3.38	1.40	0.60	30	1.17	5.02	1,460	7,330	0.70	1
9130	0.04	0.01	0.41	0.26	0.20	100	0.64	8.30	1,270	10,500	0.29	1
9140	0.08	0.06	0.47	0.25	0.18	200	0.87	8.28	810	6,710	0.95	1
9160	0.04	0.01	0.34	0.14	0.14	80	0.54	2.86	910	2,600	0.24	1
9170	0.13	0.04	1.10	0.62	0.19	100	0.61	3.79	1,340	5,080	1.19	1
9175[b]	0.20	0.07	1.50	0.65	0.23	10	0.77	3.83	1,430	5,480	0.96	1
9180	<0.01	0	0.22	0.02	0.02	40	0.36	11.00	800	8,800	0.10	1
9190	0.75	0.32	3.46	2.40	0.60	120	1.37	4.38	1,280	5,610	1.28	2
9192	0.16	0.09	0.52	0.40	0.16	120	0.88	4.88	1,250	6,100	1.15	2
9194	0.09	0.05	0.26	0.21	0.15	90	0.87	2.13	1,310	2,790	0.79	2
9198	0.07	0.03	0.35	0.24	0.24	1,080	0.52	0.92	340	310	0.40	2
9200	0.92	0.39	4.09	2.85	0.82	130	1.70	3.56	1,270	4,520	2.26	2
9205[b]	0.97	0.40	6.09	4.10	1.03	5	2.20	3.32	1,390	4,620	1.36	2
9220	0.74	0.28	5.40	3.60	0.78	140	1.52	4.78	1,160	5,540	1.18	2
9230	0.24	0.13	0.96	0.70	0.18	250	0.62	6.22	1,060	6,590	1.50	2
9240	0.16	0.07	0.90	0.61	0.17	180	0.66	6.18	1,080	6,670	1.14	2
9250	0.90	0.52	5.00	3.30	0.74	120	1.40	4.43	1,120	4,960	1.23	2

Table 5. Summary of data for continuous-record gaging stations, partial-record stations, and miscellaneous sites used in regional regression analysis, Tutuila, American Samoa--Continued

[7Q2, 7-day, 2-year low flow; 7Q10, 7-day 10-year low flow; ft³/s, cubic feet per second; DA, drainage area; GA, gage altitude; CL, main channel length; DD, drainage density; BR, basin relief; BS, basin slope; BFI, base-flow index; mi², square mile; ft, feet; ft/mi, feet per mile; ft³/s/mi², cubic foot per second per square mile]

Station	7Q2 (ft³/s)	7Q10 (ft³/s)	Mean flow (ft³/s)	Median flow (ft³/s)	DA (mi²)	GA (ft)	CL (mi)	DD (1/mi)	BR (ft)	BS (ft/mi)	BFI (ft³/s/mi²)	Region (plate 1)
9260	0.05	0.02	0.28	0.14	0.11	300	0.61	3.82	4,80	1,830	0.73	2
9270	0.04	0.01	0.26	0.16	0.03	110	0.32	7.67	4,60	3,530	1.33	2
9280	0.13	0.06	0.73	0.38	0.17	45	0.82	5.88	760	4,470	0.68	2
9290	0.17	0.08	0.73	0.41	0.15	80	0.87	4.33	850	3,680	1.12	2
9300	0.11	0.04	1.05	0.44	0.16	50	0.68	5.88	1,110	6,530	0.48	2
9302	0.07	0.02	1.00	0.36	0.21	90	0.83	3.05	950	2,900	0.14	2
9310[b]	0.20	0.08	1.45	0.69	0.24	20	1.11	4.04	960	3,880	0.92	2
9315[b]	0.47	0.24	2.54	1.60	0.32	330	1.10	5.78	770	4,450	2.06	2
9320	0.68	0.25	2.76	1.85	0.55	150	1.39	6.05	1,030	6,230	1.90	2
9325	0.58	0.21	5.73	2.85	0.66	20	1.77	5.62	1,160	6,520	1.07	2
9330	0.06	0.02	0.35	0.24	0.08	300	0.50	3.50	570	2,000	0.67	2
9335[b]	0.73	0.38	4.56	2.50	0.31	370	0.86	5.13	920	4,720	3.55	2
9340	0.88	0.38	4.55	2.61	0.69	240	1.21	5.35	1,050	5,620	1.84	2
9350	0.17	0.06	1.20	0.79	0.29	280	0.88	6.24	1,040	6,490	0.79	2
9355	0.01	<0.01	0.05	0.03	0.01	200	0.40	8.00	280	2,240	1.00	2
9360	0.11	0.05	0.47	0.33	0.15	620	0.82	4.93	490	2,420	0.57	2
9370	0.32	0.18	0.85	0.67	0.18	220	1.10	5.61	1,450	8,130	1.68	1
9380	0.11	0.05	0.55	0.26	0.09	180	0.60	5.55	1,100	6,100	1.22	1
9390	0.06	0.03	0.20	0.12	0.02	400	0.24	8.00	880	7,040	3.00	2
9400	0.09	0.02	0.30	0.22	0.04	360	0.33	6.50	960	6,240	3.00	2
9410	0.10	0.05	0.29	0.23	0.08	400	0.59	5.50	960	5,280	2.29	2
9420	0.10	0.05	0.37	0.25	0.09	190	0.61	5.00	1,250	6,250	1.48	1
9430	0.31	0.15	0.98	0.60	0.14	220	0.58	2.00	1,320	2,640	3.36	1
9440	0.54	0.21	2.83	1.48	0.57	120	0.98	4.32	1,700	7,340	1.35	1
9442[b]	0.18	0.04	4.18	1.30	0.78	30	1.38	4.54	1,800	8,170	0.08	[a]1
9450	0.11	0.04	1.30	0.45	0.19	190	1.14	5.74	1,420	8,150	1.22	1
9460	0.10	0.05	0.40	0.23	0.09	140	0.50	4.44	9,80	4,350	0.85	1
9470	0.03	0.01	0.58	0.17	0.22	100	0.82	5.18	1,650	8,550	0.19	1
9480[b]	0.04	0.02	1.44	0.30	0.25	80	1.18	4.40	1,530	6,730	0.36	[a]1
9490	0.14	0.09	1.10	0.33	0.24	460	0.85	3.83	1,250	4,790	0.35	[a]1
9495	0.13	0.08	1.10	0.32	0.42	75	1.33	5.64	1,640	9,250	0.42	[a]1

Table 5. Summary of data for continuous-record gaging stations, partial-record stations, and miscellaneous sites used in regional regression analysis, Tutuila, American Samoa--Continued

[7Q2, 7-day, 2-year low flow; 7Q10, 7-day 10-year low flow; ft³/s, cubic feet per second; DA, drainage area; GA, gage altitude; CL, main channel length; DD, drainage density; BR, basin relief; BS, basin slope; BFI, base-flow index; mi², square mile; ft, feet; ft/mi, feet per mile; ft³/s/mi², cubic foot per second per square mile]

Station	7Q2 (ft³/s)	7Q10 (ft³/s)	Mean flow (ft³/s)	Median flow (ft³/s)	DA (mi²)	GA (ft)	CL (mi)	DD (1/mi)	BR (ft)	BS (ft/mi)	BFI (ft³/s/ mi²)	Region (plate 1)
9497	0.06	0.02	0.35	0.16	0.05	540	0.40	6.40	980	6,270	1.23	1
9498	0.23	0.14	0.65	0.42	0.07	510	0.35	4.00	1,050	4,200	3.63	1
9505	0.14	0.06	0.45	0.25	0.17	290	0.63	3.29	1,220	4,010	0.55	[a]1
9510	0.65	0.30	6.40	1.76	0.75	50	1.21	5.91	1,460	8,630	0.44	[a]1
9525	0.09	0.03	0.44	0.21	0.14	140	0.45	3.57	1,330	4,750	0.92	1
9530	0.07	0.03	0.24	0.14	0.03	180	0.32	7.67	1,300	9,970	2.15	1
9550	0.04	0.02	0.37	0.15	0.05	60	0.53	8.40	970	8,150	1.49	1
9555	0.02	<0.01	0.16	0.06	0.06	60	0.40	4.83	580	2,800	0.31	1
9560	0.33	0.19	1.07	0.65	0.19	90	0.55	3.53	1,520	5,370	1.87	1
9565	0.02	0.01	0.11	0.05	0.05	100	0.31	4.80	800	3,840	0.37	1
9570	0.13	0.05	0.68	0.32	0.02	80	0.24	8.50	520	4,420	5.60	1
9580	0.04	0.01	0.63	0.20	0.10	190	0.53	6.00	730	4,380	0.37	1
9585	0.05	0.02	0.22	0.12	0.02	150	0.32	10.50	650	6,825	2.44	1
9590	0.11	0.05	0.84	0.37	0.16	35	0.65	6.25	880	5,500	0.90	1
9600[b]	0.42	0.23	1.21	0.78	0.19	180	0.94	6.00	890	5,340	2.21	1
9605	0.15	0.08	0.40	0.26	0.04	200	0.29	4.75	850	4,040	6.02	1
9610	0.16	0.08	1.01	0.48	0.22	280	0.62	5.64	830	4,680	0.76	1
9620	0.03	0.01	0.32	0.12	0.09	100	0.45	3.78	660	2,500	0.47	1
9630	0.02	<0.01	0.45	0.11	0.10	120	0.56	7.20	540	3,890	0.20	1
9639[b]	0.04	0.02	0.32	0.11	0.11	120	0.60	6.54	710	4,640	0.36	1
9640	0.05	0.02	0.24	0.12	0.12	100	0.62	6.17	730	4,500	0.46	1
9650	0.03	0.02	0.14	0.08	0.10	140	0.75	7.90	930	7,350	0.42	1
9660	0.01	0.01	0.03	0.02	0.02	110	0.24	8.00	290	2,320	1.00	1
2[c]	0.08	0.05	0.29	0.17	0.15	240	0.55	6.38	640	4,080	0.56	1
40[c]	0.70	0.26	5.80	2.70	0.50	365	0.94	5.20	925	4,810	1.80	2
43[c]	0.13	0.06	0.70	0.49	0.14	400	0.82	6.29	850	5,340	1.79	2
46[c]	0.30	0.14	1.60	1.10	0.35	200	1.30	5.86	900	5,270	1.60	2

[a] Station had significant diversions, not used in regional regression analysis.
[b] Continuous-record stream-gaging station
[c] Miscellaneous sites treated as low-flow partial-record sites

Table 6. Regression equations for estimating low-flow characteristics for ungaged sites in region 1, eastern Tutuila, American Samoa

[Region 1 shown in plate 1]

Regression equation	Adjusted coefficient of determination, R^2	Standard error of estimate (percent)
$7Q2 = 0.0000335 \ (DA)^{0.488} \ (GA)^{0.244} \ (BR)^{1.16}$	0.47	95.2
$7Q10 = 0.00000447 \ (DA)^{0.448} \ (GA)^{0.280} \ (BR)^{1.30}$	0.41	110
$Mean = 0.00188 \ (DA)^{0.474} \ (BR)^{0.983}$	0.59	62.6
$Median = 0.000619 \ (DA)^{0.478} \ (BR)^{1.04}$	0.56	66.5

	Applicable range	
	minimum	maximum
DA: drainage area, in square miles......................	0.01	0.60
GA: gage altitude, in feet.............................	10	540
BR: basin relief, in feet..............................	290	1,700

7Q2: 7-day, 2-year low flow
7Q10: 7-day, 10-year low flow
Mean: mean flow
Median: median flow

Table 7. Regression equations for estimating low-flow characteristics for sites with some streamflow measurements in region1, eastern Tutuila, American Samoa

[Region 1 shown in plate 1]

Regression equation	Adjusted coefficient of determination, R^2	Standard error of estimate (percent)
$7Q2 = 0.773(DA)^{0.950} \ (BFI)^{0.920}$	0.95	20.3
$7Q10 = 0.369(DA)^{0.982} \ (BFI)^{1.04}$	0.91	25.4
$Mean = 4.45(DA)^{0.903} \ (BFI)^{0.518}$	0.72	43.8
$Median = 2.33(DA)^{0.960} \ (BFI)^{0.700}$	0.87	21.8

	Applicable range	
	minimum	maximum
DA: drainage area, in square miles......................	0.01	0.60
BFI: base-flow index, in cubic feet per second per square mile	0.1	6.02

7Q2: 7-day, 2-year low flow
7Q10: 7-day, 10-year low flow
Mean: mean flow
Median: median flow

Table 8. Regression equations for estimating low-flow characteristics for ungaged sites in region 2, western Tutuila, American Samoa

[Region 2 shown in plate 1]

Regression equation	Adjusted coefficient of determination, R^2	Standard error of estimate (percent)
$7Q2 = 0.00365 \, (DA)^{0.909} \, (GA)^{0.110} \, (BS)^{0.594}$	0.90	34.2
$7Q10 = 0.000925 \, (DA)^{0.922} \, (GA)^{0.135} \, (BS)^{0.645}$	0.86	37.5
$Mean = 0.0862 \, (DA)^{0.972} \, (BS)^{0.497}$	0.90	36.5
$Median = 0.0464 \, (DA)^{0.964} \, (BS)^{0.510}$	0.92	29.8

Applicable range

	minimum	maximum
DA: drainage area, in square miles.	0.01	1.03
GA: gage altitude, in feet	5	1,080
BS: basin slope, in feet per mile.	310	7,040

7Q2: 7-day, 2-year low flow
7Q10: 7-day, 10-year low flow
Mean: mean flow
Median: median flow

Table 9. Regression equations for estimating low-flow characteristics for sites with some streamflow measurements in region 2, western Tutuila, American Samoa

[Region 2 shown in plate 1]

Regression equation	Adjusted coefficient of determination, R^2	Standard error of estimate (percent)
$7Q2 = 0.142 (DA)^{0.905} \, (BS)^{0.206} \, (BFI)^{0.549}$	0.97	13.7
$7Q10 = 0.0741 \, (DA)^{0.920} \, (BS)^{0.181} \, (BFI)^{0.666}$	0.94	13.3
$Mean = 0.229 \, (DA)^{0.986} \, (BS)^{0.377} (BFI)^{0.199}$	0.91	35.2
$Median = 0.309 \, (DA)^{0.984} \, (BS)^{0.276} (BFI)^{0.366}$	0.95	21.6

Applicable range

	minimum	maximum
DA: drainage area, in square miles.	0.01	1.03
BS: basin slope, in feet per mile.	310	7,040
BFI: Base-flow index, in cubic feet per second per square mile	0.14	3.55

7Q2: 7-day, 2-year low flow
7Q10: 7-day, 10-year low flow
Mean: mean flow
Median: median flow

Table 10. Regression equations for estimating peak flood flows for streams on Tutuila, American Samoa

Regression equation	Adjusted coefficient of determination, R^2	Standard error of estimate (percent)
$Q_2 = 1{,}040\,(DA^{1.13})$	0.66	47.4
$Q_5 = 1{,}530\,(DA^{1.10})$	0.66	45.8
$Q_{10} = 1{,}810\,(DA^{1.07})$	0.66	45.1
$Q_{25} = 2{,}110\,(DA^{1.02})$	0.64	44.4
$Q_{50} = 2{,}300\,(DA^{0.981})$	0.63	44.0
$Q_{100} = 2{,}470\,(DA^{0.941})$	0.60	44.1

Q_t = estimated peak flood flow in cubic feet per second, where t = 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals.

Applicable range

	minimum	maximum
DA: drainage area, in square miles.	0.11	.078

For peak-flow regression analysis, ordinary-least-squares regression procedures were used to develop the final regression equations. Generalized-least-squares regression procedures were not used because the cross correlations among stations were low (average of 0.31) and the limited number of stations available did not provide a reasonable range and distribution of record lengths to make generalized-least-squares analysis superior to ordinary-least-squares analysis (Stedinger and Tasker, 1985).

Accuracy of low-flow and peak-flow characteristics estimated from the regression equations in tables 6 through 10 is dependent on the standard error of the regression relation and the data used to define the regression equations. The regression equations in tables 6 through 9 apply only to perennial streams where low flows are not significantly affected by diversions. Perennial streams can be identified as solid blue lines on the 1:24,000-scale USGS 1963 topographic map of Tutuila. In this study, any diversion for municipal use was defined as significant. Municipal diversion structures are usually well-maintained and resulting withdrawals are relatively constant. Diversions for domestic uses in the villages have been detected upstream of five continuous gaging stations. These diversions significantly affected low flows at only two of the five stations (9060 and 9480). Effects of diversions at low-flow partial-record stations and miscellaneous sites generally cannot be detected from the data collected. Most domestic diversions are small, not always well-maintained, and do

not withdraw constantly. Therefore, low-flow partial-record stations and miscellaneous sites with domestic diversions were not excluded from this study. The peak flood-flow regression equations in table 10 apply only to streams not affected by urbanization. The equations are based on data from 10 gaged streams on Tutuila, none of which represent flow from areas of high channelization and pavement. As a result, the available peak-flow data do not represent urbanized conditions.

The standard errors of the regression equations apply only to streamflow estimates for basins that have values of the independent variable(s) (basin characteristics) within the range of those values used to derive that equation. For the equations in tables 6 through 10, applicable ranges of the independent variables are shown in each table. The use of the regression equations with values that fall outside the given ranges can result in large extrapolation errors. Although the regression equations in tables 6 through 10 provide unique numerical answers for low-flow and peak-flood characteristics, the user's judgement is essential to achieving reliable results. Conditions in some drainage basins on Tutuila may be significantly different or unusual compared with those in the basins used to derive the regression equations. For such drainage basins, the user must decide if conditions warrant use or possibly adjustment of the computed values.

Regionalization.--For regional analysis, drainage basins with similar flood response or streamflow char-

acteristics are grouped into homogeneous regions. Homogeneity of a region's streamflow characteristics can reduce errors in estimates of these streamflow characteristics, whereas heterogeneity can result in higher estimation errors. In this study, regional analysis was done by using the method of residuals. The method of residuals involves classifying basins into regions using the sign and magnitude of the residuals (differences between observed and computed streamflow characteristics), basin and climatic conditions, and hydrologic judgement. Residuals with similar sign and magnitude are assumed to represent regions with similar streamflow characteristics and are grouped together. Because of the subjective nature of this method, Tasker (1982) proposed the use of the Wilcoxon signed-ranks test to provide some objectivity. This non-parametric test is used to compare residuals between regions to determine if the apparent grouping of the residuals represents consistent differences in the residuals. The Wilcoxon signed-ranks test does not statistically verify the regions but provides a quantitative index as a guide for defining "homogeneous" regions (Tasker, 1982). In addition to the Wilcoxon signed-ranks test, the regression equations for all regions were tested to insure that they met the regression requirements stated above. For the Wilcoxon signed-ranks test a significance level of 0.10 (10 percent) was used for regional verification. Failure of the Wilcoxon signed-ranks test indicates that the residuals for the individual regions are not consistently different from those of other regions.

Regression analysis was done using all 81 data sites for the four low-flow characteristics both with and without the base-flow index variable. The significant variables were drainage area, basin relief and gage altitude. The residuals in log units from the 7-day 2-year low-flow and mean-flow regression analyses were then plotted on a map of Tutuila. On the basis of this residual plot, a number of geographically continuous regions were identified. These potential regions were then checked using the Wilcoxon signed-ranks test and by regression analysis. The ideal grouping was determined to be one that divided Tutuila into two regions, eastern and western Tutuila. The dividing line between the regions, which was extended to both coasts, is located near Malaeimi Valley (see plate 1). This dividing line also corresponds to differences in geology on Tutuila. For the Wilcoxon signed-ranks test, the two groupings were significant at the 0.10 (10 percent) significance level. Regression equations were then determined for

both the regions and these are given in tables 6 through 9. Regional analysis was not done for the peak-flow regression analysis because of the sparse data set. Basin characteristics required by the equations are also identified in tables 6 through 9 and explained below. Streamflow measurements from 49 miscellaneous sites and low-flow characteristics for 25 out of the 49 sites are listed in table 4. Locations of the 49 miscellaneous sites are shown in plate 1.

Results from the regression analysis of peak floods show that drainage area was the only independent variable that was statistically significant. The values of the coefficient of determination in table 10 are low, signifying that drainage area alone does not explain much of the variations in the peak-flood estimates. It should be noted that Aasu Stream, station 9205, was an influential observation causing a bias in the initial peak-flow regression analysis. Aasu stream has the largest gaged drainage area (table 1) and low peak-flow estimates (table 2). This situation may result from the permeable cinders at Aasu Stream's headwaters causing little runoff. The data from Aasu Stream were deleted from further analysis because of their unique nature. The final regression equations in table 10 are based on data from the remaining 10 stations. The potential influence of Aasu Stream on regional flood peaks is illustrated in figure 6, which shows the regression line for the 100-year flood compared with the maximum observed flood discharges. Figure 6 shows Aasu Stream as clearly having a different flood response than the other 10 gaged basins.

Drainage-basin characteristics.--For regional regression analysis, the drainage-basin characteristics that might be related to low and peak streamflow characteristics need to be described in quantitative form. The following seven basin characteristics were considered in this study for regionalizing the low-flow estimates: drainage area, gage altitude, main channel length, drainage density, basin relief, basin slope, and base-flow index. For the peak-flow regionalization, base-flow index was not used, and two additional basin characteristics, channel slope and basin altitude, were added. These two characteristics are listed for the 11 continuous-record stream-gaging stations in table 2. The other seven characteristics are listed for the 11 continuous gaging stations and 77 low-flow partial-record stations and miscellaneous sites in table 5 and all nine are described below.
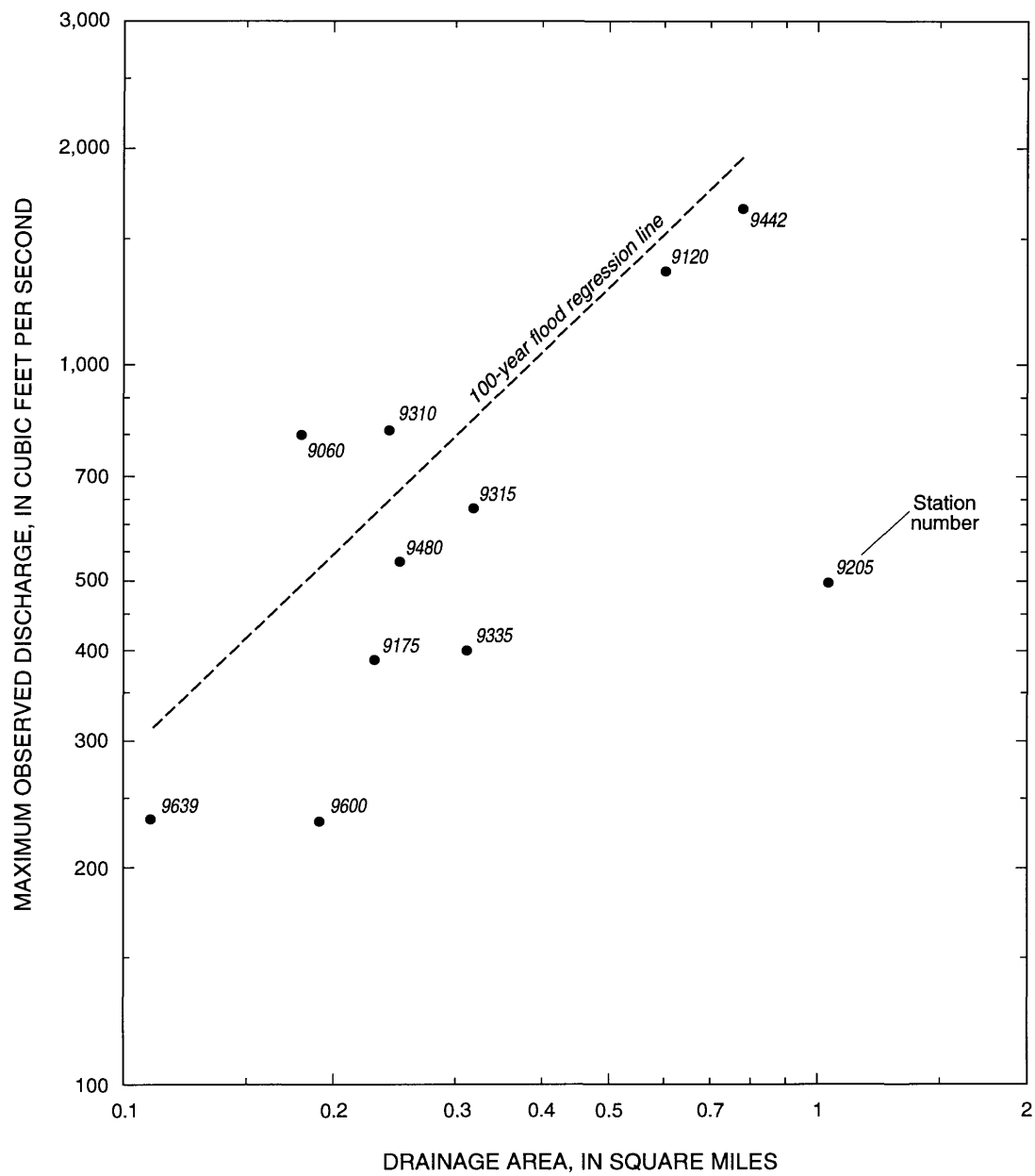
Figure 6. Maximum observed flood discharges compared with drainage area and 100-year flood regression line (with bias-correction factor) for stream-gaging stations on Tutuila, American Samoa.

Drainage area (DA)--in square miles; measured by planimetering or by computer digitizing using a geographic information systems (GIS) analysis of the area enclosed by basin divides drawn on the 1963 and 1989 1:24,000-scale USGS topographic map of Tutuila. Previous studies have shown that drainage area is an important factor in estimating streamflow characteristics for a basin (Thomas and Benson, 1970). Drainage areas measured using 1963 or 1989 maps should provide equivalent results.

Gage altitude (GA)--in feet; is the stream altitude at the gaged site measured either from the 1963 1:24,000-scale USGS topographic map or by field survey from a known benchmark.

Main channel length (CL)--in miles; is the longest distance measured along a stream from the gaged site to the basin divide. The stream channel was defined by the stream symbol (blue line) on the 1989 1:24,000-scale USGS topographic map and measured by using GIS analysis. Alternatively, channel length can be measured by using a compass or divider set to a 0.02 mi increment.

Drainage density (DD)--in 1/miles; is the ratio of the total length of all stream channels in a basin divided by the drainage area. The total length of stream channels was defined by the blue lines on the 1989 1:24,000-scale USGS topographic map and determined by the same methods as channel length.

Basin relief (BR)--in feet; is the measure of the difference between the highest altitude and the gage altitude in a basin (Fennessey and Vogel, 1990). The highest basin altitude was determined from the 1989 1:24,000-scale USGS topographic map by averaging the three highest points in the basin (Fennessey and Vogel, 1990).

Basin slope (BS)--in feet/mile; determined by multiplying the basin relief and drainage density (BS = BR x DD) (Fennessey and Vogel, 1990).

Base-flow index (BFI)--in cubic feet per second per square mile; is an indicator of a stream's low-flow potential. Base-flow measurements provide information about the aquifer characteristics that provide base-flow to a stream. Because measurements are obtained at various flow durations and at sites with different drainage areas, it is necessary to relate them to an index station. This is computed by the following equation:

$$BFI = \frac{Q_m Q_{90}}{DA Q_i}, \qquad (4)$$

where:

BFI = base-flow index, in cubic feet per second per square mile,

Q_m = measured discharge at low-flow partial-record station or miscellaneous site, in cubic feet per second,

Q_{90} = discharge equalled or exceeded 90 percent of the time at the index station, from flow-duration analysis, in cubic feet per second,

DA = drainage area of low-flow partial-record station or miscellaneous site, in square miles, and

Q_i = daily mean discharge recorded at index station on corresponding day that Q_m was made at the partial-record or miscellaneous site, in cubic feet per second.

This equation converts the measured discharge (Q_m) to a unit discharge by dividing by drainage area (DA). This value is then adjusted to the 90-percent flow duration by multiplying it by the ratio Q_{90}/Q_i (Gebert, 1982). The 90-percent flow duration was selected to represent base-flow (Gebert, 1982). For computing base-flow indexes for the low-flow partial-record and miscellaneous sites in this study with multiple measurements, the measurement with the corresponding Q_i which is closest to the Q_{90} at the index station was chosen. This was done to make the ratio Q_{90}/Q_i as close to one as possible. For continuous-record stream-gaging stations with computed flow-duration curves, the base-flow index was computed simply as a unit discharge, Q_{90}/DA. A detailed discussion on calculating and using the base-flow index value at miscellaneous sites with one measurement can be found in the "Discussion of analysis of low-flow characteristics" section.

Channel slope (CS)--in feet per mile; is the main channel slope determined by dividing the elevation difference between points located at the 10 percent and 85 percent distances of the channel length (CL) upstream from the gaged site by the distance between these points (Benson, 1962).

Mean basin altitude (BA)--in feet; determined by placing a uniform grid over the basin outline on a

1:24,000-scale topographic map. The altitude at a minimum of 20 to 25 grid intersections were determined and the average of these values represents the mean basin altitude.

Discussion of Analysis of Low-Flow Characteristics

A comparison of all the methods used to estimate low-flow characteristics was conducted by using the computed standard error of estimate, in percent, as a basis for comparison. The standard error of estimate can be computed for all analytical methods used in this study, thus providing a comparison between accuracy and time to collect data. Because error in estimates of streamflow characteristics are dependent on the amount and type of data and the analytical technique used, standard errors are not precise and are presented as a guide to indicate a general level of confidence. Lower standard errors represent lower uncertainty in the estimates of streamflow characteristics. In statistical terms, standard error is the standard deviation of the sampling distribution of a random variable (Freund and Williams, 1991). This means that 67 percent of the estimated streamflow characteristics should lie within one standard error above or below of the true value.

The comparison of accuracy and time to collect data is given in table 11 for region 1 and table 12 for region 2. Such a comparison can help in planning a future data-collection network. From table 11, the average standard error of estimate for the 7-day 2-year low flow at the 5 continuous-record stream-gaging stations in region 1 is 14.4 percent. The average standard error of estimate for the 7-day 2-year low-flow for low-flow partial-record stations and continuous-record gaging stations with less than 9 years of record is 25.2 percent, comparable to that of the miscellaneous sites with a least one base-flow measurement, 20.3 percent. The estimates of the 7-day 2-year low flow at ungaged sites has the highest standard error, but is the easiest to compute in terms of time to collect data.

The comparison of standard errors associated with estimates for 7-day 2-year low-flows for region 2 (table 12) is similar to that of table 1. Again, the continuous-record gaging stations gave the lowest standard errors, and the low-flow partial-record stations and continuous-record gaging stations with less than 9 years of record had comparable standard errors with the miscellaneous sites. Overall, the stations and sites in region 2 gave 7-day 2-year low-flow estimates with lower standard errors than region 1. This is probably because of the higher variability of streamflow characteristics in region 1 as a result of the geologic differences.

In both regions, the use of the base-flow index variable provided standard errors for the regression equations that were similar to those at the low-flow partial-record stations (tables 11 and 12). The use of the equations in tables 7 and 9 provides a low-flow estimate with reasonable error considering, the effort involved in data collection. The equations however, should not be thought of as substitutes for low-flow partial-record stations because this comparison looks at just one of the low-flow characteristics and for the low-flow partial-record sites, the standard error of estimate represents an average. A number of low-flow partial-record stations (table 3) have lower standard errors. Also, in this analysis, the base-flow index variable is assumed to be measured without error.

The base-flow index variable in this study was calculated at most low-flow sites from a selection of numerous measurements and index stations. In practice, it is assumed that only one base-flow measurement will be used. The index station chosen should be the closest to the miscellaneous site in question. When two index stations are close to a miscellaneous site, the base-flow index can be calculated separately using each index station, and then the average of the two values can be used as the base-flow index for that site. This was done for miscellaneous sites 39, 41, and 42 because both index stations, 9205 and 9310, were close to these miscellaneous sites. These index stations were also used with nearby low-flow partial-record stations and miscellaneous sites (9335, 9340, 40, and 43). Having more than one base-flow measurement can improve the reliability of the base-flow index variable by providing increased confidence that a base-flow measurement has been made.

The division between regions 1 and 2 falls near the transition in geology between the older Pago Volcano and the younger Taputapu eruptions (plate 1). The latter eruptions created a layer of permeable cinders on the summit of Taputapu Volcano which reduces surface runoff and sustains higher low flows. This can be briefly illustrated by looking at some flow characteristics at two representative gages, station 9120 for region 1 and station 9205 for region 2. These gages were chosen to

Table 11. Methods available to estimate low-flow characteristics in region 1, eastern Tutuila, American Samoa

[Region 1 shown in plate 1; 7Q2, 7-day 2-year low flow]

Type of site	Type of data	Number of sites	Time required to collect data	Analytical method to determine 7Q2	Average standard error of estimate of 7Q2 (percent)
Continuous stream-gaging station	9 or more years of recorded streamflow data	5	9 to 31 years	frequency analysis	14.4
Low-flow partial-record stations and continuous gaging stations with less than 9 years of data[a]	8 to 30 base-flow measurements	51	3 or more years	moments approach or graphical correlation	25.2[b]
Miscellaneous sites	at least 1 base-flow measurement	limited to sites meeting conditions on page 21 and table 7	1 day	regression analysis with data from 49 sites	20.3
Ungaged sites	basin characteristics	limited to sites meeting conditions on page 21 and table 6	1 hour	regression analysis with data from 49 sites	95.2

[a] includes one miscellaneous site with sufficient measurements

[b] does not include standard error from station 9180 which has no standard error computed

Table 12. Methods available to estimate low-flow characteristics in region 2, western Tutuila, American Samoa

[Region 2 shown in plate 1; 7Q2, 7-day 2-year low flow]

Type of site	Type of data	Number of sites	Time required to collect data	Analytical method to determine 7Q2	Average standard error of estimate of 7Q2 (percent)
Continuous stream-gaging station	9 or more years of recorded streamflow data	2	31 years	frequency analysis	10.0
Low-flow partial-record stations and continuous-gaging stations with less than 9 years of data[a]	8 to 34 base-flow measurements	30	3 or more years	moments approach or graphical correlation	17.1
Miscellaneous sites	at least 1 base-flow measurement	limited to sites meeting conditions on page 21 and table 9	1 day	regression analysis with data from 32 sites	13.7
Ungaged sites	basin characteristics	limited to sites meeting conditions on page 21 and table 8	1 hour	regression analysis with data from 32 sites	34.2

[a] includes three miscellaneous sites with sufficient measurements

represent the two regions based on the number of times they were used as index stations (table 13). From table 13 it can be seen that stations 9120 and 9205 are the most important index stations. Station 9120 has a index of variability from the flow-duration curve of 0.424, whereas the index of variability is lower (0.335) at station 9205 (table 1). Also from table 1, station 9120 has a larger range between low and peak flows with higher peak flows than station 9205, although the drainage area of station 9120 is smaller. The larger number of different index stations used in region 1 (table 13) is also an indicator of the greater variability of streamflow in region 1.

Table 13. Summary of index stations and the number of partial-record stations which used that index station to estimate low-flow characteristics by region, Tutuila, American Samoa
[Regions shown in plate 1]

Index station	Number of partial-record stations		Total number of partial-record stations
	Region 1	Region 2	
9120	20	1	21
9205	14	21	35
9310	3	10	13
9480	10	0	10
9600	10	0	10

EXAMPLES -- HOW TO ESTIMATE STREAMFLOW CHARACTERISTICS

In order to use the streamflow characteristics or apply the regression equations determined above, the user should have knowledge of the accuracies and limitations involved as explained above in the methods and results section. Applying results from regression equations beyond the limitations of such equations can result in large errors. The following examples illustrate the use of selected regression equations in tables 6 through 10 for estimating streamflow characteristics.

Example 1. Estimate the 7-day 2-year low flow at Mulialevai Stream at Auto. This location is partial-record station 9610. For the purposes of this example, assume this is an ungaged site.

For an ungaged site, first determine the region it is in. From plate 1, station 9610 is found to be in region 1. From the 1963 USGS topographic map of Tutuila,

Mulialevai Stream at altitude 280 ft is shown as a perennial stream. To compute the 7-day 2-year low flow at an ungaged site in region 1 use the equation from table 6. For the 7-day 2-year low flow the equation from table 6 is:

$$7Q2 = 0.0000335 (DA)^{0.488}(GA)^{0.244}(BR)^{1.16} , \quad (5)$$

where:

7Q2 = 7-day 2-year low flow,
DA = drainage area, in square miles,
GA = gage altitude, in feet, and
BR = basin relief, in feet.

Next, determine the necessary basin characteristics. Application of equation 5 requires three basin characteristics. The required basin characteristics are computed from the 1963 or 1989 1:24,000 USGS topographic map of Tutuila. For site 9610, the computed drainage area is 0.22 mi^2, gage altitude is 280 ft, and basin relief is 830 ft (table 5). These values were computed using methods discussed in the data analysis section of this report.

Next, the computed basin characteristics are checked against the applicable range of basin characteristics in table 6. The values computed all are within the applicable range, so equation 5 can be used for site 9610. The 7-day 2-year low flow can now be estimated by inserting the computed basin characteristics into equation 5:

$$7Q2 = 0.0000335 (0.22)^{0.488}(280)^{0.244}(830)^{1.16}$$

$$= 0.0000335 (0.478) (3.96) (2430)$$

$$= 0.15 \text{ ft}^3/\text{s}$$

The estimate of the 7-day 2-year low flow at station 9610 as an ungaged site is 0.15 ft^3/s and has a standard error of 95.2 percent.

Example 2. Compute the 7-day 2-year low flow assuming station 9610 is a miscellaneous site with one streamflow measurement. The site is in region 1 and because of the streamflow measurement, the equation in table 7 is used. This equation is:

$$7Q2 = 0.773 (DA)^{0.950} (BFI)^{0.920} , \quad (6)$$

where:

7Q2 = 7-day 2-year low flow,
DA = drainage area, in square miles, and
BFI = base-flow index, in cubic feet per second per square mile.

The base-flow index characteristic is described in the regional regression analysis and discussion of analysis of low-flow characteristics sections of this report. The computation of the base-flow index requires the value of the discharge measurement, the corresponding mean daily discharge at a nearby index station, the drainage area of the miscellaneous site, and the flow exceeded 90 percent of the time at the index station. For site 9610, assume the discharge was 0.16 ft^3/s measured on 9-22-1961. The corresponding mean daily flow at station 9120, the chosen index station, was 0.40 ft^3/s (U.S. Geological Survey, 1971). The computed drainage area of station 9610 is 0.22 mi^2. From table 1, the flow exceeded 90 percent of the time at 9120 is 0.42 ft^3/s, so the base-flow index computed by applying equation 1 at 9610 is 0.76 ft^3/s/mi^2 (table 5).

Inserting the computed basin characteristics into equation 6:

$$7Q2 = 0.773 \, (0.22)^{0.950}(0.76)^{0.920}$$

$$= 0.773 \, (0.237) \, (0.777)$$

$$= 0.14 \text{ ft}^3/\text{s}.$$

The 7-day 2-year low flow at station 9610 as a miscellaneous site is 0.14 ft^3/s with a standard error of 20.3 percent. This estimate has a lower standard error of estimate than the value computed in example 1, so it is likely to be a better estimate of the 7-day 2-year low flow at site 9610 because of the lower uncertainty.

Example 3. Compute the 7-day 2-year low flow at station 9610. In this example, station 9610 is a partial-record station. The low-flow characteristics have already been computed. From table 3 the 7-day 2-year low flow is 0.16 ft^3/s with an standard error of 13.4 percent. Because of the lower uncertainty, this estimate is a better one than in example 2. For some sites, the use of equations in tables 7 and 9 at partial-record sites will result in lower standard errors than the graphical correlations or moments method used at that site because of the mathematics involved. If so, the user should decide which estimate to use given the factors involved in the methods used.

Example 4. Compute the 100-year flood at station 9610. Station 9610 is a low-flow partial-record station so use the equations in table 10. From table 10, the equation for the 100-year flood is:

$$Q_{100} = 2,470 \, (DA)^{0.941} , \qquad (7)$$

where:

Q100 = the 100-year flood, in cubic feet per second, and

DA = drainage area, in square miles.

The drainage area at station 9610 is 0.22 mi^2, which falls within the applicable ranges of 0.11 to 0.78 for using equation 7. Inserting this value into equation 7 yields a 100-year flood estimate of 594 ft^3/s with a standard error of 44.1 percent. The magnitude of the 100-year flood has a 1 in 100 chance of being exceeded in any given year.

SUMMARY

Techniques for estimating streamflow characteristics for the low, high, and peak flows for streams on Tutuila, American Samoa are discussed in this report. Application of these techniques allow the user to compute estimates for the 7-day low flow with 2-year and 10-year recurrence intervals; the median flow; the mean flow; and the 2-, 5-, 10-, 25-, 50, and 100-year peak flood flows at sites on gaged and ungaged streams. In addition, frequency techniques were used to compute the 1-, 7-, 14-, 30-, 60-, 90-, 120-, and 183-day low flows with 2-, 5-, 10-, and 20-year recurrence intervals; the 1-, 7-, 15-, 30-day high flows with 2-, 5-, 10-, and 25-year recurrence intervals; and the 2-, 5-, 10-, 25-, 50-, 100-year peak flows for gaged sites. The equations and streamflow characteristics are based on streamflow data collected from 1958 through 1990 at 11 continuous-record stream-gaging stations with 9 to 32 years of record, 75 low-flow partial-record stations, and 49 miscellaneous sites.

Graphical regression and the moments approach techniques were used to transfer streamflow characteristics from gaged sites to low-flow partial-record sites having eight or more base-flow measurements. Regional regression analysis was used to transfer streamflow characteristics at gaged and low-flow partial-record sites to ungaged and miscellaneous sites. The generalized least squares estimator was used for low-flow regression analysis because it could accommodate the data at low-flow partial-record sites. Regression equations for ungaged sites had standard errors of estimate ranging from 29.8 to 110 percent. Regression analysis

for miscellaneous sites using the base-flow index basin characteristic provided results with standard errors of estimate ranging from 13.3 to 43.8 percent. These standard errors are comparable to the average values at the low-flow partial-record stations. Regional analysis using the method of residuals, divided Tutuila into two hydrologic regions that correspond to differences in geology and hydrologic response.

Regression analysis of peak-flow data used the ordinary least squares estimator because of the small sample size and low cross-correlations among the gaging stations. The small sample size also prevented the subdivision of Tutuila into more than one region. Peak-flow regression equations had coefficients of determination ranging from 0.60 to 0.66 and standard errors of estimate ranging from 44.0 to 47.4 percent. The large standard errors associated with the regression equations result from the large variability of flood peaks compared with drainage area and the small sample size available to analyze this variability. The geology of Tutuila also affects the magnitude of observed flood peaks as seen in the unusual hydrologic conditions of Aasu Stream.

Example applications of the equations for estimating low- and peak-flow characteristics are included. A discussion on the limitations and accuracy of the estimating equations provides guidance to the user. In general, the low-flow regression equations are only applicable for perennial streams with no significant diversions. The peak-flow regression equations are applicable only to non-urbanized drainage basins.

REFERENCES CITED

Austin, Smith, and Associates, Consulting Engineers, Inc., 1963, Report covering a master-planned water supply and distribution system for the Pago Pago and Tafuna areas: A report to the Government of American Samoa, 48 p.

Beard, L.R., 1962, Statistical methods in hydrology: U.S. Army Corps of Engineers, 62 p., app 1-2.

Benson, M.A., 1962, Factors affecting the occurrence of floods in a humid region of diverse terrain: U.S. Geological Survey Water-Supply Paper 1580-B, 64 p.

Department of the Army, Pacific Ocean Division, [U.S. Army] Corps of Engineers, 1976a, Flood hazard study: Fagaalu Stream, Tutuila, American Samoa: 6 p., 4 pls.

----------, 1976b, Flood hazard study: Leone Village area, Tutuila American Samoa: 6 p., 16 pls.

----------, 1977a, Flood hazard study: Aua and Lauliituai, Tutuila American Samoa: 5 p., 14 pls.

----------, 1977b, Flood hazard study: Fagaitua and Amouli, Tutuila American Samoa: 5 p., 21 pls.

----------, 1977c, Flood hazard study: Tafunafou, Tutuila American Samoa: 5 p., 31 pls.

Draper, N.R., and Smith, Harry, 1981, Applied regression analysis (2nd ed.): New York, Wiley, 709 p.

Duan, Naihua, 1983, Smearing estimate: A nonparametric retransformation method: Journal of the American Statistical Association, v. 78, no. 383, p. 605–610.

Fennessey, Neil and Vogel, R.M., 1990, Regional flow-duration curves for ungaged sites in Massachusetts: Journal of Water Resources Planning and Management, v.116, no. 4, p. 530–549.

Freund, J.E., and Williams, F.J., 1991, Dictionary/outline of basic statistics: New York, Dover, 195 p.

Friel, E.A., Embree, W.N., Jack, A.R., and Atkins, J.T., Jr., 1989, Low-flow characteristics of streams in West Virginia: U.S. Geological Survey Water-Resources Investigations Report 88-4072, 34 p.

Gebert, W.A., 1982, Low-flow characteristics of streams in the central Wisconsin River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 81-495, 99 p.

Government of American Samoa, 1975, Water system study: western portion of Tutuila island, 85 p.

Hardison, C.H., 1969, Accuracy of streamflow characteristics: U.S. Geological Survey Professional Paper 650-D, p. D210–D214.

----------, 1971, Prediction error of regression estimates of streamflow characteristics at ungaged streams: U.S. Geological Survey Professional Paper 750-C, p. C228–C236.

----------, 1974, Generalized skew coefficients of annual floods in the United States and their application: Water Resources Research, v. 10, no. 4, p. 745–752.

Hardison, C.H., and Moss, M.E., 1972, Accuracy of low-flow characteristics estimated by correlation of base-flow measurements: U.S. Geological Survey Water-Supply Paper 1542-B, 55 p.

Hazen, Allen, 1930, Flood flows: a study of frequencies and magnitudes: New York, Wiley, 199 p.

[U.S.] Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency: Hydrology Subcommittee Bulletin 17B, U.S. Department of the Interior, Geological Survey, Reston, Virginia, 28 p., app 1-14.

Kendall, M.G., and Stuart, Alan, 1963, The advanced theory of statistics, volume 1, distribution theory (2nd ed.): New York, Hafner Press, 433 p.

Kirby, W.H., 1979, Annual flood frequency analysis using U.S. Water Resources Council Guidelines (Program J407), in WATSTORE National Water Data Storage and Retrieval Systems's User's Guide, v. 4, chap. I, section C: U.S. Geological Survey Open-File Report 79-1336-I.

Kite, G.W., 1977, Frequency and risk analysis in hydrology: Fort Collins, Colo., Water Resources Publications, 224 p.

Lumb, A.M., Kittle, J.L., and Flynn, K.M., 1990, Users manual for ANNIE, A computer program for interactive hydrologic analyses and data management: U.S. Geological Survey Water-Resources Investigations Report 89-4080, 236 p.

M & E Pacific, Inc., 1987, Examination of village water systems, American Samoa: prepared for the Environmental Quality Commission, Office of the Governor, American Samoa, p. I-1–XII-17.

Matsuoka, Iwao, 1978, Flow characteristics of streams in Tutuila, American Samoa: U.S. Geological Survey Water-Resources Investigations Report 78-103, 34 p.

Meeks, W.C., 1975, Daily values statistics (Program A969), in, WATSTORE National Water Data Storage and Retrieval Systems's User's Guide, v. 1, chap. IV, section G: U.S. Geological Survey Open-File Report 75-426.

Miller, D.M., 1984, Reducing transformation bias in curve fitting: American Statistician, v. 38, no. 2, p. 124–126.

Nakahara, R.H., Yee, J.J.S., Yamashiro, Isao, Tateishi, G.A., and Domingo, J.A., 1990, Water resources data, Hawaii and other Pacific areas, water year 1988, v. 2, Guam, Northern Mariana Islands, Federated States of Micronesia, Palau, and American Samoa, U.S. Geological Survey Water-Data Report HI-88-2, 136 p.

National Oceanic and Atmospheric Administration, 1957–1988, Climatological data annual summary: v. 53–84, no. 13.

Riggs, H.C., 1968a, Some statistical tools in hydrology: U.S. Geological Survey Techniques of Water-Resources Investigations, book 4, chap. A1, 39 p.

---------, 1968b, Frequency curves: U.S. Geological Survey Techniques of Water-Resources Investigations, book 4, chap. A2, 15 p.

---------, 1972, Low-flow investigations: U.S. Geological Survey Techniques of Water-Resources Investigations, book 4, chap. B1, 18 p.

---------, 1973, Regional analyses of streamflow characteristics: U.S. Geological Survey Techniques of Water-Resources Investigations, book 4, chap. B3, 15 p.

---------, 1985, Streamflow characteristics: New York, Elsevier, 249 p.

Searcy, J.K., 1959, Flow-duration curves: U.S. Geological Survey Water-Supply Paper 1542-A, 33 p.

---------, 1960, Graphical correlation of gaging-station records: U.S. Geological Survey Water-Supply Paper 1541-C, 34 p.

Stearns, H.T., 1944, Geology of the Samoan Islands: Geological Society of America Bulletin, v. 55, p. 1279–1332.

Stedinger, J.R., and Tasker, G.D., 1985, Regional hydrologic analysis 1: ordinary, weighted, and generalized least squares compared: Water Resources Research, v. 21, no. 9, p. 1421–1432.

Stedinger, J.R., and Thomas, W.O., Jr., 1985, Low-flow frequency estimation using base-flow measurements: U.S. Geological Survey Open-File Report 85-95, 22 p.

Tasker, G.D., 1982, Simplified testing of hydrologic regression regions: Journal of the Hydraulics Division, American Society of Civil Engineers, v. 108, no. HY10, p. 1218–1221.

Tasker, G.D., and Stedinger, J.R., 1986, Regional skew with weighted least squares regression: Journal of Water resources Planning and Management, v. 112, no. 2, p. 225–237.

---------, 1989, An operational GLS model for hydrologic regression: Journal of Hydrology, v. 111, p. 361–375.

Thomas, D.M., and Benson, M.A., 1970, Generalization of streamflow characteristics from drainage-basin characteristics: U.S. Geological Survey Water-Supply Paper 1975, 55 p.

U.S. Army [Corps of Engineers] Engineer District, Honolulu, 1977, American Samoa water resources study: plan of study, 80 p., 5 app.

U.S. Army [Corps of Engineers] Engineer District, Honolulu, 1978a, American Samoa water resources study: assessment of water systems American Samoa, 159 p., 3 app.

U.S. Army [Corps of Engineers] Engineer District, Honolulu, 1978b, Hydrologic investigation of surface water for water supply and hydropower, Tutuila island, American Samoa, 55 p.

U.S. Department of Commerce, Bureau of Census, 1992, 1990 Census of population and housing; social, economic and housing characteristics, American Samoa: Washington D.C.

U.S. Geological Survey, 1962, Surface water supply of Mariana, Caroline and Samoa Islands through June 1960, U.S. Geological Survey Water-Supply Paper 1751, 107 p.

---------, 1971, Surface water supply of the United States 1960-65, part 16, Hawaii and other Pacific Areas, U.S. Geological Survey Water-Supply Paper 1937, 710 p.

---------, 1977, Surface water supply of the United States 1966-70, part 16, Hawaii and other Pacific Areas, U.S. Geological Survey Water-Supply Paper 2137, 750 p.

Table 1. Low-flow and high-flow characteristics for continuous-record stream-gaging stations on Tutuila, American Samoa

<center>16906000 Vaitolu Stream near Aoa.</center>

Location.--Lat 14°16'19"S., long 170°35'32"W., on left bank 0.5 mile upstream from mouth and 0.7 mile southwest of Aoa.

Drainage area.--0.18 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous-record station.

Period of record.--March 1958 - December 1971

Mean discharge(since upstream diversion began).--7 years (1965-71), 0.33 ft^3/s.

Extremes for period of record.--Maximum discharge, 804 ft^3/s on Dec. 19, 1962; minimum, no flow at times in 1964-66.

Low-flow frequency.--As a partial-record station.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	27.7
7-day, 10-year low	<0.01	36.1
Mean (1965-71)	0.33	9.7
Median (1965-71)	0.08	23.1

Basis of estimate.--Moments approach using 56 mean daily base-flow discharges from 1964-71 with station 16912000.

<center>Duration table of daily flow
for water years 1959-64</center>

Discharge, in cubic feet per second, which was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft^3/s	3.5	1.6	1.1	0.52	0.35
Percent	40	50	60	70	80
ft^3/s	0.29	0.24	0.20	0.16	0.14
Percent	90	95	98	99	99.9
ft^3/s	0.09	0.08	0.06	0.05	0.03

Index of variability = 0.351

16906000 Vaitolu Stream near Aoa--Continued.

Duration table of daily flow
for water years 1965-71
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft^3/s	2.5	1.5	0.72	0.36	0.21
Percent	40	50	60	70	80
ft^3/s	0.12	0.08	0.06	0.05	0.04
Percent	90	95	98	99	99.9
ft^3/s	0.03	0.02	0.01	0	--

Index of variability = 0.518

Period of consecutive days	Magnitude and frequency of annual high flow for water years 1959-71 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	8.8	12	14	18
7	3.2	4.2	4.8	5.6
15	2.0	2.6	3.0	3.5
30	1.3	1.8	2.1	2.4

Remarks.--Small diversion above station for domestic use since Sept 14, 1964. Because of diversion, low-flow data not suitable for low-flow frequency analysis. Station treated as a partial record site for low-flow frequency.

16912000 Pago Stream at Afono.

Location.--Lat 14°16'03"S., long 170°39'02"W., on left bank 0.2 mile south of Afono and 0.3 mile upstream from mouth.

Drainage area.--0.60 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous-record station.

Period of record.--October 1958 - Present as of 1990

Mean discharge.--31 years (water years 1960-90), 3.38 ft^3/s.

Extremes for period of record.--Maximum discharge, 1,350 ft^3/s on July 5, 1969, minimum, 0.10 ft^2/s on September 29, 1989.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.38	10.8
7-day, 10-year low	0.17	15.9
Mean	3.38	5.1
Median	1.40	8.4

Period of con- secutive days	Magnitude and frequency of annual low flow for climatic years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.34	0.20	0.16	0.12
7	0.38	0.22	0.17	0.13
14	0.42	0.25	0.18	0.15
30	0.54	0.31	0.22	0.17
60	0.88	0.43	0.30	0.21
90	1.0	0.57	0.38	0.27
120	1.3	0.72	0.51	0.36
183	1.9	1.1	0.79	0.65

16912000 Pago Stream at Afono--continued.

Duration table of daily flow
for water years 1960-1990
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	26	13	6.8	3.6	2.5
Percent	40	50	60	70	80
ft³/s	1.8	1.4	1.1	0.86	0.64
Percent	90	95	98	99	99.9
ft³/s	0.42	0.29	0.19	0.16	0.12

Index of variability = 0.424

Period of con- secutive days	Magnitude and frequency of annual high flow for water years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	72	102	119	141
7	25	34	38	43
15	15	20	22	25
30	10	13	15	16

Remarks.--About 0.06 ft³/s is diverted about 0.5 mile above station for domestic use in Afono since 1958.

16917500 Leele Stream at Mouth, at Fagasa.

Location.--Lat 14°17'28"S., long 170°43'09"W., on left bank at Fagasa and 200 ft upstream from mouth.

Drainage area.--0.23 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous- and partial-record station.

Period of record.--July 1966 - September 1976 as a continous station, 1977, 1981-90 as a partial-record station.

Mean discharge.--10 years (water years 1967-1976), 1.50 ft^3/s.

Extremes for period of record.--Maximum discharge, 390 ft^3/s on Aug. 30, 1970; minimum, 0.03 ft^3/s on Sept. 3 and 4, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.20	18.8
7-day, 10-year low	0.07	54.7
Mean	1.50	7.1
Median	0.65	11.1

Period of con- secutive days	Magnitude and frequency of annual low flow for climatic years 1968-76 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.18	0.10	0.06	0.04
7	0.20	0.11	0.07	0.04
14	0.25	0.14	0.09	0.06
30	0.32	0.16	0.10	0.06
60	0.50	0.21	0.12	0.07
90	0.60	0.25	0.15	0.09
120	0.72	0.30	0.17	0.10
183	1.2	0.46	0.29	0.21

16917500 Leele Stream at Mouth, at Fagasa--continued.

Duration table of daily flow
for water years 1967-1976
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft^3/s	10	6.0	3.5	1.8	1.2
Percent	40	50	60	70	80
ft^3/s	0.83	0.65	0.52	0.40	0.31
Percent	90	95	98	99	99.9
ft^3/s	0.22	0.16	0.08	0.06	0.04

Index of variability = 0.418

Period of con- secutive days	Magnitude and frequency of annual high flow for water years 1967-76 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	26	39	47	57
7	9.0	11	13	15
15	5.6	7.3	7.9	8.6
30	4.0	4.6	4.8	5.1

Remarks.--No diversion above station. Low-flow frequency analysis based on 9 climatic years of data. List of measurements made, total of 23, during period of operation as a low-flow partial-record station.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-18-76	c0.29	09-14-83	0.06
11-27-76	c0.20	08-17-84	0.08
12-02-76	c1.0	08-07-85	0.41
12-06-76	ca16.0	09-06-85	0.31
12-28-76	ca3.1	09-04-86	0.41
01-13-77	b0.24	07-01-87	0.14
02-01-77	0.92	09-04-87	0.26
08-06-81	0.41	09-27-88	0.24
09-29-81	0.29	07-19-89	0.21
04-28-82	0.27	09-27-89	0.14
10-20-82	0.30	07-19-90	0.17
08-03-83	0.07		

a, includes surface runoff
b, revision
c, not previously published

Table 1. Low-flow and high-flow characteristics for continuous-record stream-gaging stations on Tutuila, American Samoa--Continued

<center>16920500   Aasu Stream at Aasu.</center>

Location.--Lat 14°17'51"S., long 170°45'30"W., on right bank at Aasu 200 ft upstream from mouth.

Drainage area.--1.03 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous-record station.

Period of record.--October 1958 - Present as of 1990

Mean discharge.--31 years (water years 1960-90), 6.09 ft^3/s.

Extremes for period of record.--Maximum discharge, 498 ft^3/s on September 7, 1972; minimum, 0.12 ft^3/s on October 21, 23, 24, 27, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.97	10.0
7-day, 10-year low	0.40	21.3
Mean	6.09	3.8
Median	4.10	6.2

Period of con- secutive days	Magnitude and frequency of annual low flow for climatic years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.87	0.51	0.36	0.26
7	0.97	0.56	0.40	0.28
14	1.1	0.62	0.44	0.30
30	1.5	0.76	0.60	0.44
60	2.3	1.1	0.81	0.56
90	2.7	1.5	1.0	0.75
120	3.3	1.9	1.3	0.90
183	4.5	2.9	2.1	1.6

16920500   Aasu Stream at Aasu--continued.

Duration table of daily flow
for water years 1960-1990
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	28	18	13	8.6	6.6
Percent	40	50	60	70	80
ft³/s	5.2	4.1	3.3	2.6	2.1
Percent	90	95	98	99	99.9
ft³/s	1.4	1.0	0.65	0.45	0.15

Index of variability = 0.335

Period of consecutive days	Magnitude and frequency of annual high flow for water years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	57	74	80	118
7	28	35	40	49
15	21	25	28	32
30	15	18	19	21

Remarks.--Small diversion above station for domestic use since the early
1960's. Diversion diminishing with time as villagers move out of
valley. Only about 35 people were living in the valley in 1974 and
only about 5 in 1990. Domestic diversion from spring in headwaters
starting in 1968 (see 16919800).

16931000   Atauloma Stream at Afao.

Location.--Lat 14°20'10"S., long 170°48'02"W., on left bank at Afao, 100 ft upstream from highway bridge and 300 ft upstream from mouth.

Drainage area.--0.24 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous-record station.

Period of record.--October 1958 - Present as of 1990

Average discharge.--31 years (water years 1960-90), 1.45 ft^3/s.

Extremes for period of record.--Maximum discharge, 815 ft^3/s on October 28, 1979; minimum, 0.04 ft^3/s on October 24-26, 28-31, and November 1, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.20	9.9
7-day, 10-year low	0.08	17.9
Mean	1.45	4.8
Median	0.69	8.0

Period of con- secutive days	Magnitude and frequency of annual low flow for climatic years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.17	0.11	0.08	0.06
7	0.20	0.11	0.08	0.07
14	0.23	0.13	0.10	0.08
30	0.28	0.17	0.13	0.10
60	0.43	0.24	0.17	0.12
90	0.51	0.29	0.22	0.15
120	0.69	0.38	0.26	0.17
183	1.0	0.56	0.38	0.24

16931000 Atauloma Stream at Afao--continued.

Duration table of daily flow
for water years 1960-1990
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	10	5.0	2.9	1.7	1.2
Percent	40	50	60	70	80
ft³/s	0.88	0.69	0.55	0.43	0.32
Percent	90	95	98	99	99.9
ft³/s	0.22	0.17	0.12	0.11	0.05

Index of variability = 0.390

Period of consecutive days	Magnitude and frequency of annual high flow for water years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	28	38	45	54
7	8.9	13	16	18
15	5.9	8.0	9.3	10
30	4.0	5.4	5.8	6.7

Remarks.--About 0.02 ft³/s diverted upstream from station for domestic use in Afao since 1958 and at Atauloma School from 1958-1972.

169315000 Asili Stream at altitude 330 ft near Asili.

Location.--Lat 14°19'34"S., long 170°47'38"W., on right bank 1.3 miles northwest of Leone, 1.5 miles southwest of Aoloaufou, and 0.8 mile upstream from mouth.

Drainage area.--0.32 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous- and partial-record station.

Period of record.--October 1977 - September 1986 as a continous station, 1987-90 as a partial-record station.

Mean discharge.--9 years (water years 1978-86), 2.54 ft^3/s.

Extremes for period of record.--Maximum discharge, 635 ft^3/s on October 28, 1980; minimum, 0.20 ft^3/s on August 16, 1983.

Low-flow frequency.--As a partial-record site, only 8 climatic years of record.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.47	10.8
7-day, 10-year low	0.24	22.5
Mean	2.54	9.1
Median	1.60	7.7

Basis of estimate.--Graphical correlation with station 16920500 using 8 values of annual 7-day low flows.

Duration table of daily flow
for water years 1978-86
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft^3/s	13	8.1	5.5	3.4	2.4
Percent	40	50	60	70	80
ft^3/s	1.9	1.6	1.3	1.1	0.88
Percent	90	95	98	99	99.9
ft^3/s	0.66	0.51	0.34	0.28	0.22

Index of variability = 0.318

169315000 Asili Stream at Altitude 330 ft near Asili--continued.

Period of consecutive days	Magnitude and frequency of annual high flow for water years 1978-86 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	28	36	42	51
7	12	15	16	18
15	8.0	9.6	10	11
30	5.9	7.1	7.7	8.2

Remarks.--No diversions above station. List of measurements made, total of 11 during period when station was operated as a low-flow partial-record station.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-14-77	ac2.11	06-05-87	0.44
08-18-77	c0.34	09-02-87	0.42
10-01-86	ac5.6	09-28-88	0.47
10-08-86	ac2.0	08-15-89	0.28
10-30-86	c0.95	08-07-90	1.52
12-02-86	c1.05		

a, includes surface runoff
c, not previously published

169335000   Leafu Stream at altitude 370 ft, near Leone.

Location.--Lat 14°19'31"S., long 170°46'50"W., on left bank 900 ft upstream from village stream intake, 1.3 miles northeast of Leone, and 1.0 mile southwest of Aoloaufou.

Drainage area.--0.31 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous- and partial-record station.

Period of record.--October 1977 - September 1986 as a continuous station, 1987-90 as a partial record station.

Mean discharge.--9 years (water years 1978-86), 4.56 ft^3/s.

Extremes for period of record.--Maximum discharge, 400 ft^3/s on December 3, 1984; minimum, 0.32 ft^3/s on August 9, 1983, and August 21, 1984.

Low-Flow frequency.--As a partial-record site. Only 8 climatic years of data.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.73	12.2
7-day, 10-year low	0.38	25.2
Mean	4.56	8.8
Median	2.50	10.6

Basis of estimate.--Graphical correlation with station 16920500 using 8 values of annual 7-day lows.

Duration table of daily flow
for water years 1978-86
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft^3/s	25	16	9.6	5.8	4.1
Percent	40	50	60	70	80
ft^3/s	3.1	2.5	2.1	1.8	1.4
Percent	90	95	98	99	99.9
ft^3/s	1.1	0.78	0.56	0.46	0.40

Index of variability = 0.338

169335000   Leafu Stream at altitude 370 ft, near Leone--continued.

Period of con- secutive days	Magnitude and frequency of annual high flow for water years 1977-86 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	50	64	74	87
7	24	29	32	36
15	16	20	23	25
30	12	15	17	19

Remarks.--No diversions above station. List of measurements made, total of 10, during period when station was operated as a low-flow partial-record station.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-13-77	c0.95	06-02-87	1.44
08-19-77	c0.33	09-02-87	0.98
10-07-86	a3.81	09-28-88	1.79
10-28-86	1.36	08-15-89	1.40
11-26-86	2.28	08-07-90	1.58

a, includes surface runoff
c, not previously published

169442000   Papa Stream at Nuuuli.

Location.--Lat 14°18'48"S., long 170°42'33"W., on right bank 500 ft downstream from Tauese Stream 0.8 mile northwest of Nuuuli.

Drainage area.--0.78 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous- and partial-record station.

Period of record.--July 1966 - September 1967, November 1968 - September 1976 as a continuous-record station, 1968, 1977-78, 1981-83 as a partial-record station.

Mean discharge.--8 years (water years 1967, 1970-76), 4.18 ft^3/s.

Extremes for period of record.--Maximum discharge, 1,640 ft^3/s on April 29, 1975; minimum, no flow for many days each year.

Low-flow frequency.--As a partial-record station. Only 7 climatic years of data.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.18	31.6
7-day, 10-year low	0.04	44.0
Mean	4.18	6.8
Median	1.30	45.8

Basis of estimate.--Moments approach with station 16920500 using 10 base-flow measurements.

Duration table of daily flow
for water years 1967, 1970-76
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft^3/s	36	18	9.3	4.7	3.0
Percent	40	50	60	70	80
ft^3/s	2.0	1.3	0.64	0.11	0.01
Percent	90	95	98	99	99.9
ft^3/s	0.0	--	--	--	--

Index of variability = 1.04

169442000   Papa Stream at Nuuuli.

Remarks.--Diversion by frequent pumping from gage pool for public water supply during period of continuous record. No high-flow frequency done because of only 8 water years of data. However, 10 years of peak-flow record is available for flood-frequency analysis. As a partial-record station the measurements from 9-30-68 to 7-19-83 were previously published as belonging to station 16944000. List of measurements, total of 11, made during period when station operated as a low-flow partial-record site.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-03-68	c1.83	08-07-81	1.50
09-27-68	g0.05	09-24-81	0.89
09-30-68	0.06	04-28-82	0.40
02-16-77	0.60	10-26-82	0.38
08-24-77	0.16	07-19-83	0.07
08-07-78	0.31		

c, not previously published
g, measurement made below diversion

16948000 Afuelo Stream at Matuu.

<u>Location</u>.--Lat 14°18'07"S., long 170°41'07"W., on left bank 0.2 mile northwest of Matuu and 0.3 mile upstream from mouth.

<u>Drainage area</u>.--0.25 mi^2 <u>Tributary to</u>.--Pacific Ocean.

<u>Type of site</u>.--Continuous-record station.

<u>Period of record</u>.--March 1958 - Present as of 1990

<u>Mean discharge</u>.--14 years (water years 1959-72), 1.48 ft^3/s. Since diversion began, 18 years (water years 1973-1990), 1.44 ft^3/s.

<u>Extremes for period of record</u>.--Maximum discharge, 535 ft^3/s on May 3, 1985; minimum, 0.01 ft^3/s on September 16, 17, 20-26, 28, 29, 1975, April 5-7, 1976 and on September 17, 19, 20, 27, 28, 1990.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	16.6
7-day, 10-year low	0.02	27.8
Mean (1973-90)	1.44	8.1
Median (1973-90)	0.30	14.2

Period of consecutive days	Magnitude and frequency of annual low flow for climatic years 1974-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.04	0.02	0.01	0.01
7	0.04	0.02	0.02	0.01
14	0.06	0.03	0.02	0.02
30	0.10	0.04	0.03	0.02
60	0.23	0.06	0.04	0.03
90	0.36	0.11	0.06	0.05
120	0.47	0.20	0.10	0.06
183	0.69	0.42	0.29	0.22

Table 1. Low-flow and high-flow characteristics for continuous-record stream-gaging stations on Tutuila, American Samoa--Continued

16948000   Afuelo Stream at Matuu--continued.

Duration table of daily flow
for water years 1959-1972
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	11	5.6	3.0	1.7	1.1
Percent	40	50	60	70	80
ft³/s	0.76	0.63	0.42	0.35	0.29
Percent	90	95	98	99	99.9
ft³/s	0.24	0.19	0.14	0.11	0.07

Index of variability = 0.399

Duration table of daily flow
for water years 1973-1990
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	13	6.9	3.4	1.5	0.76
Percent	40	50	60	70	80
ft³/s	0.47	0.30	0.20	0.14	0.10
Percent	90	95	98	99	99.9
ft³/s	0.06	0.05	0.03	0.02	0.01

Index of variability = 0.606

16948000 Afuelo Stream at Matuu--Continued.

Period of con- secutive days	Magnitude and frequency of annual high flow for water years 1959-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	32	40	42	48
7	10	13	15	16
15	6.5	7.6	8.2	9.6
30	4.6	5.1	5.6	6.0

Remarks.--Small diversion 100 ft upstream of station since September 1972 for domestic use. This diversion has made the entire data set unsuitable for low-flow frequency analysis, so only the 17 climatic years after the diversion was used for low-flow frequency analysis.

16960000 Alega Stream at Alega.

Location.--Lat 14°16'58"S., long 170°38'19"W., on left bank 0.2 mile northwest of Alega and 0.3 mile upstream from mouth.

Drainage area.--0.19 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous- and partial-record station.

Period of record.--March 1958 - September 1976 as a continuous station, 1977-78, 1981-90, as a partial-record site.

Mean discharge.--18 years (water years 1959-76), 1.21 ft^3/s.

Extremes for period of record.--Maximum discharge, 232 ft^3/s on April 8, 1970; minimum, 0.17 ft^3/s on many days during July and August 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.42	10.0
7-day, 10-year low	0.23	20.2
Mean	1.21	4.5
Median	0.78	6.5

Period of con- secutive days	Magnitude and frequency of annual low flow for climatic years 1959-76 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.41	0.27	0.22	0.18
7	0.42	0.30	0.23	0.19
14	0.43	0.30	0.24	0.20
30	0.48	0.34	0.27	0.22
60	0.58	0.40	0.32	0.25
90	0.65	0.44	0.35	0.28
120	0.71	0.49	0.39	0.31
183	0.86	0.60	0.49	0.38

16960000 Alega Stream at Alega--continued.

Duration table of daily flow
for water years 1959-1976
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	5.9	3.5	2.3	1.5	1.1
Percent	40	50	60	70	80
ft³/s	0.91	0.78	0.68	0.59	0.51
Percent	90	95	98	99	99.9
ft³/s	0.42	0.32	0.25	0.22	0.17

Index of variability = 0.265

Period of consecutive days	Magnitude and frequency of annual high flow for water years 1960-90 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	16	22	24	26
7	6.3	8.3	9.2	9.8
15	4.2	5.5	5.9	6.5
30	3.1	3.8	4.1	4.7

Remarks.--No diversion above station. List of measurements, total of 23, made at station during period of operation as a low-flow partial-record station.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
10-25-76	c0.34	09-15-83	0.30
11-27-76	0.40	08-17-84	0.27
12-27-76	ac3.73	08-07-85	0.55
01-18-77	0.55	09-06-85	0.37
03-29-77	0.64	08-08-86	0.66
08-22-77	0.39	05-21-87	0.51
08-07-78	0.49	09-15-87	0.24
08-07-81	0.88	09-22-88	0.50
09-24-81	0.84	07-19-89	0.44
04-28-82	0.58	09-27-89	0.38
10-20-82	0.46	07-19-90	0.49
08-02-83	0.26		

a, includes surface runoff
c, not previously published

16963900   Leafu Stream near Auasi.

Location.--Lat 14°16'27"S., long 170°34'25"W., on right bank 35 ft upstream from upper village intake, 0.1 mile north of Auasi and 0.2 mile upstream from mouth.

Drainage area.--0.11 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Continuous- and partial-record station.

Period of record.--Febuary 1972 - September 1986 as a continuous station, 1987-90 as a partial-record station.

Mean discharge.--14 years (water years 1973-86), 0.32 ft^3/s.

Extremes for period of record.--Maximum discharge 234 ft^3/s on December 5, 1980; minimum, 0.02 ft^3/s on several days in 1976 and many days in 1983, 1984.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	15.6
7-day, 10-year low	0.02	18.0
Mean	0.32	13.2
Median	0.11	17.2

Period of con- secutive days	Magnitude and frequency of annual low flow for climatic years 1973-86 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	20
1	0.04	0.02	0.02	0.02
7	0.04	0.02	0.02	0.02
14	0.04	0.02	0.02	0.02
30	0.05	0.03	0.02	0.02
60	0.06	0.03	0.02	0.02
90	0.08	0.04	0.03	0.02
120	0.10	0.05	0.04	0.03
183	0.14	0.07	0.05	0.04

16963900 Leafu Stream near Auasi--Continued.

Duration table of daily flow
for water years 1973-1986
Discharge, in cubic feet per second, which
was exceeded for indicated percentage of time

Percent	2	5	10	20	30
ft³/s	2.9	1.4	0.64	0.28	0.18
Percent	40	50	60	70	80
ft³/s	0.14	0.11	0.09	0.07	0.05
Percent	90	95	98	99	99.9
ft³/s	0.04	0.04	0.03	0.03	0.02

Index of variability = 0.415

Period of con- secutive days	Magnitude and frequency of annual high flow for water years 1973-86 Discharge, in cubic feet per second, for indicated recurrence interval, in years			
	2	5	10	25
1	7.0	11	14	18
7	3.0	4.6	5.5	6.3
15	1.8	2.7	3.1	3.5
30	1.1	1.7	2.1	2.4

Remarks.--No diversion above station. List of measurements made, total of 8, during period of operation as a low-flow partial-record station.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
10-30-86	0.05	09-22-88	0.04
11-75-86	0.04	07-19-89	0.05
05-21-87	0.05	09-27-89	0.04
09-15-87	0.03	07-19-90	0.03

16900000 Vailoa Stream at Tula.

Location.--Lat 14°15'33"S., long 170°34'20"W., 0.5 mile west of Tula and 0.6 mile upstream from mouth.

Drainage area.--0.06 mi^2.   Tributary to.--N/A.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.01	22.5
7-day, 10-year low	<0.01	35.1
Mean	0.05	22.7
Median	0.02	14.5

Basis of estimate.--Graphical correlation with station 16912000.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-29-58	0.02	02-07-63	0.03
07-29-59	0.01	02-18-63	b0.04
09-21-60	0.02	05-18-64	0.06
09-28-60	0.02	06-15-65	a0.30
09-21-61	b0.01		

a, includes surface runoff
b, revision

16901000   Left Fork Vaisa Stream at Onenoa.

Location.--Lat 14°15'30"S., long 170°34'43"W., 0.1 mile upstream from confluence with Right Fork and 0.1 mile south of Onenoa.

Drainage area.--0.09 mi². Tributary to.--Vaisa Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963, 1965, 1968.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.08	17.2
7-day, 10-year low	0.04	39.1
Mean	0.35	19.4
Median	0.18	12.9

Basis of estimate.--Graphical correlation with station 16960000.

Remarks.--Minor diversion upstream of site for domestic use starting about 1971.

List of measurements: total of 11

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
10-28-58	0.10	09-28-61	0.09
07-29-59	0.10	02-07-63	0.23
08-11-59	0.09	02-18-63	0.22
09-21-60	0.11	06-15-65	ab0.65
09-28-60	0.09	05-02-68	b0.23
09-21-61	0.11		

a, includes surface runoff
b, revision

16902000   Right Fork Vaisa Stream at Onenoa.

Location.--Lat 14°15'27"S., long 170°34'42"W., 100 ft upstream from mouth and 0.1 mile southeast of Onenoa.

Drainage area.--0.03 mi^2 Tributary to.--Vaisa Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	17.2
7-day, 10-year low	0.01	42.8
Mean	0.08	25.4
Median	0.04	15.0

Basis of estimate.--Graphical correlation with station 16960000.

Remarks.--Validity of 11-16-1971 measurement in question, not used.

List of measurements: total of 10.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-28-58	0.02	09-21-61	0.03
07-29-59	0.03	09-28-61	0.02
08-11-59	0.03	02-07-63	b0.04
09-21-60	0.03	02-18-63	0.06
09-28-60	0.02	11-16-71	0.38

b, revision

16902500   Vaisa Stream at Onenoa.

Location.--Lat 14°15'26"S., long 170°34'44"W., 30 ft downstream from
    unnamed tributary, 0.1 mile southeast of Onenoa, and 0.1 mile upstream
    from mouth (revision).

Drainage area.--0.12 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1964-65, 1968-69, 1972, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.07	31.3
7-day, 10-year low	0.03	56.5
Mean	0.36	26.8
Median	0.25	20.2

Basis of estimate.--Graphical correlation with station 16920500.

Remarks.--Minor diversion upstream of site for domestic use starting in
    1971.

List of measurements: total of 10.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-14-64	0.31	11-16-71	0.11
05-18-64	0.20	07-15-74	0.13
06-15-65	ab0.49	11-13-74	0.09
05-02-68	0.37	09-30-75	0.10
05-23-69	0.29	09-13-76	0.05

a, includes surface runoff
b, revision

16903000   Afimuao Stream at Onenoa.

Location.--Lat 14°15'34"S., long 170°34'53"W., 200 ft upstream from unnamed tributary, 0.2 mile southwest of Onenoa, and 0.2 mile upstream from mouth.

Drainage area.--0.06 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	27.4
7-day, 10-year low	<0.01	38.5
Mean	0.13	32.0
Median	0.07	24.6

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-28-58	0.02	05-14-64	0.06
07-29-59	b0.03	05-18-64	0.05
08-11-59	0.03	06-15-65	a0.43
09-21-60	b0.04	05-03-68	0.19
09-28-60	0.02	05-23-69	c0.11
09-21-61	0.02	07-15-74	c0.04
09-28-61	0.02	11-13-74	c0.01
02-07-63	0.09	09-30-75	c0.03
02-18-63	0.08	09-13-76	c0.01

a, includes surface runoff
b, revision
c, not previously published

16904000 Laoulu Stream at Aoa.

Location.--Lat 14°15'54"S., long 170°34'50"W., 0.2 mile east of Aoa and 0.2 mile upstream of mouth.

Drainage area.--0.05 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.01	38.5
7-day, 10-year low	<0.01	64.5
Mean	0.07	38.3
Median	0.03	21.9

Basis of estimate.--Graphical correlation with station 16912000.

List of measurements: total of 11.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-17-58	0.02	02-28-63	0.02
01-02-59	c0.09	02-21-63	0.02
07-29-59	0.01	05-14-64	0.05
09-22-60	0.02	06-16-65	a0.11
09-29-60	d0 (0.005)	05-10-68	0.02
09-21-61	b0.01		

a, includes surface runoff
b, revision
c, not previously published
d, measurements less than 0.01 cubic feet per second are published as 0

16905000   Lepa Stream at Aoa.

Location.--Lat 14°16'21"S., long 170°35'17"W., 0.5 mile upstream from mouth and 0.6 mile southwest of Aoa.

Drainage area.--0.09 mi^2 Tributary to.--Tapua Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.03	16.1
7-day, 10-year low	0.01	18.9
Mean	0.29	19.4
Median	0.11	13.7

Basis of estimate.--Moments approach with stations 16912000 and 16960000.

List of measurements: total of 22.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-17-58	0.11	06-16-65	b0.29
07-29-59	0.04	05-26-67	0.19
08-11-59	0.06	05-10-68	0.20
09-22-60	b0.04	10-09-68	c0.06
09-29-60	b0.04	09-12-70	0.07
09-21-61	0.02	10-28-70	0.05
09-29-61	0.03	05-04-71	0.14
02-08-63	b0.13	05-21-69	0.13
02-21-63	0.08	03-11-74	0.11
05-14-64	b0.24	11-12-74	0.01
05-20-64	e0.32	11-11-75	0.02

b, revision
c, not previously published
e, may include surface runoff

16907000   Panota Stream at Masausi.

Location.--Lat 14°15'54"S., long 170°36'09"W., 0.1 mile southeast of
        Masausi and 0.2 mile upstream from mouth.

Drainage area.--0.06 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1968, 1970-71, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	35.8
7-day, 10-year low	0.01	53.9
Mean	0.11	19.7
Median	0.07	13.8

Basis of estimate.--Moments approach with station 16920500.

Remarks.--Minor diversion for domestic use upstream of site at 90 ft
    altitude starting in 1968.

List of measurements: total of 12.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-04-58	0.07	05-19-64	a0.57
08-01-59	0.04	05-07-68	0.10
09-26-60	b0.04	09-12-70	0.09
10-04-61	0.06	10-20-70	0.04
02-13-63	b0.13	03-15-74	0.08
02-21-63	0.09	11-11-75	0.02

a, includes surface runoff
b, revision

16908000   Vaipito Stream at Masausi.

Location.--Lat 14°16'05"S., long 170°36'18"W., 0.2 mile south of Masausi
    and 0.3 mile upstream from mouth.

Drainage area.--0.08 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1967-70, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.01	101
7-day, 10-year low	<0.01	241
Mean	0.18	43.4
Median	0.07	28.3

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 13.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-04-58	0.07	05-25-67	0.11
08-01-59	0.05	05-07-68	0.19
09-26-60	0.05	09-12-70	0.07
10-04-61	b0.01	05-23-69	0.22
02-13-63	0.06	03-15-74	0.12
02-21-63	b0.12	11-11-75	0.01
05-19-64	a0.87		

a, includes surface runoff
b, revision

16909500   Talaloa Stream at Masefau Village.

Location.--Lat 14°15'51"S., long 170°38'07"W., 50 ft downstream from unnammed tributary, 0.5 mile southwest of Masefau, and 0.5 mile upstream from mouth.

Drainage area.--0.47 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1967-71, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.19	33.5
7-day, 10-year low	0.08	60.4
Mean	0.83	30.6
Median	0.43	23.9

Basis of estimate.--Graphical correlation with 16960000.

Remarks.--Measurement on 11-04-58 contains diverted flow from Tagau Stream. Flow diverted from Tagau Stream into Talaloa Stream upstream from station from 1958 through the early 1960's. Minor diversion for domestic use upstream of site at altitude 120 ft from 1958.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-04-58	0.35	05-25-67	b0.69
08-01-59	0.46	05-07-68	0.33
09-26-60	0.12	09-12-70	0.54
10-04-61	0.29	10-20-70	0.11
02-06-63	0.74	05-23-69	0.88
02-15-63	b1.03	03-15-74	0.14
05-19-64	a4.97	11-11-75	0.06

a, includes surface runoff
b, revision

16910000 Tagau Stream at Masefau.

Location.--Lat 14°15'47"S., long 170°38'20"W., 0.4 mile upstream from mouth and 0.6 mile southwest of Masefau.

Drainage area.--0.01 mi^2 Tributary to.--Talaloa Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1968, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	56.6
7-day, 10-year low	<0.01	105
Mean	0.22	35.7
Median	0.12	23.3

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 10.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-04-58	0.03	02-15-63	0.16
08-01-59	0.02	05-19-64	a0.32
09-26-60	b0.04	05-07-68	0.23
10-04-61	0.05	03-15-74	0.10
02-06-63	0.06	11-11-75	0.02

a, includes surface runoff
b, revision

16911000   Pago Stream tributary at Afono.

Location.--Lat 14°16'07"S., long 170°38'56"W., 200 ft upstream from mouth and 0.3 mile southeast of Afono.

Drainage area.--0.10 mi^2 Tributary to.--Pago Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1971, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.07	33.0
7-day, 10-year low	0.03	67.9
Mean	0.42	42.8
Median	0.28	30.7

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 11.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
08-01-59	0.22	05-19-64	ab1.15
08-07-59	0.12	05-12-71	0.10
09-26-60	0.16	06-18-74	0.13
10-04-61	0.09	11-21-74	0.06
02-06-63	0.22	10-23-75	0.05
02-15-63	0.36		

a, includes surface runoff
b, revision

16913000   Gaoa Stream at Vatia.

Location.--Lat 14°15'33"S., long 170°40'36"W., 0.3 mile southwest of Vatia and 0.4 mile upstream from mouth.

Drainage area.--0.20 mi^2 Tributary to.--Leafu Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1972.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	23.6
7-day, 10-year low	0.01	44.0
Mean	0.41	18.1
Median	0.26	15.4

Basis of estimate.--Graphical correlation with station 16920500.

Remarks.--Stream observed dry in October, 1974.

List of measurements: total of 8.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-04-58	0.33	02-06-63	b0.13
08-08-59	0.24	02-15-63	0.26
09-26-60	0.08	05-19-64	a2.18
10-28-61	0.25	10-01-71	0.02

a, includes surface runoff
b, revision

16914000   Leafu Stream at Vatia.

Location.--Lat 14°15'24"S., long 170°40'44"W., 0.3 mile west of Vatia and
    0.3 mile upstream from mouth.

Drainage area.--0.18 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-64, 1970, 1972.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.08	38.6
7-day, 10-year low	0.06	70.2
Mean	0.47	33.2
Median	0.25	25.3

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 11.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-04-58	0.37	02-06-63	b0.13
08-01-59	0.15	02-15-63	0.42
09-26-60	0.12	05-19-64	a1.49
10-04-61	0.40	09-16-70	a1.53
10-04-61	ac4.20	10-01-71	0.06
10-28-61	0.19		

a, includes surface runoff
b, revision
c, not previously published

16916000   Leua Stream at Fagasa.

Location.--Lat 14°17'24"S., long 170°43'00"W., 0.2 mile northeast of
   Fagasa and 0.2 mile upstream from mouth.

Drainage area.--0.14 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-71, 1974-75.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	30.3
7-day, 10-year low	0.01	40.4
Mean	0.34	45.3
Median	0.14	32.5

Basis of estimate.--Moments approach with stations 16920500 and
16948000.

Remarks.--Diversion by U.S. Marine Corps in the 1940's, no diversion
   during period of record.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	0.29	05-15-64	b0.15
08-04-59	0.18	06-14-65	ab1.16
08-12-59	0.07	04-30-68	0.38
09-28-60	b0.02	05-21-69	0.31
10-04-60	b0.04	09-13-70	0.29
09-20-61	0.23	05-10-71	0.13
09-29-61	0.03	03-12-74	0.12
02-04-63	0.06	11-04-74	0.01
02-22-63	b0.04	09-23-75	0.02

a, includes surface runoff
b, revision

16917000   Leele Stream at Fagasa.

Location.--Lat 14°17'32"S., long 170°43'01"W., 0.1 mile southeast of Fagasa and 0.2 mile upstream from mouth.

Drainage area.--0.19 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1971, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.13	21.7
7-day, 10-year low	0.04	30.1
Mean	1.10	27.6
Median	0.62	22.5

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 17.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	0.57	05-15-64	b0.32
08-04-59	0.66	06-14-65	a2.03
08-12-59	0.25	04-30-68	1.02
09-28-60	b0.24	05-10-71	0.58
10-04-60	b0.21	03-12-74	0.43
09-20-61	0.39	11-04-74	0.01
09-29-61	0.16	09-23-75	0.12
02-04-63	0.34	09-27-76	0.08
02-22-63	0.39		

a, includes surface runoff
b, revision

16918000   Lesina Stream at Fagasa.

Location.--Lat 14°17'37"S., long 170°43'14"W., 0.1 mile upstream from mouth and 0.2 mile southwest of Fagasa.

Drainage area.--0.02 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	<0.01	--
7-day, 10-year low	0	--
Mean	0.22	64.1
Median	0.02	41.4

Basis of estimate.--Graphical correlation with station 16948000.

List of measurements: total of 10.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	0.07	09-20-61	d0 (0.005)
08-04-59	0.07	02-04-63	b0.01
08-12-59	0.01	02-22-63	0.02
09-28-60	d0 (0.003)	05-15-64	0.02
10-04-60	d0 (0.003)	06-14-65	ab0.25

a, includes surface runoff
b, revision
d, measurements less than 0.01 cubic feet per second are published as 0

16919000   Leaveave Stream near Aasu.

Location.--Lat 14°18'28"S., long 170°45'06"W., 0.6 mile upstream from
   mouth and 0.9 mile southeast of Aasu.

Drainage area.--0.60 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-63, 1968, 1974-76, 1979, 1981, 1983,
   1986-87, 1989-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.75	11.7
7-day, 10-year low	0.32	21.7
Mean	3.46	12.8
Median	2.40	11.2

Basis of estimate.--Moments approach with station 16920500.

Remarks.--No villages in valley. U.S. Marine Corps used valley during
   the 1940's.

List of measurements: total of 22.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-27-59	1.14	10-30-78	2.70
08-14-59	1.14	07-17-81	1.70
09-27-60	1.24	09-03-81	e3.70
10-03-61	e2.12	12-28-82	0.66
02-05-63	1.62	08-16-83	0.32
02-16-63	2.07	07-15-86	1.04
05-08-68	e3.10	07-10-87	1.05
08-14-74	0.55	09-01-87	1.50
10-16-74	0.18	08-11-89	1.24
11-04-75	0.34	09-29-89	0.41
02-07-77	3.00	07-18-90	0.99

e, may include surface runoff

16919200 Leaveave Stream tributary No. 2 near Aasu.

Location.--Lat 14°18'24"S., long 170°45'03"W., 50 ft upstream from mouth and 0.8 mile southeast of Aasu.

Drainage area.--0.16 mi^2 Tributary to.--Leaveave Stream

Type of site.--Low-flow partial-record station.

Period of record.--1960, 1962-63, 1968, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.16	12.7
7-day, 10-year low	0.09	21.3
Mean	0.52	20.8
Median	0.40	17.3

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
09-27-60	0.34	05-08-68	0.39
10-03-61	a0.51	08-14-74	0.13
12-09-61	0.25	10-16-74	0.05
02-05-63	b0.33	11-04-75	0.05
02-16-63	b0.30		

a, includes surface runoff
b, revision

16919400   Leaveave Stream tributary No. 1 near Aasu.

Location.--Lat 14°18'21"S., long 170°45'01"W., 50 ft upstream from mouth
   and 0.8 mile southeast of Aasu.

Drainage area.--0.15 mi^2 Tributary to.--Leaveave Stream

Type of site.--Low-flow partial-record station.

Period of record.--1960, 1962-63, 1968, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.09	14.1
7-day, 10-year low	0.05	22.8
Mean	0.26	21.9
Median	0.21	18.4

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
09-27-60	0.11	05-08-68	0.16
10-03-61	ac0.70	08-14-74	0.07
12-09-61	0.16	10-16-74	0.03
02-05-63	0.17	11-04-75	0.05
02-16-63	0.32		

a, includes surface runoff
c, not previously published

16919800   Aasu Stream at Aoloaufou.

Location.--Lat 14°18'54"S., long 170°46'00"W., 0.3 mile north of
  Aoloaufou and 1.3 miles southeast of Aoloautuai.

Drainage area.--0.24 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1960-65, 1968, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.07	21.2
7-day, 10-year low	0.03	37.0
Mean	0.35	15.7
Median	0.24	12.8

Basis of estimate.--Graphical correlation with station 16920500.

Remarks.--Minor diversion from spring upstream of site for domestic use
  starting in 1968.

List of measurements: total of 10.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
09-24-60	0.12	02-20-63	0.32
10-03-60	0.09	05-14-64	0.16
09-26-61	0.05	06-18-65	0.34
10-02-61	bf0.04	05-07-68	0.91
02-11-63	0.23	07-16-74	c0.07

b, revision
c, not previously published
f, surface runoff at index station on this date

16920000   Aasu Stream near Aasu.

Location.--Lat 14°18'16"S., long 170°45'29"W., 300 ft downstream from 100-foot waterfall, 0.5 mile south of Aasu, and 0.5 mile upstream from mouth.

Drainage area.--0.82 mi^2 Tributary to.--Pacifc Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-63, 1968, 1974-76, 1978-79, 1981, 1983, 1985-87, 1989-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.92	11.7
7-day, 10-year low	0.39	21.6
Mean	4.09	12.8
Median	2.85	11.2

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 26.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-29-59	1.84	07-17-81	1.90
08-14-59	1.84	09-03-81	4.60
09-27-60	b1.77	12-28-82	1.27
10-10-60	b1.20	07-26-83	0.48
10-03-61	b2.25	08-16-83	0.30
02-05-63	2.55	09-17-85	1.13
02-16-63	3.40	07-15-86	1.47
05-08-68	e5.25	07-10-87	0.83
08-14-74	0.79	09-01-87	1.83
10-16-74	0.21	07-21-89	1.72
11-04-75	0.56	09-29-89	0.44
08-21-78	2.42	07-18-90	1.31
10-30-78	2.90	08-21-90	2.26

b, revision
e, may include surface runoff

16922000   Vaisa Stream at Aoloautuai.

Location.--Lat 14°18'15"S., long 170°47'00"W., 200 ft below unnamed
    tributary, 0.3 mile upstream from Vailolo Stream, and 0.3 mile
    southwest of Aoloautuai.

Drainage area.--0.78 mi^2.   Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-63, 1965, 1968-69, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.74	21.1
7-day, 10-year low	0.28	40.9
Mean	5.40	19.9
Median	3.60	15.5

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-27-59	b1.63	02-16-63	b4.88
08-14-59	b1.09	05-08-68	5.00
09-27-60	b1.40	05-21-69	0.55
10-03-61	b1.52	08-14-74	b0.61
02-05-63	2.71		

b, revision

16923000 Vailolo Stream at Aoloautuai.

Location.--Lat 14°18'22"S., long 170°46'45"W., 100 ft downstream from unnamed tributary, 0.4 mile upstream from mouth, and 0.4 mile south of Aoloautuai.

Drainage area.--0.18 mi².   Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-63, 1968-69, 1974.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.24	16.5
7-day, 10-year low	0.13	31.2
Mean	0.96	16.4
Median	0.70	12.4

Basis of estimate.--Graphical correlation with station 16920500.

Remarks.--Stream flows into Pacific Ocean, not into Vaisa Stream as shown on USGS topographic maps (1963,1989). Noted by field observation in 1963.

List of measurements: total of 9.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
07-27-59	b0.42	02-16-63	0.82
08-14-59	b0.32	05-08-68	1.40
09-27-60	b0.36	05-21-69	0.53
10-03-61	b0.39	08-14-74	b0.19
02-05-63	0.57		

b, revision

16924000   Matavai Stream at Fagamalo.

Location.--Lat 14°18'21"S., long 170°48'23"W., 0.2 mile southeast of Fagamalo and 0.3 mile upstream from mouth.

Drainage area.--0.17 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-63, 1968, 1975.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.16	18.2
7-day, 10-year low	0.07	31.8
Mean	0.90	21.9
Median	0.61	18.5

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 8.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-27-59	0.23	02-05-63	0.50
08-14-59	0.24	02-16-63	0.71
09-27-60	0.36	05-07-68	1.30
10-03-61	0.28	10-16-74	0.03

79

16925000 Maloata Stream at Maloata.

Location.--Lat 14°18'44"S., long 170°48'36"W., 0.4 mile southeast of Maloata and 0.4 mile upstream from mouth.

Drainage area.--0.74 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-60, 1962-63, 1968, 1975.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.90	13.3
7-day, 10-year low	0.52	23.2
Mean	5.00	7.6
Median	3.30	7.4

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 8.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-27-59	1.30	02-05-63	2.15
08-14-59	1.08	02-16-63	3.23
09-27-60	b1.54	05-07-68	4.9
10-03-61	b1.37	10-16-74	b0.28

b, revision

16926000   Vaitele Stream at Poloa.

Location.--Lat 14°19'19"S., long 170°49'35"W., 0.4 mile east of Poloa and 0.6 mile upstream from mouth.

Drainage area.--0.11 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-64, 1969-70, 1974-75, 1977.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.05	25.2
7-day, 10-year low	0.02	41.8
Mean	0.28	36.8
Median	0.14	21.8

Basis of estimate.--Graphical correlation with station 16912000.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-28-59	0.05	05-12-64	0.12
08-05-59	0.05	05-26-69	0.42
09-23-60	b0.07	09-14-70	0.49
09-30-60	0.06	07-31-74	0.08
09-25-61	b0.04	08-23-74	0.06
02-09-63	0.08	09-22-75	0.14
02-18-63	0.09	11-22-76	c0.05

b, revision
c, not previously published

16927000   Puna Stream at Amanave.

Location.--Lat 14°19'39"S., long 170°49'48"W., 0.2 mile upstream from Maululu Stream and 0.2 mile north of Amanave.

Drainage area.--0.03 mi^2 Tributary to.--Maululu Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1974-75.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	19.2
7-day, 10-year low	0.01	26.9
Mean	0.26	18.8
Median	0.16	19.5

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 15.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
04-15-59	b0.07	05-12-64	0.17
08-03-59	0.22	05-20-64	b0.30
09-20-60	b0.04	06-16-65	a0.76
09-30-60	b0.04	05-06-68	0.55
09-25-61	0.02	05-26-69	0.09
09-30-61	0.02	04-25-74	0.06
02-09-63	b0.10	09-22-75	0.07
02-18-63	0.09		

a, includes surface runoff
b, revision

16928000   Afutele Stream at Agugulu.

Location.--Lat 14°20'05"S., long 170°49'06"W., 30 ft downstream from
    unnamed tributary at Agugulu and 0.1 mile upstream from mouth.

Drainage area.--0.17 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-71, 1974, 1976-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.13	10.5
7-day, 10-year low	0.06	18.4
Mean	0.73	7.3
Median	0.38	8.0

Basis of estimate.--Moments approach with station 16931000.

List of measurements: total of 19.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
04-29-59	0.24	06-15-65	a1.36
08-03-59	0.39	05-06-68	b1.28
09-20-60	0.28	05-26-69	0.35
09-30-60	0.23	09-14-70	0.57
09-25-61	b0.15	09-29-70	0.59
09-30-61	b0.13	07-09-71	0.18
02-09-63	0.31	04-25-74	0.15
02-18-63	0.37	09-28-76	0.11
05-12-64	0.48	11-22-76	c0.08
05-20-64	b0.55		

a, includes surface runoff
b, revision
c, not previously published

16929000   Vaialae Stream at Utumea.

Location.--Lat 14°19'56"S., long 170°48'50"W., 0.1 mile north of Utumea
   and 0.1 mile upstream from mouth.

Drainage area.--0.15 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-71, 1974, 1976-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.17	11.3
7-day, 10-year low	0.08	19.4
Mean	0.73	10.5
Median	0.41	8.8

Basis of estimate.--Moments approach with station 16931000.

List of measurements: total of 19.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
04-29-59	b0.27	06-15-65	ab1.00
08-03-59	0.35	05-06-68	a1.10
09-23-60	b0.33	05-26-69	0.97
09-30-60	b0.27	09-14-70	0.56
09-25-61	b0.18	07-09-71	0.18
09-30-61	0.16	04-25-74	0.15
02-09-63	b0.30	09-22-75	0.16
02-18-63	0.37	09-28-76	0.16
05-12-64	0.46	11-22-76	c0.11
05-20-64	0.54		

a, includes surface runoff
b, revision
c, not previously published

16930000   Soonapule Stream near Seetaga.

Location.--Lat 14°19'42"S., long 170°48'36"W., 50 ft upstream from Utanuatele Stream and 0.1 mile north of Seetaga.

Drainage area.--0.16 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-64, 1968-71, 1974, 1976-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.11	16.4
7-day, 10-year low	0.04	22.1
Mean	1.05	17.7
Median	0.44	14.1

Basis of estimate.--Moments approach with station 16931000.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
04-29-59	0.24	05-20-64	0.74
08-03-59	1.02	05-06-68	1.34
09-23-60	0.20	05-20-69	1.77
09-30-60	b0.15	09-14-70	0.56
09-25-61	b0.10	08-11-71	0.14
09-30-61	0.11	04-25-74	0.14
02-09-63	0.34	10-31-75	0.06
02-18-63	b0.37	09-15-76	0.08
05-14-64	0.45	11-22-76	c0.08

b, revision
c, not previously published

16930200   Utanuatele Stream at Seetaga.

Location.--Lat 14°19'41"S., long 170°48'35"W., 200 ft upstream from mouth and 0.2 mile north of Seetaga.

Drainage area.--0.21 mi^2.   Tributary to.--Soonapule Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1960-61, 1963-64, 1968-71, 1974, 1976-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.07	19.1
7-day, 10-year low	0.02	26.0
Mean	1.00	18.1
Median	0.36	15.4

Basis of estimate.--Moments approach with station 16931000.

Remarks.--Minor diversion for domestic use upstream of site at 100 ft altitude starting about 1968.

List of measurements: total of 15.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
09-23-60	b0.24	05-06-68	e1.86
09-30-60	0.16	05-20-69	1.06
09-25-61	b0.10	09-14-70	0.60
09-30-61	0.09	08-11-71	0.10
02-09-63	0.28	04-25-74	0.06
02-18-63	0.32	09-15-76	0.03
05-12-64	0.53	11-22-76	c0.04
05-20-64	0.71		

b, revision
c, not previously published
e, may include surface runoff

16932000 Asili Stream near Asili.

Location.--Lat 14°19'46"S., long 170°47'42"W., 0.4 mile north of Asili
    and 0.5 mile upstream from mouth.

Drainage area.--0.55 mi^2.   Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1970, 1974-77, 1981-82, 1984.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.68	18.2
7-day, 10-year low	0.25	25.8
Mean	2.76	23.0
Median	1.85	17.9

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 24.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	1.52	09-14-70	1.99
08-05-59	1.77	04-25-74	0.89
09-23-60	b0.91	11-21-74	1.83
10-01-60	b0.78	09-25-75	b0.97
09-25-61	0.51	09-15-76	0.76
09-30-61	0.51	11-23-76	c1.61
02-09-63	1.28	01-26-77	f0.98
02-18-63	b2.36	03-28-77	2.62
05-12-64	1.69	08-05-81	1.80
05-20-64	2.51	09-30-81	1.03
06-16-65	a6.01	05-07-82	0.45
05-06-68	a5.67	08-22-84	0.11

a, includes surface runoff
b, revision
c, not previously published
f, surface runoff at index station on this date

16932500   Asili Stream at Asili.

Location.--Lat 14°20'04"S., long 170°47'40"W., 100 ft upstream from highway bridge at Asili and 0.1 mile upstream from mouth.

Drainage area.--0.66 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1958-59h, 1960-61, 1963-65, 1967-69, 1972, 1974-77, 1981-85, 1987-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.58	13.9
7-day, 10-year low	0.21	17.6
Mean	5.73	14.5
Median	2.85	10.9

Basis of estimate.--Moments approach with stations 16920500 and 16931000.

List of measurements: total of 34.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	2.11	09-25-75	b1.14
08-05-59	2.30	09-15-76	0.54
09-23-60	0.96	11-23-76	c1.40
10-01-60	b0.95	01-26-77	f0.96
09-25-61	0.60	03-28-77	2.28
09-30-61	0.54	08-05-81	2.17
02-09-63	b1.63	09-30-81	1.05
02-18-63	2.37	05-07-82	0.59
05-12-64	2.21	07-12-83	0.34
05-20-64	3.11	08-09-83	0.26
06-16-65	a6.87	08-22-84	0.30
05-25-67	3.48	08-13-85	0.90
05-06-68	a7.09	06-05-87	0.97
05-20-69	5.93	09-02-87	0.68
05-26-69	2.77	09-28-88	1.14
11-17-71	1.30	08-15-89	1.02
04-25-74	1.07	08-07-90	1.32

a, includes surface runoff
b, revision
c, not previously published
f, surface runoff at index station on this date
h, operated as a continuous-gaging station

16933000   Vaipuna Stream at Amaluia.

Location.--Lat 14°19'48"S., long 170°47'20"W., 300 ft upstream from
    unnamed tributary, 0.6 mile north of Amaluia, and 0.7 mile upstream
    from mouth.

Drainage area.--0.08 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1972.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.06	28.0
7-day, 10-year low	0.02	49.0
Mean	0.35	27.4
Median	0.24	22.3

Basis of estimate.--Graphical correlation with station 16920500.

List of measurements: total of 11.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-23-59	0.16	02-12-63	e0.45
08-05-59	0.24	02-19-63	0.26
09-24-60	b0.07	05-15-64	b0.15
10-03-60	0.05	06-16-65	a0.68
09-27-61	0.03	10-01-71	0.56
09-30-61	0.05		

a, includes surface runoff
b, revision
e, may include surface runoff

16934000   Leafu Stream near Leone.

Location.--Lat 14°19'47"S., long 170°46'55"W., 30 ft upstream from
     reservoir, 0.9 mile upstream from mouth, and 1.0 mile north of Leone.

Drainage area.--0.69 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-64, 1968-69, 1971-74, 1976-78, 1981-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.88	11.6
7-day, 10-year low	0.38	15.4
Mean	4.55	18.7
Median	2.61	12.9

Basis of estimate.--Moments approach with stations 16920500 and
     16931000.

List of measurements: total of 36.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-05-58	2.77	02-15-77	b1.56
08-04-59	3.16	07-13-77	c3.59
09-24-60	b1.40	08-19-77	0.74
10-03-60	1.05	07-12-78	c1.06
09-27-61	0.96	07-19-78	c1.02
10-02-61	be2.13	08-03-81	b4.01
02-13-63	be4.00	10-01-81	b1.64
02-20-63	3.98	04-20-82	1.29
05-13-64	b1.88	07-14-83	0.69
05-09-68	b4.45	08-09-83	0.46
05-24-69	b3.56	08-21-84	0.56
08-05-71	b1.26	08-09-85	0.70
10-12-71	0.90	09-24-86	1.49
12-15-72	1.30	06-02-87	0.53
07-17-74	1.70	09-02-87	1.13
08-22-74	0.49	09-28-88	0.88
09-22-76	0.84	08-15-89	0.55
09-22-76	0.94	08-07-90	0.84

b, revision
c, not previously published
e, may include surface runoff

16935000   Fuafua Stream at Malaeloa.

Location.--Lat 14°19'58"S., long 170°46'12"W., 40 ft downstream from
    unnamed tributary, 0.8 mile north of Malaeloa, and 2.1 miles upstream
    from mouth.

Drainage area.--0.29 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1971, 1973-74, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.17	20.6
7-day, 10-year low	0.06	31.4
Mean	1.20	30.1
Median	0.79	23.0

Basis of estimate.--Moments approach with station 16920500.

Remarks.--Lower section of Fuafua Stream called Vailepa Stream.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-23-59	0.50	02-20-63	e1.08
08-05-59	0.53	05-14-64	b0.69
08-13-59	b0.37	06-17-65	ab2.84
09-24-60	0.28	07-15-71	0.21
10-03-60	b0.24	12-15-72	0.23
09-27-61	0.22	07-17-74	0.21
02-13-63	0.79	09-22-76	0.06

a, includes surface runoff
b, revision
e, may include surface runoff

16935500   Sigaloa Stream at Malaeloa.

Location.--Lat 14°20'27"S., long 170°45'53"W., 0.1 mile upstream from mouth and 0.3 mile northeast of Malaeloa.

Drainage area.--0.01 mi^2 Tributary to.--Vaitai Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.01	25.2
7-day, 10-year low	<0.01	34.2
Mean	0.05	25.8
Median	0.03	16.6

Basis of estimate.--Moments approach with station 16931000.

List of measurements: total of 11.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-23-59	0.01	02-13-63	b0.02
08-05-59	0.02	02-20-63	b0.02
08-13-59	0.01	05-13-64	b0.04
09-24-60	0.02	06-17-65	0.09
10-03-60	b0.01	05-07-68	0.06
09-27-61	0.02		

b, revision

16936000   Leaveave Stream at Mapusagafou.

Location.--Lat 14°19'12"S., long 170°45'00"W., 0.1 mile upstream from Puna Stream and 0.7 mile north of Mapusagafou.

Drainage area.--0.15 mi^2 Tributary to.--N/A.

Type of site.--Low-flow partial-record station.

Period of record.--1959-65, 1968, 1971, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.11	18.5
7-day, 10-year low	0.05	25.8
Mean	0.47	17.0
Median	0.33	13.7

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 15.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	0.37	02-20-63	be0.55
08-06-59	0.24	05-14-64	b0.30
08-12-59	0.17	06-18-65	0.62
09-24-60	b0.10	05-07-68	0.57
10-03-60	0.08	03-08-71	0.36
09-26-61	0.11	07-17-74	0.16
10-02-61	0.17	10-29-75	0.08
02-14-63	e0.31		

b, revision
e, may include surface runoff

16937000 Vaitele Stream at Lepine.

Location.--Lat 14°18'51"S., long 170°43'35"W., 0.7 mile north of Lepine
and 1.1 miles upstream from mouth.

Drainage area.--0.18 mi².   Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1971, 1974, 1976, 1989.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.32	10.3
7-day, 10-year low	0.18	21.3
Mean	0.85	12.0
Median	0.67	10.0

Basis of estimate.--Moments approach with station 16920500.

List of measurements: total of 19.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
10-18-58	1.14	05-18-64	a2.03
08-04-59	0.85	06-23-65	ab2.76
08-13-59	0.42	05-24-67	b1.01
09-23-60	b0.35	05-03-68	0.71
10-03-60	0.28	05-22-69	0.86
09-22-61	0.28	07-28-71	0.33
09-29-61	0.25	07-17-74	0.39
02-11-63	0.68	10-29-75	0.23
02-21-63	0.51	09-28-89	0.22
05-11-64	b0.97		

a, includes surface runoff
b, revision

16938000 Vaitele Stream tributary at Lepine.

Location.--Lat 14°18'57"S., 170°43'21"W., 0.2 mile upstream from mouth
    and 0.7 mile northeast of Lepine.

Drainage area.--0.09 mi^2 Tributary to.--Vaitele Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.11	20.1
7-day, 10-year low	0.05	26.2
Mean	0.55	20.2
Median	0.26	12.5

Basis of estimate.--Moments approach with station 16948000.

List of measurements: total of 17.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-18-58	0.39	05-16-64	0.25
08-04-59	0.28	05-18-64	ab0.47
08-13-59	0.16	06-23-65	a0.82
09-23-60	0.22	05-24-67	0.46
10-03-60	0.16	05-03-68	f0.67
09-22-61	b0.18	05-22-69	0.53
09-29-61	b0.16	07-17-74	0.11
02-11-63	0.29	09-27-76	0.05
02-21-63	b0.21		

a, includes surface runoff
b, revision
f, surface runoff at index station on this date

16939000 Taumata Stream near Mapusaga.

Location.--Lat. 14°18'23"S., long 170°44'00"W., 100 ft upstream from unnamed tributary, 1.6 miles north of Mapusaga, and 2.2 miles upstream from mouth.

Drainage area.--0.02 mi^2 Tributary to.--Vaitele Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.06	10.8
7-day, 10-year low	0.03	19.6
Mean	0.20	12.9
Median	0.12	9.3

Basis of estimate.--Moments approach with station 16931000.

Remarks.--Measurements from 1959 to 1965 were previously published in error as belonging to station 16940000. Stream goes dry at lower elevations.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	0.07	02-12-63	b0.17
08-06-59	0.08	02-19-63	0.12
08-13-59	0.06	05-15-64	0.10
09-23-60	0.12	06-18-65	b0.25
10-03-60	0.12	05-09-68	0.19
09-22-61	0.06	05-27-69	0.09
09-29-61	0.07	09-04-74	0.03

b, revision

16940000   Taumata Stream tributary near Mapusaga.

Location.--Lat 14°18'27"S., long 170°43'49"W., 0.5 mile upstream from
mouth and 1.6 miles northeast of Mapusaga.

Drainage area.--0.04 mi²   Tributary to.--Taumata Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1969, 1974.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.09	24.8
7-day, 10-year low	0.02	45.0
Mean	0.30	26.6
Median	0.22	20.8

Basis of estimate.--Graphical correlation with station 16931000.

Remarks.--Measurements from 1959 to 1965 were previously published in
error as belonging to station 16939000.

List of measurements: total of 13.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
07-24-59	0.13	02-12-63	b0.27
08-06-59	0.17	02-19-63	0.12
08-13-59	0.12	05-15-64	0.20
09-23-60	0.23	06-18-65	b0.55
10-03-60	0.17	05-27-69	c0.25
09-22-61	0.14	09-04-74	c 0
09-29-61	0.11		

b, revision
c, not previously published

16941000 Mapusagatuai Stream at Mapusaga.

Location.--Lat 14°19'38"S., long 170°44'48"W., 0.3 mile west of Mapusaga
   and 1.2 mile upstream from mouth.

Drainage area.--0.08 mi^2 Tributary to.--Taumata Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-70, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.11	15.5
7-day, 10-year low	0.05	21.5
Mean	0.29	21.5
Median	0.23	16.7

Basis of estimate.--Moments approach with station 16920500.

Remarks.--Stream goes dry downstream from station because of diversion
   by village.

List of measurements: total of 16.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	0.14	05-14-64	b0.27
08-06-59	0.12	05-18-64	f0.32
09-23-60	b0.18	06-17-65	0.56
10-01-60	0.17	05-07-68	0.30
09-25-61	0.10	05-26-69	0.25
09-29-61	0.09	09-17-70	f0.20
02-12-63	b0.13	07-17-74	0.15
02-20-63	0.26	10-29-75	0.04

b, revision
f, surface runoff at index station on this date

16942000   Sauino Stream near Nuuuli.

Location.--Lat 14°18'53"S., long 170°43'03"W., 0.6 mile upstream from mouth and 1.3 miles west of Nuuuli.

Drainage area.--0.09 mi².   Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1971, 1974-75.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.10	12.7
7-day, 10-year low	0.05	24.6
Mean	0.37	15.8
Median	0.25	11.8

Basis of estimate.--Moments approach with stations 16920500 and 16948000.

List of measurements: total of 17.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
07-23-59	0.14	05-16-64	b0.24
08-06-59	0.16	05-22-64	0.48
08-13-59	0.14	06-24-65	be0.58
09-23-60	0.20	05-03-68	0.37
10-03-60	b0.15	05-22-69	0.42
09-22-61	0.08	10-01-70	0.21
09-30-61	0.09	07-22-74	0.14
02-09-63	0.19	09-25-75	0.08
02-21-63	0.17		

b, revision
e, may include surface runoff

16943000 Mataalii Stream near Nuuuli.

Location.--Lat 14°18'42"S., long 170°42'51"W., 0.6 mile upstream from mouth and 1.1 miles northwest of Nuuuli.

Drainage area.--0.14 mi^2.   Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.31	15.7
7-day, 10-year low	0.15	20.8
Mean	0.98	20.0
Median	0.60	13.1

Basis of estimate.--Moments approach with station 16931000.

List of measurements: total of 17.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	0.52	05-16-64	0.53
08-06-59	0.57	05-22-64	e1.21
08-13-59	0.47	06-24-65	be1.15
09-22-60	0.56	05-03-68	0.73
09-30-60	0.46	05-27-69	0.45
09-25-61	b0.47	07-22-74	0.14
09-30-61	0.39	09-25-75	0.20
02-09-63	0.60	09-14-76	0.15
02-22-63	b0.61		

b, revision
e, may include surface runoff

16944000   Papa Stream near Nuuuli.

Location.--Lat 14°18'31"S., long 170°42'29"W., 0.3 mile upstream from Tauese Stream and 0.9 mile northwest of Nuuuli.

Drainage area.--0.57 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-64, 1967-68, 1974-76, 1983-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.54	14.5
7-day, 10-year low	0.21	21.3
Mean	2.83	28.4
Median	1.48	19.5

Basis of estimate.--Moments approach with stations 16920500 and 16948000.

Remarks.--Stream was observed dry below station in October 1974.

List of measurements: total of 30.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-28-59	1.11	04-03-75	a9.71
08-05-59	1.90	09-26-75	0.74
08-12-59	1.16	09-14-76	0.74
09-22-60	1.04	09-14-83	0.20
09-30-60	0.76	08-21-84	0.07
09-25-61	b0.75	07-23-85	1.11
09-30-61	0.59	09-06-85	0.85
02-09-63	1.19	08-06-86	0.90
02-22-63	1.59	09-05-86	0.42
05-16-63	c1.94	06-02-87	0.69
05-16-64	b1.43	09-17-87	0.70
05-22-64	a4.02	09-27-88	0.69
05-24-67	a3.19	07-19-89	0.97
05-03-68	2.09	09-21-89	0.67
08-19-74	0.18	08-30-90	0.58

a, includes surface runoff
b, revision
c, not previously published

16945000   Amaile Stream at Nuuuli.

Location.--Lat 14°18'43"S., long 170°41'48"W., 0.3 mile upstream from mouth and 0.5 mile north of Nuuuli.

Drainage area.--0.19 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-64, 1968-69, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.11	24.7
7-day, 10-year low	0.04	35.1
Mean	1.30	44.0
Median	0.45	24.1

Basis of estimate.--Moments approach with 16912000.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-23-59	0.21	02-19-63	b0.44
08-05-59	0.24	05-16-64	b0.61
09-22-60	b0.39	05-02-68	0.73
09-30-60	b0.38	05-26-69	0.37
09-26-61	0.22	07-22-74	0.07
09-29-61	b0.16	09-29-75	0.08
02-09-63	0.42	09-14-76	0.04

b, revision

16946000   Avau Stream at Faganeanea.

Location.--Lat 14°18'34"S., long 170°41'35"W., 0.2 mile upstream from mouth and 0.4 mile southwest of Faganeanea.

Drainage area.--0.09 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.10	12.2
7-day, 10-year low	0.05	16.7
Mean	0.40	14.4
Median	0.23	10.3

Basis of estimate.--Moments approach with station 16931000.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-23-59	0.08	05-22-64	0.42
08-04-59	0.12	06-16-65	0.53
09-22-60	0.12	05-29-67	0.36
09-30-60	0.17	05-02-68	0.40
09-26-61	0.12	05-22-69	0.25
09-29-61	0.12	07-22-74	0.12
02-09-63	b0.24	09-23-74	0.08
02-22-63	b0.18	09-29-75	0.08
05-16-64	0.28	09-14-76	0.10

b, revision

16947000   Afu Stream at Faganeanea.

Location.--Lat 14°18'16"S., long 170°41'25"W., 0.2 mile northwest of Faganeanea and 0.3 mile upstream from mouth.

Drainage area.--0.22 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1971, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.03	24.0
7-day, 10-year low	0.01	33.7
Mean	0.58	39.3
Median	0.17	23.2

Basis of estimate.--Moments approach with station 16912000.

List of measurements: total of 20.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-18-58	0.46	05-22-64	a1.45
07-30-59	0.09	06-14-65	a1.64
08-13-59	0.08	05-29-67	0.32
09-22-60	0.06	05-02-68	0.39
09-30-60	b0.04	05-22-69	0.20
09-26-61	b0.04	10-01-70	0.27
09-29-61	0.02	07-22-74	0.07
02-09-63	0.12	09-23-74	0.03
02-22-63	b0.18	09-25-75	0.05
05-16-64	b0.15	09-14-76	0.01

a, includes surface runoff
b, revision

16949000   Matafao Stream at Fagaalu.

Location.--Lat 14°17'34"S., long 170°41'43"W., 100 ft upstream from Vaitanoa Pool and 0.9 mile west of Fagaalu.

Drainage area.--0.24 mi^2 Tributary to.--Fagaalu Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959, 1961, 1963-64.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.14	18.8
7-day, 10-year low	0.09	30.3
Mean	1.10	18.6
Median	0.33	14.3

Basis of estimate.--Graphical correlation with station 16948000 using pre-diversion values.

Remarks.--Municipal diversion upstream from site.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-25-59	0.22	02-13-63	b0.58
08-07-59	0.25	02-22-63	b0.52
10-01-60	b0.15	05-13-63	c0.58
10-04-60	0.20	05-23-64	0.62
09-23-61	0.14		

b, revision
c, not previously published

16949500 Fagaalu Stream at Fagaalu.

Location.--Lat 14°17'36"S., long 170°41'20"W., on right bank 75 ft
    upstream from pipeline intake and 0.5 mile west of Fagaalu (revision).

Drainage area.--0.42 mi ^{2} Tributary to.--Pacific Ocean.

Type of site.--Daily record station.

Period of record.--April 1957 - June 1958, miscellaneous measurement in
    1958 and 1963.

Average discharge.--not determined.

Extremes for period of record.--Maximum not determined;   minimum 0.43
    ft^3/s on February 1 and 2, 1958.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.13	38.5
7-day, 10-year low	0.08	79.1
Mean	1.10	24.6
Median	0.32	16.4

Basis of estimate.--Graphical correlation with station 16948000 using 11
    mean daily base-flow discharges from March to June 1958.

Remarks.--Station treated as a low-flow partial-record site. Municipal
    diversion upstream of site prior to period of record.

List of measurements: total of 2.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
04-07-58	1.42	05-15-63	0.85

16949700   Vaima Stream at Pago Pago.

Location.--Lat 14°17'30"S., long 170°42'29"W., 0.4 mile upstream from
   mouth and 1.0 mile southwest from Pago Pago.

Drainage area.--0.05 mi^2 Tributary to.--Vaipito Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-65, 1967-68, 1970, 1975-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.06	21.1
7-day, 10-year low	0.02	28.1
Mean	0.35	30.2
Median	0.16	19.7

Basis of estimate.--Moments approach with station 16931000 and 16948000.

List of measurements: total of 20.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	0.21	06-14-65	ab0.69
08-04-59	0.22	05-29-67	0.09
08-12-59	0.11	04-30-68	0.33
09-28-60	0.09	09-13-70	0.22
10-04-60	b0.10	09-30-70	0.24
09-20-61	b0.10	05-10-71	0.10
10-02-61	f0.50	03-12-74	c0.12
02-04-63	0.12	11-04-74	0.01
02-22-63	b0.13	09-23-75	0.06
05-11-64	0.16	09-23-76	0.18

a, includes surface runoff
b, revision
c, not previously published
f, surface runoff at index station on this date

16949800   Utumoa Stream near Pago Pago.

Location.--Lat 14°17'35"S., long 170°42'20"W., 0.6 mile upstream from
    mouth and 1.1 miles south of Pago Pago.

Drainage area.--0.07 mi^2.   Tributary to.--Vaipito Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-71, 1974-75, 1983, 1986-87,
    1989.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.23	10.4
7-day, 10-year low	0.14	15.3
Mean	0.65	12.4
Median	0.42	8.1

Basis of estimate.--Moments approach with station 16912000.

Remarks.--Municipal diversion (Vaipito intake) immediately downstream of
    site.

List of measurements: total of 29.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	c0.48	05-27-69	0.45
08-03-59	c0.55	09-13-70	0.40
08-12-59	c0.28	09-30-70	b0.35
09-28-60	0.29	03-13-74	0.24
10-04-60	0.25	11-04-74	0.11
09-20-61	0.37	09-23-75	0.15
09-28-61	b0.18	05-04-83	0.33
02-04-63	b0.30	08-07-86	0.22
02-22-63	0.36	09-04-86	0.33
05-14-63	0.38	07-01-87	0.26
05-13-64	b0.49	09-04-87	0.22
06-14-65	a0.84	05-24-89	0.36
05-26-67	0.46	08-23-89	0.14
04-30-68	0.58	09-23-90	0.20
05-21-69	0.64		

a, includes surface runoff
b, revision
c, not previously published

16950000 Utumoa pipeline diversion near Pago Pago.

Location.--Lat 14°17'33"S., long 170°42'20"W., at stilling basin 150 ft below diversion on Utumoa Stream and 1.1 miles south of Pago Pago (revision).

Drainage area.--N/A.   Tributary to.--N/A.

Type of site.--Daily record station.

Period of record.--April 1957 - June 1958.

Average discharge.--not determined.

Extremes for period of record.--Maximum not determined; No flow Feb. 9, 1958.

Low-Flow frequency.--None.

Remarks.--These records combined with those of Utumoa Stream (16950500 old) will show total flow at 460 ft altitude.

16950500 (old) Utumoa Stream at Pago Pago.

Location.--Lat 14°17'33"S., long 170°42'20"W., 150 feet downstream from pipeline diversion, 0.5 mile upstream from mouth, and 1.1 mile south of Pago Pago (revision).

Drainage area.--0.08 mi^2 Tributary to.--Vaipito Stream

Type of site.--Daily record station.

Period of record.--1957-58, 1974.

Low-flow frequency.--None.

Remarks.--Operated as a daily recording gage from April 1957 until June 1958. Municipal diversion located upstream of site.

List of measurements: total of 2.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
09-22-58	c0.31	11-04-74	c0.04

c, not previously published

16950500 (new) Utumoa Stream at Pago Pago.

Location.--Lat 14°17'21"S., long 170°42'21"W., 0.2 mile downstream from pipeline diversion, 0.3 mile upstream from mouth, and 0.8 mile south of Pago Pago (revision).

Drainage area.--0.17 mi^2 Tributary to.--Vaipito Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-65, 1967-68, 1972, 1974-75.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.14	22.2
7-day, 10-year low	0.06	29.8
Mean	0.45	23.8
Median	0.25	15.5

Basis of estimate.--Moments approach with station 16948000.

Remarks.--Municipal diversion located upstream of site.

List of measurements: total of 17.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-22-59	c0.38	05-14-63	c0.48
08-03-59	c0.54	05-13-64	0.39
08-12-59	c0.24	06-14-65	a1.22
09-28-60	0.17	05-29-67	0.39
10-03-60	b0.13	05-30-68	0.67
09-20-61	0.23	05-05-72	0.14
10-02-61	0.53	03-13-74	0.07
02-04-63	0.22	09-23-75	0.08
02-22-63	b0.38		

a, includes surface runoff
b, revision
c, not previously published

16951000 Vaipito Stream at Pago Pago.

Location.--Lat 14°16'57"S., long 170°42'16"W., 800 ft upstream from Pago
    Stream and 0.3 mile southwest of highway junction in Pago Pago.

Drainage area.--0.75 mi^2.   Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1966-67, 1969-70.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.65	28.7
7-day, 10-year low	0.30	45.0
Mean	6.40	30.5
Median	1.76	17.5

Basis of estimate.--Graphical correlataion with 16948000.

Remarks.--All measurements are revisions from previously published ones.
    Pumping occurs from pool at site, all measurements below were made
    above pool. Municipal and domestic diversions upstream of site.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
06-11-66	3.72	09-30-68	0.58
06-30-66	1.92	05-27-69	c1.36
09-20-66	3.32	08-05-69	1.24
11-29-66	1.41	08-04-70	1.55
02-28-67	1.91		

c, not previously published

16952500   Lalolamauta Stream at Aua.

Location.--Lat 14°16'25"S., long 170°39'31"W., 300 ft upstream from Amano
    Stream and 0.4 mile east of Aua.

Drainage area.--0.14 mi^2.   Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-70, 1974-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.09	23.8
7-day, 10-year low	0.03	32.3
Mean	0.44	33.0
Median	0.21	21.7

Basis of estimate.--Moments approach with station 16960000.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
01-02-59	0.11	06-14-65	a1.90
07-28-59	0.10	04-30-68	0.85
09-22-60	0.09	05-22-69	0.22
09-29-60	b0.07	09-15-70	0.83
09-20-61	0.11	03-13-74	0.12
09-28-61	0.05	11-06-74	0.12
02-07-63	b0.10	09-24-75	0.08
02-22-63	b0.13	09-16-76	0.05
05-13-64	b0.35	11-24-76	c0.09

a, includes surface runoff
b, revision
c, not previously published

16953000   Matagimalie Stream at Aua.

Location.--Lat 14°16'19"S., long 170°39'50"W., 0.2 mile north of Aua and 0.2 mile upstream from mouth.

Drainage area.--0.03 mi^2.   Tributary to.--Lalolamauta Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1971, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.07	19.2
7-day, 10-year low	0.03	27.0
Mean	0.24	28.5
Median	0.14	18.5

Basis of estimate.--Moments approach with station 16960000.

List of measurements: total of 19.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
01-02-59	0.12	04-30-68	0.19
07-28-59	0.10	05-21-69	0.09
09-22-60	0.12	05-22-69	0.20
09-29-60	0.12	09-22-71	0.06
09-20-61	b0.13	03-13-74	0.12
09-28-61	0.12	11-06-74	0.01
02-07-63	0.16	09-24-75	0.04
02-22-63	0.12	09-16-76	0.10
05-13-64	0.16	11-24-76	c0.10
06-14-65	a0.34		

a, includes surface runoff
b, revision
c, not previously published

16955000   Anasosopo Stream at Anasosopo.

Location.--Lat 14°17'14"S., long 170°39'44"W., 400 ft upstream from highway bridge at Anasosopo and 0.1 mile upstream from mouth.

Drainage area.--0.05 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1971, 1974-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	18.4
7-day, 10-year low	0.02	25.2
Mean	0.37	32.1
Median	0.15	19.4

Basis of estimate.--Moments approach with station 16912000.

Remarks.--Diversion for domestic use upstream of site.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-28-59	0.06	06-14-65	ab0.50
08-04-59	0.10	04-30-68	0.31
09-21-60	b0.10	05-25-69	c0.25
09-29-60	b0.07	09-29-71	0.04
09-20-61	0.08	03-14-74	0.06
09-28-61	0.06	11-06-74	0.01
02-07-63	0.08	09-24-75	0.05
02-22-63	0.06	09-16-76	0.05
05-13-64	b0.35	11-24-76	c0.08

a, includes surface runoff
b, revision
c, not previously published

16955500   Vaisina Stream at Lauliifou.

Location.--Lat 14°17'34"S., long 170°39'25"W., 0.1 mile north of Lauliifou and 600 ft upstream from highway bridge.

Drainage area.--0.06 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	20.5
7-day, 10-year low	<0.01	28.2
Mean	0.16	24.3
Median	0.06	15.1

Basis of estimate.--Moments approach with station 16912000.

Remarks.--Stream has been observed to go dry.

List of measurements: total of 12.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-28-59	0.02	02-07-63	0.05
08-04-59	0.03	02-22-63	0.05
09-21-60	0.06	05-13-64	b0.18
09-29-60	0.05	06-17-65	0.16
09-20-61	b0.02	04-30-68	b0.12
09-28-61	0.02	03-14-74	0.03

b, revision

16956000   Vaitele Stream at Lauliituai.

Location.--Lat 14°17'05"S., long 170°39'07"W., 200 ft upstream from unnamed tributary, 0.5 mile north of Lauliituai, and 0.7 mile upstream from mouth.

Drainage area.--0.19 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1970, 1974-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.33	11.8
7-day, 10-year low	0.19	15.5
Mean	1.07	15.1
Median	0.65	9.9

Basis of estimate.--Moments approach with 16912000.

Remarks.--Diversion for domestic use upstream of site at altitude 140 ft starting in 1964.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	b0.33	05-22-64	1.56
08-06-59	b0.57	06-17-65	1.61
09-21-60	b0.39	04-30-68	b1.08
09-29-60	b0.37	09-15-70	0.75
09-20-61	b0.38	03-12-74	0.57
09-28-61	b0.41	11-05-74	0.24
02-07-63	0.43	09-24-75	0.28
02-22-63	0.48	09-21-76	0.36
05-13-64	0.62	11-24-76	c0.64

b, revision
c, not previously published

16956500 Maga Stream at Lauliituai.

Location.--Lat 14°17'12"S., long 170°39'09"W., 0.1 mile upstream from mouth and 0.4 mile north of Lauliituai.

Drainage area.--0.05 mi^2 Tributary to.--Vaitele Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1974-75.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	17.6
7-day, 10-year low	0.01	23.4
Mean	0.11	20.6
Median	0.05	13.2

Basis of estimate.--Moments approach with station 16912000.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	b0.03	02-22-63	b0.04
08-06-59	b0.05	05-13-64	0.16
09-21-60	b0.03	05-22-64	b0.07
09-29-60	b0.05	06-17-65	0.09
09-20-61	b0.02	04-30-68	0.10
09-28-61	b0.03	03-14-74	0.03
02-07-63	0.05	09-24-75	0.01

b, revision

16957000   Lesea Stream at Lauliituai.

Location.--Lat 14°17'19"S., long 170°39'00"W., 0.1 mile upstream from mouth and 0.3 mile northeast of Lauliituai.

Drainage area.--0.02 mi^2 Tributary to.--Vaitele Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.13	22.7
7-day, 10-year low	0.05	29.5
Mean	0.68	33.0
Median	0.32	20.2

Basis of estimate.--Moments approach with station 16912000.

List of measurements: total of 17.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-24-59	0.17	05-22-64	be1.15
08-06-59	0.23	06-17-65	e1.01
09-21-60	0.19	04-30-68	0.64
09-29-60	b0.15	03-12-74	0.28
09-20-61	0.12	11-06-74	0.14
09-28-61	0.12	09-24-75	0.12
02-07-63	b0.04	09-21-76	0.19
02-22-63	0.22	11-24-76	c0.23
05-13-64	0.65		

b, revision
c, not previously published
e, may include surface runoff

16958000 Visa Stream at Alega.

Location.--Lat 14°17'21"S., long 170°38'37"W., 0.2 mile upstream from mouth and 0.5 mile southwest of Alega.

Drainage area.--0.10 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1971, 1974-77.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	24.0
7-day, 10-year low	0.01	34.4
Mean	0.63	33.3
Median	0.20	19.3

Basis of estimate.--Moments approach with station 16912000.

Remarks.--Diversion for domestic use upstream of site starting in 1974.

List of measurements: total of 21.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-03-58	0.09	05-25-67	b0.35
07-24-59	0.07	05-02-68	0.28
08-11-59	0.08	10-03-68	0.14
09-21-60	0.11	05-27-69	0.23
09-29-60	b0.07	05-06-71	0.35
09-20-61	b0.04	03-12-74	0.10
09-27-61	b0.02	11-05-74	g0.01
02-08-63	b0.10	09-24-75	0.05
02-22-63	b0.10	09-21-76	0.09
05-13-64	0.57	11-24-76	cg0.04
06-14-65	ab0.78		

a, includes surface runoff
b, revision
c, not previously published
g, measurement made below diversion

16958500   Visa Stream tributary at Aumi.

Location.--Lat 14°17'24"S., long 170°38'35"W., 200 ft upstream from mouth and 0.3 mile northeast of Aumi.

Drainage area.--0.02 mi^2.   Tributary to.--Visa Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1971, 1974-75.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.05	29.3
7-day, 10-year low	0.02	58.1
Mean	0.22	37.6
Median	0.12	24.9

Basis of estimate.--Graphical correlation with 16960000.

List of measurements: total of 21.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-03-58	0.02	05-25-67	0.20
07-24-59	0.03	05-02-68	0.20
08-11-59	0.03	10-03-68	0.10
09-21-60	0.06	05-27-69	0.24
09-29-60	0.03	05-06-71	c0.19
09-20-61	b0.04	09-22-71	0.11
09-27-61	0.05	03-12-74	0.12
02-08-63	0.05	11-05-74	0.08
02-22-63	0.05	09-24-75	0.10
05-13-64	b0.10	11-24-76	c0.14
06-14-65	a0.17		

a, includes surface runoff
b, revision
c, not previously published

16959000 Visa Stream at Aumi.

Location.--Lat 14°17'27"S., 170°38'36"W., 100 ft upstream from highway bridge and 0.2 mile east of Aumi.

Drainage area.--0.16 mi²   Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1957-58, 1963-64, 1968-71, 1974-77.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.11	15.6
7-day, 10-year low	0.05	21.3
Mean	0.84	20.8
Median	0.37	13.6

Basis of estimate.--Moments approach with station 16912000.

Remarks.--Operated as a daily record station from April 1957 to June 1958. Diversion for domestic use upstream of site at altitude 200 ft starting in 1974 and at altitude 50 ft after period of record.

List of measurements: total of 18.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
04-08-57	c0.37	05-27-69	0.23
04-12-57	c1.12	09-11-70	0.26
04-25-57	c0.46	05-06-71	c0.51
02-08-63	b0.30	09-22-71	0.13
02-22-63	b0.27	03-12-74	0.34
05-22-64	0.65	11-05-74	0.10
05-02-68	0.56	09-24-75	0.14
10-03-68	0.19	09-21-76	0.04
05-20-69	0.49	11-24-76	c0.13

b, revision
c, not previously published

16960500   Alega Stream tributary at Alega.

Location.--Lat 14°16'57"S., long 170°38'16"W., 300 ft upstream from mouth and 0.2 mile north of Alega.

Drainage area.--0.04 mi^2.   Tributary to.--Alega Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1967-69, 1974, 1976.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.15	14.6
7-day, 10-year low	0.08	19.5
Mean	0.40	21.3
Median	0.26	12.7

Basis of estimate.--Moments approach with stations 16912000 and 16960000.

List of measurements: total of 19.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
11-03-58	c0.14	05-20-64	a1.02
08-03-59	c0.19	06-17-65	0.59
08-11-59	c0.16	05-26-67	0.32
09-21-60	c0.21	05-02-68	0.39
09-29-60	c0.21	10-03-68	c0.05
09-22-61	b0.30	05-20-69	0.31
09-27-61	0.17	08-13-74	0.12
02-08-63	0.19	09-16-74	0.10
02-14-63	0.22	10-07-75	0.15
05-15-64	b0.38		

a, includes surface runoff
b, revision
c, not previously published

16961000   Mulioevai Stream at Auto.

Location.--Lat 14°16'37"S., long 170°37'54"W., 400 ft downstream from
    unnamed tributary, 0.5 mile northwest of Auto, and 0.5 mile upstream
    from mouth (revision).

Drainage area.--0.22 mi².   Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-69, 1974, 1976.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.16	13.4
7-day, 10-year low	0.08	18.5
Mean	1.01	14.4
Median	0.48	10.1

Basis of estimate.--Moments approach with station 16912000.

Remarks.--Stream observed dry downstream of site in 1974.

List of measurements: total of 16.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
11-03-58	0.27	05-15-64	0.87
08-03-59	0.38	05-20-64	0.98
09-22-60	b0.35	06-17-65	a1.67
09-29-60	0.28	05-02-68	0.76
09-22-61	0.16	05-23-69	0.57
09-29-61	0.16	08-19-74	0.22
02-08-63	b0.38	08-19-74	0.21
02-14-63	0.40	09-21-76	0.13

a, includes surface runoff
b, revision

16962000 Laloi Stream at Amouli.

Location.--Lat 14°16'43"S., long 170°35'16"W., 0.2 mile upstream from Fusiloa Stream and 0.3 mile west of Amouli.

Drainage area.--0.09 mi^2.   Tributary to.--Fusiloa Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1969, 1971, 1974.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.03	18.1
7-day, 10-year low	0.01	24.9
Mean	0.32	17.6
Median	0.12	13.1

Basis of estimate.--Moments approach with station 16912000.

List of measurements: total of 16.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-29-58	0.08	02-21-63	b0.07
07-29-59	0.03	05-15-64	0.22
08-11-59	0.04	05-22-64	0.32
09-22-60	0.06	06-16-65	e0.54
09-29-60	b0.04	05-21-69	0.14
09-21-61	b0.04	10-16-70	0.07
09-29-61	0.02	09-22-71	0.06
02-08-63	0.11	03-11-74	0.15

b, revision
e, may include surface runoff

16963000 Televai Stream at Amouli.

Location.--Lat 14°16'25"S., long 170°34'55"W., 50 ft downstream from unnamed tributary, 0.1 mile upstream from Tuavaa Stream, and 0.3 mile north of Amouli.

Drainage area.--0.10 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-71, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	24.8
7-day, 10-year low	<0.01	35.0
Mean	0.45	28.9
Median	0.11	18.9

Basis of estimate.--Moments approach with station 16912000.

List of measurements: total of 20.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-17-58	0.06	05-22-64	b0.27
07-29-59	0.03	06-16-65	a0.42
08-11-59	0.04	05-10-68	0.22
09-22-60	0.02	05-21-69	0.11
09-29-60	b0.04	09-12-70	0.10
09-21-61	b0.01	10-02-70	0.16
09-29-61	0.03	10-28-70	0.06
02-08-63	0.09	03-11-74	0.22
02-21-63	0.06	11-12-74	0.01
05-15-64	0.23	11-11-75	0.02

a, includes surface runoff
b, revision

16964000   Leafu Stream at Auasi.

Location.--Lat 14°16'28"S., long 170°34'26"W., 0.1 mile north of Auasi
    and 0.2 mile upstream from mouth.

Drainage area.--0.12 mi^2 Tributary to.--Pacific Ocean

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968-71, 1976, 1981, 1983, 1985.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.05	19.7
7-day, 10-year low	0.02	28.7
Mean	0.24	18.2
Median	0.12	13.2

Basis of estimate.--Moments approach with 16960000.

List of measurements: total of 20.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-29-58	0.08	05-22-64	b0.30
07-30-59	0.11	06-16-65	ab0.47
08-11-59	b0.10	05-07-68	0.26
09-22-60	0.09	05-23-69	0.26
09-28-60	0.06	09-15-70	0.07
09-21-61	0.06	10-06-70	0.05
09-29-61	0.06	10-01-75	0.06
02-07-63	b0.10	09-21-81	0.05
02-21-63	0.11	10-20-82	0.04
05-14-64	b0.27	09-06-85	0.01

a, includes surface runoff
b, revision

16965000 Vaialili Stream at Alao.

Location.--Lat 14°16'15"S., long 170°34'08"W., 0.2 mile upstream from Vaifusi Stream and 0.5 mile southwest of Alao.

Drainage area.--0.10 mi^2 Tributary to.--Mulivaitele Stream.

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1970-71, 1974-76.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.03	17.2
7-day, 10-year low	0.02	26.9
Mean	0.14	19.3
Median	0.08	12.3

Basis of estimate.--Graphical correlation with station 16912000.

List of measurements: total of 18.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-28-58	0.06	05-14-64	b0.12
07-29-59	0.05	05-18-64	f0.09
08-11-59	0.07	06-15-65	ab0.38
09-21-60	0.06	05-02-68	0.20
09-28-60	b0.04	09-15-70	0.07
09-21-61	b0.04	10-06-70	0.06
09-28-61	0.03	07-15-74	b0.05
02-07-63	0.11	09-30-75	0.07
02-18-63	b0.10	09-13-76	0.03

a, includes surface runoff
b, revision
f, surface runoff at index station on this date

16966000   Vaifusi Stream at Alao.

Location.--Lat 14°16'08"S., long 170°34'05"W., 400 ft upstream from mouth and 0.3 mile west of Alao.

Drainage area.--0.02 mi²   Tributary to.--Vaialiti Stream

Type of site.--Low-flow partial-record station.

Period of record.--1959-61, 1963-65, 1968, 1970, 1974-75.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	0.01	22.0
7-day, 10-year low	<0.01	38.8
Mean	0.03	23.5
Median	0.02	17.1

Basis of estimate.--Graphical correlation with station 16960000.

List of measurements: total of 17.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
10-28-58	0.02	05-14-64	b0.02
07-29-59	0.02	05-18-64	0.02
08-11-59	0.01	06-15-65	e0.05
09-21-60	0.03	05-02-68	0.03
09-28-60	b0.01	09-15-70	0.01
09-21-61	b0.01	07-15-74	0
09-28-61	0.02	11-13-74	0.01
02-07-63	0.02	09-30-75	0.01
02-18-63	0.02		

b, revision
e, may include surface runoff

Table 4. Low-flow characteristics for miscellaneous sites on Tutuila, American Samoa

1. Right Bank tributary to Vaitolu Stream near Aoa.

Location.--Lat 14°16'20"S., long 170°35'32"W., 10 ft upstream from mouth, which is at Vaitolu Stream gaging station (16906000) and 0.7 mile southwest of Aoa.

Drainage area.--0.02 mi²   Tributary to.--Vaitolu Stream.

Type of site.--Miscellaneous site.

Period of record.--1969.

Streamflow characteristic	Discharge ft³/s	Accuracy %SE
7-day, 2-year low	<0.01	20.3
7-day, 10-year low	0	25.4
Mean	0.05	43.8
Median	0.02	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.175 computed using station 16912000 as index station with the 2-7-69 streamflow measurement.

List of measurements: total of 4.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
10-31-68	0.06	03-11-69	0.02
02-07-69	0.01	09-03-69	0.07

2. Vaitolu Stream upstream of village intake near Aoa.

Location.--Lat 14°16'18"S., long 170°35'34"W., 250 ft upstream from gaging station 16906000 and right bank tributary, and 0.7 mile southwest of Aoa.

Drainage area.--0.15 mi^2 Tributary to.--Pacific Ocean

Type of site.--Miscellaneous site.

Period of record.--1969.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.08	48.6
7-day, 10-year low	0.05	77.5
Mean	0.29	28.8
Median	0.17	18.8

Basis of estimate.--Graphical correlation with station 16912000.

Remarks.--Site used in regional regression.

List of measurements: total of 9.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-09-68	f0.05	06-30-69	0.11
10-31-68	0.24	07-23-69	0.24
12-10-68	0.17	09-03-69	0.52
02-07-69	0.13	09-30-69	0.14
03-11-69	0.19		

f, surface runoff at index station on this date

3. Tuavaa Stream tributary No. 1.

Location.--Lat 14°16'31" S., long 170°34'57" W., 10 ft upstream from confluence with Televai Stream and 0.2 mile northwest of Amouli.

Drainage area.-- <0.01 mi^2 Tributary to.--Tuavaa Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Low-Flow frequency.--None computed, drainage area outside applicable range for region 1 equations (table 6 and 7). Stream is not perennial at site.

Remarks.--Previously published as Tuavaa Stream No. 4.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
01-05-71	0.10

4. Tuavaa Stream tributary No. 2.

Location.--Lat 14°16'31" S., long 170°34'58" W., 30 ft upstream from confluence with Televai Stream and 0.2 mile northwest of Amouli.

Drainage area.-- <0.01mi^2 Tributary to.--Tuavaa Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Low-Flow frequency.--None computed, drainage area outside applicable range for region 1 equations (table 6 and 7). Stream is not perennial at site.

Remarks.--Previously published as Tuavaa Stream No. 3

List of measurements: total of 1.

Date	Discharge (ft^3/s)
01-05-71	0.09

5. Tuavaa Stream at altitude 100 feet at Amouli.

Location.--Lat 14°16'32"S., long 170°35'01"W., 400 ft upstream from confluence with Televai Stream and 0.2 mile northwest of Amouli.

Drainage area.--<0.01 mi^2 Tributary to.--Televai Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Low-flow frequency.--None computed, drainage area outside applicable range for region 1 equations (tables 6 and 7).

Remarks.--Previously published as Tuavaa Stream No. 1.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
01-05-71	0.08

6.   Tuavaa Stream near mouth at Amouli.

Location.--Lat 14°16'32"S., long 170°34'58"W., 200 ft upstream from
         confluence with Televai Stream and 0.2 mile northwest of
         Amouli.

Drainage area.--0.04 mi^2 Tributary to.--Televai Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	95.2
7-day, 10-year low	0.01	110
Mean	0.12	62.6
Median	0.05	66.5

Basis of estimate.--Equations in table 6.

Remarks.--Previously published as Tuavaa Stream No. 2.   Single
    measurement is not base-flow, so equations in table 7 not used. For
    equations in table 6, GA = 80 ft and BR = 325 ft.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
01-05-71	a0.26

a, includes surface runoff

7. Fusiloa Stream at Amouli.

Location.--Lat 14°16'37"S., long 170°35'09"W., 800 ft upstream from
        confluence with Laloi Stream and 0.3 miles northwest of Amouli.

Drainage area.--0.07 mi^2 Tributary to.--Laloi Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.04	20.3
7-day, 10-year low	0.02	25.4
Mean	0.32	43.8
Median	0.13	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.65 computed using station 16912000 as
    index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
09-22-71	0.04

8.   Lausaa Stream at Vatia.

Location.--Lat 14°15'30"S., long 170°40'25"W., 1000 ft upstream from Faatafe Stream and 0.15 mile south of Vatia.

Drainage area.--0.17 mi^2 Tributary to.--Faatafe Stream.

Type of site.--Miscellaneous site.

Period of record.--1972.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.05	20.3
7-day, 10-year low	0.02	25.4
Mean	0.51	43.8
Median	0.20	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.33 computed using station 16912000 as index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
10-01-71	0.05

9.   Vaipito Stream above Fitiuli Stream at Pago Pago.

Location.--Lat 14°16'58"S., long 170°42'18"W., 0.4 mile upstream from
         mouth and 50 ft above confluence with Fitiuli Stream
         (revision).

Drainage area.--Not computed.   Tributary to.--Pago Pago Harbor.

Type of site.--Miscellaneous site.

Period of record.--1988.

Low-flow frequency.--None computed, municipal and domestic diversions
     upstream of site.

List of measurements: total of 1.

     Date   Discharge (ft^3/s)
06-28-88   1.30

10.   Vaipito Stream below Fitiuli Stream at Pago Pago.

Location.--Lat 14°16'57"S., long 170°42'17"W., 0.4 mile upstream from
         mouth and 20 ft below confluence with Fitiuli Stream.

Drainage area.--Not computed.   Tributary to.--Pago Pago Harbor.

Type of site.--Miscellaneous site.

Period of record.--1963.

Low-flow frequency.--None computed, municipal and domestic diversions
     upstream of site.

List of measurements: total of 1.

     Date   Discharge (ft^3/s)
05-17-63   c1.59

c, not previously published

11. Vaipito Stream above Pago Stream at Pago Pago.

Location.--Lat 14°16'51" S., long 170°42'15" W., 0.3 mile upstream from mouth and 100 ft above confluence with Pago Stream.

Drainage area.--Not computed. Tributary to.--Pago Pago Harbor.

Type of site.--Miscellaneous site.

Period of record.--1963.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

List of measurements: total of 1.

Date	Discharge (ft³/s)
05-17-63	c1.82

c, not previously published

12. Vaipito Stream at altitude 20 feet at Pago Pago.

Location.--Lat 14°16'48" S., long 170°42'14" W., 100 ft above pump house, 200 ft below Pago Stream, and 0.2 mile southwest of highway junction in Pago Pago.

Drainage area.--Not computed. Tributary to.--Pago Pago Harbor.

Type of site.--Miscellaneous site.

Period of record.--1968.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

List of measurements: total of 1.

Date	Discharge (ft³/s)
09-26-68	0.82

13. Vaipito Stream below Pago stream at Pago Pago.

Location.--Lat 14°16'47"S., long 170°42'14"W., 150 ft below pump house, 450 ft below Pago Stream, and 0.2 mile southwest of highway junction in Pago Pago.

Drainage area.--Not computed.   Tributary to.--Pago Pago Harbor.

Type of site.--Miscellaneous site.

Period of record.--1968.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
09-26-68	0.40

14.   Vaipito Stream near highway bridge at Pago Pago.

Location.--Lat 14°16'44"S., long 170°42'06"W., 600 ft upstream from mouth and 100 ft above highway junction in Pago Pago.

Drainage area.--Not computed.   Tributary to.--Pago Pago Harbor.

Type of site.--Miscellaneous site.

Period of record.--1963.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-17-63	c2.11

c, not previously published

15. Leau Stream at Pago Pago.

Location.--Lat 14°17'09"S., long 170°42'32"W., 10 ft upstream from confluence with Vaipito Stream and 1.8 miles west of Utulei High School.

Drainage area.--0.03 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.02	20.3
7-day, 10-year low	0.01	25.4
Mean	0.16	43.8
Median	0.06	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.70 computed using station 16912000 as index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
08-09-71	0.06

16. Right Branch Aga Stream at Pago Pago.

Location.--Lat 14°17'08"S., long 170°42'04"W., 50 ft upstream from
   confluence with Left Branch Aga Stream at altitude 210 ft and
   1.3 miles west of Utulei High School.

Drainage area.--0.05 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1967.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.01	20.3
7-day, 10-year low	<0.01	25.4
Mean	0.09	43.8
Median	0.03	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.11 computed using station 16912000 as
 index station. Not previously published.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-29-67	c0.02

c, not previously published

17. Left Branch Aga Stream at Pago Pago.

Location.--Lat 14°17'09"S., long 170°42'04"W., 200 ft upstream from
          confluence with Right Branch Aga Stream at altitude 240 ft and
          1.3 miles west of Utulei High School.

Drainage area.--0.11 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1967.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.11	20.3
7-day, 10-year low	0.05	25.4
Mean	0.65	43.8
Median	0.31	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 1.14 computed using station 16912000 as
     index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-29-67	c0.48

c, not previously published

18.   Aga Stream at Pago Pago.

Location.--Lat 14°17'06"S., long 170°42'07"W., at altitude 160 ft and 1.3
        miles west of Utulei High School.

Drainage area.--0.17 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1967.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.15	20.3
7-day, 10-year low	0.07	25.4
Mean	0.91	43.8
Median	0.43	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 1.03 computed using station 16912000 as
    index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-29-67	c0.67

c, not previously published

19. Fitiuli Stream above Aga Stream at Pago Pago.

Location.--Lat 14°17'04"S., long 170°42'12"W., 10 ft upstream from confluence with Aga Stream and 1.4 miles west of Utulei High School.

Drainage area.--0.05 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.08	24.3
7-day, 10-year low	0.04	30.6
Mean	0.41	44.0
Median	0.20	22.4

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 1.82 computed using station 16912000 as index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
08-09-71	c0.26

c, not previously published

20. Fitiuli Stream below Aga Stream at Pago Pago.

Location.--Lat 14°17'03"S., long 170°42'16"W., 500 ft upstream from confluence with Vaipito Stream and 1.4 miles west of Utulei High School.

Drainage area.--0.26 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1969, 1988.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.20	20.3
7-day, 10-year low	0.09	25.4
Mean	1.28	43.8
Median	0.61	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.94 computed using station 16912000 as index station and 6-28-88 measurement.

List of measurements: total of 2.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-27-69	c0.61	06-28-88	c0.36

c, not previously published

21. Fitiuli Stream above Vaipito Stream at Pago Pago.

Location.--Lat 14°16'59"S., long 170°42'17"W., 100 ft upstream from confluence with Vaipito Stream, 0.5 mile southeast of Pago Pago Harbor and 0.55 mile west of Mt. Sione (revision).

Drainage area.--0.27 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1988.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.24	20.3
7-day, 10-year low	0.11	25.4
Mean	1.42	43.8
Median	0.70	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 1.08 computed using station 16912000 as index station and 6-28-88 measurement.

List of measurements: total of 2.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
06-28-88	0.43	07-13-88	0.49

22.   Pago Stream at Pago Pago.

Location.--Lat 14°16'50"S., long 170°42'15"W., 60 ft upstream from
           confluence with Vaipito Stream, 0.3 mile southeast of Pago Pago
           Harbor and 1.5 mile west of Utulei High School.

Drainage area.--0.11 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1963.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.03	20.3
7-day, 10-year low	0.01	25.4
Mean	0.30	43.8
Median	0.11	21.8

Basis of estimate.--Equations in table 7.

Remarks.--Base-flow index of 0.25 computed using station 16912000 as
     index station.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-17-63	c0.08

c, not previously published

23. Utumoa Stream at altitude 400 ft.

Location.--Lat 14°17'30"S., long 170°42'20"W., 0.50 mile upstream from confluence of Vaipito Stream and 0.37 mile northwest of Fagaalu Reservoir.

Drainage area.--0.12 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1989-90.

Low-flow frequency.--None computed, municipal diversion upstream of site.

List of measurements: total of 3.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-24-89	c0.15	08-23-90	c0.09
08-23-89	c0.06		

c, not previously published

24.   Utumoa Stream at altitude 380 ft.

Location.--Lat 14°17'27"S., long 170°42'21"W., 0.45 mile upstream from confluence of Vaipito Stream and 0.44 mile northwest of Fagaalu Reservoir.

Drainage area.--0.14 mi^2 Tributary to.--Vaipito Stream.

Type of site.--Miscellaneous site.

Period of record.--1989-90.

Low-flow frequency.--None computed, municipal diversion upstream of site.

List of measurements: total of 3.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-24-89	c0.20	08-23-90	c0.07
08-23-89	c0.12		

c, not previously published

25. Fagaalu Stream above Virgin Pool.

Location.--Lat 14°17'35"S., long 170°41'48"W., 500 ft upstream from
          Virgin Pool and 1.1 mile southwest of Utulei High School.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1963, 1968.

Low-flow frequency.--None computed, municipal diversion upstream of
site.

List of measurements: total of 2.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
05-15-63	c0.33	10-01-68	c0.05

c, not previously published

26. Fagaalu Stream 200 ft below Virgin Pool.

Location.--Lat 14°17'34"S., long 170°41'41"W., 200 ft downstream from
          Virgin Pool and 1.0 mile southwest of Utulei High School.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1967-68.

Low-flow frequency.--None computed, municipal diversion upstream of
site.

List of measurements: total of 2.

Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
05-28-67	c0.64	10-01-68	c0.06

c, not previously published

27. Fagaalu Stream 700 ft below Virgin Pool.

Location.--Lat 14°17'35"S., long 170°41'38"W., 700 ft upstream from Virgin Pool at altitiude 360 ft and 1.0 mile southwest of Utulei High School.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1963.

Low-flow frequency.--None computed, municipal diversion upstream of site.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-15-63	c0.55

c, not previously published

28. Fagaalu Stream 1,200 ft below Virgin Pool.

Location.--Lat 14°17'37"S., long 170°41'36"W., 1,200 ft downstream from Virgin Pool and 0.8 mile upstream from mouth.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1963.

Low-flow frequency.--None computed, municipal diversion upstream of site.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-15-63	c0.78

c, not previously published

29. Fagaalu Stream below Station 16949500.

Location.--Lat 14°17'40"S., long 170°41'18"W., 400 ft downstream from Station 16949500 at altitude 120 ft and 0.4 mile upstream from mouth.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1963.

Low-flow frequency.--None computed, municipal diversion upstream of site.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-15-63	c0.93

c, not previously published

30. Fagaalu Stream 450 ft above mouth at Fagaalu.

Location.--Lat 14°17'47"S., long 170°41'00"W., 450 ft above mouth at Fagaalu.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1966.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

Remarks.--Previously published as Fagaalu Stream No. 1 at Fagaalu

List of measurements: total of 1.

Date	Discharge (ft^3/s)
06-19-66	5.32

31. Fagaalu Stream 350 ft above mouth at Fagaalu.

Location.--Lat 14°17'47"S., long 170°40'59"W., 350 ft above mouth at Fagaalu.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1966.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

Remarks.--Previously published as Fagaalu Stream No. 2 at Fagaalu.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
06-19-66	4.53

32. Fagaalu Stream 200 ft above mouth at Fagaalu.

Location.--Lat 14°17'47"S., long 170°40'57"W., 200 ft above mouth at Fagaalu.

Drainage area.--Not computed.   Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1966.

Low-flow frequency.--None computed, municipal and domestic diversions upstream of site.

Remarks.--Previously published as Fagaalu Stream No. 3 at Fagaalu.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
06-19-66	4.89

33.   Afuelo Stream above station 16948000.

Location.--Lat 14°18'06"S., long 170°41'08"W., 20 ft above village intake
          system, 100 ft upstream of gaging station 16948000, 0.2 mile
          northwest of Matuu, and 0.3 mile upstream from mouth
          (revision).

Drainage area.--0.24 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1983, 1987, 1989-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.06	20.3
7-day, 10-year low	0.02	25.4
Mean	1.48	43.8
Median	0.63	21.8

Basis of estimate.--Equations in table 7, with the mean and median flow
    estimates being adjusted to correspond to the pre-diversion mean and
    median flow at 16948000.

Remarks.--Base-flow index of 0.29 computed using station 16948000 as
    index station with the 10-26-82 streamflow measurement.

List of measurements: total of 6.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
10-26-82	0.08	07-30-87	g0.02
07-13-83	0.09	08-16-89	0.09
08-18-83	0.07	08-07-90	g0.02

g, measurement made below diversion

34. Puna Stream tributary at Mapusagafou.

Location.--Lat 14°19'17"S., long 170°44'56"W., at mouth of confluence with Puna Stream, 0.6 mile northwest of Mapusaga High School, and 1.2 miles east of Aoloaufou School (revision).

Drainage area.-- <0.01 mi^2 Tributary to.--Puna Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Low-flow frequency.--No estimates made, drainage area outside of applicable limits. Stream is not perennial at site.

Remarks.--Stream goes dry during the dry season.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
03-08-71	b0.22

b, revision

35.   Puna Stream at Mapusagafou.

Location.--Lat 14°19'17"S., long 170°44'56"W., 700 ft upstream from
        confluence with Leaveave Stream and 0.7 mile northeast of
        Mapusagafou (revision).

Drainage area.--0.08 mi^2 Tributary to.--Leaveave Stream.

Type of site.--Miscellaneous site.

Period of record.--1971.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.09	13.7
7-day, 10-year low	0.04	13.3
Mean	0.46	35.2
Median	0.28	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 1.27 computed using station 16920500 as
    index station with the 8-2-71 streamflow measurement. Basin slope is
    4,260 ft/mile.

List of measurements: total of 2.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
03-08-71	0.33	08-02-71	0.08

36.   Leaveave Stream.

Location.--Lat 14°19'16"S., long 170°44'58"W., 25 ft downstream of
          confluence with Puna Stream, 0.7 mile northwest of Mapusaga
          High School and 1.2 miles east of Aoloaufou School (revision).

Drainage area.--0.25 mi^2 Tributary to.--N/A.

Type of site.--Miscellaneous site.

Period of record.--1971.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.19	13.7
7-day, 10-year low	0.08	13.3
Mean	1.23	35.2
Median	0.70	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 0.80 computed using station 16920500 as
     index station. Basin slope is 3,630 ft/mile.

Remarks.--

List of measurements: total of 1.

Date	Discharge (ft^3/s)
08-18-71	0.11

37. Tafeta Stream.

<u>Location</u>.--Lat 14°19'12"S., long 170°45'08"W., 0.2 mile upstream from confluence with Leaveave Stream and 0.6 mile north of Mapusagafou.

<u>Drainage area</u>.--0.09 mi^2.   <u>Tributary to</u>.--Leaveave Stream.

<u>Type of site</u>.--Miscellaneous site.

<u>Period of record</u>.--1971.

<u>Low-flow frequency</u>.--None computed. Stream is not shown on USGS Tutuila topographic map. Unknown if stream is perennial.

<u>List of measurements</u>: total of 1.

Date	Discharge (ft^3/s)
08-18-71	0.08

38. Leafu Stream at altitude 160 ft at Leone.

<u>Location</u>.--Lat 14°19'49"S., long 170°46'55"W., 0.9 mile north of St. Theresa Girl's School at Leone and 1.4 mile northeast of Atauloma School at Afao (revision).

<u>Drainage area</u>.--Not computed.   <u>Tributary to</u>.--Pacific Ocean

<u>Type of site</u>.--Miscellaneous site.

<u>Period of record</u>.--1971.

<u>Low-flow frequency</u>.--None computed. Municipal diversion upstream of site.

<u>List of measurements</u>: total of 1.

Date	Discharge (ft^3/s)
08-05-71	0.58

39. Leafu Stream at altitude 360 ft near Leone.

Location.--Lat 14°19'38"S., long 170°46'56"W., 900 ft above village
        catchment, 800 ft above partial-record station 16934000, and
        1.2 miles northeast of Leone (revision).

Drainage area.--0.66 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1969, 1977-78.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.78	13.7
7-day, 10-year low	0.35	13.3
Mean	4.23	35.2
Median	2.67	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 1.80 computed using an average from stations
    16920500 and 16931000 as index stations with the 7-12-78 streamflow
    measurement. Basin slope is 4,970 ft/mile.

List of measurements: total of 5.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-24-69	ca3.73	07-12-78	c0.88
07-13-77	e2.85	07-19-78	c0.81
08-19-77	0.66		

a, includes surface runoff
c, not previously published
e, may include surface runoff

40. Leafu Stream above 2nd unnamed tributary to Leafu Stream.

Location.--Lat 14°19'35"S., long 170°46'54"W., 1,100 ft above village catchment at altitude 365 ft and 1.3 miles northeast of Leone (revision).

Drainage area.--0.50 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1977, 1981-83, 1987, 1989-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.70	22.7
7-day, 10-year low	0.26	44.9
Mean	5.80	61.9
Median	2.70	39.1

Basis of estimate.--Graphical correlation with station 16931000.

Remarks.--Site used in regression analysis.

List of measurements: total of 11.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-13-77	be2.34	08-09-83	0.44
08-19-77	0.10	06-02-87	0.86
08-03-81	be4.18	09-02-87	1.02
10-01-81	b1.57	08-15-89	0.85
04-20-82	1.27	08-07-90	0.60
07-14-83	0.63		

b, revision
e, may include surface runoff

41. 2nd unnamed tributary to Leafu Stream.

Location.--Lat 14°19'35"S., long 170°46'57"W., 300 ft above confluence
with Leafu Stream at altitude 390 ft and 1.3 miles northeast
of Leone.

Drainage area.--0.14 mi^2 Tributary to.--Leafu Stream.

Type of site.--Miscellaneous site.

Period of record.--1977, 1983.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.15	13.7
7-day, 10-year low	0.06	13.3
Mean	0.79	35.2
Median	0.48	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 1.21 computed using an average from stations
16920500 and 16931000 as index stations with the 8-9-83 streamflow
measurement. Basin slope is 4,100 ft/mile.

List of measurements: total of 3.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-13-77	0.50	08-09-83	0.07
08-19-77	0.53		

42. Leafu Stream below 1st unnamed tributary near Leone.

Location.--Lat 14°19'33"S., long 170°46'52"W., 1,500 ft upstream of
            village catchment and 1.3 miles northeast of Leone.

Drainage area.--0.48 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1977-78.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.63	13.7
7-day, 10-year low	0.29	13.3
Mean	3.15	35.2
Median	2.05	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 2.12 computed using an average from stations
    16920500 and 16931000 as index stations with the 7-12-78 streamflow
    measurement. Basin slope is 4,810 ft/mile.

List of measurements: total of 4.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-13-77	be1.56	07-12-78	c0.75
08-19-77	0.32	07-19-78	c0.55

b, revision
c, not previously published
e, may include surface runoff

43. 1st unnamed tributary to Leafu Stream near Leone.

Location.--Lat 14°19'31"S., long 170°46'52"W., 0.2 mile above village
    catchment and 1.3 miles northeast of Leone (revision).

Drainage area.--0.14 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1977-78.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.13	11.9
7-day, 10-year low	0.06	23.4
Mean	0.70	9.3
Median	0.49	8.6

Basis of estimate.--Graphical correlation with station 16920500.

Remarks.--Site used in regional regression analysis.

List of measurements: total of 21.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
07-13-77	f0.10	06-30-78	c0.18
08-19-77	0.01	07-12-78	c0.11
01-11-78	ac1.26	07-19-78	c0.11
02-08-78	ac1.23	08-14-78	ac1.28
03-07-78	c0.26	09-11-78	c0.43
03-31-78	ac1.14	09-18-78	c0.36
04-26-78	c0.32	09-26-78	c0.28
05-03-78	c0.94	10-02-78	c0.18
05-10-78	ac0.96	10-16-78	c0.60
06-07-78	c0.37	11-06-78	c0.79
06-26-78	c0.25		

a, includes surface runoff
c, not previously published
f, surface runoff at index station on this data

44. Vaipuna Stream at Highway crossing at Amaluia.

Location.--Lat 14°20'18"S., long 170°47'27"W., 100 ft upstream of highway crossing at Amaluia and 0.6 miles northwest of Leone.

Drainage area.--0.35 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1969.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.36	13.7
7-day, 10-year low	0.15	13.3
Mean	2.07	35.2
Median	1.24	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 1.26 computed using station 16931000 as index station. Basin slope is 4,760 ft/mile. Domestic diversion above site observed in 1975.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-26-69	1.40

45. Asili Stream at altitude 270 ft at Asili.

Location.--Lat 14°19'34"S., long 170°47'40"W., at altitude 270 ft and 0.5
        mile north of Asili (revision).

Drainage area.-0.33 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1967.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.38	34.2
7-day, 10-year low	0.17	37.5
Mean	2.00	36.5
Median	1.21	29.8

Basis of estimate.--Equations in table 8.

Remarks.--Single measurement not base flow, so equations in table 9 not
    used. Gage altitude is 270 ft, basin slope is 4,900 ft/mi.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-25-67	a2.17

a, includes surface runoff

46. Asili Stream at altitude 190 ft at Asili.

Location.--Lat 14°19'41"S., long 170°47'44"W., at altitude 190 ft and 0.5
        mile north of Asili.

Drainage area.--0.35 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1967, 1977-79, 1982-85, 87, 1989-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.30	27.6
7-day, 10-year low	0.14	50.3
Mean	1.60	42.3
Median	1.10	33.3

Basis of estimate.--Graphical correlation with station 16920500.

Remarks.--Measurements from 10-28-82 through 08-07-90 were previously
    published under station 16932000 heading. Site used in regional
    regression analysis.

List of measurements: total of 13.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-25-67	ac2.00	07-12-83	b0.24
07-14-77	a2.50	08-09-83	b0.18
08-18-77	0.43	08-13-85	b0.53
07-11-78	c0.06	06-05-87	b0.32
07-18-78	c0.65	08-15-89	b0.52
10-03-78	c0.50	08-07-90	b0.33
10-28-82	b0.80		

a, includes surface runoff
b, revision
c, not previously published

47. Unnamed tributary to Asili Stream at Asili.

Location.--Lat 14°19'42"S., long 170°47'46"W., 200 ft above confluence
with Asili Stream and 0.5 mile northwest of Asili.

Drainage area.--0.17 mi^2 Tributary to.--Asili Stream.

Type of site.--Miscellaneous site.

Period of record.--1977-79, 1983, 1987-90.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.06	13.7
7-day, 10-year low	0.02	13.3
Mean	0.73	35.2
Median	0.29	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 0.14 computed using 08-15-89 measurement
and station 16931000 as index station. Basin slope is 6,300 ft/mile.
Correlation coefficient with station 16931000 less than 0.50 so
graphical correlation method was not used.

List of measurements: total of 14.

Date	Discharge (ft^3/s)	Date	Discharge (ft^3/s)
05-25-69	ac0.60	07-12-83	0.09
07-14-77	a0.60	08-09-83	0.08
08-18-77	0.09	06-05-87	0.03
07-11-78	c0.06	09-02-87	0.12
07-18-78	c0.07	09-28-88	0.02
10-03-78	c0.21	08-15-89	0.02
10-28-82	0.24	08-07-90	0.02

a, includes surface runoff
c, not previously published

48.   Asili Stream at altitude 60 ft at Asili.

Location.--Lat 14°19'57"S., long 170°47'40"W., at altitude 60 ft and 0.2
        mile north of Asili.

Drainage area.--0.64 mi^2 Tributary to.--Pacific Ocean.

Type of site.--Miscellaneous site.

Period of record.--1967.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.66	34.2
7-day, 10-year low	0.29	37.5
Mean	4.19	36.5
Median	2.53	29.8

Basis of estimate.--Equations in table 8.

Remarks.--Single measurement not base flow, so equations in table 9 not
    used. Gage altitude is 60 ft, basin slope is 5,920 ft/mi.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
05-25-67	a3.26

a, includes surface runoff

49. Fagalii Stream at Fagalii.

Location.--Lat 14°18'45"S. long 170°49'25"W., 600 ft upstream from mouth, and 100 ft downstream from left bank tributary (revision).

Drainage area.--0.38 mi^2 Tributary to.--Pacific Ocean

Type of site.--Miscellaneous site.

Period of record.--1970.

Streamflow characteristic	Discharge ft^3/s	Accuracy %SE
7-day, 2-year low	0.27	13.7
7-day, 10-year low	0.11	13.3
Mean	1.95	35.2
Median	1.06	21.6

Basis of estimate.--Equations in table 9.

Remarks.--Base-flow index of 0.68 computed using station 16931000 as index station. Basin slope is 4,530 ft/mile. Domestic diversion above site observed in 1975.

List of measurements: total of 1.

Date	Discharge (ft^3/s)
08-05-70	0.80