

U.S. Department of the Interior

Statistical Summary of Hydrologic and Water-Quality Data from the Halawa, Haiku, and Kaneohe Drainage Basins Before, During, and After H-3 Highway Construction, Oahu, Hawaii, 1983–99

U.S. GEOLOGICAL SURVEY

Open-File Report 01-64

Prepared in cooperation with the

STATE OF HAWAII DEPARTMENT OF TRANSPORTATION
and the FEDERAL HIGHWAY ADMINISTRATION



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By Michael F. Wong and Stacie T.M. Young

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Honolulu, Hawaii
2001

U.S. DEPARTMENT OF THE INTERIOR

Gale A. Norton, Secretary

U.S. GEOLOGICAL SURVEY

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CONTENTS

Abstract	1
Introduction	1
Purpose and Scope	2
Description of the Study Area	2
Acknowledgements.....	8
Methods of Hydrologic and Water-Quality Data Collection	8
Rainfall	8
Streamflow	10
Suspended Sediment.....	10
Water Quality	10
Statistical Summary of Hydrologic and Water-Quality Data	11
Rainfall	11
Streamflow	11
Suspended Sediment.....	13
Water Quality	13
References Cited	15

FIGURES

1–2. Maps showing:	
1. Selected stream-gaging stations and drainage basins in the H-3 Highway study area, Oahu, Hawaii	3
2. Haiku and Kaneohe drainage basins study area, Oahu, Hawaii.....	4
3. Block diagram showing typical drainage-basin shapes for Oahu, Hawaii.....	5
4. Flow-duration curves of daily flows for stations 16226200 North Halawa Stream and 16275000 Haiku Stream, 1983–99, Oahu, Hawaii	6
5. Diagram showing stream-gaging and water-quality stations in the Kaneohe drainage basin, Kaneohe, Oahu, Hawaii	9
6. Total annual rainfall at Haiku rain gage 839.3, Oahu, Hawaii, water years 1987–98	12
7. Total annual streamflow at station 16226200, North Halawa Stream near Honolulu, Oahu, Hawaii, water years 1983–99.....	14

TABLES

1. Chronology of construction activities, H-3 Highway construction project, 1983–99, Oahu, Hawaii,	17
2. Chronology of hydrologic and water-quality data-collection activities, H-3 Highway study area, Oahu, Hawaii. . .	18
3. Physiography of basin upstream from gaging stations in the H-3 Highway study area, Oahu, Hawaii	19
4. Average suspended-sediment particle-size analyses at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii	20
5. Total annual rainfall in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99.	20
6. Total annual streamflow at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99.	21
7. Total annual streamflow per unit area at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99	22
8. Summary of suspended-sediment concentrations at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99.	23
9. Total annual suspended-sediment loads at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99.	25
10. Total annual suspended-sediment loads per unit value of total streamflow at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99	26
11. Total annual suspended-sediment yields at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99	26
12–30. Statistical summary of selected water-quality data collected at station:	
12. 16226200, North Halawa Stream near Honolulu, Oahu, Hawaii, from May 1983 to March 1999.	27
13. 16227100, Halawa Stream below H-1, Oahu, Hawaii, from November 1988 to November 1998	30
14. 16265600, Right Branch Kamooolii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998	33
15. 16265700, Kamooolii Stream at alt 200 ft near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998	36
16. 16266500, Hooleinaiwa Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to February 1997	38
17. 16267500, Hooleinaiwa Stream above confluence with Kamooolii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998	40
18. 16269500, Kuou Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998	42
19. 16270900, Luluku Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998	44
20. 16272200, Kamooolii Stream below Luluku Stream near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998	47
21. 16273950, South Fork Kapunahala Stream at Kaneohe, Oahu, Hawaii, from May 1988 to April 1998 . .	50

22.	16274100, Kaneohe Stream below Kamehameha Highway at Kaneohe, Oahu, Hawaii, from November 1988 to August 1999	53
23.	16275000, Haiku Stream near Heeia, Oahu, Hawaii, from March 1983 to April 1998	56
24.	212335157482603, Waimaluhia Reservoir cross-section 1-3 (composite) near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	59
25.	212335157482603, Waimaluhia Reservoir cross-section 1-3 at 1 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	62
26.	212335157482603, Waimaluhia Reservoir cross-section 1-3 at 7 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	63
27.	212335157482603, Waimaluhia Reservoir cross-section 1-3 at 11 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	64
28.	212329157483102, Waimaluhia Reservoir cross-section 3-2 at 1 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	65
29.	212329157483102, Waimaluhia Reservoir cross-section 3-2 at 5 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	66
30.	212329157483102, Waimaluhia Reservoir cross-section 3-2 at 10 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998.	67
31.	Pesticides, herbicides, and polychlorinated compounds analyzed for at stream-gaging and water-quality stations in the H-3 Highway study area, Oahu, Hawaii, from February 1983 to August 1999	68
32.	Pesticides, herbicides, and polychlorinated compounds detected at stream-gaging and water-quality stations in the H-3 Highway study area, Oahu, Hawaii, from February 1983 to August 1999	69

CONVERSION FACTORS

Multiply	By	To obtain
Length		
inch (in)	2.54	centimeter
foot (ft)	0.3048	meter
Area		
acres	4,047	square meter
square mile (mi ²)	2.590	square kilometer
square mile (mi ²)	640	acres
Volume per unit time (includes flow)		
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second
cubic foot per second-days (ft ³ /s-days)	0.02832	cubic meter per second-days
Weight		
ton (ton)	0.9072	metric ton
ton per square mile (ton/mi ²)	0.3503	metric ton per square kilometer

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$^{\circ}\text{C}=(^{\circ}\text{F}-32)/1.8$$

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=1.8(^{\circ}\text{C}) + 32$$

Abbreviations used: $\mu\text{S}/\text{cm}$ @ 25°C, microsiemens per centimeter at 25°C
NTU, nephelometric turbidity units
0.7 μm -MF, 0.7-micron membrane-filter method
mg/L, milligrams per liter
 $\mu\text{g}/\text{L}$, micrograms per liter

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By Michael F. Wong and Stacie T.M. Young

Abstract

This report provides statistical summaries of rainfall, streamflow, suspended-sediment, and water-quality data collected in the Halawa, Haiku, and Kaneohe drainage basins before, during, and after construction of the H-3 Highway on the island of Oahu, Hawaii. Methods of data collection also are described. Data collected during water years 1983 through 1999 at eight streamflow and six stream water-quality gaging-stations, and two water-quality stations located in Waimaluhia Reservoir are included. Physiographic data for all basins contributing to the 14 stream stations as well as brief land-use descriptions of the Halawa, Haiku, and Kaneohe drainage basins are provided.

INTRODUCTION

The construction of the H-3 Highway across the Koolau Range on the island of Oahu, Hawaii (fig. 1) raised concerns over the potential effects of the construction on streamflow, sediment transport, and quality of surface water in the drainage basins affected by the construction. In 1983, the U.S. Geological Survey, in cooperation with the State of Hawaii Department of Transportation and the Federal Highway Administration, began a study of the streamflow, sediment, and water-quality characteristics of these surface waters. The purpose of this study was to determine if construction activities were affecting streams along the highway right-of-way, and if so, the magnitude and extent of

construction effects. Data collection was carried out before, during, and after construction of the H-3 Highway.

The H-3 Highway route traverses the drainage basins of Halawa and Haiku Streams and the tributaries of Kaneohe Stream (fig. 1). The H-3 extends from the H-1 Highway near the East Loch of Pearl Harbor on the leeward (southwestern) side of the Koolau Range to the Halekou Interchange on the windward (northeastern) side, where the H-3 connects to a previously constructed section of H-3 leading from Kamehameha Highway to Kaneohe Marine Corps Base-Hawaii. The completed H-3 Highway consists of part cut-and-fill and part viaduct sections in the lower North Halawa Valley, a viaduct through the upper North Halawa Valley, twin tunnels below the crest of the Koolau Range, a viaduct through the Haiku drainage basin, and a cut-and-fill section through the Kapunahala and Kamooolii drainage sub-basins of the Kaneohe drainage basin (U.S. Department of Transportation, Federal Highway Administration and State of Hawaii Department of Transportation, 1987). Highway construction affected from 3 to 11 percent of the drainage basin areas upstream of the stream-gaging stations discussed in this report.

Construction of the H-3 Highway proceeded in increments (table 1—all tables are at the end of the report). Construction was at times halted by court actions, and the planned route was modified to avoid sites of cultural importance. Access roads were built in the North Halawa and Haiku Valleys before construction of the highway. An exploratory tunnel was

excavated below the crest of the Koolau Range before the larger, traffic tunnels were excavated.

Erosion-control measures were used throughout construction of the H-3 Highway to reduce sediment delivery from construction areas in all affected drainage basins. These measures included erosion-cloth barriers installed on hillslopes and along channels, loose-rock check dams in channels, and hydromulching and installation of plastic netting on cut-and-fill slopes. Streamflow in several channel reaches in upper North Halawa Valley was diverted into culverts, which were then buried, during construction to prevent sediment disturbed by construction from reaching the stream. Sections of North Halawa Stream in the upper valley also were channelized as part of the highway construction.

Purpose and Scope

This report describes the Halawa, Haiku, and Kaneohe drainage basins, the methods used for hydrologic and water-quality data collection, and statistical summaries of the hydrologic and water-quality data collected during the 17-year (1983–99) study period. Data are presented for the Halawa (station 227100), North Halawa (stations 225800, 226000, and 226200), Haiku (station 275000), South Fork Kapunahala (station 273950), Kamooalii (stations 265600, 265700, 266500, 267500, 269500, 270900, and 272200), and Kaneohe (station 274100) drainage basins (figs. 1 and 2). Six-digit station numbers used in this report are abbreviated numbers. Complete station numbers are preceded by 16. For example, for station 225800 the complete number is 16225800. Water-quality data also are presented for two locations in the Waimaluha Reservoir. Different types of data were collected at various times at the above stations. Table 2 summarizes the dates that streamflow, suspended-sediment, and water-quality data were collected at the stations. This report updates a previously published statistical summary of data collected during water years 1983–89 (Wong and Hill, 1992).

Daily values of streamflow, suspended-sediment concentration, particle-size, and load, and instantaneous water-quality data, that are statistically summarized in this report, have been published in the U.S. Geological Survey's annual water-resources data reports for Hawaii, water years 1983 through 1999. For example see Hill and others (2000) for the water year 1999

report. A water year is a 12-month period that extends from October 1 through September 30 and is designated by the calendar year in which it ends.

Description of the Study Area

The study area for this report consists of the Halawa drainage basin on the leeward or western side of the Koolau Range (fig. 1) and the Haiku and Kaneohe drainage basins (fig. 2) on the windward or eastern side. In the Halawa drainage basin, most of the data were collected in the North Halawa drainage basin (fig. 1), while in the Kaneohe drainage basin, most of the data were collected in the South Fork Kapunahala and Kamooalii drainage basins (fig. 2). The Kamooalii drainage basin was further divided with extensive data collection in the Luluku and Right Branch Kamooalii drainage basins (fig. 2).

Physiography and lithology.--The Koolau Range is the eroded remnant of the larger and younger of the two major shield volcanoes that formed the island of Oahu (Visher and Mink, 1964). Much of the windward side of the original Koolau Volcano has been eroded, leaving a steep windward slope indented with short, broad, amphitheater-shaped valleys (Hinds, 1925). This is in sharp contrast to the gentle leeward slopes which are deeply dissected by long roughly linear valleys (fig. 3). Ridges on the leeward side approximate the original morphology of the Koolau volcanic dome (Wentworth, 1943). Selected physiographic data for the drainage basins upstream of the 14 gaging stations and Waimaluha Reservoir are listed in table 3. Physiographic measurements were made manually using the U.S. Geological Survey's 1983, 1:24,000 scale, 7.5 minute topographic quadrangle maps of Oahu. Values in table 3 show that the study drainage basins are all small in size and have steep channel gradients.

Lithology of the study area consists primarily of basalt that was extruded in numerous, gently dipping, thin (less than 10 ft) flows of aa and pahoehoe lava (Visher and Mink, 1964). These flows are intruded by near-vertical dikes in the rift zone near the crest of the present Koolau Range (Visher and Mink, 1964). More recent volcanic rocks are exposed in small areas on the windward side of the study area (Takasaki and others, 1969). The gently sloping lower parts of the windward drainage basins and the valley floor of the North Halawa drainage basin are overlain by alluvium derived

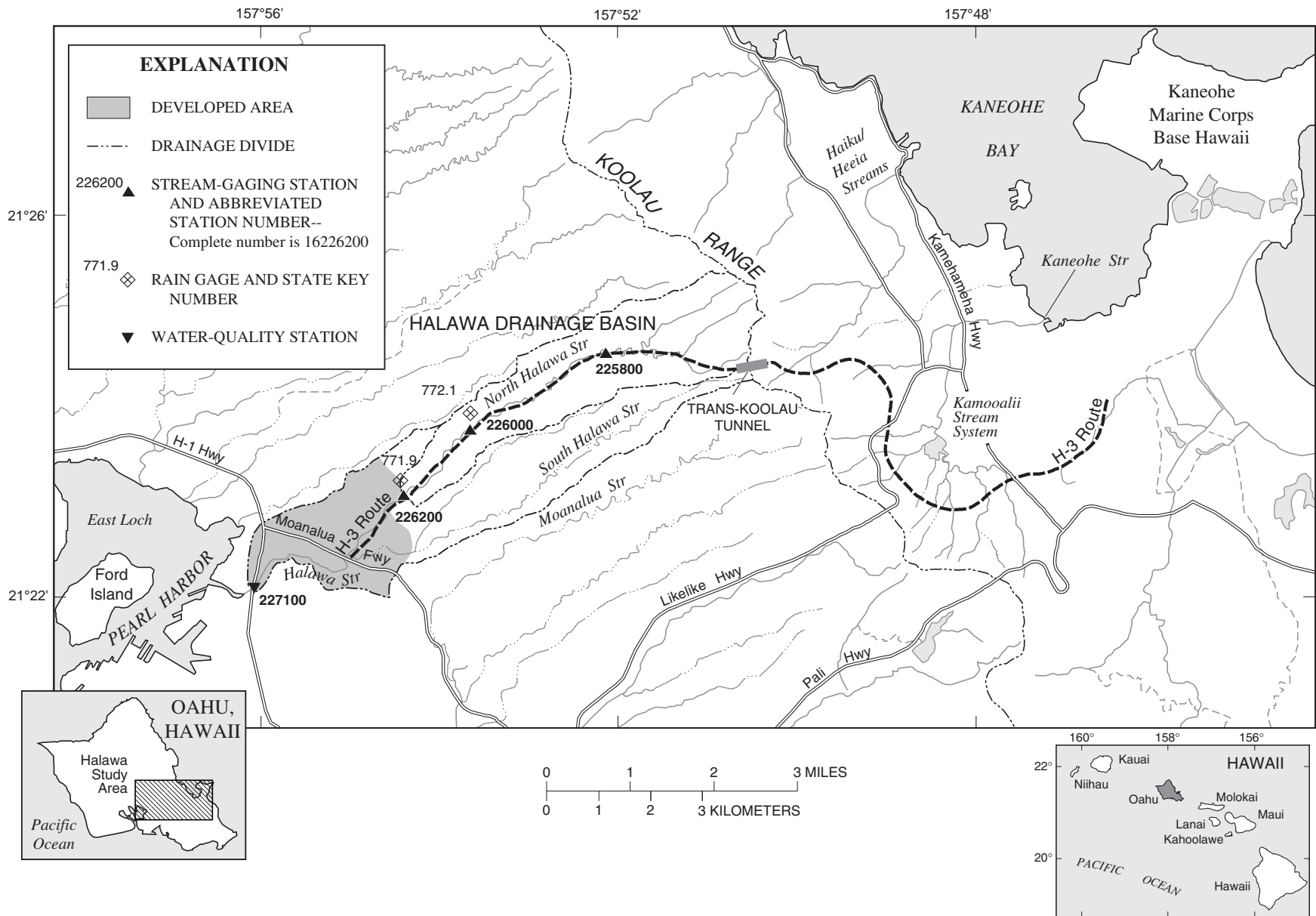


Figure 1. Selected stream-gaging stations and drainage basins in the H-3 Highway study area, Oahu, Hawaii.

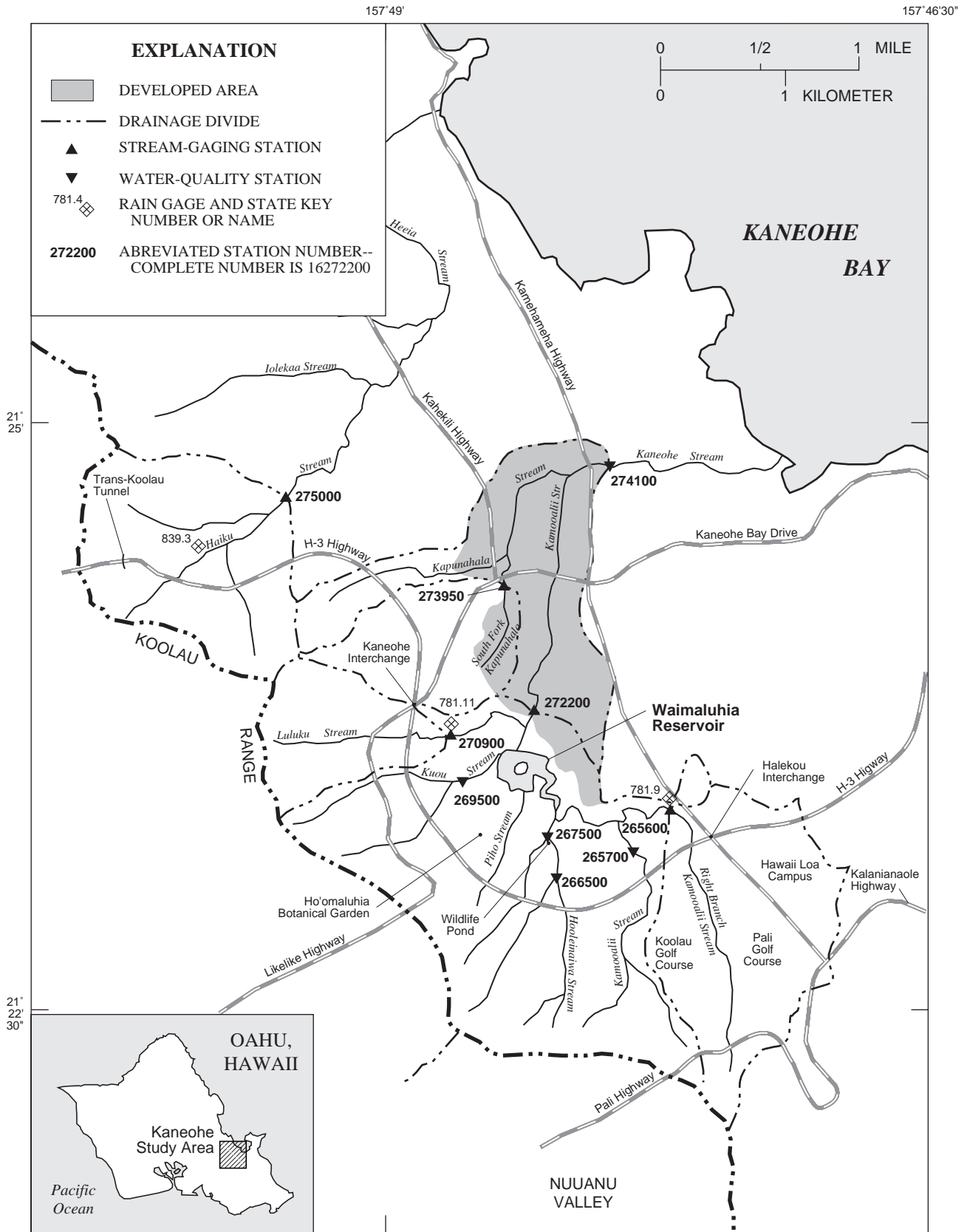


Figure 2. Haiku and Kaneohe drainage basins study area, Oahu, Hawaii.

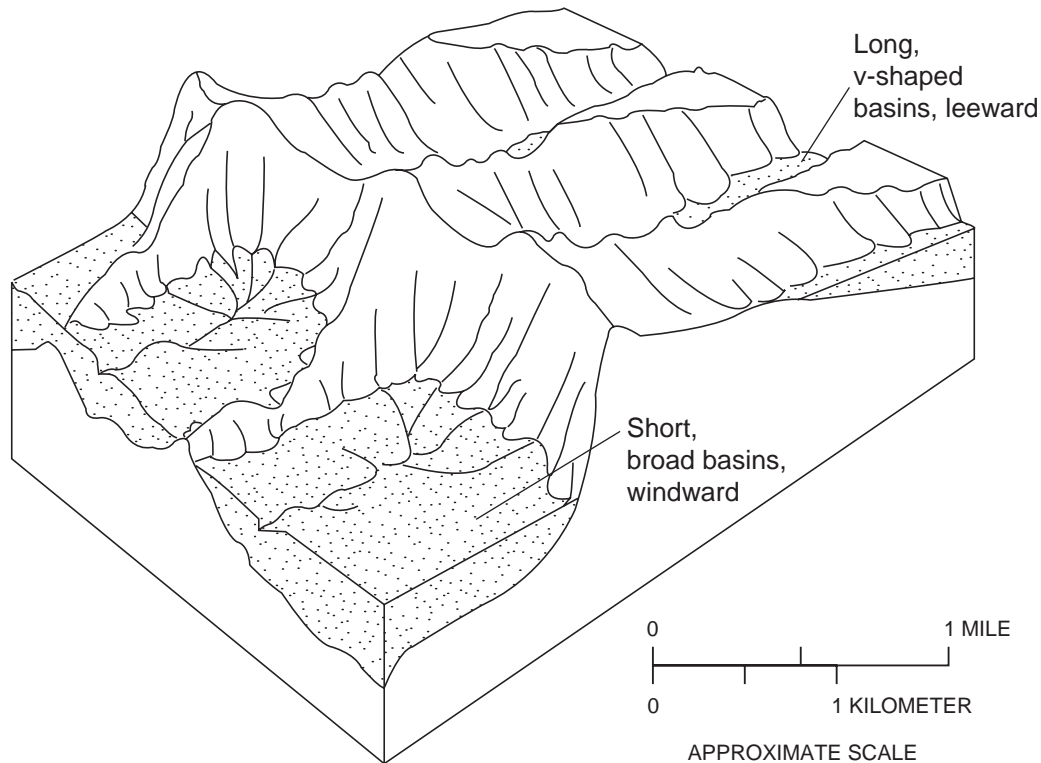


Figure 3. Block diagram showing typical drainage-basin shapes for Oahu, Hawaii (by S.K. Izuka, U.S. Geological Survey).

from erosion of the Koolau Range (Takasaki and others, 1969; Izuka, 1992).

Climate and streamflow.--The climate of Oahu is warm and humid. Average annual temperature ranges from 74° to 76°F in the study area; temperatures above 95°F and below 50°F are rare (Blumenstock and Price, 1961). The distribution of rainfall is affected by the prevailing northeasterly trade winds and the topography of the island. Orographic lifting and cooling of marine air masses moving with the trade winds result in heavier and more frequent rainfall on the windward side and near the crest of the Koolau Range. The heaviest rainfall occurs about 0.5 to 1 mi leeward of the crest (C.K. Wentworth, written commun., 1942; Mink, 1960). Rainfall varies seasonally, with most rainfall falling between November and April. Mean annual rainfall ranges from 75 to 150 in. on the windward side of the study area, and from 40 to more than 150 in. on the leeward side (Blumenstock and Price, 1961). Mean annual pan evaporation is between 50 to 70 in. on the windward side and between 30 to 80 in. on the leeward side of the study area (Ekern and Chang, 1985).

The temporal and spatial distribution of streamflow is determined to a large extent by geology and climate. Streams respond rapidly to direct runoff that takes place during heavy rainfall. Large quantities of rainfall and the presence of numerous low-permeability dikes result in storage of large quantities of high-level groundwater. These high-level reservoirs maintain the base flow of streams on the windward side (Takasaki and others, 1969). Streamflow in Halawa Stream is intermittent and is dependent primarily on direct runoff that occurs during heavy rainfall. Most infiltrating rainfall in the North Halawa Valley percolates to the basal aquifer and does not maintain base flows in the streams located there (Izuka, 1992). Streamflow is supplemented by the discharge of small quantities of groundwater from alluvial aquifers that extend recession flows only to a minor extent (Izuka, 1992). The contrast between streamflow characteristics in the leeward and windward drainage basins of the study area is shown by using flow-duration curves (fig. 4). A flow-duration curve indicates the percentage of time that values of daily mean streamflow were equalled or exceeded (Searcy, 1959). The steep

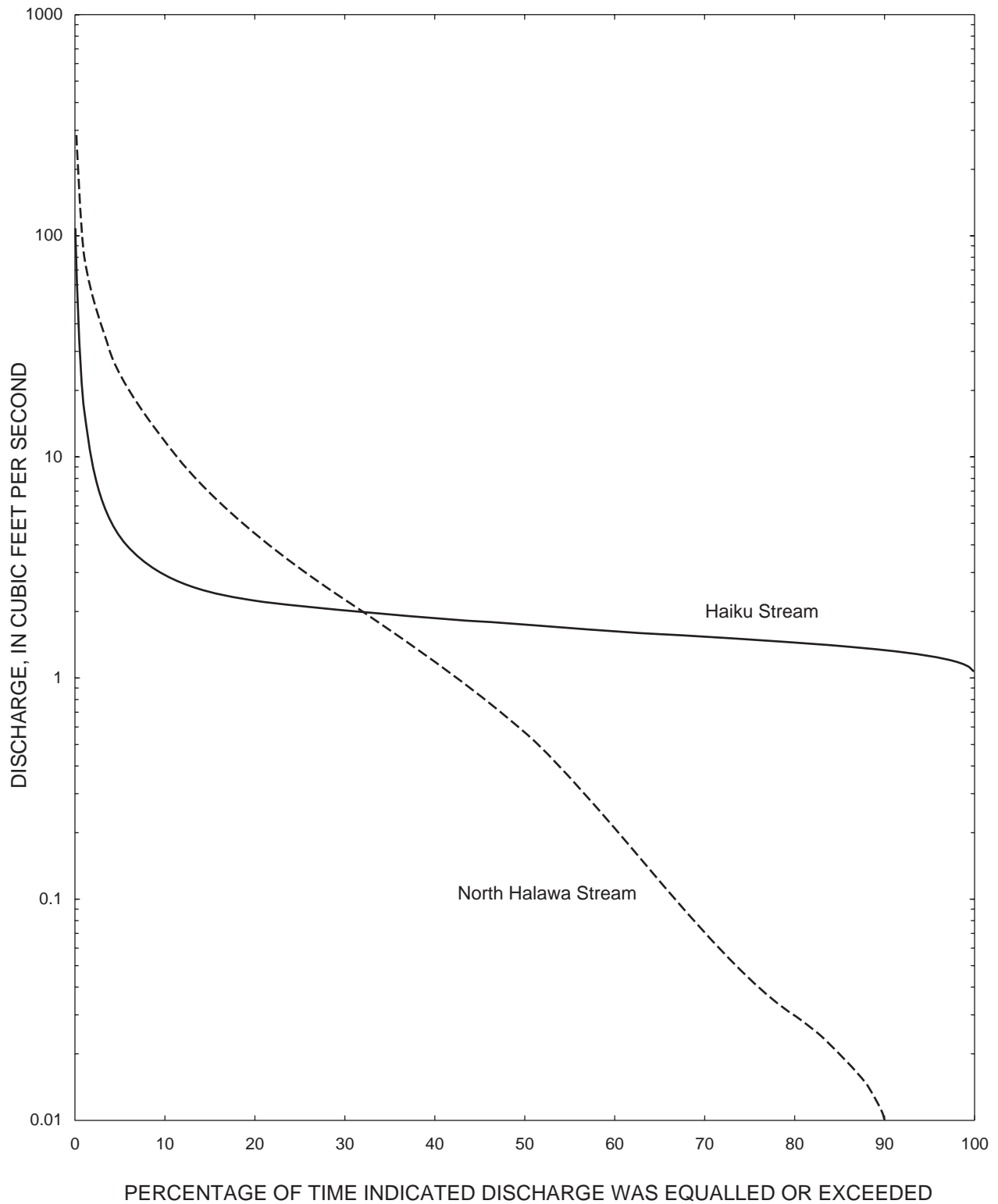


Figure 4. Flow-duration curves of daily flows for stations 16226200 North Halawa Stream and 16275000 Haiku Stream, 1983-99, Oahu, Hawaii.

slope of the North Halawa Stream flow-duration curve indicates the highly variable nature of streamflow in Halawa Valley, whereas the flat slope of the Haiku Stream curve indicates the large storage of ground water on the windward side (fig. 4).

Soils and vegetation.--Soils in the Halawa drainage basin are classified as low permeability, very stony clays of the Kaena series with Kawaihapai clay loam soils by the mouth of Halawa Stream (Foote and others, 1972). Soils in the Haiku and Kaneohe drainage basins are classified as Lokelaa with some Kaneohe and Hanaiei series silty clays. These types of silty clays have moderate permeability and are highly erodible on steep slopes (Foote and others, 1972). The majority of the mountainous areas within all the study drainage basins are classified as "rough mountainous land," "rock land," or "rock outcrop" (Foote and others, 1972), and little information is available on the soils of these areas.

Except where disturbed by development (figs. 1 and 2), all study basins are completely covered with one form or another of vegetation. Most of the native vegetation on the windward side of the study area has been replaced by cultivated crops, other non-native plants, and residential and commercial developments. Much of the Lulukū sub-drainage basin (station 270900, fig. 2) has been converted to banana plantations. Vegetation in the North Halawa Valley is representative of undisturbed forest in the leeward Koolau Range and includes native and introduced species.

Halawa drainage basin.--The Halawa drainage basin is on the leeward side of the crest of the Koolau Range and has a drainage area of 8.90 mi² upstream of station 227100. Halawa Stream flows into the East Loch of Pearl Harbor and originates at the confluence of North and South Halawa Streams, downstream of Moanalua Freeway (fig. 2). Data collection in the Halawa study basin was concentrated in the North Halawa Valley. The water-quality data collected at station 227100, on Halawa Stream (fig. 1), was the only data collected outside of North Halawa Valley during the study. Between stations 227100 and 226200 the land is developed and consists of a light industrial park near the mouths of both North and South Halawa Streams and residential areas near the Moanalua Freeway and H-1 Highway. The H-3 Highway constitutes about 4 percent of the North Halawa 4.01 mi² drainage area upstream of station 226200. Before highway construction in the val-

ley began in November 1987, this drainage basin was undeveloped.

Haiku drainage basin.--The Haiku drainage basin is on the windward side of the Koolau Range and adjoins the North Halawa drainage basin along the crest of the Koolau Range (fig. 1). At stream-gaging station 275000, Haiku Stream flows perennially. Haiku Stream joins Iolekaa Stream downstream of station 275000 to form Heeia Stream, which flows into Kaneohe Bay (fig. 2). Almost all of the 0.97 mi² drainage basin upstream of station 275000 was part of a U.S. Coast Guard navigational facility which was operated from 1944 to September 30, 1997. Highway construction in the Haiku drainage basin began in October of 1988 (table 1). The part of the H-3 Highway located within the Haiku drainage basin was constructed entirely as a viaduct, and covers about 3 percent of the drainage area upstream from station 275000.

Kaneohe drainage basin.--The Kaneohe drainage basin is on the windward side of the Koolau Range, south of the Haiku drainage basin, and has an area of 5.22 mi² upstream of station 274100. Kaneohe Stream flows into Kaneohe Bay downstream from the confluence of Kapunahala and Kamooalii Streams which join to form Kaneohe Stream near Kamehameha Highway (fig. 2). Data collected in the study basin was concentrated in the Kapunahala and Kamooalii sub-drainage basins. Only water-quality data was collected at station 274100 on Kaneohe Stream (fig. 2). Land use upstream of station 274100 and downstream of stations 272200 and 273950 consists entirely of residential and urban areas of Kaneohe town.

In the Kapunahala sub-drainage basin, only the South Fork of Kapunahala Stream was monitored during the study. The South Fork Kapunahala sub-drainage basin lies to the southeast of the Haiku drainage basin and has a drainage area of 0.40 mi² upstream from station 273950, located at an altitude of 111 ft (fig. 2). The drainage basin consists of residential and some agricultural lands in the lower portions of the basin. H-3 Highway construction in the basin began in March 1989 (table 1) with most of the construction activities occurring near the 400 ft altitude. The H-3 Highway covers about 3 percent of the drainage area upstream from station 273950.

The Kamooalii sub-drainage basin upstream of stream-gaging station 272200, at an altitude of 116 ft, has an area of 3.81 mi² (fig. 2). Land use upstream of

the station includes the Hoomaluhia Botanical Garden, two golf courses, banana plantations, the Hawaii Loa Campus of Hawaii Pacific University, a small area of residential development, and undeveloped land. Parts of both Likelike and Pali Highways cross the drainage basin near the Koolau Range (fig. 2).

Highway construction within the Kamooalii sub-drainage basin began in 1983 (table 1) with the construction of the Halekou Interchange upstream of station 265600 on the right branch of Kamooalii Stream (fig. 2). Numerous court injunctions delayed the construction at various times (table 1). Construction of the Windward Highway segment of the H-3 Highway, which affects most of the basin, began in the summer of 1989 and ended in the summer of 1992 (table 1). Most of the highway segments in the Kamooalii sub-drainage basin were constructed using cut and fill techniques. The H-3 Highway constitutes about 4 percent of the drainage area upstream from station 272200.

In addition to station 272200, streamflow, suspended-sediment, and water-quality data were collected in the Kamooalii sub-drainage basin at station 265600 on the Right Branch of Kamooalii Stream and at station 270900 on Luluku Stream. Streamflow at stations 272200, 265600, and 270900 is perennial. Streamflow at station 272200 includes water flowing through Waimaluhia Reservoir, a flood-control reservoir completed in 1981 upstream of the confluence of Luluku and Kamooalii Streams, and water from Luluku Stream that does not pass through the reservoir. The area affected by the H-3 Highway construction includes about 11 percent of the drainage area for station 270900 and 5 percent of the drainage area for station 265600. Additional water-quality data were collected at 12 sites in Waimaluhia Reservoir (fig. 5) and at four water-quality partial-record stations upstream of the reservoir: station 265700, Kamooalii Stream at altitude 200 ft, station 266500, Hooleinaiwa Stream at altitude 220 ft, station 267500, Hooleinaiwa Stream above confluence with Kamooalii Stream, and station 269500, Kuou Stream at altitude 220 ft (figs. 2 and 5).

Acknowledgements

The authors gratefully acknowledge retired U.S. Geological Survey employees Harold Sexton, George Day and Frank Romualdo for their assistance with instrumentation and data collection. Mr. Ted Kamisato

of Kaneohe, assisted in collecting suspended-sediment samples at station 265600. The staff at the Hoomaluhia Botanical Garden, Department of Parks and Recreation, City and County of Honolulu provided access to Waimaluhia Reservoir and provided boats used for field data collection. Start and end dates for construction activities were provided by Dennis Higa, Earl Kobataki, and Emilio Barroga Jr. of the State of Hawaii Department of Transportation. Stream-gaging stations 226000, 275000, and 272200 were operated in cooperation with the State of Hawaii Commission on Water Resource Management, Honolulu Board of Water Supply, and the U.S. Army Corps of Engineers, respectively. Suspended-sediment data collection from 1976 to 1997 at station 272200 was collected in cooperation with the U.S. Army Corps of Engineers.

METHODS OF HYDROLOGIC AND WATER-QUALITY DATA COLLECTION

Rainfall, streamflow, suspended-sediment, and water-quality data were collected at the network of stream-gaging and water-quality stations described above (figs. 1, 2, and 5). Stream-gaging stations were equipped with stage recorders and automatic suspended-sediment samplers except at station 226000, where sediment data were not collected. In addition, stations 226000, 226200, 265600, and 270900 were equipped with recording rain gages. An additional rain gage was operated in Haiku Valley (fig. 2).

Rainfall

Rainfall was recorded using two types of rain gages. Both types used the standard National Weather Service 8-inch rain collector. At stream-gaging stations 226200, 265600, and 270900, tipping-bucket rain gages were used for most data collection. A tipping-bucket gage records the times at which set increments of rainfall have accumulated. All tipping-bucket gages in this study used 0.1 in. calibrated buckets and cumulative storage cans. The cumulative storage cans capture rainfall released when the bucket is tipped and provides a volumetric check on accumulated rainfall totals. At stream-gaging station 226000 and at the Haiku rain gage, a float-type rain gage was used. The float-type rain gage was used beginning in March 1997, January 1997, and July 1998 at stations 226200, 265600, and

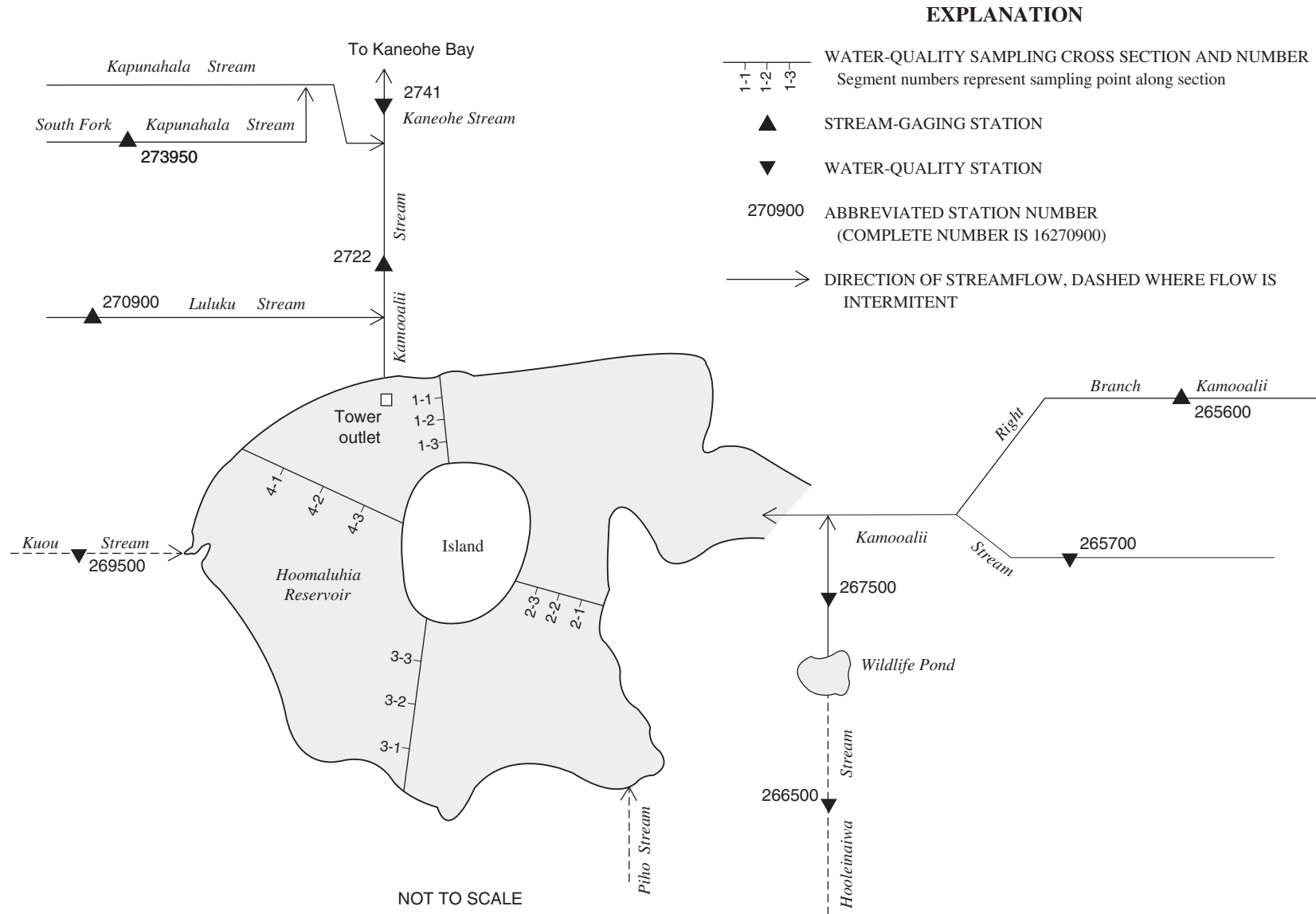


Figure 5. Diagram showing stream-gaging and water-quality stations in the Kaneohe drainage basin, Kaneohe, Oahu, Hawaii.

270900, respectively, in place of the tipping-bucket gages. A float-type gage records continuous changes in rainfall volumes that are captured in a storage can connected to the 8-in. rain collector.

Streamflow

Direct measurements of streamflow were made periodically at all stream-gaging and stream water-quality stations using standard practices for current-meter measurements (Rantz and others, 1982). Peak flows that could not be measured with current meters were measured using the slope-area method (Dalrymple and Benson, 1967). Daily mean values of streamflow were computed for eight stream-gaging stations (225800, 226000, 226200, 265600, 270900, 272200, 273950, 275000). Data were computed using the streamflow measurements and water level or stage recorded at each of the stations as described by Rantz and others (1982).

Suspended Sediment

Suspended-sediment samples were collected at stream-gaging stations (table 2) using PS-69 automatic suspended-sediment samplers (Edwards and Glysson, 1988). Samples were collected once a day when conditions permitted, and more frequently during storms. Manual, depth-integrated cross-sectional samples were collected periodically using the equal-width-increment method (Edwards and Glysson, 1988) and were used to calibrate the PS-69 sample data (Porterfield, 1972). At station 265600, a Manning automatic sampler (Edwards and Glysson, 1988) was used at times in place of the PS-69 because of suspended-sediment deposition near the PS-69 intake. In 1990, the automatic samplers at station 265600 were removed, and an observer was used to collect daily cross-sectional samples. Suspended-sediment concentrations (SSC) were determined by the U.S. Geological Survey office in Honolulu using methods described by Guy (1969). Suspended-sediment samples with concentrations of about 1,000 mg/L and higher were analyzed using method 2540D (Standard Methods for the Examination of Water and Wastewater, 19th ed., 1995) for total suspended solids (TSS) during water years 1995 through 1997. The difference in methods used to determine SSC and TSS results in a bias. TSS

concentrations are lower compared with SSC when the percentage of sand-sized particles in the suspended-sediment sample increases beyond 25 percent (Gray and others, 2000). Based on particle-size analysis data collected during this study (table 4) and previously (Jones and others, 1971), average percentage of sand-sized particles did not exceed 20 percent. Therefore, the suspended-sediment samples that were computed for TSS concentrations during water years 1995 through 1997 were used without correction for bias. Suspended-sediment loads were computed using suspended-sediment concentrations and streamflow records as described by Porterfield (1972).

Water Quality

Water-quality measurements and samples were collected at the following 12 stream-gaging and water-quality stations: 226200, 227100, 265600, 265700, 266500, 267500, 269500, 270900, 272200, 273950, 274100 and 275000, as well as at various depths at 12 sites in Waimaluhia Reservoir (figs. 1, 2, and 5). Measurements of physical properties such as streamflow, water temperature, specific conductance, pH, and dissolved oxygen were made in the field. In addition, samples were collected and subsequently analyzed for inorganic constituents such as turbidity, total suspended solids, major ions, nutrients, and trace metals, biological constituents such as fecal coliform bacteria, and organic constituents such as total organic carbon, oil and grease, pesticides, herbicides, and polychlorinated compounds. All physical measurements and samples for chemical constituent analyses were collected and processed according to guidelines in Ward and Harr (1990).

Stream sample collection was done using an equal-width increment method when flow conditions (stream widths greater than 3 ft and depths greater than 0.5 ft) permitted otherwise by dip sampling at the center of streamflow. Inorganic samples were collected using a DH-81 sampler with 1-liter polyethylene bottles when depths were greater than 0.5 ft. An open mouth polyethylene bottle was used to collect samples from shallower depths. A churn splitter (Ward and Harr, 1990) was used to composite and split all inorganic samples. Samples for fecal coliform bacteria and organic analyses were collected directly into sterile (bacteria) or baked

(organic) glass containers by dip sampling at the center of streamflow.

Samples from Waimaluhia Reservoir were collected using a modified vertical configuration Van-Dorn sampler until 1995, after which a standard horizontal configuration Van-Dorn sampler was used (Ward and Harr, 1990). Reservoir measurements for physical properties and sampling for turbidity, total suspended solids, nutrients, and fecal coliform bacteria was done by depth at cross-sections 1-3 and 3-2 (fig. 5). In addition, at cross section 1-3, samples were collected by depth and then composited for analyses of major ions, trace metal, and organic constituents. All samples, except those for major ions and trace metals, were collected directly into sample bottles from the Van-Dorn sampler. Major ion and trace metal samples were composited first in a churn splitter. The composite for organic constituents at cross-section 1-3 was done by filling part of each bottle from part of the sample collected at the various depths. Measurements for physical properties only were done by depth at the remaining reservoir sites (fig. 5) and these data are not summarized in this report.

Water-quality samples at stream sites were collected on average ten times per year. Sampling dates were equally divided between wet (October to April) and dry (May to September) seasons. Measurements of streamflow, water temperature, specific conductance, pH, and dissolved oxygen and samples for turbidity and total suspended solids were collected for all ten of the sampling dates during a water year. Samples for nutrients and fecal coliform bacteria were collected during four of the ten sampling dates, and samples for major ions, trace metals, and organic constituents were collected during two of the ten sampling dates. At Waimaluhia Reservoir, measurements of water temperature, specific conductance, pH, and dissolved oxygen and samples for turbidity, nutrients, and fecal coliform bacteria were collected four times a year and samples for major ions, trace metals, and organic constituents were collected during two of the four sampling dates.

Starting in water year 1995, samples for inorganic constituents such as major ions, nutrients, and trace metals were collected and processed using the part per billion protocol in Horowitz and others (1994). Samples for trace metal analyses were preserved with non-ultra-pure nitric acid until water year 1995 when the use of

ultra-pure nitric acid was started. Prior to October 1994, samples for nutrient analyses were preserved with mercuric chloride and chilled to 4°C. After October 1994, nutrient samples were preserved only by chilling. Starting in January 1999, nutrient samples for total ammonia and organic nitrogen and total phosphorus were preserved with sulfuric acid and chilled.

The methods used for the analyses of all the water-quality properties and constituents followed those in Wershaw and others (1987), Britton and Greeson (1989), Fishman and Friedman (1989), and Fishman (1993). All laboratory analyses were conducted by the U.S. Geological Survey's National Water Quality Laboratory (NWQL) in Colorado. Quality control practices at NWQL are documented in Friedman and Erdmann (1982) and Pritt and Rease (1992). In January 1993, laboratory analysis for total nitrate and nitrite was discontinued and only dissolved nitrate and nitrite were analyzed after that date, because values for total and dissolved nitrate and nitrite were statistically indistinguishable (U.S. Geological Survey Office of Water Quality Technical Memorandum 93.04).

STATISTICAL SUMMARY OF HYDROLOGIC AND WATER-QUALITY DATA

Rainfall

Total annual rainfall by water year for the five rain gages in the study area are shown in table 5. Compared to average rainfall for the 1983–99 period, 1988–89 and 1996–97 were relatively wet, whereas 1984, 1992, 1995, and 1998 were relatively dry. Figure 6 shows that rainfall was generally higher during the construction period in the Haiku drainage basin.

Streamflow

Total annual streamflow for the eight stream-gaging stations in the study area are shown in table 6. Total annual streamflow is determined by summing the daily mean values of discharge for the water year. Total annual streamflow was higher in water years 1988, 1989, 1991, 1994, and 1997 than during the other years of the 1983–99 study period (table 6). Annual streamflow ranged from 122 cubic feet per second-days

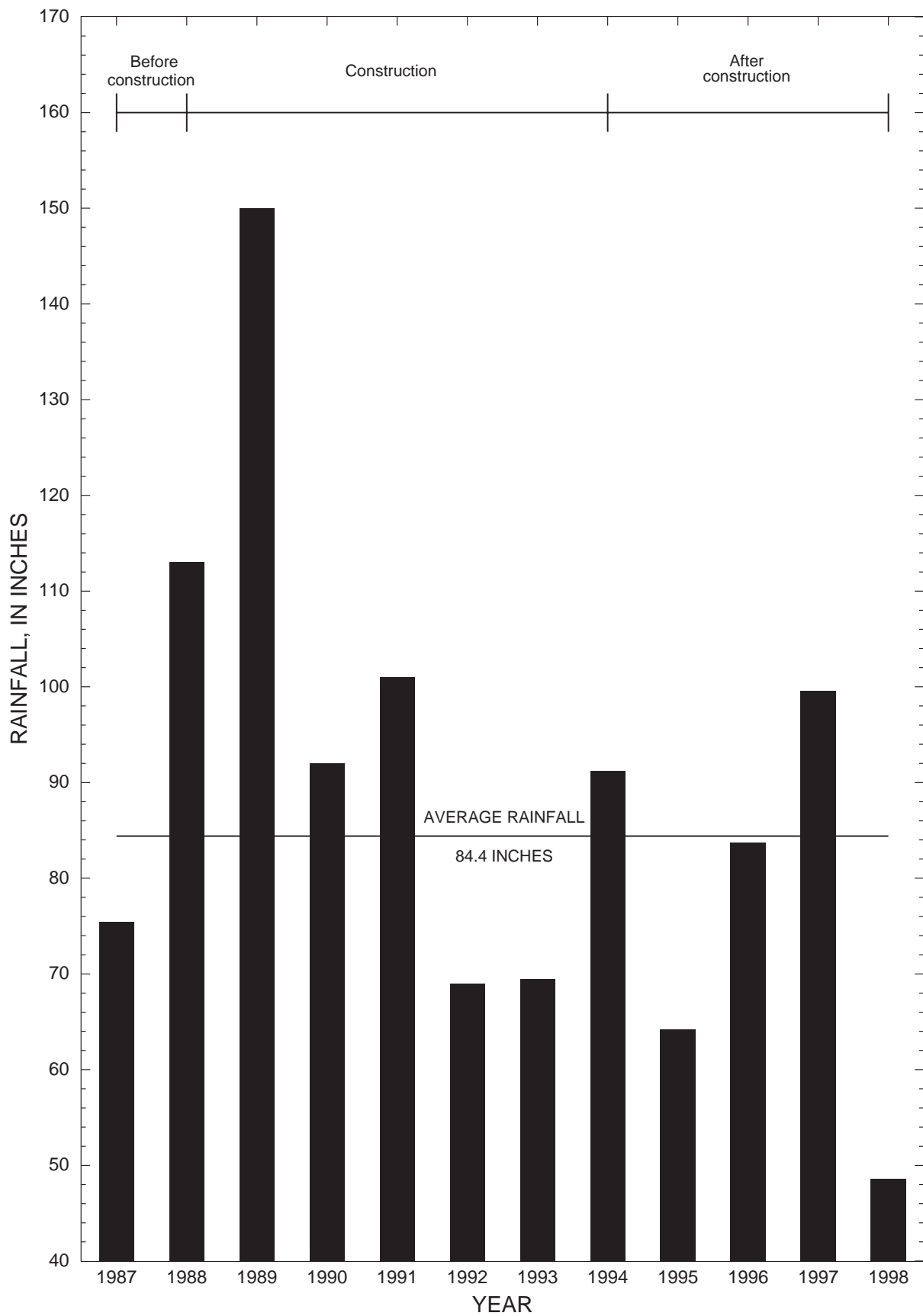


Figure 6. Total annual rainfall at Haiku rain gage 839.3, Oahu, Hawaii, water years 1987–98.

[(ft³/s)d] at station 265600 in 1984 to 6,070 at station 272200 in 1988. Long-term records available for stream-gaging stations 226000, 272200, and 275000 prior to the 1983–99 period show that annual streamflow was higher in 1932 at station 226000 (5,740 [(ft³/s)d]), 1982 at station 272200 (8,040 [(ft³/s)d]), and in 1941 at station 275000 (3,000 [(ft³/s)d]) than for any year during the study period (table 6). The years of highest streamflow during the study period coincided with years of high rainfall (table 5). At North Halawa Stream station 226200, the years of highest streamflow corresponded to the period of highway construction in the valley (fig. 7). Average streamflow per unit of drainage basin area ([(ft³/s)d]/ mi², table 7) can be used to compare streamflow between gages. Streamflow per unit of drainage basin area ranged from 110 ([(ft³/s)d]/ mi²) at station 265600 in 1984 to 2,620 ([(ft³/s)d]/ mi²) at station 273950 in 1989 (table 7).

Suspended Sediment

Suspended-sediment concentrations at seven stream-gaging stations (225800, 226200, 265600, 270900, 272200, 273950, 275000) are shown in table 8. Suspended-sediment concentrations are summarized by water year and include both automatically and manually collected samples. Suspended-sediment concentrations ranged from less than 0.5 mg/L at most stations to 32,800 mg/L at station 226200 in water year 1997 (table 8). Annual median suspended-sediment concentrations ranged from 1 mg/L at station 275000 in water years 1991 and 1997 to 1,320 mg/L at station 270900 in water year 1987 (table 8). Total annual suspended-sediment loads at the same seven stream-gaging stations are shown in table 9. Total annual suspended-sediment loads were variable from year to year and station to station. Total annual loads ranged from 23.7 tons at station 265600 in 1984 to 19,600 tons at station 226200 in 1997 (table 9). High annual loads correlated with years of high streamflow (tables 6 and 9). Total annual suspended-sediment loads per total annual streamflow (tons per cubic feet per second-day [tons/(ft³/s)d]) in table 10 can be used to compare total annual loads between water years at the same station. Loads per total annual streamflow ranged from 0.04 tons/(ft³/s)d at station 272200 in 1984 to 7.26 tons/(ft³/s)d at station

226200 in 1997 (table 10). Total annual suspended-sediment yields (total annual suspended-sediment loads per unit of drainage basin area) in tons per square mile (tons/mi²) in table 11 can be used to compare suspended-sediment loads between stations. Sediment yields ranged from 7.71 tons/mi² in 1984 at station 226200 to 4,890 tons/mi² in 1997 also at station 226200 (table 11).

Water Quality

Statistical summaries that list the percentiles and minimum and maximum values for water-quality data from individual stream stations are given in tables 12 through 23 and summaries for the reservoir are given in tables 24 and 30. The water-quality data listed include selected physical properties, fecal coliform bacteria, organic carbon, oil and grease, major ions, nutrients, and trace metals. Statistical summaries at water-quality stations 265700, 266500, 267500, and 269500 only list physical properties, turbidity, total suspended solids, fecal coliform bacteria, and nutrients. Major ions, trace metals and organic compounds were sampled at these stations and at the wildlife pond on Hooleinaiwa Stream (figs. 2 and 5) in water years 1983–84 only. These data were summarized in Wong and Hill (1992) and are therefore not summarized in this report. Table 31 is a list of pesticides, herbicides, and polychlorinated compounds analyzed for during this study with corresponding laboratory detection limits. Only those compounds detected are listed in table 32. Properties or constituents had statistics computed only when the number of samples collected exceeded five. Summary statistics for data that include observations at or below laboratory reporting detection limits, called censored data, were computed by log-probability regression (Helsel and Gilliom, 1986). This method estimates summary statistics by combining above-reporting-limit values with extrapolated below-reporting-limit values. Some constituents had different laboratory reporting detection limits during the 17-year study period due to improving analytical techniques.

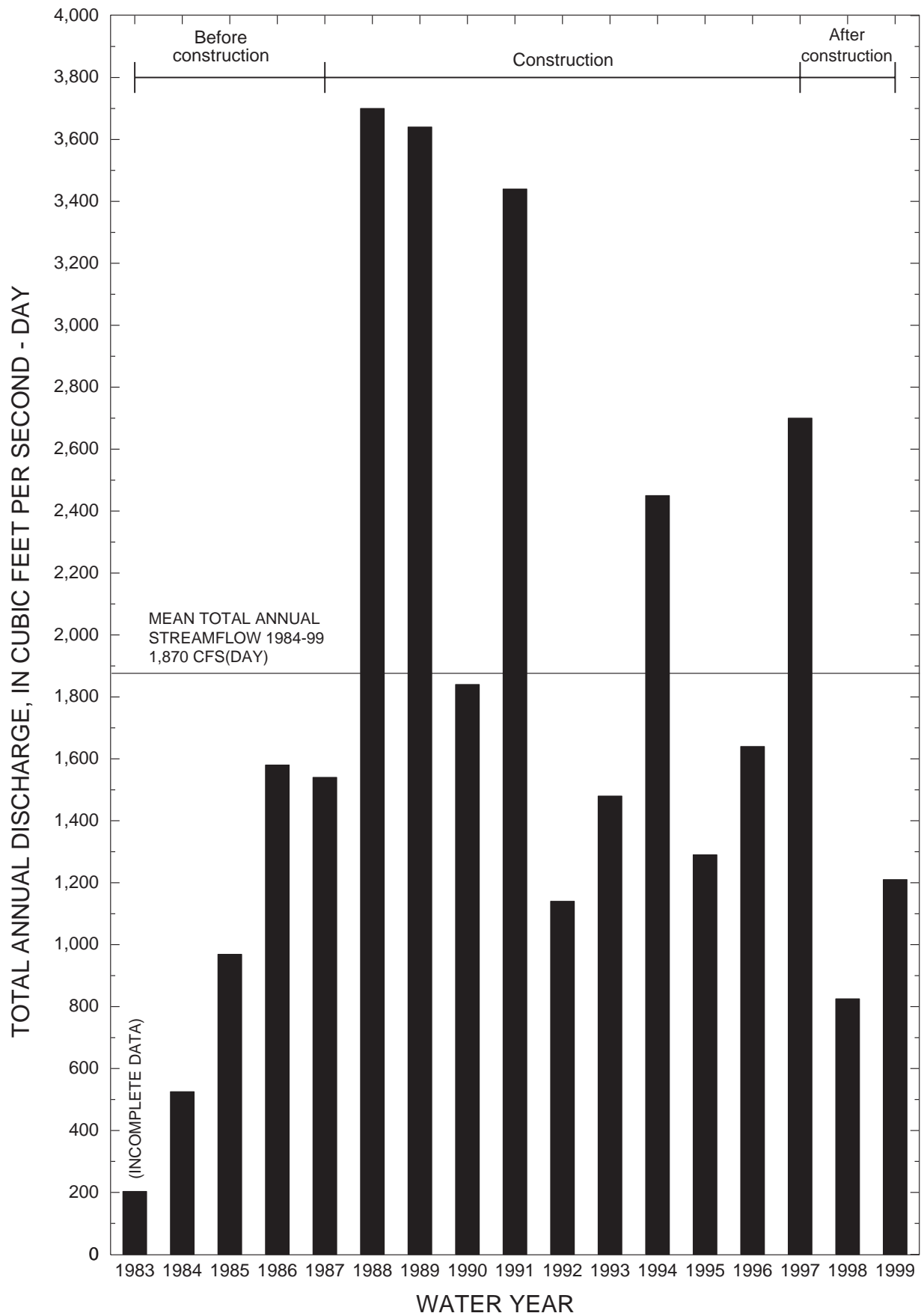


Figure 7. Total annual streamflow at station 16226200, North Halawa Stream near Honolulu, Oahu, Hawaii, water years 1983–99.

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Table 1. Chronology of construction activities, H-3 Highway construction project, 1983–99, Oahu, Hawaii

[Locations of construction activities and stream-gaging stations are shown in figures 2–3; station numbers are abbreviated, complete numbers are preceded by 16; do., ditto. Start and end dates provided by the State of Hawaii, Department of Transportation, (written commun., 1999)]

Construction activity	Start date	End date
Halawa drainage basin—downstream stream-gaging station 227100		
N. Halawa sub-drainage basin—downstream stream-gaging station 225800, 226000, 226200, and 227100		
Trans-Koolau tunnel	03/19/91	02/07/98 ²
N. Halawa viaduct	02/21/92	06/95
N. Halawa sub-drainage basin—downstream stream-gaging stations 226000, 226200 and 227100		
N. Halawa access road	11/02/87	03/89
Exploratory tunnel	02/27/89	03/90
Drilled shaft test program	11/13/90	02/91
Trans-Koolau tunnel	03/19/91	02/07/98 ²
N. Halawa viaduct	02/21/92	06/95
N. Halawa Valley highway Unit I Phase 1A	04/11/94	09/95
N. Halawa Valley highway Unit I Phase 1B	05/24/95	12/12/97
N. Halawa Valley highway Unit II	08/01/94	12/12/97
Haiku drainage basin—downstream stream-gaging station 275000		
Haiku access road	10/24/88	06/90
Exploratory tunnel	02/27/89	03/90
Haiku Valley bridges	08/07/89	03/91
Windward viaduct	01/08/90	05/13/93
Trans-Koolau tunnel	10/01/90	02/07/98 ²
Kaneohe drainage basin—downstream stream-gaging station 274100		
S. Fork Kapunahala sub-drainage basin—downstream stream-gaging stations 273950 and 274100		
Hospital Rock tunnel	03/06/89	05/92
Kaneohe Interchange	01/19/93	12/22/95
Kamooalii sub-drainage basin—downstream stations 265600, 265700, 266500, 267500, 269500, 270900, 272200, Waimaluhia Reservoir, and 274100		
Windward highway	06/19/89	06/92
Right Branch Kamooalii sub-drainage basin—downstream stations 265600, 272200, 274100, and Waimaluhia Reservoir		
Halekou Interchange ¹	02/22/83	12/01/83
do.	03/02/84	07/31/85
do.	11/04/85	02/28/86
do.	11/02/86	12/31/86
do.	06/15/87	09/30/88
Luluku sub-drainage basin—downstream stream-gaging stations 270900, 272200, and 274100		
Windward highway	06/19/89	06/92
Kaneohe Interchange	01/19/93	12/22/95

¹ Work on Halekou Interchange interrupted multiple times by court injunctions

² This is the official completion date for all work on the tunnel, however for the Haiku Valley portion of the tunnel construction, all land disturbance work was completed by 11/94, so for the purpose of determining the post-construction dates, 11/94 will be used. In North Halawa Valley, channel and earthwork near the tunnel continued until 09/97, so 09/30/97 will be used for the purpose of determining the post-construction dates.

Table 2. Chronology of hydrologic and water-quality data-collection activities, H-3 Highway study area, Oahu, Hawaii

[--, no data; P, data collection continuous at present, 2001; station numbers are abbreviated, complete numbers are preceded by 16]

Station number or site	Station name	Streamflow data		Suspended-sediment data		Water-quality data	
		Start	End	Start	End	Start	End
Halawa drainage basin							
227100	Halawa Str below H-1	--	--	--	--	Nov 1988	Nov 1998
N. Halawa sub-drainage basin							
225800	N. Halawa Str nr Kaneohe	Apr 1991	Sept 1999	Apr 1991	Sept 1999	--	--
226000	N. Halawa Str nr Aiea	¹ July 1953	P	--	--	--	--
226200	N. Halawa Str nr Honolulu	Feb 1983	P	Feb 1983	Sept 1999	May 1983	Mar 1999
Haiku drainage basin							
275000	Haiku Str	³ Oct 1982	P	⁴ July 1987	Sept 1998	Mar 1983	Apr 1998
Kaneohe drainage basin							
274100	Kaneohe Str	--	--	--	--	Nov 1988	Aug 1999
S. Fork Kapunahala sub-drainage basin							
273950	S. Fork Kapunahala Str	Oct 1987	June 1998	Oct 1987	June 1998	May 1988	Apr 1998
Kamooalii sub-drainage basin							
265600	R.B. Kamooalii Str	Feb 1983	Sept 1997	Feb 1983	Sept 1997	Feb 1983	Jan 1998
265700	Kamooalii Str at alt 200 ft	--	--	--	--	Feb 1983	Jan 1998
266500	Hooleinaiwa Str at alt 220 ft	--	--	--	--	Feb 1983	Feb 1997
267500	Hooleinaiwa Str abv confluence with Kamooalii Str	--	--	--	--	Feb 1983	Jan 1998
269500	Kuou Str	--	--	--	--	Feb 1983	Jan 1998
270900	Luluku Str	² Apr 1984	June 1998	Apr 1984	June 1998	Feb 1983	Apr 1998
272200	Kamooalii Str below Luluku Str	Nov 1976	P	Nov 1976	Sept 1998	Feb 1983	Apr 1998
Waimaluhia Reservoir		--	--	--	--	May 1983	Jan 1998

¹ Streamflow data were previously collected 1929–33

² Streamflow data were previously collected 1960–63 (low flows only), 1965–71, 1971–84 (annual maximum only)

³ Streamflow data were previously collected 1914–19, 1939–77

⁴ Suspended-sediment data were previously collected December 1983 to September 1984

Table 3. Physiography of basins upstream from gaging stations in the H-3 Highway study area, Oahu, Hawaii

[Basin relief is the maximum altitude in the basin minus the altitude at the gage. Channel length is the length of the longest stream in the basin selected from those shown as blue lines on the 1983 Oahu 1:24,000 topographic maps, and measured from the drainage basin divide to the gage. Channel gradient is the basin relief divided by the channel length; ft, feet; mi², square mile; mi, mile; ft/ft, feet/foot]

Station number or site	Station name	Altitude of gaging station (ft)	Basin relief (ft)	Drainage area (mi ²)	Channel length (mi)	Channel gradient (ft/ft)
225800	N. Halawa Str nr Kaneohe	646	2,180	1.64	2.74	0.151
226000	N. Halawa Str nr Aiea	320	2,510	3.45	5.55	0.086
226200	N. Halawa Str nr Honolulu	160	2,670	4.01	6.59	0.077
227100	Halawa Str below H-1	20	2,800	8.90	8.99	0.059
265600	R.B. Kamooalii Str	195	2,200	1.11	1.75	0.238
265700	Kamooalii Str at alt 200 ft	200	1,800	0.46	1.14	0.299
266500	Hooleinaiwa Str at alt 220 ft	220	2,480	0.41	0.91	0.516
267500	Hooleinaiwa Str abv conf with Kamooalii Str	180	2,520	0.57	1.10	0.434
269500	Kuou Str	220	2,460	0.34	0.91	0.512
270900	Luluku Str	220	2,600	0.44	1.01	0.486
272200	Kamooalii Str below Luluku Str	116	2,700	3.81	5.44	0.094
273950	S. Fork Kapunahala Str	111	2,330	0.40	1.12	0.394
274100	Kaneohe Str	40	2,780	5.22	7.05	0.075
275000	Haiku Str	272	2,450	0.97	1.19	0.390
Waimaluhia Reservoir	at outlet	160	2,540	3.20	5.18	0.093

Table 4. Average suspended-sediment particle-size analyses at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99

[station numbers are abbreviated, complete numbers are preceded by 16;--, no data]

Station number	Number of samples	Average percentage of silt and clay particles	Average percentage of sand-sized or larger particles
225800	18	95	5
226200	41	86	14
265600	1	68	32
270900	8	77	23
272200	8	79	21
273950	0	--	--
275000	10	86	14
Average of all stations		82	18

Table 5. Total annual rainfall in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99

[All values in inches; --, no data; P, partial year of record, more than one month of record missing; e, estimated annual total, one or more days were estimated, data were estimated by comparison with nearby raingages; USGS station numbers are abbreviated, complete numbers are preceded by 16; Numbers below gage numbers or names are 4 digit State key numbers assigned to rain gages in Hawaii by the Commission on Water Resource Management, Department of Land and Natural Resources, State of Hawaii; average is for complete years only for the period 1983–99]

Water year	Rain gage				
	226000 (772.1)	226200 (771.9)	265600 (781.9)	270900 (781.11)	Haiku (839.3)
1983	65.4	P	P	--	--
1984	44.1	23.5	38.9	P	--
1985	61.6	40.7	63.9	66.8	--
1986	60.9	32.9	59.2	66.2	P
1987	68.3	33.8	67.2	66.7	75.4
1988	90.6	56.5	86.8	95.1	113
1989	e91.2	55.5	84.1	87.2	105
1990	66.5	35.3	62.4	62.8	92.0
1991	80.2	41.2	68.5	64.9	e101
1992	52.8	27.3	42.2	e55.9	69.0
1993	e58.7	e33.5	P	61.6	69.5
1994	P	23.6	P	71.2	91.2
1995	49.4	e43.8	e40.2	49.1	64.2
1996	53.7	43.4	e60.1	73.7	83.7
1997	63.8	61.0	e75.9	e81.5	99.6
1998	33.3	23.7	P	44.7	48.6
1999	35.9	31.8	--	--	--
Average	61.0	38.0	62.4	67.7	84.4

Table 6. Total annual streamflow at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983-99
 [All values are in cubic feet per second-days ((ft³/s)d); --, no data; station numbers are abbreviated, complete numbers are preceded by 16]

Water year	Station							
	225800	226000	226200	265600	270900	272200	273950	275000
1983	--	964	¹ 203	¹ 267	--	4,090	--	877
1984	--	517	525	122	² 44.5	1,600	--	520
1985	--	827	969	284	152	2,290	--	604
1986	--	1,590	1,580	406	150	2,940	--	674
1987	--	1,440	1,540	612	327	3,760	--	790
1988	--	3,140	3,700	986	509	6,070	1,020	1,270
1989	--	3,040	3,640	1,040	532	5,930	1,050	1,420
1990	--	1,670	1,840	532	488	4,280	847	888
1991	² 458	2,740	3,440	762	737	5,000	938	1,230
1992	818	1,030	1,140	308	471	3,030	828	806
1993	1,020	1,410	1,480	605	394	3,610	860	738
1994	1,560	2,150	2,450	609	519	4,240	838	941
1995	708	1,030	1,290	216	606	2,600	704	618
1996	801	1,260	1,640	504	520	3,580	722	735
1997	1,200	1,890	2,700	721	554	5,370	894	1,030
1998	506	609	824	--	³ 341	2,730	³ 540	696
1999	565	1,130	1,220	--	--	1,800	--	566

¹ Data from February to September

² Data from April to September

³ Data from October to June

Table 7. Total annual streamflow per unit area at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99

[All values are in cubic feet per second-days per square mile of drainage basin area ((ft³/s)d)/mi²); only data for water years with complete streamflow records are listed; --, no data; station numbers are abbreviated, complete numbers are preceded by 16]

Water year	Station							
	225800	226000	226200	265600	270900	272200	273950	275000
1983	--	279	--	--	--	1,070	--	904
1984	--	150	131	110	--	420	--	536
1985	--	240	242	256	345	601	--	623
1986	--	461	394	366	341	772	--	695
1987	--	417	384	551	743	987	--	814
1988	--	910	923	888	1,160	1,590	2,550	1,310
1989	--	881	908	937	1,210	1,560	2,620	1,460
1990	--	484	459	479	1,110	1,120	2,120	916
1991	--	794	858	686	1,680	1,310	2,340	1,270
1992	499	299	283	277	1,070	795	2,070	831
1993	622	409	369	545	895	948	2,150	761
1994	951	623	611	549	1,180	1,110	2,100	970
1995	432	299	323	195	1,380	682	1,760	637
1996	488	365	409	454	1,180	940	1,810	758
1997	732	548	674	650	1,260	1,410	2,240	1,060
1998	308	177	205	--	--	717	--	718
1999	344	354	302	--	--	472	--	584

Table 8. Summary of suspended-sediment concentrations at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99

[All concentrations are reported in milligrams per liter; <, less than; unpublished data in the files of the U.S. Geological Survey, Hawaii District; station numbers are abbreviated, complete numbers are preceded by 16; d, during construction; a, after construction; b, before construction]

Station number	Water year	Number of samples	Minimum	Concentration percentile			Maximum	Notes
				25	50	75		
225800	1991	53	<0.5	2	8	40	2,130	d
	1992	247	<0.5	12	109	454	7,850	d
	1993	97	9	40	105	824	23,600	d
	1994	54	4	184	290	475	3,900	d
	1995	93	1	80	137	269	4,880	d
	1996	62	2	33	94	135	400	d
	1997	93	<0.5	12	50	129	742	d
	1998	50	<0.5	5	14	85	3,160	a
	1999	146	<0.5	3	44	118	1,740	a
226200	1983	45	<0.5	3	6	17	79	b
	1984	90	1	4	7	23	144	b
	1985	83	2	6	13	101	2,800	b
	1986	153	1	3	5	18	1,880	b
	1987	198	1	3	7	30	4,740	b
	1988	420	<0.5	13	82	294	6,250	d
	1989	300	1	47	324	1,150	18,000	d
	1990	375	<0.5	6	25	197	4,940	d
	1991	466	<0.5	19	70	228	8,330	d
	1992	158	3	31	461	1,270	15,200	d
	1993	244	3	37	135	649	15,300	d
	1994	263	5	24	56	229	5,990	d
	1995	253	4	18	49	222	5,930	d
	1996	211	6	27	244	783	9,650	d
	1997	279	<0.5	7	28	218	32,800	d
1998	287	<0.5	2	4	19	13,000	a	
1999	451	<0.5	3	11	69	2,360	a	
265600	1983	328	3	11	17	51	8,950	d
	1984	243	3	6	9	22	6,340	d
	1985	424	2	6	9	17	5,080	d
	1986	120	7	84	160	316	1,670	d
	1987	96	7	11	115	376	3,400	d
	1988	266	1	56	254	561	6,040	d
	1989	131	18	137	180	281	13,000	d
	1990	292	1	8	20	240	12,500	d
	1991	369	2	5	7	16	1,800	d
	1992	385	<0.5	2	3	4	174	d
	1993	389	<0.5	2	2	4	1,440	a
	1994	363	<0.5	2	2	4	324	a
	1995	240	1	2	3	4	104	a
	1996	18	<0.5	2	8	24	44	a
	1997	39	<0.5	2	4	27	300	a
270900	1984	31	6	15	54	417	1,450	b
	1985	127	2	17	47	207	3,060	b
	1986	52	6	15	66	615	6,480	b
	1987	62	10	270	1,320	2,320	4,640	b
	1988	231	1	88	267	601	5,980	b
	1989	195	6	90	220	686	8,500	b

Table 8. Summary of suspended-sediment concentrations at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99--Continued

[All concentrations are reported in milligrams per liter; <, less than; unpublished data in the files of the U.S. Geological Survey, Hawaii District; station numbers are abbreviated, complete numbers are preceded by 16; d, during construction; a, after construction; b, before construction]

Station number	Water year	Number of samples	Minimum	Concentration percentile			Maximum	Notes
				25	50	75		
270900--Continued								
	1990	105	<0.5	10	41	170	2,930	d
	1991	440	<0.5	9	36	147	3,250	d
	1992	82	2	24	96	253	1,960	d
	1993	85	4	18	69	192	2,650	d
	1994	214	3	8	17	112	4,500	d
	1995	161	<0.5	5	8	15	2,270	d
	1996	145	3	8	16	120	2,180	a
	1997	198	1	5	16	70	1,710	a
	1998	175	<0.5	1	7	33	718	a
272200								
	1983	411	1	5	8	12	939	d
	1984	250	2	7	10	15	426	d
	1985	243	3	9	19	46	959	d
	1986	390	3	6	10	19	2,590	d
	1987	451	2	5	8	19	4,290	d
	1988	253	<0.5	5	18	55	2,390	d
	1989	287	3	10	22	49	2,670	d
	1990	363	1	7	12	27	8,400	d
	1991	408	1	7	13	35	7,840	d
	1992	240	3	6	9	13	191	d
	1993	217	1	6	8	18	1,130	d
	1994	346	1	5	8	15	1,600	d
	1995	207	4	9	13	18	1,530	d
	1996	204	1	4	7	16	1,150	a
	1997	261	1	5	8	18	696	a
	1998	91	2	7	11	29	357	a
273950								
	1988	280	3	9	19	169	1,470	b
	1989	150	7	33	340	964	9,870	b
	1990	145	4	9	13	103	1,200	d
	1991	97	15	108	609	1,740	8,570	d
	1992	35	19	35	89	229	1,730	d
	1993	49	8	22	46	152	2,020	d
	1994	166	5	12	18	174	6,270	d
	1995	315	2	8	11	18	656	d
	1996	111	6	26	65	144	614	a
	1997	100	7	26	40	84	794	a
	1998	54	6	11	16	84	417	a
275000								
	1984	113	1	3	5	7	81	b
	1988	237	1	4	7	16	3,430	b
	1989	370	1	5	13	36	14,000	d
	1990	273	<0.5	3	6	25	15,400	d
	1991	360	<0.5	1	1	11	15,700	d
	1992	382	<0.5	2	4	8	15,780	d
	1993	255	1	3	5	13	3,260	d
	1994	341	1	4	6	16	7,090	d
	1995	193	1	3	5	8	4,030	a
	1996	147	1	3	5	14	6,610	a
	1997	100	<0.5	1	1	14	785	a
	1998	212	<0.5	1	2	3	86	a

Table 9. Total annual suspended-sediment loads at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983-99

[All values are in tons; --, no data; station numbers are abbreviated, complete numbers are preceded by 16]

Water year	Station number						
	225800	226200	265600	270900	272200	273950	275000
1983	--	¹ 5.45	¹ 12.7	--	173	--	--
1984	--	30.9	23.7	² 1.37	76.6	--	³ 6.08
1985	--	314	541	43.0	336	--	--
1986	--	362	472	91.1	322	--	--
1987	--	615	631	402	1,190	--	⁴ 114
1988	--	3,500	1,730	485	2,240	187	1,310
1989	--	16,600	1,220	180	1,290	488	3,400
1990	--	2,260	1,160	52.6	593	73.5	1,660
1991	² 894	5,220	512	333	1,270	435	2,970
1992	3,650	4,290	64.8	70.4	148	81.6	1,610
1993	3,810	3,460	421	185	801	102	359
1994	2,180	9,180	278	193	606	182	665
1995	663	2,505	63.7	66.1	222	48.9	75.4
1996	267	5,040	1,940	884	1,370	57.3	683
1997	397	19,600	146	135	424	131	770
1998	286	2,780	--	⁵ 14.9	131	⁵ 24.9	86.7
1999	179	573	--	--	--	--	--

¹ Data from February to September

² Data from April to September

³ Data from December to September

⁴ Data from July to September

⁵ Data from October to June

Table 10. Total annual suspended-sediment loads per unit value of total streamflow at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99

[All values are in tons per cubic feet per second-days (tons/(ft³/s)d); only data for years with complete sediment records are listed; --, no data; station numbers are abbreviated, complete numbers are preceded by 16]

Water year	Station number						
	225800	226200	265600	270900	272200	273950	275000
1983	--	--	--	--	0.04	--	--
1984	--	0.06	0.19	--	0.05	--	--
1985	--	0.32	1.90	0.28	0.15	--	--
1986	--	0.23	1.16	0.61	0.11	--	--
1987	--	0.40	1.03	1.23	0.32	--	--
1988	--	0.95	1.76	0.95	0.37	0.18	1.03
1989	--	4.56	1.17	0.34	0.22	0.46	2.39
1990	--	1.23	2.18	0.11	0.14	0.09	1.87
1991	--	1.52	0.67	0.45	0.25	0.46	2.42
1992	4.46	3.78	0.21	0.15	0.05	0.10	2.00
1993	3.73	2.34	0.70	0.47	0.22	0.12	0.49
1994	1.40	3.75	0.46	0.37	0.14	0.22	0.71
1995	0.94	1.94	0.30	0.11	0.08	0.07	0.12
1996	0.33	3.07	3.85	1.70	0.38	0.08	0.93
1997	0.33	7.26	0.20	0.24	0.08	0.15	0.75
1998	0.56	3.37	--	--	0.05	--	0.12
1999	0.32	0.47	--	--	--	--	--

Table 11. Total annual suspended-sediment yields at stream-gaging stations in the H-3 Highway study area, Oahu, Hawaii, water years 1983–99

[All values are in tons per square mile (tons/mi²); only data for years with complete sediment records are listed; --, no data; station numbers are abbreviated, complete numbers are preceded by 16]

Water year	Station number						
	225800	226200	265600	270900	272200	273950	275000
1983	--	--	--	--	45.4	--	--
1984	--	7.71	21.4	--	20.1	--	--
1985	--	78.3	487	97.7	88.2	--	--
1986	--	90.3	425	207	84.5	--	--
1987	--	153	568	914	312	--	--
1988	--	873	1,560	1,100	588	468	1,350
1989	--	4,140	1,100	409	339	1,220	3,510
1990	--	564	1,040	120	156	184	1,710
1991	--	1,300	461	757	333	1,090	3,060
1992	2,230	1,070	65	160	38.8	204	1,660
1993	2,320	863	421	420	210	255	370
1994	1,330	2,290	278	439	159	455	686
1995	404	625	57.4	150	58.3	122	77.7
1996	162	1,260	1,750	2,010	362	143	704
1997	242	4,890	131	307	111	328	794
1998	174	693	--	--	34.4	--	89.4
1999	109	143	--	--	--	--	--

Table 12. Statistical summary of selected water-quality data collected at station 16226200, North Halawa Stream near Honolulu, Oahu, Hawaii, from May 1983 to March 1999

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, May 1983 to August 1987, physical, biological, and organic								
Discharge, inst., (ft^3/s)	23	0	23	0.03	0.20	1.8	3.9	37
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	23	0.1	23	69.0	120	135	145	180
pH (units)	23	0.1	23	6.5	6.9	6.9	7.3	7.5
Temperature, water ($^\circ\text{C}$)	23	0.5	23	19.0	21.0	21.8	23.0	24.5
Turbidity (NTU)	11	0.1	11	0.4	1.2	1.5	6.8	14
Oxygen dissolved (mg/L)	11	0.1	11	7.2	7.6	7.7	8.0	8.4
Fecal coliform 0.7 μm -MF (cols./100 mL)	8	0	8	16	49	90	400	6,200
Solids, residue at 105°C , suspended (mg/L)	10	1	9	<1	e0.3	e2	e8	25
Carbon, organic, total (mg/L)	5	0.1	5	0.6	--	4.3	--	7.1
Oil and grease, total (mg/L)	5	1	1	--	--	--	--	5
During construction, November 1987 to November 1997, physical, biological, and organic								
Discharge, inst., (ft^3/s)	90	0	90	0.01	0.07	0.5	2.9	229
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	90	0.1	90	49	174	216	268	660
pH (units)	90	0.1	90	6.6	7.5	7.7	8.0	8.3
Temperature, water ($^\circ\text{C}$)	90	0.5	90	17.5	21.5	22.5	24.0	26.5
Turbidity (NTU)	88	0.1	88	0.2	0.8	2.1	32	2,000
Oxygen dissolved (mg/L)	90	0.1	90	5.6	7.4	8.1	8.5	9.4
Fecal coliform 0.7 μm -MF (cols./100 mL)	35	0	35	48	160	340	1,300	16,000
Solids, residue at 105°C , suspended (mg/L)	36	1	31	<1	e2	e5.5	e31	680
Carbon, organic, total (mg/L)	18	0.1	18	0.8	1.2	2.4	5.2	89
Oil and grease, total (mg/L)	18	1	0	--	--	--	--	--
After construction, December 1997 to March 1999, physical, biological, and organic								
Discharge, inst., (ft^3/s)	11	0	11	0.01	0.02	0.16	35	44
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	8	0.1	8	144	192	336	357	386
pH (units)	8	0.1	8	7.3	7.5	7.6	7.8	7.9
Temperature, water ($^\circ\text{C}$)	8	0.5	8	18.0	20.0	22.0	23.0	23.5
Turbidity (NTU)	11	0.1	11	0.2	0.3	2.5	20	390
Oxygen dissolved (mg/L)	8	0.1	8	6.6	7.4	7.8	8.6	8.7
Fecal coliform 0.7 μm -MF (cols./100 mL)	2	0	2	130	--	--	--	1,600
Solids, residue at 105°C , suspended (mg/L)	8	1	8	1	4	40	73	1,030
Carbon, organic, total (mg/L)	4	0.1	4	1.4	--	--	--	10
Oil and grease, total (mg/L)	4	1	0	--	--	--	--	--

Table 12. Statistical summary of selected water-quality data collected at station 16226200, North Halawa Stream near Honolulu, Oahu, Hawaii, from May 1983 to March 1999--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, May 1983 to August 1987, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	5	1	5	17	--	30	--	37
Calcium, dissolved	5	0.02	5	2.9	--	4.9	--	5.7
Magnesium, dissolved	5	0.01	5	2.3	--	4.4	--	5.5
Sodium, dissolved	5	0.2	5	7.4	--	12	--	13
Potassium, dissolved	5	0.1	5	0.7	--	0.8	--	1.0
Alkalinity (as CaCO ₃)	5	1	5	19	--	29	--	40
Sulfate, dissolved	5	0.1	5	3.5	--	4.9	--	7.4
Chloride, dissolved	5	0.1	5	11	--	17	--	18
Fluoride, dissolved	5	0.1	0	--	--	--	--	--
Silica, dissolved	5	0.01	5	8.8	--	20	--	21
Nitrogen, nitrite plus nitrate, total (as N)	7	0.05	0	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	8	0.2	6	<0.2	e0.22	e0.40	e0.78	0.80
Phosphorus, total (as P)	8	0.01	6	<0.01	e0.01	e0.02	e0.04	0.06
During construction, November 1987 to November 1997, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	18	1	18	12	44	57	90	140
Calcium, dissolved	18	0.02	18	2	7.6	12	16	28
Magnesium, dissolved	18	0.01	18	1.7	5.6	6.9	11	16
Sodium, dissolved	18	0.2	18	6.2	13	16	20	23
Potassium, dissolved	18	0.1	18	0.9	0.9	1.2	1.3	1.5
Alkalinity (as CaCO ₃)	18	1	18	11	44	60	86	124
Sulfate, dissolved	18	0.1	18	3.8	5.0	6.9	8.0	11
Chloride, dissolved	18	0.1	18	9.8	18	19	31	43
Fluoride, dissolved	18	0.1	6	<0.1	--	--	--	0.1
Silica, dissolved	18	0.01	18	6.9	16	20	23	25
Nitrogen, nitrite plus nitrate, total (as N)	19	0.05	7	<0.1	e0.01	e0.02	e0.1	1.0
Nitrogen, nitrite plus nitrate, dissolved (as N)	13	0.05	8	<0.05	e0.03	e0.06	e0.10	0.18
Nitrogen, ammonia plus organic, total (as N)	36	0.2	9	<0.2	--	e0.03	e0.18	2.8
Phosphorus, total (as P)	36	0.01	21	<0.01	--	e0.02	e0.04	0.28
After construction, December 1997 to March 1999, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	1	1	1	--	--	--	--	130
Calcium, dissolved	1	0.02	1	--	--	--	--	27
Magnesium, dissolved	1	0.01	1	--	--	--	--	16
Sodium, dissolved	1	0.2	1	--	--	--	--	27
Potassium, dissolved	1	0.1	1	--	--	--	--	1.5
Alkalinity (as CaCO ₃)	1	1	1	--	--	--	--	137
Sulfate, dissolved	4	0.1	4	3.9	--	--	--	12
Chloride, dissolved	4	0.1	4	15	--	--	--	40
Fluoride, dissolved	1	0.1	0	--	--	--	--	--
Silica, dissolved	1	0.01	1	--	--	--	--	21
Nitrogen, nitrite plus nitrate, dissolved (as N)	5	0.05	2	--	--	--	--	0.07
Nitrogen, ammonia plus organic, total (as N)	5	0.1	4	--	--	--	--	0.86
Phosphorus, total (as P)	5	0.05	1	--	--	--	--	0.11

Table 12. Statistical summary of selected water-quality data collected at station 16226200, North Halawa Stream near Honolulu, Oahu Hawaii, from May 1983 to March 1999--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, May 1983 to August 1987, trace metals (µg/L)								
Aluminum, total recoverable	5	10	5	50	--	80	--	540
Aluminum, dissolved	5	10	5	30	--	60	--	240
Cadmium, total recoverable	5	1	0	--	--	--	--	--
Cadmium, dissolved	5	1	0	--	--	--	--	--
Chromium, total recoverable	5	10	1	--	--	--	--	10
Chromium, dissolved	5	1	1	--	--	--	1	--
Copper, total recoverable	5	1	5	2	--	5	--	6
Copper, dissolved	5	1	4	<1	--	1	--	6
Iron, total recoverable	5	10	5	20	--	70	--	1,300
Iron, dissolved	5	3	5	24	--	44	--	160
Lead, total recoverable	5	1	2	--	--	--	--	11
Lead, dissolved	5	1	2	--	--	--	--	5
Nickel, total recoverable	5	1	4	<1	--	4	--	13
Nickel, dissolved	5	1	2	--	--	--	--	1
Zinc, total recoverable	5	10	4	<10	--	30	--	270
Zinc, dissolved	5	3	5	4	--	5.0	--	20
During construction, November 1987 to November 1997, trace metals (µg/L)								
Aluminum, total recoverable	18	10	18	40	95	240	1,800	180,000
Aluminum, dissolved	18	10	14	<10	e9	e30	e93	340
Cadmium, total recoverable	18	1	0	--	--	--	--	--
Cadmium, dissolved	6	1	0	--	--	--	--	--
Chromium, total recoverable	18	1	11	<1	e.09	e1	e7	190
Chromium, dissolved	6	1	0	--	--	--	--	--
Copper, total recoverable	18	1	15	<1	e1	e1	e5.2	59
Copper, dissolved	6	1	0	--	--	--	--	--
Iron, total recoverable	18	10	18	90	190	400	2,100	51,000
Iron, dissolved	18	3	17	<3	e21	e50	e90	230
Lead, total recoverable	18	1	5	<1	e0.3	e0.5	e1	2
Lead, dissolved	6	1	0	--	--	--	--	--
Nickel, total recoverable	18	1	13	<1	e0.3	e1.5	e5.2	92
Nickel, dissolved	18	1	5	<1	e0.3	e0.5	e1	2
Zinc, total recoverable	18	10	9	<10	e5	e15	e22	100
Zinc, dissolved	6	3	5	<3	e4	e5	e8	9
After construction, December 1997 to March 1999, trace metals (µg/L)								
Aluminum, total recoverable	1	10	1	--	--	--	--	20
Aluminum, dissolved	1	10	0	--	--	--	--	--
Cadmium, total recoverable	1	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	0	--	--	--	--	--
Chromium, total recoverable	2	1	0	--	--	--	--	--
Chromium, dissolved	3	1	0	--	--	--	--	--
Copper, total recoverable	2	1	0	--	--	--	--	--
Copper, dissolved	3	1	0	--	--	--	--	--
Iron, total recoverable	1	10	1	--	--	--	--	80
Iron, dissolved	1	3	1	--	--	--	--	31
Lead, total recoverable	2	1	0	--	--	--	--	--
Lead, dissolved	3	1	0	--	--	--	--	--
Nickel, total recoverable	2	1	0	--	--	--	--	--
Nickel, dissolved	4	1	0	--	--	--	--	--
Zinc, total recoverable	2	10	0	--	--	--	--	--
Zinc, dissolved	3	20	0	--	--	--	--	--

Table 13. Statistical summary of selected water-quality data collected at station 16227100, Halawa Stream below H-1, Oahu, Hawaii, from November 1988 to November 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L , milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; $0.7\ \mu\text{m-MF}$, $0.7\ \mu\text{m}$ membrane filter; $\text{cols.}/100\ \text{mL}$, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, November 1988 to November 1997, physical, biological, and organic								
Discharge, inst., (ft^3/s)	88	0	87	0	0.22	0.68	3.0	750
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	89	1	89	90	328	570	770	1,500
pH (units)	89	0.1	89	6.7	8.6	9.0	9.3	10.1
Temperature, water ($^\circ\text{C}$)	89	0.5	89	19.5	24.0	27.5	29.8	37.0
Turbidity (NTU)	87	0.1	87	0.3	1.0	2.0	4.2	400
Oxygen dissolved (mg/L)	89	0.1	89	6.0	9.6	10.7	11.4	14.0
Fecal coliform $0.7\ \mu\text{m-MF}$ ($\text{cols.}/100\ \text{mL}$)	33	0	33	97	930	2,000	5,450	50,000
Solids, residue at 105°C , suspended (mg/L)	33	1	28	4	e4.5	e9.0	e16.5	405
Carbon, organic, total (mg/L)	17	0.1	17	1.4	3.0	4.6	6.4	52.0
Oil and grease, total (mg/L)	16	1	1	--	--	--	--	1
After construction, December 1997 to November 1998, physical, biological, and organic								
Discharge, inst., (ft^3/s)	4	0	4	0.01	--	2.4	--	4.8
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	4	1	4	173	--	542	--	912
pH (units)	4	0.1	4	8.7	--	8.9	--	9.1
Temperature, water ($^\circ\text{C}$)	4	0.5	4	22.5	--	25.0	--	27.5
Turbidity (NTU)	4	0.1	4	0.66	--	1.3	--	2.0
Oxygen dissolved (mg/L)	4	0.1	4	9.7	--	10.8	--	11.9
Fecal coliform $0.7\ \mu\text{m-MF}$ ($\text{cols.}/100\ \text{mL}$)	2	0	2	1,800	--	--	--	2,800
Solids, residue at 105°C , suspended (mg/L)	3	1	3	4.0	--	6.0	--	8.0
Carbon, organic, total (mg/L)	1	0.1	1	--	--	--	--	2.9
Oil and grease, total (mg/L)	1	1	0	--	--	--	--	--

Table 13. Statistical summary of selected water-quality data collected at station 16227100, Halawa Stream below H-1, Oahu, Hawaii, from November 1988 to November 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, November 1988 to December 1997, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	17	1	17	30	72	130	235	270
Calcium, dissolved	17	0.02	17	6.7	15	25	38	50
Magnesium, dissolved	17	0.01	17	3.3	8.8	15	34	36
Sodium, dissolved	17	0.2	17	12	24	43	72	97
Potassium, dissolved	17	0.1	17	1.1	1.5	1.8	3.7	5.1
Alkalinity (as CaCO ₃)	16	1	16	30	48	72	100	163
Sulfate, dissolved	17	0.1	17	6	10	21	36	53
Chloride, dissolved	17	0.1	17	14	35	71	160	310
Fluoride, dissolved	17	0.1	10	0.1	e0.1	e0.1	e0.1	0.2
Silica, dissolved	17	0.01	17	11	15	21	24	34
Nitrogen, nitrite plus nitrate, total (as N)	18	0.05	8	<0.1	e0.01	e0.04	e0.24	2.7
Nitrogen, nitrite plus nitrate, dissolved (as N)	12	0.05	4	<0.05	--	--	--	0.29
Nitrogen, ammonia plus organic, total (as N)	34	0.2	26	<0.2	e0.19	e0.30	e0.50	1.5
Phosphorus, total (as P)	34	0.01	26	<0.01	e0.01	e0.03	e0.05	0.15
After construction, December 1997 to November 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	0	1	0	--	--	--	--	--
Calcium, dissolved	0	0.02	0	--	--	--	--	--
Magnesium, dissolved	0	0.01	0	--	--	--	--	--
Sodium, dissolved	0	0.2	0	--	--	--	--	--
Potassium, dissolved	0	0.1	0	--	--	--	--	--
Alkalinity (as CaCO ₃)	0	1	0	--	--	--	--	--
Sulfate, dissolved	1	0.1	1	--	--	--	--	5.8
Chloride, dissolved	1	0.1	1	--	--	--	--	17
Fluoride, dissolved	0	0.1	0	--	--	--	--	--
Silica, dissolved	0	0.01	0	--	--	--	--	--
Nitrogen, nitrite plus nitrate, dissolved (as N)	3	0.05	0	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	3	0.1	3	0.15	--	0.35	--	0.55
Phosphorus, total (as P)	3	0.05	1	--	--	--	--	0.16

Table 13. Statistical summary of selected water-quality data collected at station 16227100, Halawa Stream below H-1, Oahu, Hawaii, from November 1988 to November 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, November 1988 to November 1997, trace metals (µg/L)								
Aluminum, total recoverable	17	10	17	40	120	230	1300	550,000
Aluminum, dissolved	17	10	9	10	e2.0	e10	e35	300
Cadmium, total recoverable	17	1	2	<1	--	--	--	2
Cadmium, dissolved	6	1	0	--	--	--	--	--
Chromium, total recoverable	17	1	11	<1	e0.21	e2.0	e7.5	230
Chromium, dissolved	6	1	3	<1	--	--	--	9
Copper, total recoverable	17	1	17	2	3	4	8	130
Copper, dissolved	6	1	6	2	3	4	6	8
Iron, total recoverable	17	10	17	90	175	320	1400	76,000
Iron, dissolved	17	3	17	5	10	13	48	580
Lead, total recoverable	17	1	8	1	e0.10	e0.54	e3.5	70
Lead, dissolved	6	1	4	<1	--	--	--	1
Nickel, total recoverable	17	1	16	<1	e1.5	e2.0	e3.5	140
Nickel, dissolved	17	1	7	<1	e0.45	e0.67	e1.0	2.0
Zinc, total recoverable	17	10	9	<10	e2.8	e10	e35	200
Zinc, dissolved	6	3	5	<3	e3.6	e11	e22	22
After construction, December 1997 to November 1998, trace metals (µg/L)								
Aluminum, total recoverable	0	10	0	--	--	--	--	--
Aluminum, dissolved	0	10	0	--	--	--	--	--
Cadmium, total recoverable	0	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	0	--	--	--	--	--
Chromium, total recoverable	0	1	0	--	--	--	--	--
Chromium, dissolved	0	1	0	--	--	--	--	--
Copper, total recoverable	0	1	0	--	--	--	--	--
Copper, dissolved	0	1	0	--	--	--	--	--
Iron, total recoverable	0	10	0	--	--	--	--	--
Iron, dissolved	0	3	0	--	--	--	--	--
Lead, total recoverable	0	1	0	--	--	--	--	--
Lead, dissolved	0	1	0	--	--	--	--	--
Nickel, total recoverable	0	1	0	--	--	--	--	--
Nickel, dissolved	0	1	0	--	--	--	--	--
Zinc, total recoverable	0	10	0	--	--	--	--	--
Zinc, dissolved	0	20	0	--	--	--	--	--

Table 14. Statistical summary of selected water-quality data collected at station 16265600, Right Branch Kamooolii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983, physical, biological, and organic								
Discharge, inst., (ft^3/s)	1	0	1	--	--	--	--	1.8
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	1	0.1	1	--	--	--	--	196
pH (units)	1	0.1	1	--	--	--	--	5.9
Temperature, water ($^\circ\text{C}$)	1	0.5	1	--	--	--	--	22.4
Turbidity (NTU)	1	0.1	1	--	--	--	--	0.90
Oxygen dissolved (mg/L)	1	0.1	1	--	--	--	--	6.8
Fecal coliform 0.7 μm -MF (cols./100 mL)	1	0	1	--	--	--	--	37
Solids, residue at 105°C , suspended (mg/L)	1	1	0	--	--	--	--	--
Carbon, organic, total (mg/L)	1	0.1	1	--	--	--	--	1.8
Oil and grease, total (mg/L)	5	1	0	--	--	--	--	--
During construction, April 1983 to June 1992, physical, biological, and organic								
Discharge, inst., (ft^3/s)	75	0	75	0.07	0.42	0.80	1.2	21
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	73	1	73	87	200	220	238	360
pH (units)	73	0.1	73	5.7	6.5	6.6	6.8	7.9
Temperature, water ($^\circ\text{C}$)	75	0.5	75	20.0	23.0	24.0	25.0	27.5
Turbidity (NTU)	63	0.1	63	0.90	1.6	3.0	12	360
Oxygen dissolved (mg/L)	64	0.1	64	4.0	5.4	6.2	6.9	8.6
Fecal coliform 0.7 μm -MF (cols./100 mL)	31	0	31	23	230	620	2,800	9,000
Solids, residue at 105°C , suspended (mg/L)	41	1	32	<1	e1	e5	e23	500
Carbon, organic, total (mg/L)	15	0.1	15	0.5	0.7	0.9	1.2	9.5
Oil and grease, total (mg/L)	15	1	2	<1	--	--	--	3.0
After construction, July 1992 to January 1998, physical, biological, and organic								
Discharge, inst., (ft^3/s)	57	0	57	0.13	0.27	0.45	0.83	8
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	57	1	57	80	208	220	234	295
pH (units)	57	0.1	57	6.0	6.6	6.6	6.8	7.9
Temperature, water ($^\circ\text{C}$)	57	0.5	57	21.0	23.0	23.5	24.0	25.5
Turbidity (NTU)	56	0.1	56	0.30	0.80	1.3	2.0	30
Oxygen dissolved (mg/L)	57	0.1	57	3.1	4.8	5.2	5.7	8.4
Fecal coliform 0.7 μm -MF (cols./100 mL)	23	0	23	160	260	590	1,500	8,600
Solids, residue at 105°C , suspended (mg/L)	23	1	13	<1	e0.57	e3.0	e4.0	50
Carbon, organic, total (mg/L)	12	0.1	12	0.4	0.6	1.4	1.8	5.2
Oil and grease, total (mg/L)	12	1	1	<1	--	--	--	2

Table 14. Statistical summary of selected water-quality data collected at station 16265600, Right Branch Kamooolii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	1	1	1	--	--	--	--	54
Calcium, dissolved	1	0.02	1	--	--	--	--	11.0
Magnesium, dissolved	1	0.01	0	--	--	--	--	6.5
Sodium, dissolved	1	0.2	1	--	--	--	--	16
Potassium, dissolved	1	0.1	1	--	--	--	--	0.9
Alkalinity (as CaCO ₃)	1	1	1	--	--	--	--	54
Sulfate, dissolved	1	0.1	1	--	--	--	--	7.0
Chloride, dissolved	1	0.1	1	--	--	--	--	19
Fluoride, dissolved	1	0.1	0	--	--	--	--	--
Silica, dissolved	1	0.01	1	--	--	--	--	18
Nitrogen, nitrite plus nitrate, total (as N)	1	0.05	1	--	--	--	--	0.4
Nitrogen, ammonia plus organic, total (as N)	1	0.2	1	--	--	--	--	0.70
Phosphorus, total (as P)	1	0.01	1	--	--	--	--	0.01
During construction, April 1983 to June 1992, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	15	1	15	21	62	67	87	100
Calcium, dissolved	15	0.02	15	4.9	13	14	19	31
Magnesium, dissolved	15	0.01	15	2.2	6.9	7.5	8.5	13
Sodium, dissolved	15	0.2	15	5.3	16	18	20	24
Potassium, dissolved	15	0.1	15	0.9	0.9	1	2	8
Alkalinity (as CaCO ₃)	15	1	15	17	52	57	68	94
Sulfate, dissolved	15	0.1	15	10	12	16	21	44
Chloride, dissolved	15	0.1	15	5.2	19	20	22	24
Fluoride, dissolved	15	0.1	4	<0.1	--	--	--	0.30
Silica, dissolved	15	0.01	15	3.0	18	20	22	24
Nitrogen, nitrite plus nitrate, total (as N)	38	0.05	38	0.2	0.40	0.50	0.60	2.6
Nitrogen, ammonia plus organic, total (as N)	38	0.2	26	<0.20	e0.10	e0.30	e0.40	2.6
Phosphorus, total (as P)	38	0.01	34	<0.01	e0.02	e0.03	e0.06	0.58
After construction, July 1992 to January 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	12	1	12	52	60	66	74	76
Calcium, dissolved	12	0.02	12	11	12	13	15	16
Magnesium, dissolved	12	0.01	12	5.9	7.2	7.8	8.4	9.3
Sodium, dissolved	12	0.2	12	15	17	18	19	19
Potassium, dissolved	12	0.1	12	0.9	1.1	1.2	1.6	1.7
Alkalinity (as CaCO ₃)	12	1	12	50	57	61	67	74
Sulfate, dissolved	12	0.1	12	9.9	12	15	17	18
Chloride, dissolved	12	0.1	12	19	19	21	22	24
Fluoride, dissolved	12	0.1	1	<0.1	--	--	--	0.1
Silica, dissolved	12	0.01	12	16	17	19	21	23
Nitrogen, nitrite plus nitrate, total (as N)	2	0.05	2	<0.1	--	--	--	0.55
Nitrogen, nitrite plus nitrate, dissolved (as N)	17	0.05	17	0.32	0.38	0.45	0.50	0.55
Nitrogen, ammonia plus organic, total (as N)	23	0.1	1	<0.2	--	--	--	0.5
Phosphorus, total (as P)	23	0.05	17	<0.01	e0.003	e0.01	e0.02	0.28

Table 14. Statistical summary of selected water-quality data collected at station 16265600, Right Branch Kamooolii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 trace metals (µg/L)								
Aluminum, total recoverable	1	10	1	--	--	--	--	90
Aluminum, dissolved	1	10	1	--	--	--	--	10
Cadmium, total recoverable	1	1	0	--	--	--	--	--
Cadmium, dissolved	1	1	0	--	--	--	--	--
Chromium, total recoverable	1	10	0	--	--	--	--	--
Chromium, dissolved	1	1	0	--	--	--	--	--
Copper, total recoverable	1	1	1	--	--	--	--	1
Copper, dissolved	1	1	1	--	--	--	--	1
Iron, total recoverable	1	10	1	--	--	--	--	450
Iron, dissolved	1	3	1	--	--	--	--	270
Lead, total recoverable	1	1	1	--	--	--	--	1
Lead, dissolved	1	1	1	--	--	--	--	1
Nickel, total recoverable	1	1	1	--	--	--	--	5
Nickel, dissolved	1	1	1	--	--	--	--	3
Zinc, total recoverable	1	10	1	--	--	--	--	40
Zinc, dissolved	1	3	1	--	--	--	--	33
During construction, April 1983 to June 1992, trace metals (µg/L)								
Aluminum, total recoverable	15	10	15	40	140	200	520	5,400
Aluminum, dissolved	15	10	5	<10	e0.26	e1.5	e10	110
Cadmium, total recoverable	15	1	1	<1	--	--	--	3
Cadmium, dissolved	14	1	0	--	--	--	--	--
Chromium, total recoverable	15	1	10	<1	e1	e2	e10	80
Chromium, dissolved	14	1	2	<1	--	--	--	10
Copper, total recoverable	15	1	15	2	2	4	5	60
Copper, dissolved	14	1	14	1	1	2	4	8
Iron, total recoverable	15	10	15	270	520	720	1,700	39,000
Iron, dissolved	15	3	15	10	40	80	100	170
Lead, total recoverable	15	1	12	<1	e1	e2	e3	31
Lead, dissolved	14	1	8	<1	e0.46	e1.0	e1.2	4.0
Nickel, total recoverable	15	1	15	1	3	9	17	120
Nickel, dissolved	15	1	11	<1	e0.80	e2.0	e4.0	e8.0
Zinc, total recoverable	15	10	14	<10	e40	e50	e140	170
Zinc, dissolved	14	3	13	<3	e13	e22	e54	160
After construction, July 1992 to January 1998, trace metals (µg/L)								
Aluminum, total recoverable	12	10	11	<10	e20	e50	e90	1,100
Aluminum, dissolved	12	10	3	<5	--	--	--	30
Cadmium, total recoverable	12	1	0	--	--	--	--	--
Cadmium, dissolved	--	1	--	--	--	--	--	--
Chromium, total recoverable	12	1	6	<1	e0.16	e0.44	e1.8	5.0
Chromium, dissolved	--	1	--	--	--	--	--	--
Copper, total recoverable	12	1	6	<1	e0.30	e0.67	e2.0	5.0
Copper, dissolved	--	1	--	--	--	--	--	--
Iron, total recoverable	12	10	12	340	400	460	720	4,600
Iron, dissolved	12	3	12	36	86	100	130	290
Lead, total recoverable	12	1	2	<1	--	--	--	3
Lead, dissolved	--	1	--	--	--	--	--	--
Nickel, total recoverable	12	1	12	1	1	2	2	6
Nickel, dissolved	12	1	6	<1	e0.41	e0.65	e1.0	2.0
Zinc, total recoverable	12	10	9	<10	e7.4	e10	e30	30
Zinc, dissolved	--	20	--	--	--	--	--	--

Table 15. Statistical summary of selected water-quality data collected at station 16265700, Kamooalii Stream at alt 200 ft. near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, physical, biological, and nutrients								
Discharge, inst., (ft^3/s)	19	0	19	0.05	0.40	0.85	2.8	4.7
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	19	1	19	159	193	200	207	212
pH (units)	19	0.1	19	6.0	6.5	6.8	7.0	8.6
Temperature, water (°C)	19	0.5	19	20.0	21.5	22.5	22.5	26.0
Turbidity (NTU)	18	0.1	18	0.40	0.50	0.95	1.4	9.0
Oxygen dissolved (mg/L)	18	0.1	18	6.0	7.2	7.8	8.3	9.4
Fecal coliform 0.7 μm -MF (cols./100 mL)	10	0	10	33	95	320	1,007	2,000
Solids, residue at 105°C, suspended (mg/L)	14	1	13	<1	e2.0	e4.5	e10	18
Nitrogen, nitrite plus nitrate, total (as N)	11	0.1	11	0.20	0.20	0.20	0.30	0.30
Nitrogen, ammonia plus organic, total (as N)	11	0.2	10	<0.2	e0.20	e0.40	e0.50	1.1
Phosphorus, total (as P)	11	0.01	11	0.01	0.02	0.03	0.04	0.07
During construction, June 1989 to June 1992, physical, biological, and nutrients								
Discharge, inst., (ft^3/s)	34	0	34	0.15	0.61	1.3	2.3	39
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	33	1	33	148	204	220	230	380
pH (units)	33	0.1	33	6.4	6.9	7.0	7.4	8.1
Temperature, water (°C)	33	0.5	33	20.5	21.2	22.0	23.0	24.0
Turbidity (NTU)	34	0.1	34	0.40	0.98	5.6	78	13,000
Oxygen dissolved (mg/L)	31	0.1	31	5.8	7.4	7.7	7.9	8.8
Fecal coliform 0.7 μm -MF (cols./100 mL)	12	0	12	64	135	480	2,625	12,000
Solids, residue at 105°C, suspended (mg/L)	13	1	10	<1	e2.3	e5.0	e46	404
Nitrogen, nitrite plus nitrate, total (as N)	13	0.1	13	0.10	0.19	0.26	0.45	0.84
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	13	0.2	6	<0.2	e0.09	e0.15	e0.30	0.50
Phosphorus, total (as P)	13	0.01	9	<0.01	e0.01	e0.03	e0.24	0.36

Table 15. Statistical summary of selected water-quality data collected at station 16265700, Kamooalii Stream at alt 200 ft near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
After construction, July 1992 to January 1998, physical, biological, and nutrients								
Discharge, inst., (ft ³ /s)	47	0	47	0.12	0.32	0.68	1.2	3.2
Specific conductance (µS/cm at 25°C)	47	1	47	23	215	223	232	267
pH (units)	47	0.1	47	4.5	6.6	6.8	7.1	7.6
Temperature, water (°C)	47	0.5	47	20.0	21.5	22.0	22.5	24.5
Turbidity (NTU)	47	0.1	47	0.10	0.30	0.60	1.0	2.5
Oxygen dissolved (mg/L)	46	0.1	46	4.3	6.4	7.4	8.1	8.8
Fecal coliform 0.7 µm-MF (cols./100 mL)	19	0	19	27	80	180	500	2,500
Solids, residue at 105°C, suspended (mg/L)	19	1	13	<1	e0.6	e1.0	e4.0	8.0
Nitrogen, nitrite plus nitrate, total (as N)	2	0.05	2	0.20	--	--	--	0.30
Nitrogen, nitrite plus nitrate, dissolved (as N)	12	0.05	12	0.16	0.24	0.33	0.54	0.59
Nitrogen, ammonia plus organic, total (as N)	19	0.1	0	--	--	--	--	--
Phosphorus, total (as P)	19	0.05	16	<0.05	e0.01	e0.02	e0.03	0.06

Table 16. Statistical summary of selected water-quality data collected at station 16266500, Hooleinaiwa Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to February 1997

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L , milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; $0.7\ \mu\text{m-MF}$, $0.7\ \mu\text{m}$ membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, physical, biological, and nutrients								
Discharge, inst., (ft^3/s)	16	0	16	0.07	0.13	0.30	0.77	1.7
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	16	1	16	99	113	121	125	133
pH (units)	16	0.1	16	6.1	6.4	6.7	6.8	7.0
Temperature, water ($^\circ\text{C}$)	16	0.5	16	21.0	22.3	22.5	23.5	25.0
Turbidity (NTU)	15	0.1	15	0.30	0.30	0.70	1.0	2.4
Oxygen dissolved (mg/L)	15	0.1	15	6.6	6.9	7.3	8.5	9.3
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	10	0	10	50	85	125	252	290
Solids, residue at 105°C , suspended (mg/L)	13	1	9	<1	e1.1	e5.0	e9.5	31
Nitrogen, nitrite plus nitrate, total (as N)	10	0.05	2	<0.1	--	--	--	0.10
Nitrogen, ammonia plus organic, total (as N)	10	0.2	4	<0.2	--	--	--	0.60
Phosphorus, total (as P)	9	0.01	5	<0.01	e0.002	e0.01	e0.01	0.07
During construction, June 1989 to June 1992, physical, biological, and nutrients								
Discharge, inst., (ft^3/s)	31	0	31	0.06	0.17	0.28	0.77	6.2
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	30	1	30	110	129	151	160	190
pH (units)	30	0.1	30	6.2	6.8	7.0	7.2	7.5
Temperature, water ($^\circ\text{C}$)	30	0.5	30	20.0	22.0	22.5	23.0	24.5
Turbidity (NTU)	32	0.1	32	0.20	0.40	0.65	1.5	4,700
Oxygen dissolved (mg/L)	30	0.1	30	5.4	7.1	7.9	8.3	8.8
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	11	0	11	20	82	180	840	3,100
Solids, residue at 105°C , suspended (mg/L)	12	1	5	<1	e0.08	e0.60	e8.2	37
Nitrogen, nitrite plus nitrate, total (as N)	12	0.05	9	<0.1	e0.08	e0.13	e0.27	0.40
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	12	0.2	3	0.2	--	0.4	--	0.6
Phosphorus, total (as P)	12	0.01	5	<0.01	e0.002	e0.006	e0.03	0.07

Table 16. Statistical summary of selected water-quality data collected at station 16266500, Hooleinaiwa Stream at alt 200 ft near Kaneohe, Oahu, Hawaii, from February 1983 to February 1997--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
After construction, July 1992 to February 1997, physical, biological, and nutrients								
Discharge, inst., (ft ³ /s)	46	0	46	0.01	0.08	0.19	0.38	1.9
Specific conductance (μS/cm at 25°C)	46	1	46	140	155	161	170	250
pH (units)	46	0.1	46	6.0	6.6	6.8	6.9	7.4
Temperature, water (°C)	45	0.5	45	20.0	21.8	22.5	23.0	24.5
Turbidity (NTU)	46	0.1	46	0.20	0.30	0.40	0.72	36
Oxygen dissolved (mg/L)	46	0.1	46	4.0	6.4	6.8	7.3	8.9
Fecal coliform 0.7 μm-MF (cols./100 mL)	17	0	17	7	30	90	175	17,000
Solids, residue at 105°C, suspended (mg/L)	18	1	9	<1	e0.10	e0.72	e3.5	86
Nitrogen, nitrite plus nitrate, total (as N)	2	0.05	2	0.12	--	--	--	0.25
Nitrogen, nitrite plus nitrate, dissolved (as N)	12	0.05	10	<0.05	e0.07	e0.10	e0.14	0.18
Nitrogen, ammonia plus organic, total (as N)	17	0.1	1	--	--	--	--	0.50
Phosphorus, total (as P)	18	0.05	2	--	--	--	--	0.12

Table 17. Statistical summary of selected water-quality data collected at station 16267500, Hooleinaiwa Stream above confluence with Kamooalii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998

[inst., instantaneous; uS/cm at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; µg/L, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 µm-MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft³/s, cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, physical, biological, and nutrients								
Discharge, inst., (ft ³ /s)	17	0	17	0.44	0.64	0.84	1.2	3.5
Specific conductance (µS/cm at 25°C)	17	1	17	115	147	166	174	188
pH (units)	17	0.1	17	6.3	6.7	6.9	7.1	7.4
Temperature, water (°C)	17	0.5	17	21.6	23.0	24.5	25.2	30.0
Turbidity (NTU)	17	0.1	17	2.0	2.5	2.7	3.6	12
Oxygen dissolved (mg/L)	17	0.1	17	5.6	6.5	6.8	7.8	5.6
Fecal coliform 0.7 µm-MF (cols./100 mL)	10	0	10	10	28	86	232	3,300
Solids, residue at 105°C, suspended (mg/L)	14	1	11	<1	e1.0	e6.5	e10	13
Nitrogen, nitrite plus nitrate, total (as N)	11	0.05	2	--	--	--	--	0.10
Nitrogen, ammonia plus organic, total (as N)	11	0.2	6	<0.2	e0.16	e0.21	e0.50	0.70
Phosphorus, total (as P)	11	0.01	8	<0.01	e0.01	e0.02	e0.03	0.03
During construction, June 1989 to June 1992, physical, biological, and nutrients								
Discharge, inst., (ft ³ /s)	30	0	30	0.35	0.62	0.75	1.1	150
Specific conductance (µS/cm at 25°C)	30	1	30	65	154	178	195	203
pH (units)	30	0.1	30	6.8	7.0	7.3	7.4	7.8
Temperature, water (°C)	30	0.5	30	20.0	22.0	23.5	24.1	26.0
Turbidity (NTU)	31	0.1	31	0.50	3.4	4.3	15	550
Oxygen dissolved (mg/L)	30	0.1	30	6.2	7.4	7.8	8.1	8.6
Fecal coliform 0.7 µm-MF (cols./100 mL)	11	0	11	36	78	210	490	9,300
Solids, residue at 105°C, suspended (mg/L)	12	1	11	<1	e1.8	e12	e28	168
Nitrogen, nitrite plus nitrate, total (as N)	12	0.05	4	<0.05	--	--	--	0.30
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	12	0.2	4	<0.2	--	--	--	0.6
Phosphorus, total (as P)	12	0.01	7	<0.01	e0.003	e0.01	e0.05	0.12

Table 17. Statistical summary of selected water-quality data collected at station 16267500, Hooleinaiwa Stream above confluence with Kamooalii Stream near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
After construction, July 1992 to January 1998, physical, biological, and nutrients								
Discharge, inst., (ft ³ /s)	48	0	48	0.08	0.45	0.62	0.93	3.7
Specific conductance (µS/cm at 25°C)	48	1	48	142	186	192	197	200
pH (units)	48	0.1	48	6.3	7.0	7.2	7.4	7.6
Temperature, water (°C)	47	0.5	47	20.0	22.0	23.0	24.0	26.5
Turbidity (NTU)	48	0.1	48	0.38	1.8	3.1	5.0	61
Oxygen dissolved (mg/L)	48	0.1	48	5.4	6.9	7.3	7.8	8.8
Fecal coliform 0.7 µm-MF (cols./100 mL)	20	0	20	16	44	130	218	5,500
Solids, residue at 105°C, suspended (mg/L)	20	1	16	<1	e1.0	e4.0	e8.7	174
Nitrogen, nitrite plus nitrate, total (as N)	2	0.05	1	<0.05	--	--	--	0.08
Nitrogen, nitrite plus nitrate, dissolved (as N)	14	0.05	9	<0.05	e0.04	e0.06	e0.09	0.09
Nitrogen, ammonia plus organic, total (as N)	20	0.1	1	--	--	--	--	0.30
Phosphorus, total (as P)	20	0.05	10	<0.05	e0.01	e0.02	e0.02	0.09

Table 18. Statistical summary of selected water-quality data collected at station 16269500, Kuou Stream at alt 200 ft near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, physical, biological, and nutrients								
Discharge, inst., (ft^3/s)	17	0	17	0.03	0.01	0.20	0.52	6.0
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	16	1	16	200	212	248	290	320
pH (units)	17	0.1	17	6.0	6.8	6.9	7.0	7.4
Temperature, water (°C)	17	0.5	17	20.5	22.0	22.4	22.8	24.5
Turbidity (NTU)	15	0.1	15	1.4	2.3	2.7	4.0	43
Oxygen dissolved (mg/L)	16	0.1	16	5.0	5.5	7.0	7.9	9.4
Fecal coliform 0.7 μm -MF (cols./100 mL)	10	0	10	10	33	112	245	390
Solids, residue at 105°C, suspended (mg/L)	13	1	8	<1	e2.3	e5.0	e9.0	13
Nitrogen, nitrite plus nitrate, total (as N)	10	0.05	7	<0.1	e0.03	e0.20	e0.65	4.1
Nitrogen, ammonia plus organic, total (as N)	10	0.2	7	<0.2	e0.17	e0.35	e0.52	0.70
Phosphorus, total (as P)	10	0.01	7	<0.01	e0.002	e0.01	e0.02	0.20
During construction, June 1989 to June 1992, physical, biological, and nutrients								
Discharge, inst., (ft^3/s)	30	0	30	0.01	0.02	0.06	0.17	1.1
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	30	1	30	225	260	280	300	325
pH (units)	29	0.1	29	6.6	7.0	7.0	7.4	7.9
Temperature, water (°C)	30	0.5	30	20.5	22.0	22.5	23.0	25.0
Turbidity (NTU)	31	0.1	31	0.2	1.0	2.4	4.3	16
Oxygen dissolved (mg/L)	30	0.1	30	5.7	7.0	7.4	8.2	8.7
Fecal coliform 0.7 μm -MF (cols./100 mL)	11	0	11	9.0	140	160	380	540
Solids, residue at 105°C, suspended (mg/L)	12	1	9	<1	e1.4	e4.0	e10	21
Nitrogen, nitrite plus nitrate, total (as N)	12	0.05	12	0.10	0.20	0.28	0.48	0.70
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	12	0.2	4	<0.2	--	--	--	0.70
Phosphorus, total (as P)	12	0.01	7	<0.01	e0.005	e0.01	e0.02	0.04

Table 18. Statistical summary of selected water-quality data collected at station 16269500, Kuou Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
After construction, July 1992 to January 1998, physical, biological, and nutrients								
Discharge, inst., (ft ³ /s)	43	0	43	0	0.02	0.03	0.08	1.0
Specific conductance (µS/cm at at 25°C)	45	1	45	215	304	318	350	400
pH (units)	45	0.1	45	6.5	6.8	7.1	7.3	7.5
Temperature, water (°C)	45	0.5	45	20.5	21.5	22.3	23.2	27.0
Turbidity (NTU)	45	0.1	45	0.2	0.4	0.8	1.4	33
Oxygen dissolved (mg/L)	45	0.1	45	2.6	7.0	7.4	8.0	11
Fecal coliform 0.7 µm-MF (cols./100 mL)	17	0	17	37	205	440	1,900	9,600
Solids, residue at 105°C, suspended (mg/L)	18	1	13	<1	e0.7	e3.5	e6.8	46
Nitrogen, nitrite plus nitrate, dissolved (as N)	13	0.05	13	0.13	0.22	0.27	0.33	0.50
Nitrogen, ammonia plus organic, total (as N)	18	0.1	2	<0.1	--	--	--	0.40
Phosphorus, total (as P)	18	0.05	9	<0.05	e0.004	e0.01	e0.02	0.09

Table 19. Statistical summary of selected water-quality data collected at station 16270900, Luluku Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, physical, biological, and organic								
Discharge, inst., (ft^3/s)	43	0	43	0.07	0.16	0.62	1.5	222
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	43	1	43	126	158	162	177	195
pH (units)	43	0.1	43	6.3	6.9	7.1	7.4	8.3
Temperature, water (°C)	43	0.5	43	19.5	20.1	21.5	22.5	26.0
Turbidity (NTU)	25	0.1	25	0.4	0.7	1.0	6.6	140
Oxygen dissolved (mg/L)	25	0.1	25	6.8	7.6	8.2	8.8	9.8
Fecal coliform 0.7 μm -MF (cols./100 mL)	27	0	17	68	135	590	1,050	4,900
Solids, residue at 105°C, suspended (mg/L)	22	1	15	<1	e1.2	e5.5	e13	81
Carbon, organic, total (mg/L)	8	0.1	8	0.6	0.6	0.8	4.2	5.4
Oil and grease, total (mg/L)	8	1	1	--	--	--	--	1
During construction, June 1989 to December 1995, physical, biological, and organic								
Discharge, inst., (ft^3/s)	68	0	68	0.20	0.94	1.2	1.7	93
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	68	1	68	108	150	160	169	218
pH (units)	68	0.1	68	6.0	7.2	7.5	7.7	8.1
Temperature, water (°C)	67	0.5	67	19.5	20.0	21.0	21.5	26.0
Turbidity (NTU)	68	0.1	68	0.2	0.6	1.0	2.3	770
Oxygen dissolved (mg/L)	68	0.1	68	6.9	8.2	8.4	8.8	9.5
Fecal coliform 0.7 μm -MF (cols./100 mL)	27	0	27	200	520	1,400	2,400	9,800
Solids, residue at 105°C, suspended (mg/L)	28	1	17	<1	e0.14	e1.5	e7.5	1,020
Carbon, organic, total (mg/L)	14	0.1	14	0.40	0.70	0.90	1.6	9.9
Oil and grease, total (mg/L)	14	1	0	--	--	--	--	--
After construction, January 1996 to April 1998, physical, biological, and organic								
Discharge, inst., (ft^3/s)	18	0	18	0.74	1.1	1.3	1.4	10
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	21	1	21	120	156	158	172	187
pH (units)	21	0.1	21	7.0	7.4	7.6	7.7	7.9
Temperature, water (°C)	18	0.5	18	18.5	20.0	21.0	21.5	22.0
Turbidity (NTU)	20	0.1	20	0.10	0.30	0.34	0.50	34
Oxygen dissolved (mg/L)	20	0.1	20	6.9	8.5	8.8	8.8	9.2
Fecal coliform 0.7 μm -MF (cols./100 mL)	9	0	9	130	175	230	410	1,000
Solids, residue at 105°C, suspended (mg/L)	9	1	7	<1	e0.8	e1.0	e3.0	3.0
Carbon, organic, total (mg/L)	4	0.1	4	0.5	--	2.0	--	3.6
Oil and grease, total (mg/L)	4	1	0	--	--	--	--	--

Table 19. Statistical summary of selected water-quality data collected at station 16270900, Luluku Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	8	1	8	46	46	47	52	61
Calcium, dissolved	8	0.02	8	8.5	8.8	9.1	10	12
Magnesium, dissolved	8	0.01	8	5.7	5.8	6.0	6.8	7.5
Sodium, dissolved	8	0.2	8	10	12	13	14	14
Potassium, dissolved	8	0.1	8	0.9	1.0	1.2	2.0	3.1
Alkalinity (as CaCO ₃)	7	1	7	41	44	47	51	55
Sulfate, dissolved	8	0.1	7	3.5	e3.7	e4.8	e7.2	15
Chloride, dissolved	8	0.1	8	15	15	16	18	20
Fluoride, dissolved	8	0.1	3	0.1	--	0.2	--	0.3
Silica, dissolved	8	0.01	8	21	23	27	28	29
Nitrogen, nitrite plus nitrate, total (as N)	19	0.05	13	<0.2	e0.10	e0.20	e0.40	1.3
Nitrogen, ammonia plus organic, total (as N)	19	0.2	12	<0.2	e0.10	e0.20	e0.50	1.0
Phosphorus, total (as P)	19	0.01	18	0.01	e0.01	e0.02	e0.03	0.29
During construction, June 1989 to December 1995, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	14	1	14	21	44	46	50	60
Calcium, dissolved	14	0.02	14	4.5	8.8	9.3	10	12
Magnesium, dissolved	14	0.01	14	2.4	5.3	5.5	5.8	7.2
Sodium, dissolved	14	0.2	14	6.5	13	13	13	14
Potassium, dissolved	14	0.1	14	0.8	0.9	1.0	1.3	3.0
Alkalinity (as CaCO ₃)	14	1	14	22	47	49	50	61
Sulfate, dissolved	14	0.1	14	1.9	2.9	3.6	4.6	10
Chloride, dissolved	14	0.1	14	9.0	15	16	17	19
Fluoride, dissolved	14	0.1	3	<0.1	--	--	--	0.2
Silica, dissolved	14	0.01	14	10	26	28	29	30
Nitrogen, nitrite plus nitrate, total (as N)	16	0.05	15	<0.05	e0.10	e0.15	e0.20	0.40
Nitrogen, nitrite plus nitrate, dissolved (as N)	8	0.05	8	0.10	0.15	0.17	0.19	0.37
Nitrogen, ammonia plus organic, total (as N)	28	0.2	9	<0.20	e0.07	e0.12	e0.28	0.80
Phosphorus, total (as P)	28	0.01	25	<0.01	e0.02	e0.03	e0.03	1.0
After construction, January 1996 to April 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	4	1	4	45	--	49	--	53
Calcium, dissolved	4	0.02	4	9.0	--	10	--	11
Magnesium, dissolved	4	0.01	4	5.5	--	5.8	--	6.1
Sodium, dissolved	4	0.2	4	11	--	12	--	12
Potassium, dissolved	4	0.1	4	0.88	--	0.94	--	1.0
Alkalinity (as CaCO ₃)	4	1	4	48	--	51	--	54
Sulfate, dissolved	4	0.1	4	4.0	--	5.4	--	6.8
Chloride, dissolved	4	0.1	4	16	--	16	--	17
Fluoride, dissolved	4	0.1	0	--	--	--	--	--
Silica, dissolved	4	0.01	4	25	--	26	--	27
Nitrogen, nitrite plus nitrate, dissolved (as N)	9	0.05	9	0.08	0.11	0.17	0.20	0.23
Nitrogen, ammonia plus organic, total (as N)	9	0.1	0	--	--	--	--	--
Phosphorus, total (as P)	9	0.05	7	<0.05	e0.01	e0.01	e0.02	0.03

Table 19. Statistical summary of selected water-quality data collected at station 16270900, Luluku Stream at alt 220 ft near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Mini-mum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983 to June 1989, trace metals (µg/L)								
Aluminum, total recoverable	8	10	8	20	52	80	252	1,600
Aluminum, dissolved	8	10	5	10	e1.5	e10	e28	160
Cadmium, total recoverable	8	1	1	--	--	--	--	1.0
Cadmium, dissolved	8	1	1	--	--	--	--	2.0
Chromium, total recoverable	8	10	4	<1	--	--	--	20
Chromium, dissolved	8	1	3	<1	--	--	--	7.0
Copper, total recoverable	8	1	7	<1	e2.2	e3.5	e7.2	8.0
Copper, dissolved	8	1	5	<1	e0.72	e1.5	e2.8	3.0
Iron, total recoverable	8	10	8	60	90	125	1,325	4,400
Iron, dissolved	8	3	8	20	20	20	65	100
Lead, total recoverable	8	1	4	<1	--	--	--	10
Lead, dissolved	8	1	3	<1	--	--	--	2.0
Nickel, total recoverable	8	1	8	1.0	2.2	5.5	8.0	9.0
Nickel, dissolved	8	1	3	<1	--	--	--	5.0
Zinc, total recoverable	8	10	6	<10	4.4	e10	20	140
Zinc, dissolved	8	3	5	<3.0	1.4	e4.5	8.8	19
During construction, June 1989 to December 1995, trace metals (µg/L)								
Aluminum, total recoverable	14	10	14	20	62	120	6,300	6,300
Aluminum, dissolved	14	10	9	<10	e2.8	e10	e30	170
Cadmium, total recoverable	14	1	0	--	--	--	--	--
Cadmium, dissolved	5	1	0	--	--	--	--	--
Chromium, total recoverable	14	1	10	<10	e1.0	e1.5	e2.0	30
Chromium, dissolved	5	1	2	<1	--	--	--	3.0
Copper, total recoverable	14	1	12	<1	e0.22	e1.0	e2.2	10
Copper, dissolved	5	1	3	<1	--	--	--	3.0
Iron, total recoverable	14	10	14	40	108	220	400	8,600
Iron, dissolved	14	3	14	10	20	25	38	230
Lead, total recoverable	14	1	4	<1	--	--	--	6
Lead, dissolved	5	1	1	--	--	--	--	1.0
Nickel, total recoverable	14	1	6	<1	e0.06	e0.27	e13	13
Nickel, dissolved	14	1	1	--	--	--	--	1.0
Zinc, total recoverable	14	10	4	<10	--	--	--	30
Zinc, dissolved	5	3	4	<3	--	--	--	6
After construction, January 1996 to April 1998, trace metals (µg/L)								
Aluminum, total recoverable	4	10	4	10	--	30	--	50
Aluminum, dissolved	4	10	0	--	--	--	--	--
Cadmium, total recoverable	4	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	--	--	--	--	--	--
Chromium, total recoverable	4	1	2	<1	--	--	--	1
Chromium, dissolved	0	1	--	--	--	--	--	--
Copper, total recoverable	4	1	1	--	--	--	--	1
Copper, dissolved	0	1	--	--	--	--	--	--
Iron, total recoverable	4	10	4	40	--	--	--	100
Iron, dissolved	4	3	3	5.0	--	--	--	6.0
Lead, total recoverable	4	1	0	--	--	--	--	--
Lead, dissolved	0	1	--	--	--	--	--	--
Nickel, total recoverable	4	1	0	--	--	--	--	--
Nickel, dissolved	4	1	0	--	--	--	--	--
Zinc, total recoverable	4	10	0	--	--	--	--	--
Zinc, dissolved	0	20	--	--	--	--	--	--

Table 20. Statistical summary of selected water-quality data collected at station 16272200, Kamooalii Stream below Luluku Stream near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L , milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; $0.7\ \mu\text{m-MF}$, $0.7\ \mu\text{m}$ membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983, physical, biological, and organic								
Discharge, inst., (ft^3/s)	1	0	1	--	--	--	--	14
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	1	1	1	--	--	--	--	176
pH (units)	1	0.1	1	--	--	--	--	7.1
Temperature, water ($^\circ\text{C}$)	1	0.5	1	--	--	--	--	20.5
Turbidity (NTU)	1	0.1	1	--	--	--	--	1.5
Oxygen dissolved (mg/L)	1	0.1	1	--	--	--	--	8.6
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	1	0	--	--	--	--	--	19
Solids, residue at 105°C , suspended (mg/L)	1	1	0	--	--	--	--	--
Carbon, organic, total (mg/L)	1	0.1	1	--	--	--	--	1.8
Oil and grease, total (mg/L)	1	1	0	--	--	--	--	--
During construction, February 1983 to December 1995, physical, biological, and organic								
Discharge, inst., (ft^3/s)	159	0	159	0.29	5.7	9.4	180	1180
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	130	1	130	80	170	180	190	220
pH (units)	118	0.1	118	6.4	7.3	7.8	8.0	8.5
Temperature, water ($^\circ\text{C}$)	118	0.5	118	20.5	23.0	24.8	26.2	31.0
Turbidity (NTU)	141	0.1	141	0.5	1.6	2.6	85	550
Oxygen dissolved (mg/L)	100	0.1	100	5.4	8.0	8.4	8.8	10.8
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	46	0	46	16	73	135	292	22,000
Solids, residue at 105°C , suspended (mg/L)	81	1	76	<1	e5.0	e9.0	e186	752
Carbon, organic, total (mg/L)	36	0.1	36	1.0	1.6	2.0	7.9	27
Oil and grease, total (mg/L)	25	1	2	<1	--	--	--	2
After construction, January 1996 to April 1998, physical, biological, and organic								
Discharge, inst., (ft^3/s)	18	0	18	4.8	7.1	9.7	13.2	19
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	17	1	17	138	180	190	196	215
pH (units)	18	0.1	18	6.5	7.6	7.9	8.0	8.1
Temperature, water ($^\circ\text{C}$)	18	0.5	18	19.5	22.5	23.8	25.5	27.0
Turbidity (NTU)	18	0.1	18	0.3	0.8	1.4	2.1	6.0
Oxygen dissolved (mg/L)	20	0.1	20	7.9	8.4	8.8	9.1	9.5
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	8	0	8	50	83	105	155	270
Solids, residue at 105°C , suspended (mg/L)	9	1	5	<1	e0.2	e1.0	e4.0	e8.0
Carbon, organic, total (mg/L)	4	0.1	4	1.1	--	1.4	--	2.1
Oil and grease, total (mg/L)	4	1	0	--	--	--	--	--

Table 20. Statistical summary of selected water-quality data collected at station 16272200, Kamooalii Stream below Luluku Stream near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	1	1	1	--	--	--	--	52
Calcium, dissolved	1	0.02	1	--	--	--	--	8.2
Magnesium, dissolved	1	0.01	1	--	--	--	--	7.6
Sodium, dissolved	1	0.2	1	--	--	--	--	15
Potassium, dissolved	1	0.1	1	--	--	--	--	0.9
Alkalinity (as CaCO ₃)	1	1	1	--	--	--	--	59
Sulfate, dissolved	1	0.1	1	--	--	--	--	6.8
Chloride, dissolved	1	0.1	1	--	--	--	--	18
Fluoride, dissolved	1	0.1	1	--	--	--	--	--
Silica, dissolved	1	0.01	1	--	--	--	--	22
Nitrogen, nitrite plus nitrate, total (as N)	1	0.1	1	--	--	--	--	0.30
Nitrogen, ammonia plus organic, total (as N)	1	0.2	1	--	--	--	--	0.80
Phosphorus, total (as P)	1	0.01	1	--	--	--	--	0.05
During construction, February 1983 to December 1995, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	26	1	26	26	51	54	56	67
Calcium, dissolved	26	0.02	26	5.0	7.8	8.9	9.3	11
Magnesium, dissolved	26	0.01	26	3.3	7.1	7.8	8.3	9.6
Sodium, dissolved	26	0.2	26	5.7	13	15	15	17
Potassium, dissolved	26	0.1	26	0.9	0.9	1.1	1.3	2.1
Alkalinity (as CaCO ₃)	26	1	26	21	46	54	55	61
Sulfate, dissolved	26	0.1	26	3.6	6.8	7.8	9.3	25
Chloride, dissolved	26	0.1	26	6.6	17	18	19	22
Fluoride, dissolved	26	0.1	8	<0.1	e0.02	e0.05	e0.10	0.30
Silica, dissolved	26	0.01	26	9.0	20	21	22	23
Nitrogen, nitrite plus nitrate, total (as N)	54	0.1	51	<0.1	e0.20	e0.30	e0.30	0.80
Nitrogen, nitrite plus nitrate, dissolved (as N)	7	0.05	7	0.22	0.25	0.29	0.31	0.41
Nitrogen, ammonia plus organic, total (as N)	66	0.2	45	<0.2	e0.14	e0.30	e0.82	4.6
Phosphorus, total (as P)	66	0.01	60	<0.01	e0.01	e0.02	e0.26	0.75
After construction, January 1996 to April 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	4	1	4	55	--	58	--	60
Calcium, dissolved	4	0.02	4	9.4	--	9.7	--	10
Magnesium, dissolved	4	0.01	4	7.4	--	8.0	--	8.6
Sodium, dissolved	4	0.2	4	13	--	14	--	14
Potassium, dissolved	4	0.1	4	0.9	--	1.2	--	1.5
Alkalinity (as CaCO ₃)	4	1	4	55	--	57	--	59
Sulfate, dissolved	4	0.1	4	6.9	--	7.8	--	8.8
Chloride, dissolved	4	0.1	4	17	--	18	--	20
Fluoride, dissolved	4	0.1	0	--	--	--	--	--
Silica, dissolved	4	0.01	4	18	--	19	--	20
Nitrogen, nitrite plus nitrate, dissolved (as N)	9	0.05	9	0.28	0.32	0.33	0.36	0.41
Nitrogen, ammonia plus organic, total (as N)	9	0.1	4	<0.1	--	--	--	0.20
Phosphorus, total (as P)	9	0.05	8	<0.05	e0.01	e0.02	e0.02	0.03

Table 20. Statistical summary of selected water-quality data collected at station 272200, Kamooolii Stream below Luluku Stream near Kaneohe, Oahu, Hawaii, from February 1983 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, February 1983, trace metals (µg/L)								
Aluminum, total recoverable	1	10	1	--	--	--	--	170
Aluminum, dissolved	1	10	1	--	--	--	--	10
Cadmium, total recoverable	1	1	0	--	--	--	--	--
Cadmium, dissolved	1	1	0	--	--	--	--	--
Chromium, total recoverable	1	10	0	--	--	--	--	--
Chromium, dissolved	1	1	0	--	--	--	--	--
Copper, total recoverable	1	1	0	--	--	--	--	--
Copper, dissolved	1	1	0	--	--	--	--	--
Iron, total recoverable	0	10	--	--	--	--	--	--
Iron, dissolved	1	3	0	--	--	--	--	--
Lead, total recoverable	1	1	0	--	--	--	--	--
Lead, dissolved	1	1	0	--	--	--	--	--
Nickel, total recoverable	1	1	1	--	--	--	--	5.0
Nickel, dissolved	1	1	1	--	--	--	--	1.0
Zinc, total recoverable	1	10	1	--	--	--	--	10
Zinc, dissolved	1	3	1	--	--	--	--	4.0
During construction, February 1983 to December 1995, trace metals (µg/L)								
Aluminum, total recoverable	28	10	28	90	140	245	460	34,000
Aluminum, dissolved	26	10	21	<10	e8.8	e20	e32	1,200
Cadmium, total recoverable	28	1	4	<1	--	--	--	1
Cadmium, dissolved	17	1	1	<1	--	--	--	1
Chromium, total recoverable	28	1	17	<1	e0.35	e1.8	e8.3	80
Chromium, dissolved	17	1	1	--	--	--	--	3.0
Copper, total recoverable	28	1	27	1.0	1.2	3.0	5.0	70
Copper, dissolved	17	1	16	<1	e1.0	e1.0	e4.0	6.0
Iron, total recoverable	28	10	28	130	285	405	697	43,000
Iron, dissolved	26	3	26	10	20	35	57	480
Lead, total recoverable	28	1	13	<1	e0.1	e0.6	e2.8	100
Lead, dissolved	17	1	3	<1	--	--	--	4.0
Nickel, total recoverable	28	1	25	<1	e2.0	e3.0	e12	150
Nickel, dissolved	26	1	11	<1	e0.3	e0.5	e1.0	5.0
Zinc, total recoverable	28	10	13	<10	e1.6	e5.7	e20	190
Zinc, dissolved	17	3	11	<3	e2.4	e4.0	e6.5	11
After construction, January 1996 to April 1998, trace metals (µg/L)								
Aluminum, total recoverable	4	10	4	60	--	--	--	200
Aluminum, dissolved	4	10	1	--	--	--	--	9.3
Cadmium, total recoverable	4	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	--	--	--	--	--	--
Chromium, total recoverable	4	1	1	--	--	--	--	2
Chromium, dissolved	0	1	--	--	--	--	--	--
Copper, total recoverable	4	1	1	--	--	--	--	1
Copper, dissolved	0	1	--	--	--	--	--	--
Iron, total recoverable	4	10	4	230	--	430	--	630
Iron, dissolved	4	3	4	44	--	54	--	65
Lead, total recoverable	4	1	0	--	--	--	--	--
Lead, dissolved	0	1	--	--	--	--	--	--
Nickel, total recoverable	4	1	2	--	--	--	--	--
Nickel, dissolved	4	1	0	--	--	--	--	--
Zinc, total recoverable	4	10	0	--	--	--	--	--
Zinc, dissolved	0	20	0	--	--	--	--	--

Table 21. Statistical summary of selected water-quality data collected at station 273950, South Fork Kapunahala Stream at Kaneohe, Oahu, Hawaii, from May 1988 to April 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, May 1988 to December 1988, physical, biological, and organic								
Discharge, inst., (ft^3/s)	5	0	5	2.1	--	2.8	--	4.9
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	5	1	5	190	--	195	--	200
pH (units)	5	0.1	5	7.1	--	7.7	--	7.9
Temperature, water (°C)	5	0.5	5	22.5	--	23.0	--	23.3
Turbidity (NTU)	5	0.1	5	2.4	--	3.8	--	41
Oxygen dissolved (mg/L)	5	0.1	5	7.6	--	7.9	--	8.1
Fecal coliform 0.7 μm -MF (cols./100 mL)	3	0	3	2,200	--	--	--	10,000
Solids, residue at 105°C, suspended (mg/L)	3	1	3	3	--	8	--	12
Carbon, organic, total (mg/L)	2	0.1	2	1.7	--	--	--	1.9
Oil and grease, total (mg/L)	2	1	0	--	--	--	--	--
During construction, March 1989 to December 1995, physical, biological, and organic								
Discharge, inst., (ft^3/s)	72	0	72	1.6	1.9	2.1	2.4	99
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	71	1	71	160	190	198	205	376
pH (units)	71	0.1	71	6.8	7.6	7.8	7.9	8.1
Temperature, water (°C)	71	0.5	71	20.0	21.5	22.5	23.0	25.5
Turbidity (NTU)	71	0.1	71	0.3	2.3	3.3	4.3	71
Oxygen dissolved (mg/L)	71	0.1	71	7.7	8.2	8.3	8.5	8.9
Fecal coliform 0.7 μm -MF (cols./100 mL)	28	0	28	500	1,125	1,850	4,975	46,000
Solids, residue at 105°C, suspended (mg/L)	29	1	26	<1	e3.0	e9.0	e13.5	144
Carbon, organic, total (mg/L)	15	0.1	15	1.0	1.1	1.4	2.5	14
Oil and grease, total (mg/L)	15	1	2	1	--	--	--	2
After construction, January 1996 to April 1998, physical, biological, and organic								
Discharge, inst., (ft^3/s)	18	0	18	1.6	1.8	2.0	2.3	3.6
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	21	1	21	170	194	200	208	301
pH (units)	21	0.1	21	6.8	7.7	7.9	8.0	8.1
Temperature, water (°C)	18	0.5	18	20.0	21.5	22.2	23.1	25.0
Turbidity (NTU)	20	0.1	20	1.2	2.4	2.8	3.8	4.9
Oxygen dissolved (mg/L)	20	0.1	20	8.1	8.2	8.4	8.7	8.8
Fecal coliform 0.7 μm -MF (cols./100 mL)	8	0	8	780	1,300	1,950	3,875	8,000
Solids, residue at 105°C, suspended (mg/L)	9	1	8	<1	e3.0	e4.0	e7.5	15
Carbon, organic, total (mg/L)	4	0.1	4	1.3	--	--	--	2.7
Oil and grease, total (mg/L)	4	1	0	--	--	--	--	--

Table 21. Statistical summary of selected water-quality data collected at station 16273950, South Fork Kapunahala Stream at Kaneohe, Oahu, Hawaii, from May 1988 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, May 1988 to December 1988, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	2	1	2	57	--	--	--	57
Calcium, dissolved	2	0.02	2	12	--	--	--	12
Magnesium, dissolved	2	0.01	2	6.6	--	--	--	6.6
Sodium, dissolved	2	0.2	2	16	--	--	--	17
Potassium, dissolved	2	0.1	2	1.3	--	--	--	1.6
Alkalinity (as CaCO ₃)	2	1	2	57	--	--	--	60
Sulfate, dissolved	2	0.1	2	4.8	--	--	--	7.8
Chloride, dissolved	2	0.1	2	20	--	--	--	20
Fluoride, dissolved	2	0.1	2	0.1	--	--	--	0.2
Silica, dissolved	2	0.01	2	28	--	--	--	30
Nitrogen, nitrite plus nitrate, total (as N)	4	0.05	1	--	--	--	--	0.20
Nitrogen, ammonia plus organic, total (as N)	4	0.2	3	<0.2	--	--	--	0.20
Phosphorus, total (as P)	4	0.01	4	0.02	--	--	--	0.04
During construction, March 1989 to December 1995, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	15	1	15	40	55	57	60	69
Calcium, dissolved	15	0.02	15	9.6	11	12	13	15
Magnesium, dissolved	15	0.01	15	3.9	6.5	6.6	6.7	7.7
Sodium, dissolved	15	0.2	15	12	16	17	17	18
Potassium, dissolved	15	0.1	15	1.0	1.1	1.2	1.5	2.2
Alkalinity (as CaCO ₃)	15	1	15	35	60	63	65	67
Sulfate, dissolved	15	0.1	15	3.2	4.0	5.0	6.0	13
Chloride, dissolved	15	0.1	15	18	19	20	21	26
Fluoride, dissolved	15	0.1	5	<0.10	e0.04	e0.06	e0.10	0.20
Silica, dissolved	15	0.01	15	11	29	30	32	33
Nitrogen, nitrite plus nitrate, total (as N)	17	0.05	9	<0.05	e0.02	e0.08	e0.37	4.3
Nitrogen, nitrite plus nitrate, dissolved (as N)	7	0.05	6	<0.05	e0.05	e0.09	e0.11	0.51
Nitrogen, ammonia plus organic, total (as N)	29	0.2	7	<0.20	e0.04	e0.07	e0.17	0.70
Phosphorus, total (as P)	29	0.01	26	<0.01	e0.02	e0.03	e0.04	0.29
After construction, January 1996 to April 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	4	1	4	56	--	58	--	61
Calcium, dissolved	4	0.02	4	12	--	12	--	13
Magnesium, dissolved	4	0.01	4	6.4	--	6.6	--	6.8
Sodium, dissolved	4	0.2	4	15	--	16	--	17
Potassium, dissolved	4	0.1	4	1.1	--	1.2	--	1.4
Alkalinity (as CaCO ₃)	4	1	4	62	--	63	--	64
Sulfate, dissolved	4	0.1	4	4.9	--	6.6	--	8.3
Chloride, dissolved	4	0.1	4	18	--	19	--	20
Fluoride, dissolved	4	0.1	0	--	--	--	--	--
Silica, dissolved	4	0.01	4	30	--	31	--	32
Nitrogen, nitrite plus nitrate, dissolved (as N)	9	0.05	8	<0.05	e0.06	e0.08	e0.10	0.13
Nitrogen, ammonia plus organic, total (as N)	9	0.1	0	--	--	--	--	--
Phosphorus, total (as P)	9	0.05	9	0.02	0.02	0.02	0.03	0.04

Table 21. Statistical summary of selected water-quality data collected at station 16273950, South Fork Kapunahala Stream at Kaneohe, Oahu, Hawaii, from May 1988 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	<u>Concentration percentile</u>			Maximum
					25	50	75	
Before construction, May 1988 to December 1988, trace metals (µg/L)								
Aluminum, total recoverable	2	10	2	200	--	--	--	320
Aluminum, dissolved	2	10	2	10	--	--	--	20
Cadmium, total recoverable	2	1	0	--	--	--	--	--
Cadmium, dissolved	2	1	1	--	--	--	--	1.0
Chromium, total recoverable	2	10	2	1.0	--	--	--	4.0
Chromium, dissolved	2	1	0	--	--	--	--	--
Copper, total recoverable	2	1	2	4.0	--	--	--	6.0
Copper, dissolved	2	1	2	2.0	--	--	--	2.0
Iron, total recoverable	2	10	2	740	--	--	--	1,900
Iron, dissolved	2	3	2	210	--	--	--	320
Lead, total recoverable	2	1	1	--	--	--	--	5.0
Lead, dissolved	2	1	0	--	--	--	--	--
Nickel, total recoverable	2	1	2	1	--	--	--	5.0
Nickel, dissolved	2	1	1	--	--	--	--	3.0
Zinc, total recoverable	2	10	0	--	--	--	--	--
Zinc, dissolved	2	3	0	--	--	--	--	--
During construction, March 1989 to December 1995, trace metals (µg/L)								
Aluminum, total recoverable	15	10	15	60	180	270	300	7,200
Aluminum, dissolved	15	10	10	<10	e6.9	e10	e30	40
Cadmium, total recoverable	15	1	1	--	--	--	--	3
Cadmium, dissolved	6	1	0	--	--	--	--	--
Chromium, total recoverable	15	1	14	<1	e2.0	e2.0	e3.0	40
Chromium, dissolved	6	1	0	--	--	--	--	--
Copper, total recoverable	15	1	12	<1	e1.0	e2.0	e2.0	13.0
Copper, dissolved	6	1	4	1.0	--	--	--	3.0
Iron, total recoverable	15	10	15	370	680	790	860	14,000
Iron, dissolved	15	3	15	42	81	110	140	200
Lead, total recoverable	15	1	4	<1	--	--	--	12
Lead, dissolved	6	1	2	<1	--	--	--	2.0
Nickel, total recoverable	15	1	10	<10	e0.28	e1.0	e2.0	29
Nickel, dissolved	15	1	1	<1	--	--	--	2.0
Zinc, total recoverable	15	10	4	<10	--	--	--	40
Zinc, dissolved	6	3	4	<3	--	--	--	100
After construction, January 1996 to April 1998, trace metals (µg/L)								
Aluminum, total recoverable	4	10	4	70	--	--	--	210
Aluminum, dissolved	4	10	2	<2	--	--	--	7.7
Cadmium, total recoverable	4	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	--	--	--	--	--	--
Chromium, total recoverable	4	1	3	<1	--	--	--	3
Chromium, dissolved	0	1	--	--	--	--	--	--
Copper, total recoverable	4	1	3	--	--	--	--	2
Copper, dissolved	0	1	--	--	--	--	--	--
Iron, total recoverable	4	10	4	220	--	--	--	760
Iron, dissolved	4	3	4	40	--	--	--	84
Lead, total recoverable	4	1	0	--	--	--	--	--
Lead, dissolved	0	1	--	--	--	--	--	--
Nickel, total recoverable	4	1	0	--	--	--	--	--
Nickel, dissolved	0	1	--	--	--	--	--	--
Zinc, total recoverable	4	10	0	--	--	--	--	--
Zinc, dissolved	0	20	--	--	--	--	--	--

Table 22. Statistical summary of selected water-quality data collected at station 16274100, Kaneohe Stream below Kamehameha Highway at Kaneohe, Oahu, Hawaii, from November 1988 to August 1999

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L , milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, November 1988 to November 1995, physical, biological, and organic								
Discharge, inst., (ft^3/s)	73	0	73	7.5	10.5	13.0	16.5	44
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	74	1	74	120	190	198	202	225
pH (units)	73	0.1	73	6.7	8.3	8.6	8.8	9.3
Temperature, water ($^\circ\text{C}$)	74	0.5	74	20.0	23.0	25.0	26.6	31.0
Turbidity (NTU)	74	0.1	74	1.1	2.2	3.4	5.7	38
Oxygen dissolved (mg/L)	74	0.1	74	5.9	8.8	9.2	9.6	10
Fecal coliform 0.7 μm -MF (cols./100 mL)	27	0	27	11	1,300	2,600	5,400	20,000
Solids, residue at 105°C , suspended (mg/L)	29	1	28	1	6	12	18	33
Carbon, organic, total (mg/L)	14	0.1	14	1.3	1.8	2.2	2.7	3.3
Oil and grease, total (mg/L)	14	1	1	--	--	--	--	2
After construction, January 1996 to August 1999, physical, biological, and organic								
Discharge, inst., (ft^3/s)	19	0	19	8.0	11	15	18	50
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	20	1	20	194	199	204	209	213
pH (units)	19	0.1	19	7.9	8.4	8.6	9.0	9.3
Temperature, water ($^\circ\text{C}$)	20	0.5	20	21.0	22.0	24.5	26.4	21.0
Turbidity (NTU)	18	0.1	18	0.80	2.0	2.4	4.4	34
Oxygen dissolved (mg/L)	20	0.1	20	8.8	9.2	9.6	9.9	10.8
Fecal coliform 0.7 μm -MF (cols./100 mL)	8	0	8	880	1,250	2,800	4,925	5,200
Solids, residue at 105°C , suspended (mg/L)	9	1	8	<1	e3.5	e6.0	e6.0	20
Carbon, organic, total (mg/L)	5	0.1	5	1.5	--	3.2	--	5.0
Oil and grease, total (mg/L)	5	1	0	--	--	--	--	--

Table 22. Statistical summary of selected water-quality data collected at station 16274100, Kaneohe Stream below Kamehameha Highway at Kaneohe, Oahu, Hawaii, from November 1988 to August 1999--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, November 1988 to November 1995, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	14	1	14	54	56	58	61	63
Calcium, dissolved	14	0.02	14	10	10	11	12	10
Magnesium, dissolved	14	0.01	14	6.6	7.1	7.4	7.6	8.1
Sodium, dissolved	14	0.2	14	13	15	16	16	17
Potassium, dissolved	14	0.1	14	0.90	1.0	1.1	1.3	1.7
Alkalinity (as CaCO ₃)	14	1	14	50	54	57	60	63
Sulfate, dissolved	14	0.1	14	3.4	6.6	7.2	9.2	12
Chloride, dissolved	14	0.1	14	18	18	20	22	27
Fluoride, dissolved	14	0.1	5	<0.1	e0.04	e0.06	e0.10	0.20
Silica, dissolved	14	0.01	14	16	20	22	23	24
Nitrogen, nitrite plus nitrate, total (as N)	18	0.05	18	0.17	0.27	0.30	0.49	0.79
Nitrogen, nitrite plus nitrate, dissolved (as N)	7	0.05	7	0.15	0.19	0.34	0.35	0.44
Nitrogen, ammonia plus organic, total (as N)	29	0.2	15	<0.2	e0.13	e0.20	e0.30	0.60
Phosphorus, total (as P)	29	0.01	27	<0.01	e0.02	e0.03	e0.04	0.10
After construction, January 1996 to August 1999, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	6	1	6	66	60	62	64	66
Calcium, dissolved	6	0.02	6	10	11	12	12	14
Magnesium, dissolved	6	0.01	6	7.5	7.5	8.0	8.2	8.2
Sodium, dissolved	6	0.2	6	15	15	16	16	16
Potassium, dissolved	6	0.1	6	0.90	0.98	1.2	1.4	1.7
Alkalinity (as CaCO ₃)	5	1	5	63	--	63	--	65
Sulfate, dissolved	6	0.1	6	5.5	6.2	8.4	9.6	9.6
Chloride, dissolved	6	0.1	6	18	19	20	20	20
Fluoride, dissolved	6	0.1	0	--	--	--	--	--
Silica, dissolved	6	0.01	6	21	21	21	22	23
Nitrogen, nitrite plus nitrate, dissolved (as N)	10	0.05	10	0.10	0.18	0.27	0.33	0.40
Nitrogen, ammonia plus organic, total (as N)	10	0.1	7	<0.1	e0.13	e0.20	e0.32	0.47
Phosphorus, total (as P)	10	0.05	7	<0.05	e0.01	e0.03	e0.04	0.04

Table 22. Statistical summary of selected water-quality data collected at station 16274100, Kaneohe Stream below Kamehameha Highway at Kaneohe, Oahu, Hawaii, from November 1988 to August 1999--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, November 1988 to November 1995, trace metals (µg/L)								
Aluminum, total recoverable	14	10	14	90	262	370	482	1,300
Aluminum, dissolved	14	10	13	<10	e18	e20	e32	70
Cadmium, total recoverable	14	1	0	--	--	--	--	--
Cadmium, dissolved	6	1	0	--	--	--	--	--
Chromium, total recoverable	14	1	10	<1	e0.84	e2.0	e3.0	7.0
Chromium, dissolved	6	1	1	--	--	--	--	2.0
Copper, total recoverable	14	1	14	1.0	2.0	3.0	3.2	8.0
Copper, dissolved	6	1	6	1.0	1.0	1.0	3.2	4.0
Iron, total recoverable	14	10	14	350	565	840	1,100	3,100
Iron, dissolved	14	3	14	13	54	97	110	140
Lead, total recoverable	14	1	11	<1	e0.89	e1.0	e2.0	4.0
Lead, dissolved	6	1	1	--	--	--	--	1.0
Nickel, total recoverable	14	1	13	<1	e1.0	e2.0	e2.2	4.0
Nickel, dissolved	14	1	3	<1	--	--	--	2.0
Zinc, total recoverable	14	10	4	<10	--	--	--	20
Zinc, dissolved	6	20	3	<3	--	--	--	7.0
After construction, January 1996 to August 1999, trace metals (µg/L)								
Aluminum, total recoverable	5	10	5	70	--	170	--	700
Aluminum, dissolved	6	10	5	7	--	68	--	130
Cadmium, total recoverable	5	1	0	--	--	--	--	--
Cadmium, dissolved	1	1	0	--	--	--	--	--
Chromium, total recoverable	5	1	3	<1	--	--	--	2
Chromium, dissolved	1	1	0	--	--	--	--	--
Copper, total recoverable	5	1	5	1	--	2	--	3
Copper, dissolved	1	1	1	--	--	--	--	1
Iron, total recoverable	5	10	5	310	--	520	--	1,200
Iron, dissolved	6	3	6	60	e68	e95	--	e145
Lead, total recoverable	5	1	1	--	--	--	--	1
Lead, dissolved	1	1	0	--	--	--	--	--
Nickel, total recoverable	5	1	3	<1	--	--	--	2
Nickel, dissolved	6	1	0	--	--	--	--	--
Zinc, total recoverable	5	10	1	--	--	--	--	13
Zinc, dissolved	1	20	0	--	--	--	--	--

Table 23. Statistical summary of selected water-quality data collected at station 16275000, Haiku Stream near Heeia, Oahu, Hawaii, from March 1983 to April 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L , milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; $0.7\ \mu\text{m}\text{-MF}$, $0.7\ \mu\text{m}$ membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, March 1983 to September 1988, physical, biological, and organic								
Discharge, inst., (ft^3/s)	35	0	35	1.0	1.3	1.5	2.0	5.5
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	28	1	28	140	145	148	159	185
pH (units)	28	0.1	28	6.3	7.0	7.3	7.7	7.9
Temperature, water ($^\circ\text{C}$)	35	0.5	35	19.5	20.5	21.0	21.5	23.0
Turbidity (NTU)	15	0.1	15	0.2	0.5	0.7	0.9	1.6
Oxygen dissolved (mg/L)	15	0.1	15	5.5	8.0	8.3	8.6	8.6
Fecal coliform $0.7\ \mu\text{m}\text{-MF}$ (cols./100 mL)	9	0	9	23	66	92	103	130
Solids, residue at 105°C , suspended (mg/L)	13	1	8	<1	e1.7	e3.0	e9.0	11.0
Carbon, organic, total (mg/L)	6	0.1	6	0.2	0.4	0.5	0.6	0.8
Oil and grease, total (mg/L)	6	1	1	--	--	--	--	2
During construction, November 1988 to November 1994, physical, biological, and organic								
Discharge, inst., (ft^3/s)	61	0	61	1.1	1.5	1.7	2.0	33
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	61	1	61	92	145	150	154	185
pH (units)	61	0.1	61	6.5	7.6	7.8	7.9	8.2
Temperature, water ($^\circ\text{C}$)	63	0.5	63	18.5	20.0	20.5	21.0	22.5
Turbidity (NTU)	61	0.1	61	0.1	0.4	0.7	1.2	500
Oxygen dissolved (mg/L)	61	0.1	61	8.2	8.6	8.7	8.8	9.0
Fecal coliform $0.7\ \mu\text{m}\text{-MF}$ (cols./100 mL)	24	0	24	34	132	220	382	8,100
Solids, residue at 105°C , suspended (mg/L)	28	1	18	<1	e0.6	e5.0	e9.0	201
Carbon, organic, total (mg/L)	13	0.1	13	0.2	0.4	0.5	1.4	6.8
Oil and grease, total (mg/L)	13	1	0	--	--	--	--	--
After construction, December 1994 to April 1998, physical, biological, and organic								
Discharge, inst., (ft^3/s)	28	0	28	1.2	1.4	1.7	2.0	16
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	32	1	32	114	146	150	154	165
pH (units)	32	0.1	32	7.3	7.6	7.7	7.8	8.0
Temperature, water ($^\circ\text{C}$)	29	0.5	29	18.0	20.0	20.0	20.5	22.5
Turbidity (NTU)	31	0.1	31	0.2	0.3	0.3	0.5	67
Oxygen dissolved (mg/L)	32	0.1	32	8.4	8.7	8.8	9.1	9.3
Fecal coliform $0.7\ \mu\text{m}\text{-MF}$ (cols./100 mL)	11	0	11	36	68	140	210	3,400
Solids, residue at 105°C , suspended (mg/L)	12	1	6	<1	e0.3	e0.7	e1.0	4.0
Carbon, organic, total (mg/L)	6	0.1	6	0.3	0.4	0.4	1.0	1.5
Oil and grease, total (mg/L)	6	1	1	--	--	--	--	1

Table 23. Statistical summary of selected water-quality data collected at station 16275000, Haiku Stream near Heeia, Oahu, Hawaii, from March 1983 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Mini-mum	Concentration percentile			Maximum
					25	50	75	
Before construction, March 1983 to September 1988, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	6	1	6	45	45	46	47	48
Calcium, dissolved	6	0.02	6	8.3	8.4	8.6	9.2	9.5
Magnesium, dissolved	6	0.01	6	5.5	5.6	5.8	6.1	6.2
Sodium, dissolved	6	0.2	6	12	12	12	12	12
Potassium, dissolved	6	0.1	6	0.7	0.7	0.8	1	1
Alkalinity (as CaCO ₃)	5	1	5	46	--	--	--	51
Sulfate, dissolved	6	0.1	6	2.9	3.0	3.4	3.6	4.0
Chloride, dissolved	6	0.1	6	10	13	14	17	18
Fluoride, dissolved	6	0.1	1	--	--	--	--	0.1
Silica, dissolved	6	0.01	6	26	27	28	28	28
Nitrogen, nitrite plus nitrate, total (as N)	11	0.1	0	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	11	0.2	7	<0.2	e0.13	e0.20	e0.50	0.60
Phosphorus, total (as P)	11	0.01	9	<0.01	e0.01	e0.02	e0.07	0.14
During construction, November 1988 to November 1994, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	13	1	13	34	42	44	46	49
Calcium, dissolved	13	0.02	13	7.5	8.2	8.4	8.8	10
Magnesium, dissolved	13	0.01	13	3.7	5.3	5.6	5.8	6.0
Sodium, dissolved	13	0.2	13	11	12	12	12	13
Potassium, dissolved	13	0.1	13	0.2	0.8	0.8	1.0	1.2
Alkalinity (as CaCO ₃)	13	1	13	18	45	47	48	49
Sulfate, dissolved	13	0.1	13	1.4	3.0	3.1	4.5	5.7
Chloride, dissolved	13	0.1	13	14	14	16	18	21
Fluoride, dissolved	13	0.1	4	<0.1	--	--	--	0.2
Silica, dissolved	13	0.01	13	12	26	26	27	28
Nitrogen, nitrite plus nitrate, total (as N)	17	0.1	12	<0.1	e0.09	e0.10	e0.15	0.24
Nitrogen, nitrite plus nitrate, dissolved (as N)	4	0.05	4	<0.12	--	--	--	0.17
Nitrogen, ammonia plus organic, total (as N)	25	0.2	4	<0.2	--	--	--	0.30
Phosphorus, total (as P)	25	0.01	21	<0.01	e0.01	e0.02	e0.03	0.16
After construction, December 1994 to April 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	6	1	6	42	42	44	45	45
Calcium, dissolved	6	0.02	6	7.9	8.1	8.4	8.7	9.2
Magnesium, dissolved	6	0.01	6	5.3	5.3	5.5	5.7	5.7
Sodium, dissolved	6	0.2	6	11	12	12	12	12
Potassium, dissolved	6	0.1	6	0.7	0.8	0.8	0.9	0.9
Alkalinity (as CaCO ₃)	6	1	6	47	47	48	48	49
Sulfate, dissolved	6	0.1	6	3.0	3.2	3.3	3.6	3.8
Chloride, dissolved	6	0.1	6	15	15	15	15	15
Fluoride, dissolved	6	0.1	0	--	--	--	--	--
Silica, dissolved	6	0.01	6	26	26	26	27	27
Nitrogen, nitrite plus nitrate, dissolved (as N)	12	0.05	12	0.06	0.08	0.09	0.12	0.13
Nitrogen, ammonia plus organic, total (as N)	12	0.1	0	--	--	--	--	--
Phosphorus, total (as P)	12	0.05	10	<0.05	e0.01	e0.01	e0.03	0.04

Table 23. Statistical summary of selected water-quality data collected at station 16275000, Haiku Stream near Heeia, Oahu, Hawaii, from March 1983 to April 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
Before construction, March 1983 to September 1988, trace metals (µg/L)								
Aluminum, total recoverable	6	10	6	30	38	40	108	130
Aluminum, dissolved	6	10	2	<10	--	--	--	20
Cadmium, total recoverable	6	1	0	--	--	--	--	--
Cadmium, dissolved	6	1	0	--	--	--	--	--
Chromium, total recoverable	6	10	3	<10	--	--	--	10
Chromium, dissolved	6	1	1	--	--	--	--	1.0
Copper, total recoverable	6	1	6	1.0	1.0	2.5	4.2	5.0
Copper, dissolved	6	1	4	<4	--	--	--	4.0
Iron, total recoverable	6	10	6	170	192	245	378	400
Iron, dissolved	6	3	6	57	74	95	112	120
Lead, total recoverable	6	1	2	<1	--	--	--	1.0
Lead, dissolved	6	1	2	<1	--	--	--	8.0
Nickel, total recoverable	6	1	4	<1	--	--	--	13
Nickel, dissolved	6	1	6	<1	--	--	--	7.0
Zinc, total recoverable	6	10	4	<10	--	--	--	420
Zinc, dissolved	6	3	2	<3	--	--	--	11
During construction, November 1988 to November 1994, trace metals (µg/L)								
Aluminum, total recoverable	13	10	13	10	30	50	130	16,000
Aluminum, dissolved	13	10	8	<10	e4.3	e10	e50	50
Cadmium, total recoverable	13	1	1	--	--	--	--	8.0
Cadmium, dissolved	6	1	1	--	--	--	--	2.0
Chromium, total recoverable	13	10	5	<10	e0.02	e0.17	e1.5	55
Chromium, dissolved	6	1	0	--	--	--	--	--
Copper, total recoverable	13	1	5	<1	e0.04	e0.21	e2.0	25
Copper, dissolved	6	1	5	<1	e0.91	e1.5	e2.0	2.0
Iron, total recoverable	13	10	13	70	85	130	345	21,000
Iron, dissolved	13	3	13	26	40	47	68	100
Lead, total recoverable	13	1	3	<1	--	--	--	4.0
Lead, dissolved	6	1	1	--	--	--	--	1.0
Nickel, total recoverable	13	1	6	<1	e0.03	e0.20	e2.0	43
Nickel, dissolved	13	1	3	<1	--	--	--	1.0
Zinc, total recoverable	13	10	3	<10	--	--	--	40
Zinc, dissolved	6	3	5	<3	e3.6	e4.5	e8.0	8.0
After construction, December 1994 to April 1998, trace metals (µg/L)								
Aluminum, total recoverable	6	10	6	10	25	30	32	40
Aluminum, dissolved	6	10	4	<10	--	--	--	20
Cadmium, total recoverable	6	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	--	--	--	--	--	--
Chromium, total recoverable	6	1	1	--	--	--	--	1
Chromium, dissolved	0	1	--	--	--	--	--	--
Copper, total recoverable	6	1	0	--	--	--	--	--
Copper, dissolved	0	1	--	--	--	--	--	--
Iron, total recoverable	6	10	6	50	58	95	152	160
Iron, dissolved	6	3	6	16	28	41	76	84
Lead, total recoverable	6	1	0	--	--	--	--	--
Lead, dissolved	0	1	--	--	--	--	--	--
Nickel, total recoverable	6	1	0	--	--	--	--	--
Nickel, dissolved	6	1	0	--	--	--	--	--
Zinc, total recoverable	6	10	0	--	--	--	--	--
Zinc, dissolved	0	20	--	--	--	--	--	--

Table 24. Statistical summary of selected water-quality data collected at station 212335157482603, Waimaluhia Reservoir cross-section 1-3 (composite) near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft³/s, cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, physical, biological, and organic								
Specific conductance								
($\mu\text{S}/\text{cm}$ at 25°C)	274	1	274	147	182	186	191	210
pH (units)	271	0.1	271	6.4	7.2	7.4	7.6	8.6
Temperature, water (°C)	274	0.5	274	20.7	23.1	25.0	25.9	28.8
Turbidity (NTU)	113	0.1	113	0.4	1.2	1.7	2.3	170
Oxygen dissolved (mg/L)	273	0.1	273	2.6	6.0	7.0	7.6	9.6
Fecal coliform 0.7 μm -MF								
(cols./100 mL)	72	0	71	1.0	7.0	20	64	640
Solids, residue at 105°C,								
suspended (mg/L)	78	1	60	<1	e1.0	e3.0	e7.0	23
Carbon, organic, total (mg/L)	13	0.1	13	1.4	1.6	2.0	2.5	4.7
Oil and grease, total (mg/L)	12	1	1	--	--	--	--	1
After construction, August 1992 to January 1998, physical, biological, and organic								
Specific conductance								
($\mu\text{S}/\text{cm}$ at 25°C)	106	1	106	152	186	191	196	214
pH (units)	106	0.1	106	6.9	7.2	7.4	7.6	7.8
Temperature, water (°C)	106	0.5	106	20.5	21.5	24.0	25.9	28.2
Turbidity (NTU)	55	0.1	55	0.3	1.2	1.5	5.0	27
Oxygen dissolved (mg/L)	106	0.1	106	2.1	6.0	6.6	7.1	8.7
Fecal coliform 0.7 μm -MF								
(cols./100 mL)	22	0	22	4	14	40	105	1,200
Solids, residue at 105°C,								
suspended (mg/L)	29	1	24	<1	e0.6	e3.0	e5.5	10
Carbon, organic, total (mg/L)	6	0.1	6	1.7	1.8	2.0	2.0	2.2
Oil and grease, total (mg/L)	6	1	2	<1	--	--	--	3

Table 24. Statistical summary of selected water-quality data collected at station 212335157482603, Waimaluhia Reservoir cross-section 1-3 (composite) near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	13	1	13	52	56	57	60	52
Calcium, dissolved	13	0.02	13	7.9	8.5	8.9	9.8	11
Magnesium, dissolved	13	0.01	13	7.5	7.9	8.5	8.8	7.5
Sodium, dissolved	13	0.2	13	14	15	15	16	17
Potassium, dissolved	13	0.1	13	0.8	1.0	1.0	1.2	1.4
Alkalinity (as CaCO ₃)	13	1	12	<1	e50	e53	e54	63
Sulfate, dissolved	13	0.1	13	6.7	7.0	8.2	9.0	11
Chloride, dissolved	13	0.1	13	17	18	19	22	22
Fluoride, dissolved	13	0.1	5	<0.1	e0.1	e0.1	e0.1	0.1
Silica, dissolved	13	0.01	13	18	18	20	21	20
Nitrogen, nitrite plus nitrate, total (as N)	73	0.05	73	0.10	0.20	0.30	0.40	0.50
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	75	0.2	69	<0.2	e0.30	e0.40	e0.50	1.1
Phosphorus, total (as P)	75	0.01	66	<0.01	e0.01	e0.02	e0.03	0.11
After construction, August 1992 to January 1998, major ions and nutrients (mg/L)								
Hardness, total (as CaCO ₃)	7	1	7	43	53	56	58	58
Calcium, dissolved	7	0.02	7	6.0	7.6	8.4	8.8	11
Magnesium, dissolved	7	0.01	7	6.9	7.3	8.3	8.5	9.0
Sodium, dissolved	7	0.2	7	12	13	15	16	17
Potassium, dissolved	7	0.1	7	0.2	0.9	1.2	1.2	1.9
Alkalinity (as CaCO ₃)	7	1	7	52	55	56	58	60
Sulfate, dissolved	7	0.1	7	5.1	5.8	6.4	7.8	8.6
Chloride, dissolved	7	0.1	7	15	17	20	20	23
Fluoride, dissolved	7	0.1	2	<0.1	--	--	--	0.1
Silica, dissolved	7	0.01	7	16	16	19	20	16
Nitrogen, nitrite plus nitrate, dissolved (as N)	16	0.05	16	0.30	0.34	0.39	0.47	0.55
Nitrogen, ammonia plus organic, total (as N)	22	0.1	3	<0.1	--	--	--	0.30
Phosphorus, total (as P)	22	0.05	13	<0.05	e0.01	e0.01	e0.02	0.03

Table 24. Statistical summary of selected water-quality data collected at station 212335157482603, Waimaluhia Reservoir cross-section 1-3 (composite) near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998--Continued

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, trace metals (µg/L)								
Aluminum, total recoverable	13	10	13	52	56	57	60	64
Aluminum, dissolved	13	10	8	<10	e2.9	e5.2	e15	40
Cadmium, total recoverable	13	1	0	--	--	--	--	--
Cadmium, dissolved	12	1	2	<1	--	--	--	2.0
Chromium, total recoverable	13	1	6	<1	e0.7	e1.0	e2.0	3.0
Chromium, dissolved	12	1	1	--	--	--	--	1.0
Copper, total recoverable	13	1	13	2.0	2.0	4.0	6.0	8
Copper, dissolved	12	1	10	<1	e1.0	e1.5	e2.8	4.0
Iron, total recoverable	13	10	13	160	195	330	435	600
Iron, dissolved	13	3	12	<3	e10	e14	e41	41
Lead, total recoverable	13	1	8	<1	e1.0	e2.0	e3.0	6.0
Lead, dissolved	12	1	3	1	--	--	--	15
Nickel, total recoverable	13	1	12	<1				
Nickel, dissolved	13	1	6	<1	e0.7	e1.0	e1.0	2.0
Zinc, total recoverable	13	10	5	<10	e1.1	e3.4	e15	60
Zinc, dissolved	12	3	7	<3	e3.9	e4.8	e5.0	6.0
After construction, August 1992 to January 1998, trace metals (µg/L)								
Aluminum, total recoverable	7	10	7	60	120	140	210	270
Aluminum, dissolved	7	10	5	<10	e7.1	e20	e20	40
Cadmium, total recoverable	7	1	0	--	--	--	--	--
Cadmium, dissolved	0	1	--	--	--	--	--	--
Chromium, total recoverable	7	1	1	--	--	--	--	2
Chromium, dissolved	0	1	--	--	--	--	--	--
Copper, total recoverable	7	1	5	<1	e0.5	e1.0	e2.0	3.0
Copper, dissolved	0	1	--	--	--	--	--	--
Iron, total recoverable	7	10	7	120	310	350	430	480
Iron, dissolved	7	3	7	19	19	21	74	74
Lead, total recoverable	7	1	2	<1	--	--	--	2
Lead, dissolved	0	1	--	--	--	--	--	--
Nickel, total recoverable	7	1	6	--	--	--	--	--
Nickel, dissolved	7	1	0	--	--	--	--	--
Zinc, total recoverable	7	10	1	--	--	--	--	10
Zinc, dissolved	0	20	--	--	--	--	--	--

Table 25. Statistical summary of selected water-quality data collected at station 212335157482603, Waimaluhia Reservoir cross-section 1-3 at 1 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft³/s, cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	38	1	38	156	180	184	192	208
pH (units)	37	0.1	37	6.9	7.4	7.6	7.8	8.6
Temperature, water (°C)	38	0.5	38	21.4	23.8	25.5	26.4	28.8
Turbidity (NTU)	34	0.1	34	0.5	0.9	1.2	1.7	3.8
Oxygen dissolved (mg/L)	38	0.1	38	6.1	7.3	7.6	8.1	9.5
Fecal coliform 0.7 μm -MF (cols./100 mL)	24	0	24	1	3	10	38	190
Solids, residue at 105°C, suspended (mg/L)	26	1	20	<1	e0.64	e2.0	e6.2	21
Nitrogen, nitrite plus nitrate, total (as N)	25	0.05	25	0.10	0.20	0.30	0.40	0.44
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	25	0.2	23	<0.2	e0.20	e0.40	e0.45	1.1
Phosphorus, total (as P)	25	0.01	20	<0.01	e0.01	e0.02	e0.02	0.08
After construction, August 1992 to January 1998, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	15	1	15	152	182	188	194	200
pH (units)	15	0.1	15	6.9	7.2	7.4	7.6	7.8
Temperature, water (°C)	15	0.5	15	20.9	21.6	24.0	26.0	27.0
Turbidity (NTU)	15	0.1	15	0.3	1.0	1.5	5.0	9.4
Oxygen dissolved (mg/L)	15	0.1	15	6.3	6.7	6.9	7.2	8.3
Fecal coliform 0.7 μm -MF (cols./100 mL)	7	0	7	5	13	30	100	720
Solids, residue at 105°C, suspended (mg/L)	8	1	7	<1	e0.57	e1.5	e3.5	6
Nitrogen, nitrite plus nitrate, dissolved (as N)	4	0.05	4	0.34	--	0.42	--	0.49
Nitrogen, ammonia plus organic, total (as N)	6	0.1	0	--	--	--	--	--
Phosphorus, total (as P)	6	0.05	3	<0.05	--	--	--	0.01

Table 26. Statistical summary of selected water-quality data collected at station 212335157482603, Waimaluhia Reservoir cross-section 1-3 at 7 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	38	1	38	155	181	186	191	208
pH (units)	37	0.1	37	6.9	7.3	7.4	7.6	8.6
Temperature, water (°C)	38	0.5	38	21.1	23.6	25.0	26.0	27.6
Turbidity (NTU)	33	0.1	33	0.4	1.2	1.3	2.0	5.9
Oxygen dissolved (mg/L)	38	0.1	38	4.3	6.0	7.0	7.4	8.4
Fecal coliform 0.7 μm -MF (cols./100 mL)	23	0	23	1	8	17	47	160
Solids, residue at 105°C, suspended (mg/L)	25	1	20	<1	e1.0	e3.0	e5.0	16
Nitrogen, nitrite plus nitrate, total (as N)	24	0.05	23	0.10	0.20	0.30	0.40	0.50
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	24	0.2	22	<0.2	e0.30	e0.40	e0.50	1.0
Phosphorus, total (as P)	24	0.01	21	<0.01	e0.01	e0.02	e0.02	0.04
After construction, August 1992 to January 1998, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	16	1	16	156	184	189	194	202
pH (units)	16	0.1	16	7.1	7.2	7.4	7.6	7.8
Temperature, water (°C)	16	0.5	16	20.9	21.6	23.8	25.9	27.2
Turbidity (NTU)	16	0.1	16	0.4	1.1	1.3	2.2	9.8
Oxygen dissolved (mg/L)	16	0.1	16	4.9	6.0	6.6	7.1	8.5
Fecal coliform 0.7 μm -MF (cols./100 mL)	7	0	7	4	14	38	58	620
Solids, residue at 105°C, suspended (mg/L)	9	1	7	<1	e1.9	e4.0	e4.0	7.0
Nitrogen, nitrite plus nitrate, dissolved (as N)	5	0.05	5	0.31	--	0.39	--	0.54
Nitrogen, ammonia plus organic, total (as N)	7	0.1	2	<0.1	--	--	--	0.30
Phosphorus, total (as P)	7	0.05	3	<0.05	--	--	--	0.20

Table 27. Statistical summary of selected water-quality data collected at station 212335157482603, Waimaluhia Reservoir cross-section 1-3 at 11 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998

[Inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Mini-mum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	35	1	35	165	186	189	194	207
pH (units)	34	0.1	34	6.6	7.1	7.2	7.3	8.5
Temperature, water (°C)	35	0.5	35	20.9	23.0	24.2	25.0	26.5
Turbidity (NTU)	20	0.1	20	1.0	1.8	2.2	3.8	25
Oxygen dissolved (mg/L)	35	0.1	35	3.5	4.8	5.6	6.6	7.6
Fecal coliform 0.7 μm -MF (cols./100 mL)	14	0	14	10	26	72	110	640
Solids, residue at 105°C, suspended (mg/L)	15	1	13	<1	e2.0	e6.0	e13	23
Nitrogen, nitrite plus nitrate, total (as N)	15	0.05	15	0.30	0.30	0.40	0.40	0.49
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	15	0.2	15	0.20	0.20	0.30	0.60	1.1
Phosphorus, total (as P)	15	0.01	14	<0.01	e0.01	e0.02	e0.04	0.11
After construction, August 1992 to January 1998, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	16	1	16	156	189	195	204	214
pH (units)	16	0.1	16	7.1	7.2	7.3	7.3	7.7
Temperature, water (°C)	16	0.5	16	20.5	21.6	23.2	24.9	26.0
Turbidity (NTU)	16	0.1	16	1.0	1.2	2.5	6.4	27.0
Oxygen dissolved (mg/L)	16	0.1	16	4.2	5.2	5.6	6.0	8.7
Fecal coliform 0.7 μm -MF (cols./100 mL)	7	0	7	10	27	85	690	1,200
Solids, residue at 105°C, suspended (mg/L)	9	1	8	<1	e3.0	e5.0	e7.5	10
Nitrogen, nitrite plus nitrate, dissolved (as N)	5	0.05	5	0.35	--	0.40	--	0.55
Nitrogen, ammonia plus organic, total (as N)	7	0.1	1	--	--	--	--	0.30
Phosphorus, total (as P)	7	0.05	6	<0.05	e0.01	e0.02	e0.03	0.03

Table 28. Statistical summary of selected water-quality data collected at station 212329157483102, Waimaluhia Reservoir cross-section 3-2 at 1 ft depth near Kaneohe, Oahu, Hawaii, from September 1983 to January 1998

[inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, September 1983 to June 1992, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	23	1	23	156	181	184	191	209
pH (units)	23	0.1	23	7.1	7.4	7.6	7.8	7.1
Temperature, water (°C)	23	0.5	23	21.4	24.5	26.3	26.6	28.1
Turbidity (NTU)	21	0.1	21	0.50	0.75	1.0	1.6	31
Oxygen dissolved (mg/L)	23	0.1	23	6.0	7.2	7.6	8.0	9.6
Fecal coliform 0.7 μm -MF (cols./100 mL)	11	0	11	1	2	8	9	59
Solids, residue at 105°C, suspended (mg/L)	12	1	8	<1	e1.1	e3.0	e3.8	12
Nitrogen, nitrite plus nitrate, total (as N)	11	0.05	9	<0.1	e0.20	e0.30	e0.35	0.40
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	11	0.2	9	<0.2	e0.20	e0.30	e0.40	0.60
Phosphorus, total (as P)	11	0.01	9	<0.01	e0.01	e0.01	e0.02	0.03
After construction, August 1992 to January 1998, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	15	1	15	144	184	186	194	200
pH (units)	15	0.1	15	7.2	7.5	7.6	7.7	7.8
Temperature, water (°C)	15	0.5	15	20.8	21.5	23.0	26.5	27.5
Turbidity (NTU)	15	0.1	15	0.20	1.0	1.3	2.1	16
Oxygen dissolved (mg/L)	15	0.1	15	6.1	6.9	7.3	7.7	8.2
Fecal coliform 0.7 μm -MF (cols./100 mL)	8	0	8	2	5	13	55	1,400
Solids, residue at 105°C, suspended (mg/L)	9	1	8	<1	e1.0	e2.0	e4.0	7.0
Nitrogen, nitrite plus nitrate, dissolved (as N)	5	0.05	5	0.30	--	0.37	--	0.51
Nitrogen, ammonia plus organic, total (as N)	7	0.1	2	<0.1	--	--	--	0.20
Phosphorus, total (as P)	7	0.05	3	<0.05	--	--	--	0.02

Table 29. Statistical summary of selected water-quality data collected at station 212329157483102, Waimaluhia Reservoir cross-section 3-2 at 5 ft depth near Kaneohe, Oahu, Hawaii, from January 1984 to January 1998

[Inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C , microsiemens per centimeter at 25 degrees Celsius; mg/L , milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; $0.7\ \mu\text{m-MF}$, $0.7\ \mu\text{m}$ membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; $^\circ\text{C}$, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, January 1984 to June 1992, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	20	1	20	157	180	184	193	209
pH (units)	20	0.1	20	7.1	7.4	7.6	7.8	8.9
Temperature, water ($^\circ\text{C}$)	20	0.5	20	21.4	24.2	26.0	26.6	27.6
Turbidity (NTU)	6	0.1	6	0.8	1.0	1.6	2.5	3.6
Oxygen dissolved (mg/L)	20	0.1	20	5.9	7.1	7.2	7.8	9.2
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	2	0	2	16	--	--	--	21
Solids, residue at 105°C , suspended (mg/L)	2	1	2	2.0	--	--	--	4.0
Nitrogen, nitrite plus nitrate, total (as N)	2	0.05	2	0.33	--	--	--	0.35
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	2	0.2	2	0.30	--	--	--	0.50
Phosphorus, total (as P)	2	0.01	2	0.02	--	--	--	0.03
After construction, August 1992 to January 1998, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	15	1	15	146	184	188	194	200
pH (units)	15	0.1	15	7.2	7.5	7.6	7.8	7.8
Temperature, water ($^\circ\text{C}$)	15	0.5	15	20.8	21.5	22.5	26.5	27.0
Turbidity (NTU)	15	0.1	15	0.4	0.8	1.3	2.2	15
Oxygen dissolved (mg/L)	15	0.1	15	6.0	6.8	7.3	7.7	8.2
Fecal coliform $0.7\ \mu\text{m-MF}$ (cols./100 mL)	8	0	8	1.0	3.2	26	144	890
Solids, residue at 105°C , suspended (mg/L)	9	1	6	<1	e0.85	e2.0	e5.0	5.0
Nitrogen, nitrite plus nitrate, dissolved (as N)	5	0.05	5	0.30	--	0.39	--	0.48
Nitrogen, ammonia plus organic, total (as N)	7	0.1	1	--	--	--	--	0.20
Phosphorus, total (as P)	7	0.05	3	<0.05	--	--	--	0.02

Table 30. Statistical summary of selected water-quality data collected at station 212329157483102, Waimaluhia Reservoir cross-section 3-2 at 10 ft depth near Kaneohe, Oahu, Hawaii, from May 1983 to January 1998

[Inst., instantaneous; $\mu\text{S}/\text{cm}$ at 25°C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligram per liter; $\mu\text{g}/\text{L}$, microgram per liter; <, less than; e, estimated using log-probability regression; 0.7 μm -MF, 0.7 micron membrane filter; cols./100 mL, colonies per 100 milliliters; ft^3/s , cubic foot per second; °C, degrees Celsius; NTU, nephelometric turbidity unit; --, no data or not computed; Range of dates are the time periods of water-quality data collection during the specified construction activity]

Property or constituent	Number of samples	Minimum detection limit	Number of detections	Minimum	Concentration percentile			Maximum
					25	50	75	
During construction, May 1983 to June 1992, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	23	1	23	157	178	186	192	208
pH (units)	23	0.1	23	6.6	7.2	7.4	7.5	8.8
Temperature, water (°C)	23	0.5	23	21.1	24.0	25.0	26.1	26.9
Turbidity (NTU)	22	0.1	22	0.7	1.5	2.4	3.2	9.5
Oxygen dissolved (mg/L)	23	0.1	23	1.4	4.9	6.6	7.0	8.3
Fecal coliform 0.7 μm -MF (cols./100 mL)	11	0	10	<1	e2	e10	e18	66
Solids, residue at 105°C, suspended (mg/L)	12	1	11	<1	e3.0	e4.5	e9.2	18
Nitrogen, nitrite plus nitrate, dissolved (as N)	0	0.05	--	--	--	--	--	--
Nitrogen, ammonia plus organic, total (as N)	11	0.05	11	0.20	0.30	0.30	0.40	1.0
Phosphorus, total (as P)	11	0.05	9	<0.05	e0.01	e0.01	e0.03	0.05
After construction, August 1992 to January 1998, physical, biological, and nutrients								
Specific conductance ($\mu\text{S}/\text{cm}$ at 25°C)	13	1	13	162	184	188	192	200
pH (units)	13	0.1	13	7.3	7.5	7.6	7.6	7.8
Temperature, water (°C)	13	0.5	13	20.8	21.5	23.0	25.4	27.0
Turbidity (NTU)	13	0.1	13	0.90	1.2	2.8	6.7	17
Oxygen dissolved (mg/L)	13	0.1	13	3.3	5.5	6.8	7.4	8.3
Fecal coliform 0.7 μm -MF (cols./100 mL)	7	0	7	<4	e6	e24	e57	860
Solids, residue at 105°C, suspended (mg/L)	8	1	7	<1	e3.0	e4.0	e20	24
Nitrogen, nitrite plus nitrate, total (as N)	0	0.1	--	--	--	--	--	--
Nitrogen, nitrite plus nitrate, dissolved (as N)	4	0.05	4	0.30	--	0.38	--	0.47
Nitrogen, ammonia plus organic, total (as N)	6	0.2	2	<0.2	--	--	--	0.20
Phosphorus, total (as P)	6	0.01	4	<0.01	--	--	--	0.09

Table 31. Pesticides, herbicides, and polychlorinated compounds analyzed for at stream-gaging and water-quality stations in the H-3 Highway study area, Oahu, Hawaii, February 1983 to August 1999

[all values in microgram per liter; USGS, U.S. Geological Survey]

Constituent	USGS parameter code	Laboratory reporting limit
Aldrin	39330	0.01
Chlordane	39350	0.1
Chlorpyrifos	38932	0.01
DDD	39360	0.01
DDE	39365	0.01
DDT	39370	0.01
DEF	39040	0.01
Diazinon	39570	0.01
Dieldrin	39380	0.01
Disulfoton	39011	0.01
Endosulfan I	39388	0.01
Endrin	39390	0.01
Ethion	39398	0.01
Fonofos	82614	0.01
Heptachlor	39410	0.01
Heptachlor epoxide	39420	0.01
Lindane	39340	0.01
Malathion	39530	0.01
Methoxychlor	39480	0.01
Parathion-methyl	39600	0.01
Mirex	39755	0.01
Parathion	39540	0.01
Perthane	39034	0.1
Phorate	39023	0.01
PCB	39516	0.1
PCN	39250	0.1
Toxaphene	39400	1
Trithion	39786	0.01
2,4-D	39730	0.01
2,4-DP	82183	0.01
2,4,5-T	39740	0.01
Silvex	39760	0.01

Table 32. Pesticides, herbicides and polychlorinated compounds detected at stream-gaging and water-quality stations in the H-3 Highway study area, Oahu, Hawaii, February 1983 to August 1999
 [µg/L, microgram per liter; b, before construction period; d, during construction period; a, after construction period; station numbers are abbreviated, complete numbers are preceded by 16]

Property or constituent	Station number	Station name	Total number of samples	Total number of detections	Highest concentration detected (µg/L)	Time period when highest concentration detected
Aldrin	272200	Kamooalii Str below Luluku Str	33	2	0.1	d
Chlordane	227100	Halawa Str below H-1	16	1	0.1	d
	273950	South Fork Kapunahala Str	21	1	0.1	d
	274100	Kaneohe Str	14	2	0.1	d
Chlorpyrifos	227100	Halawa Str below H-1	13	2	0.02	d
	265600	Right Branch Kamooalii Str	15	1	0.9	d
	265700	Kamooalii Str at alt 220 ft	1	1	0.01	b
	273950	South Fork Kapunahala Str	15	1	0.02	d
	274100	Kaneohe Str	11	1	0.01	d
DDT	227100	Halawa Str below H-1	16	1	0.01	d
	275000	Haiku Str	32	1	0.08	d
Diazinon	226200	North Halawa Str nr Honolulu	23	1	0.01	b
	227100	Halawa Str below H-1	16	9	0.04	d
	265600	Right Branch Kamooalii Str	26	1	0.01	d
	265700	Kamooalii Str at alt 220 ft	3	1	0.02	b
	267500	Hooleinaiwa Str abv confluence	6	1	0.01	b
	270900	Luluku Str	25	1	0.01	b
	272200	Kamooalii Str below Luluku Str	15	3	0.01	d
	274100	Kaneohe Str	14	3	0.01	d
	275000	Haiku Str	24	1	0.01	d
Dieldrin	227100	Halawa Str below H-1	16	1	0.01	d
	272200	Kamooalii Str below Luluku Str	33	5	0.01	d, a
	273950	South Fork Kapunahala Str	21	4	0.02	d
	274100	Kaneohe Str	14	13	0.05	d
Heptachlor epoxide	274100	Kaneohe Str	14	5	0.01	d
Malathion	226200	North Halawa Str nr Honolulu	23	1	0.02	d
	227100	Halawa Str below H-1	16	1	0.01	d
	265600	Right Branch Kamooalii Str	26	1	0.01	a
	265700	Kamooalii Str at alt 220 ft	3	1	0.28	b
	273950	South Fork Kapunahala Str	20	1	0.05	b
2,4-D	265600	Right Branch Kamooalii Str	25	2	0.02	d
	267500	Hooleinaiwa Str abv confluence	5	1	0.02	b
	272200	Kamooalii Str below Luluku Str	31	6	0.03	d
	274100	Kaneohe Str	14	1	0.02	d
	275000	Haiku Str	23	1	0.02	d
2,4-DP	227100	Halawa Str below H-1	16	2	0.03	d
	265600	Right Branch Kamooalii Str	25	1	0.02	d
	272200	Kamooalii Str below Luluku Str	31	3	0.04	d
	273950	South Fork Kapunahala Str	20	1	0.19	d
Silvex	226200	North Halawa Str nr Honolulu	23	1	0.01	b