

Section 5

GEOGRAPHY AND ENVIRONMENT

This section relates to land and water areas, physical geography, climate, air and water quality, noise, and other geographic and environmental measurements of Hawaii. Most statistics on land use and ownership, however, appear in Section 6.

The State consists of eight major islands and 124 minor islands with a total land area of 6,425 square miles and a general coastline of 750 miles. Honolulu is 214 miles from Hilo, 1,367 miles from Kure Atoll (the westernmost end of the State), 2,397 miles from San Francisco, and 4,829 miles from Washington, D.C. The highest peak in the State is Mauna Kea, 13,796 feet above sea level; the longest stream is Kaukonahua Stream, Oahu, 33 miles in length; the most extensive lake or similar body is Kawainui Marsh, 1,000 acres; and the highest named waterfall is Kahiwa, Molokai, a 1,750-foot cascade. Various measures of air pollution, such as suspended particulate matter, indicate that Honolulu is one of the cleanest cities in the nation. There is also relatively little water pollution: the 104 major beaches and streams surveyed in 1989 were found to have enterococci levels per 100 ml. ranging from 0.5 to 150.3, and four out of five were within EPA standards. More than 1,200 species, subspecies, and varieties of native fauna and flora have been proposed or accepted for inclusion on lists of endangered, threatened, or extinct organisms.

Climatically, Hawaii is marked by remarkably balmy temperatures and wide variations in rainfall. The all-time temperature range at Honolulu International Airport, for example, was from 53° to 94°F. Average precipitation, however, ranges from less than nine inches at Kawaihae to 444 inches atop Waialeale. The largest volcanic eruption in Island history (begun in 1983) had produced more than 1.6 billion cubic yards of lava by August 1990. The worst earthquake (1868) attained 7.5 on the Richter scale, the highest tsunami wave (1946) reached 56 feet, and the most destructive hurricane (Iwa, 1982) gusted to 117 miles per hour. Water withdrawn for use in 1985 averaged 1.4 billion gallons per day, compared with 2.9 billion in 1980 and 2.8 billion in 1975. Among 31 neighborhoods on Oahu, median noise levels in 1981-1982 ranged from 37 decibels (in Mililani) to 57 decibels (in Pawaa).

Important sources of data include the U.S. Geological Survey, National Ocean Survey, National Weather Service, U.S. Bureau of the Census Geography Division, the Division of Water and Land Development of the State Department of Land and Natural Resources, the State Department of Health, and the University of Hawaii Institute of Geophysics. Detailed information is given in Atlas of Hawaii, 2nd edition, published by the University of Hawaii Press in 1983. National data are reported in Statistical Abstract of the United States: 1990, Section 6.

Table 125.-- GREAT CIRCLE DISTANCES BETWEEN SPECIFIED PLACES

Places	Statute miles	Nautical miles	Kilo-meters
DISTANCES FROM HONOLULU INTERNATIONAL AIRPORT			
Hawaiian Islands locations:			
Hilo, Hawaii	214	186	344
Kailua, Kona, Hawaii	168	146	270
Kahului, Maui	98	85	158
Lanai Airport	72	63	116
Molokai Airport	54	47	87
Lihue, Kauai	103	90	166
Puuwai, Niihau	152	132	245
Nihoa	283	246	455
Necker Island	520	452	837
French Frigate Shoals	556	483	895
Gardner Pinnacles	688	598	1,107
Maro Reef	851	739	1,369
Laysan Island	936	813	1,506
Lisianski Island	1,065	925	1,714
Pearl and Hermes Atoll	1,208	1,050	1,944
Midway Islands	1,309	1,137	2,106
Kure Atoll	1,367	1,188	2,200
Other Pacific locations:			
Apra Harbor, Guam	3,806	3,307	6,124
Auckland, New Zealand	4,393	3,817	7,068
Hong Kong	5,541	4,815	8,915
Johnston Atoll	820	713	1,319
Kingman Reef	1,073	932	1,726
Kiritimati (Christmas Island), Kiribati	1,344	1,168	2,163
Majuro, Marshall Islands	2,271	1,973	3,654
Manila, Philippines	5,293	4,599	8,516
Nuku Hiva, Marquesas Islands	2,400	2,086	3,864
Pago Pago, American Samoa	2,606	2,265	4,193
Palmyra Atoll	1,101	957	1,772
Papeete, Tahiti	2,741	2,382	4,410
Suva, Fiji	3,159	2,745	5,083
Sydney (Port Jackson), Australia	5,070	4,406	8,158
Tokyo, Japan	3,847	3,343	6,190
Wake Island	2,294	1,993	3,691
North and South American locations:			
Anchorage, Alaska	2,781	2,417	4,475
Cape Horn, Chile	7,457	6,480	11,998

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Table 125.-- GREAT CIRCLE DISTANCES BETWEEN SPECIFIED PLACES -- Con.

Places	Statute miles	Nautical miles	Kilo-meters
DISTANCES FROM HONOLULU INT. AIRPORT--Con.			
North and South American locations, con.:			
Chicago, Illinois	4,179	3,631	6,724
Cristobal, Canal Zone	5,214	4,531	8,389
Los Angeles, California	2,557	2,222	4,114
Miami, Florida	4,856	4,220	7,813
New York, New York	4,959	4,309	7,979
Portland, Oregon	2,595	2,255	4,175
San Diego, California	2,610	2,268	4,199
San Francisco, California	2,397	2,083	3,857
Seattle, Washington	2,679	2,328	4,311
Vancouver, B.C.	2,709	2,354	4,359
Tijuana, Mexico	2,616	2,273	4,209
Washington, D.C.	4,829	4,196	7,770
London, England	7,226	6,279	11,627
Bombay, India	8,010	6,960	12,888
Ghanzi, Botswana 1/	12,417	10,790	19,979
Equator, due south of Honolulu	1,470	1,277	2,367
North Pole	4,740	4,119	7,631
OTHER DISTANCES			
Hilo to --			
Los Angeles, California	2,447	2,126	3,937
San Francisco, California	2,315	2,012	3,725
Kure Atoll to --			
Cape Kumukahi, Puna, Hawaii 2/	1,523	1,323	2,451
Log Point, Elliot Key, Florida 3/	5,852	5,085	9,416
Tokyo, Japan	2,486	2,160	4,000
West Quoddy Head, Maine	5,788	5,030	9,313

1/ Ghanzi, Botswana, is Honolulu's antipode, that is, the point precisely opposite to it on the globe.

2/ Cape Kumukahi and Kure Atoll are the points farthest apart in the Hawaiian Archipelago and State of Hawaii.

3/ Log Point and Kure Atoll are the points farthest apart in the 50 states.

Source: U. S. Department of the Interior, Geological Survey, Elevations and Distances in the United States (1980), pp. 22-23, and records.

Table 126.-- TIME DIFFERENTIALS BETWEEN HONOLULU AND SELECTED CITIES:
1982-1990

City	June		December	
	Day	Hour	Day	Hour
Honolulu, Hawaii	Same	12:00 N	Same	12:00 N
Papeete, Tahiti	Same	12:00 N	Same	12:00 N
Anchorage, Alaska	Same	2:00 PM	Same	1:00 PM
San Francisco, California	Same	3:00 PM	Same	2:00 PM
Denver, Colorado	Same	4:00 PM	Same	3:00 PM
Mexico City, Mexico	Same	4:00 PM	Same	4:00 PM
Houston, Texas	Same	5:00 PM	Same	4:00 PM
Chicago, Illinois	Same	5:00 PM	Same	4:00 PM
Atlanta, Georgia	Same	6:00 PM	Same	5:00 PM
Toronto, Canada	Same	6:00 PM	Same	5:00 PM
Washington, D.C.	Same	6:00 PM	Same	5:00 PM
New York, N.Y.	Same	6:00 PM	Same	5:00 PM
Rio de Janeiro, Brazil	Same	7:00 PM	Same	7:00 PM
London, United Kingdom	Same	11:00 PM	Same	10:00 PM
Bonn, West Germany	Same	12:00 Mid.	Same	11:00 PM
Vienna, Austria	Same	11:00 PM	Same	11:00 PM
Cairo, Egypt	Same	12:00 Mid.	Same	12:00 Mid.
Moscow, Soviet Union	Next	2:00 AM	Next	1:00 AM
Bombay, India	Next	3:30 AM	Next	3:30 AM
Singapore, Singapore	Next	6:00 AM	Next	6:00 AM
Hong Kong, Hong Kong	Next	7:00 AM	Next	6:00 AM
Manila, Philippines	Next	6:00 AM	Next	6:00 AM
Shanghai, China	Next	7:00 AM	Next	6:00 AM
Seoul, South Korea	Next	7:00 AM	Next	7:00 AM
Tokyo, Japan	Next	7:00 AM	Next	7:00 AM
Agana, Guam	Next	9:00 AM	Next	8:00 AM
Sydney, Australia	Next	8:00 AM	Next	9:00 AM
Auckland, New Zealand	Next	10:00 AM	Next	11:00 AM
Suva, Fiji	Next	10:00 AM	Next	10:00 AM
Pago Pago, American Samoa	Same	11:00 AM	Same	11:00 AM

Source: Doris Chase Doane, Time Changes in the USA, Rev. Ed. (1985) and Time Changes in the World, Rev. Ed. (1982); The World Almanac 1990, pp. 270-271; GTE Hawaiian Tel, Oahu Telephone Directory, February 1, 1990, p. 37A.

Table 127.-- LATITUDES AND LONGITUDES OF SELECTED PLACES

Island and place	Latitude (North)	Longitude (West)
Hawaii:		
Hilo (International Airport).....	19°43'	155°04'
Cape Kumukahi	19°31'	154°49'
Ka Lae	18°56'	155°41'
Keahole Point	19°44'	156°04'
Upolu Point	20°16'	155°51'
Geographic center of State (off Maui).	20°15'	156°20'
Maui:		
Wailuku	20°53'	156°30'
Kahului (Airport)	20°54'	156°26'
Hana	20°45'	155°59'
Cape Hanamanioa	20°35'	156°25'
Lahaina	20°52'	156°41'
Kahoolawe:		
Puu Moaulanui	20°34'	156°34'
Lanai:		
Airport	20°48'	156°57'
Molokai:		
Kaunakakai	21°05'	157°02'
Laau Point	21°06'	157°19'
Cape Halawa	21°10'	156°43'
Oahu:		
Honolulu: International Airport ...	21°20'	157°55'
Aloha Tower	21°19'	157°52'
Kaena Point	21°35'	158°17'
Kahuku Point	21°43'	157°59'
Makapuu Point	21°19'	157°39'
Diamond Head	21°16'	157°49'
Kauai:		
Lihue (Kauai Airport)	21°59'	159°21'
Mana	22°02'	159°46'
Kilauea Point	22°14'	159°24'
Niihau:		
Puuwai	21°54'	160°12'
Kure Atoll	28°25'	178°22'

Source: U.S. Board on Geographic Names, Gazetteer No. 24, Hawaiian Islands (1956); U.S. Geological Survey, Elevations and Distances in the United States (1980), pp. 17 and 22-23; U.S. Department of Commerce, National Climatic Data Center, Local Climatological Data, Annual Summary with Comparative Data, 1984 for Hilo, Kahului, Honolulu, and Lihue; Bernice P. Bishop Museum, records; Hawaii State Department of Accounting and General Services, Survey Division, records.

Table 128.-- WIDTHS AND DEPTHS OF CHANNELS

Channel <u>1/</u>	Width <u>2/</u>		Depth <u>3/</u>	
	Statute miles	Kilometers	Feet	Meters
Alenuihaha (Hawaii-Maui)	29.6	47.6	6,810	2,076
Alalakeiki (Kahoolawe-Maui)	6.7	10.8	822	251
Kealaikahiki (Kahoolawe-Lanai)	17.8	28.6	1,086	331
Auau (Lanai-Maui)	9.5	15.3	252	77
Kalohi (Lanai-Molokai)	9.2	14.8	540	165
Pailolo (Maui-Molokai)	8.8	14.2	846	258
Kaiwi (Molokai-Oahu)	25.8	41.5	2,202	671
Kauai (Oahu-Kauai)	72.1	116.0	10,890	3,319
Kaulakahi (Kauai-Niihau)	17.2	27.7	3,570	1,088
Niihau-Kaula	21.5	34.6	5,364	1,635
Niihau-Nihoa	133.9	215.5	14,550	4,435
Nihoa-Necker I.	179.6	289.0	12,600	3,840
Necker I.-French Frigate Shoals	100.3	161.4	12,780	3,895
French Frigate Shoals-Gardner Pinnacles ..	137.0	220.5	11,448	3,489
Gardner Pinnacles-Marø Reef	155.5	250.3	12,300	3,749
Marø Reef-Laysan I.	65.9	106.1	8,280	2,524
Laysan I.-Lisianski I.	137.4	221.1	16,830	5,130
Lisianski I.-Pearl and Hermes Atoll	162.6	261.7	17,400	5,304
Pearl and Hermes Atoll-Midway Islands	86.9	139.9	15,840	4,828
Midway Islands-Kure Atoll	57.1	91.9	12,960	3,950

1/ Listed in geographic order, from east to west. The channels between major islands were measured between the following points:

Alenuihaha: Upolu Pt., Hawaii, to Puhilele Pt., Maui;
 Alalakeiki: Lae o ka Ule, Kahoolawe, to Nukuele Pt., Maui;
 Kealaikahiki: Makaalae, Kahoolawe, to Kamaiki Pt., Lanai;
 Auau: Kikoa Pt., Lanai, to Lahaina, Maui;
 Kalohi: Wahie Pt., Lanai, to Kamalo, Molokai;
 Pailolo: Lipoa Pt., Maui, to Pohakuloa, Molokai;
 Kaiwi: Ilio Pt., Molokai, to Makapuu Pt., Oahu;
 Kauai: Kaena Pt., Oahu, to Kamilo Pt., Kauai;
 Kaulakahi: Mana Pt., Kauai, to Kaunuopou, Niihau.

2/ Width measured in statute miles between designated points on National Ocean Survey and Coast and Geodetic Survey charts. Width in kilometers calculated from miles (1 mile = 1.60934 km.).

3/ Depths given are the deepest soundings noted at or near the line joining the two designated points, on National Ocean Survey and Coast and Geodetic Survey charts. Depths measured in fathoms and converted to feet and meters (1 fathom = 6 feet = 1.8288 meters).

Source: Compiled by Lee S. Motteler, Geography and Map Division, Bernice P. Bishop Museum, in November 1980.

Table 129.-- GENERAL COASTLINE AND TIDAL SHORELINE OF COUNTIES AND ISLANDS

County and island	General coastline <u>1/</u>		Tidal shoreline <u>2/</u>	
	Statute miles	Kilo-meters <u>3/</u>	Statute miles	Kilo-meters <u>3/</u>
State total	750	1,207	1,052	1,693
Counties:				
Hawaii	266	428	313	504
Maui, including Kalawao	210	338	343	552
Honolulu	137	220	234	377
Kauai	137	220	162	261
Islands: <u>4/</u>				
Hawaii	266	428	313	504
Maui	120	193	149	240
Kahoolawe	29	47	36	58
Lanai	47	76	52	84
Molokai	88	142	106	171
Oahu	112	180	209	336
Kauai	90	145	110	177
Niihau	45	72	50	80
Kaula	2	3	2	3
Northwestern Hawaiian Islands <u>5/</u> ..	25	40	25	40
Nihoa	3	5	3	5
Necker Island	2	3	2	3
French Frigate Shoals	6	10	6	10
Laysan Island	6	10	6	10
Lisianski Island	3	5	3	5
Kure Atoll	5	8	5	8

1/ Figures are lengths of general outline of seacoast. Data for the four islands of Maui County are not consistent with the reported county total.

2/ Shoreline of outer coast, offshore islands, bays, rivers, and creeks is included to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet.

3/ Derived from data expressed in statute miles; independently rounded and accordingly may not add exactly to indicated totals and subtotals.
1 mi. = 1.609 km.

4/ Data are not available for five minor islands: Molokini, Lehua, Gardner Pinnacles, Maro Reef, and Pearl and Hermes Atoll.

5/ Excludes the Midway Islands, which are part of the Hawaiian Archipelago but not legally part of the State of Hawaii. Midway has a general coastline of 20 miles and a tidal shoreline of 33 miles.

Source: U.S. Department of Commerce, National Ocean Survey, The Coastline of the United States (1975) and records.

Table 130.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1989

[See maps on pages 6 and 7]

County or island	Square miles		
	Total	Land <u>2/</u>	Inland water <u>3/</u>
State total	6,470.8	6,425.2	45.6
Counties: <u>4/</u>			
Hawaii	4,035.2	4,034.2	1.0
Maui	1,171.0	1,161.6	9.4
Kalawao	14.3	13.3	1.0
Honolulu <u>5/</u>	620.5	596.3	24.2
Kauai <u>5/</u>	629.8	619.8	10.0
Islands: <u>4/</u>			
Hawaii	4,035.2	4,034.2	1.0
Maui <u>6/</u>	734.5	728.6	5.9
Kahoolawe	45.9	45.0	0.9
Lanai	141.2	140.4	0.8
Molokai	263.7	260.9	2.8
Oahu	617.6	593.6	24.0
Kauai	558.2	549.4	8.8
Niihau <u>7/</u>	71.1	70.0	1.1
Kaula	0.4	0.4	-
Northwestern Hawaiian Islands <u>8/</u>	2.910	2.690	0.220
Nihoa	0.238	0.238	-
Necker Island	0.105	0.105	-
French Frigate Shoals	0.081	0.081	-
Gardner Pinnacles	0.011	0.011	-
Maro Reef	Awash	Awash	Awash
Laysan Island	1.454	1.234	0.220
Lisianski Island	0.586	0.586	-
Pearl and Hermes Atoll	0.106	0.106	-
Kure Atoll	0.329	0.329	-

Continued on next page.

Table 130.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1989 -- Con.

County or island	Square kilometers <u>1/</u>		Acres <u>1/</u>	
	Total	Land <u>2/</u>	Total	Land <u>2/</u>
State total	16,759.3	16,641.2	4,141,312	4,112,128
Counties: <u>4/</u>				
Hawaii	10,451.1	10,448.5	2,582,528	2,581,888
Maui	3,032.9	3,008.5	749,440	743,424
Kalawao	37.0	34.4	9,152	8,512
Honolulu <u>5/</u>	1,607.1	1,544.4	397,120	381,632
Kauai <u>5/</u>	1,631.2	1,605.3	403,072	396,672
Islands: <u>4/</u>				
Hawaii	10,451.1	10,448.5	2,582,528	2,581,888
Maui <u>6/</u>	1,902.3	1,887.1	470,080	466,304
Kahoolawe	118.9	116.5	29,376	28,800
Lanai	365.7	363.6	90,368	89,856
Molokai	683.0	675.7	168,768	166,976
Oahu	1,599.6	1,537.4	395,264	379,904
Kauai	1,445.7	1,422.9	357,248	351,616
Niihau <u>7/</u>	184.1	181.3	45,504	44,800
Kaula	1.0	1.0	256	256
Northwestern Hawaiian Islands <u>8/</u>	7.5	7.0	1,862	1,722
Nihoa	0.6	0.6	152	152
Necker Island	0.3	0.3	67	67
French Frigate Shoals	0.2	0.2	52	52
Gardner Pinnacles	0.0	0.0	7	7
Maro Reef	Awash	Awash	Awash	Awash
Laysan Island	3.8	3.2	931	790
Lisianski Island	1.5	1.5	375	375
Pearl and Hermes Atoll	0.3	0.3	68	68
Kure Atoll	0.9	0.9	211	211

1/ Areas in square kilometers and acres were calculated directly from the figures shown for square miles; these equivalents were independently rounded, and hence may not add exactly to the indicated totals and subtotals. 1 square mile = 640 acres = 2.58999 square kilometers.

2/ Dry land and land temporarily or partially covered by water, as marshland, swamps, etc.; streams and canals under one-eighth statute mile wide; and lakes, reservoirs, and ponds under 40 acres of area.

Continued on next page.

Table 130.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1989 -- Con.

3/ Permanent inland water surface, such as lakes, reservoirs, and ponds having 40 acres or more of area; streams, sloughs, estuaries, and canals one-eighth statute mile or more in width; deeply indented embayments and sounds, and other coastal waters behind or sheltered by headlands or islands separated by less than 1 nautical mile of water, and islands having less than 40 acres of area.

4/ Because of rounding, island figures may not add to county figures.

5/ Reflects inclusion of Kaula in the County of Kauai rather than in the City and County of Honolulu. Kaula was transferred to the County of Kauai by Act 245, S.L.H. 1988, approved June 9, 1988.

6/ Molokini, offshore of Maui, not measured; other sources give the area of Molokini as 18.6 acres (0.03 square miles or 0.075 square kilometers).

7/ Includes Lehua, elsewhere reported as 243 acres (0.38 square miles or 0.98 square kilometers).

8/ Exclusive of the Midway Islands, which are part of the Hawaiian Archipelago but not legally part of the State of Hawaii.

Source: Unpublished data supplied by the Geography Division, U.S. Bureau of the Census, May 5, 1983; cited in the Hawaii State Department of Planning and Economic Development, Remeasurements of the Area of Hawaii, 1982 (Statistical Memorandum 83-6, May 18, 1983).

Table 131.-- LAND AND WATER AREA WITHIN THE FISHERY CONSERVATION ZONE

[Land and water area within the 200 nautical mile Fishery Conservation Zone surrounding the Hawaiian Archipelago]

Unit	Total area	Land area	Water area
Square nautical miles	634,023	4,852	629,171
Square statute miles	839,623	6,425	837,198
Square kilometers	2,174,626	16,641	2,147,985

Source: Marine Surveys and Maps, National Ocean Survey, National Oceanic and Atmospheric Administration, information supplied September 15, 1978.

Table 132.-- MAJOR AND MINOR ISLANDS IN THE HAWAIIAN ARCHIPELAGO

Classification	Number of islands		Land area (square miles)
	Total	Inhabited, 1980 <u>1/</u>	
All named islands	137	15	6,427.0
Major islands	8	7	6,419.4
Named minor islands <u>2/</u>	129	8	7.6
Offshore of major islands	96	4	2.6
Northwestern Hawaiian Islands <u>3/</u>	33	4	4.9
Part of State	28	3	2.9
Not part of State (Midway Islands)	5	1	2.0

1/ For populations, see present volume, table 4.

2/ For individual data, see DPED Report GN-6, pp. 3-7.

3/ The 33 islets are in 10 clusters.

Source: Hawaii State Department of Planning and Economic Development, Geographic Names Approved, Second Quarter 1969 (Report GN-6, July 8, 1969), p. 8; Data Book 1986, table 152.

Table 133.-- AREA AND DEPTH OF SELECTED CRATERS

Island and crater	Area (acres)	Maximum depth (feet)
Hawaii:		
Kilauea Caldera	2,319	476
Mokuaweoweo Crater <u>1/</u>	2,221	572
Maui:		
Haleakala Crater <u>2/</u>	12,575	3,028
Oahu:		
Diamond Head Crater	255	562
Koko Crater	133	968
Punchbowl Crater	62	140

1/ Data exclude North and South Pits.

2/ Data exclude Koolau and Kaupo Gaps.

Source: Measured from U.S. Geological Survey maps by DBED.

Table 134.-- ELEVATIONS OF MAJOR SUMMITS

[Elevation of the highest point on each island
and other important peaks]

Island and summit	Feet	Meters
Hawaii:		
Mauna Kea 1/	13,796	4,205
Mauna Loa 2/	13,679	4,169
Hualalai	8,271	2,521
Kaumu o Kaleihohie	5,480	1,670
Kilauea (Uwekahuna)	4,093	1,248
Kilauea (Halemaumau Rim)	3,660	1,116
Kahoolawe:		
Puu Moaulanui	1,483	452
Puu Moaulaiki	1,434	437
Molokini	160	49
Maui:		
Haleakala (Red Hill)	10,023	3,055
Haleakala (Kaupo Gap)	8,201	2,500
Puu Kukui	5,788	1,764
Iao Needle	2,250	686
Lanai:		
Lanaihale	3,366	1,026
Molokai:		
Kamakou	4,961	1,512
Olokui	4,606	1,404
Kaunuohua	4,535	1,382
Kalaupapa Lookout	1,600	488
Mauna Loa (Kukui)	1,430	436
Oahu:		
Kaala	4,003	1,220
Puu Kalena	3,504	1,068
Konahuanui	3,150	960
Tantalus	2,013	614
Olomana	1,643	501
Koko Crater (Kohelepelepe)	1,208	368
Nuuanu Pali Lookout	1,186	361
Diamond Head	760	232
Koko Head	642	196
Punchbowl	500	152

Continued on next page.

Table 134.-- ELEVATIONS OF MAJOR SUMMITS -- Con.

Island and summit	Feet	Meters
Kauai:		
Kawaikini	5,243	1,598
Waialeale	5,148	1,569
Namolokama Mountain	4,421	1,348
Kalalau Lookout	4,120	1,256
Hauptu	2,297	700
Sleeping Giant (Nonou)	1,241	378
Niihau:		
Paniau	1,250	381
Lehua	699	213
Kaula	548	167
Nihoa:		
Millers Peak	903	275
Necker Island:		
Summit Hill	276	84
French Frigate Shoals:		
La Perouse Pinnacles	120	37
Gardner Pinnacles	190	58
Maro Reef	Awash	Awash
Laysan Island	40	12
Lisianski Island	40	12
Pearl and Hermes Atoll	10	3
Midway Islands	12	4
Kure Atoll	20	6

1/ According to the 1990 Guinness Book of World Records (p. 84), "The world's tallest mountain measured from its submarine base (3,280 fathoms) in the Hawaiian Trough to peak is Mauna Kea ... with a combined height of 33,476 ft, of which 13,796 ft are above sea level."

2/ Guinness (p. 84) describes Mauna Loa as having "dimensions, but not height, [which] exceed those of Mt Everest and K2 The axes of its elliptical base, 16,322 ft below sea level, have been estimated at 74 mi and 53 mi."

Source: Hawaii State Department of Accounting and General Services, Survey Division, data provided May 21, 1990; U.S. National Cartographic Information Center, data provided October 11, 1978; U.S. Geological Survey topographic maps, 1981-1984; Hawaiian Government Survey Reg. Maps No. 1075 and 1276 (for Nihoa and Molokini); U.S.S. Tanager survey, 1923 (for Necker Island, French Frigate Shoals, Laysan, Lisianski, Pearl and Hermes Atoll and Kure Atoll).

Table 135-- LENGTH AND WIDTH OF SELECTED BEACHES

[Includes the longest white sand beach on each inhabited island,
plus other important beaches]

Island and beach	Length (miles)	Width 1/ (feet)
Hawaii:		
Hapuna	0.5+	200+
Maui:		
Spreckelsville	2+	(NA)
Kaanapali	1.5	60-80
Lanai:		
Polihua	1.5+	(NA)
Molokai:		
Papohaku	2+	300
Oahu:		
Waikiki	2	(NA)
Waimanalo	3.5-4.5	(NA)
Sunset	2-3+	200
Kauai:		
Polihale to Kekaha	15	300
Polihale	3	300
Niihau:		
Keawanui	3.5	175

NA Not available.

1/ Summer averages. Many beaches in Hawaii are seasonally reduced in width by winter storms.

Source: Hawaii State Department of Planning and Economic Development, Hawaii's Shoreline (1965), pp. 33, 47, 55, 62, 68, and 100; John R. K. Clark, Beaches of the Big Island (1985), p. 132, The Beaches of Maui County (1980), pp. 10, 62, 84-85, and 114, The Beaches of O'ahu (1977), pp. 45, 125, and 177, and Beaches of Kaua'i and Ni'ihau (1990), pp. 48-49 and 84.

Table 136.-- MAJOR STREAMS, BY ISLANDS: 1990

Island	Feature or stream	Length or ave. discharge
Longest water feature (miles):		
Hawaii	Wailuku River	32.0
Maui	Kaliialinui-Waiale Gulch	18.0
Kahoolawe	Ahupu Gulch	4.0
Lanai	Maunalei-Waialala Gulch	12.9
Molokai	Wailau-Pulena Stream	6.5
Oahu	Kaukonahua Stream (So. Fork)	33.0
Kauai	Waimea River-Poomau Stream .	19.5
Niihau	Keanaulii-Puniopo Valley ...	5.9
Largest perennial stream (miles): <u>1/</u>		
Hawaii	Wailuku River	22.7
Maui	Paliikea Stream	7.8
Molokai	Wailau-Pulena Stream	6.5
Oahu	Kaukonahua Stream	30.0
Kauai	Waimea River	19.7
Streams with greatest average discharge (million gal./day):		
Hawaii	Wailuku River	250
Maui	Iao Stream	45
Molokai	Wailau Stream	30
Oahu	Waikele Stream	25
Kauai	Hanalei River	140

1/ Estimated on basis of drainage area rather than stream runoff. Other major streams include Wailoa River, Hawaii (1/2-mile long); Honokohau Stream (9.4 miles long) and Iao Stream (5), both on Maui; Halawa Stream (6.4), Waikolu Stream (4.7), and Pelekunu (2.3), all on Molokai; Waikele Stream (15.3), Kipapa Stream (12.8), Waiakakalaua Stream (11.8), Nuuanu Stream (4), and Ala Wai Canal (1.9), all on Oahu; and the Makaweli River (15.1), Wainiha River (13.8), Hanapepe River (13.3), and Wailua River (11.8), all on Kauai.

Source: Longest water feature from U.S. Geological Survey, records; other data from Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 137.-- LAKES AND LAKE-LIKE WATERS, BY ISLANDS: 1990

Island and lake	Type	Elevation (feet)	Area 1/ (acres)	Maximum depth (feet)
Hawaii:				
Aimakapa	Coastal pool .	(SL)	15	(NA)
Green Lake	Lake	3	2	20
Lake Waiiau 2/	Lake	13,020	2	10
Waiakea Pond	Tidal pond ...	(SL)	27	7
Maui:				
Kanaha Pond	Marsh	(SL)	41	3
Kealia Pond	Marsh	(SL)	500	(NA)
Waieleele	Pond	6,690	0.5	21
Molokai:				
Kauhako	Pool	(SL)	0.9	814
Kualapuu Reservoir ..	Reservoir	821	100	50
Meyer Lake	Impoundment ..	2,021	6-10	5
Oahu:				
Ho'omaluhia	Reservoir	202	90	90
Kaelepulu Pond	Lake	(SL)	198	(NA)
Kawainui Marsh	Marsh	(SL)	1,000	(NA)
Wahiawa Reservoir ...	Reservoir	842	302	85
Kauai:				
Nomilu Fishpond	Pond	(SL)	20	66
Waita Reservoir	Reservoir	241	424	23
Niihau:				
Halalii Lake	Playa	(SL)	841-865	(NA)
Halulu Lake	Playa	(SL)	182-371	(NA)
Laysan:				
Laysan Lagoon	Closed lagoon	(SL)	161	16

NA Not available.

SL Sea level.

1/ Ranges shown for Meyer Lake, Halalii Lake, and Halulu Lake reflect differences in estimates between sources.

2/ Highest lake in the State and third highest in the United States.

Continued on next page.

Table 137.-- LAKES AND LAKE-LIKE WATERS, BY ISLANDS: 1990 - Con.

Source: J.A. Maciolek, Lakes and Lake-like Waters of the Hawaiian Archipelago (Bernice P. Bishop Museum, Occasional Papers, Vol. XXV, No. 1, April 30, 1982); Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, May 23, 1990; Hawaii State Department of Planning and Economic Development, Resource Management Plan for Kawainui Marsh (March 1983); William H. Meyer, U.S. Fish and Wildlife Service, transmittal letter (to DPED, Coastal Zone Management Program), for Kealia Pond National Wildlife Refuge, Maui, Hawaii, Final EIS (August 1981).

Table 138.-- MAJOR NAMED WATERFALLS, BY ISLANDS: 1990

Island	Waterfall	Height (feet)		Horizontal distance (feet)
		Sheer drop	Cascade	
Hawaii ..	Kaluahine .....	...	620	400
	Akaka	442	...	...
Maui	Honokohau .....	...	1,120	500
Molokai .	Kahiwa .....	...	1,750	1,000
	Papalaua .....	...	1,200	500
Oahu	Kaliuwaa (Sacred)	<u>1/</u> 80	1,520	3,000
Kauai ...	Waipoo (2 falls) .....	...	800	600
	Awini .....	...	480	500

1/ Refers to northernmost fall of a cascade of six falls.

Source: U.S. Geological Survey, records; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 139.-- MISCELLANEOUS GEOGRAPHIC STATISTICS, BY ISLANDS

Island	Extreme length (miles)	Extreme width (miles)	Miles of sea cliffs with heights 1,000 ft. or more ^{1/}	Miles from coast of most remote point	Percent of area within 5 miles of coast
The State ..	...	...	33	28.5	48.6
Hawaii	93	76	4	28.5	30.0
Maui	48	26	-	10.6	76.1
Kahoolawe	11	6	-	2.4	100.0
Lanai	18	13	1	5.2	100.0
Molokai	38	10	14	3.9	100.0
Oahu	44	30	-	10.6	79.0
Kauai	33	25	11	10.8	65.0
Niihau	8	6	3	2.4	100.0
Island	Percent of area with elevation --		Approximate mean altitude (feet)	Percent of area with slope --	
	Less than 500 feet	2,000 feet or more		Less than 10 percent	20 percent or more
The State ..	20.8	50.9	3,030	63.5	17.0
Hawaii	12.0	68.4	3,950	76.0	4.0
Kauai	24.9	41.4	2,390	38.5	36.0
Kahoolawe	38.9	0	600	60.0	9.0
Lanai	24.8	6.3	1,140	61.0	16.0
Molokai	37.3	17.8	1,150	53.0	26.0
Oahu	45.3	4.6	860	42.5	45.5
Kauai	35.6	24.0	1,380	33.5	50.5
Niihau	78.2	0	530	68.0	12.5

^{1/} According to Lee S. Motteler, Geography and Map Division, Bernice P. Bishop Museum, the sea cliffs along the northeastern coast of Molokai between Umilehi Point and Puukaoku Point drop 3,250 feet at an average slope of 58 degrees. These cliffs have been described by the Guinness Book of World Records (1990 edition, p. 89) as "the highest sea cliffs yet pinpointed anywhere in the world."

Source: Hawaii State Department of Planning and Economic Development, Hawai'i the Natural Environment (1974), p. 19; U.S. Geological Survey, Elevations and Distances in the United States (1978), pp. 4-5.

Table 140.-- VOLCANIC ERUPTIONS: 1969 TO 1990

[Complete through August 1, 1990. Four volcanoes have erupted in historical times: Haleakala, last active around 1790; Hualalai, last active in 1800-1801; and Kilauea and Mauna Loa, both active in recent years and included in this table]

Volcano and date of outbreak	Repose period since previous eruption (months)	Duration (days)	Location <u>1/</u>	Elevation (feet)	Area (square miles)	Volume (mil. cubic yards)
Mauna Loa:						
1975: July 5	301	<1	S	13,000	5.2	35.0
1984: March 25	104	22	S, ER	13,200-9,400	11±	230.0
Kilauea:						
1969: Feb. 22	4.0	6	ER	3,100-2,900	2.3	22.0
May 24	2.0	867	ER	3,150	19.3	242.0
1971: Aug. 14	-	<1	C	3,660-3,600	0.8	12.4
Sept. 24	-	5	C, SWR	3,740-2,730	1.5	10.5
1972: Feb. 4	4.3	455	ER	3,150	13.5	163.8
1973: May 5	-	<1	ER	3,340-3,250	0.1	1.6
Nov. 10	-	30	ER	3,250-2,900	0.4	3.7
Dec. 12	0.1	203	ER	3,150	3.1	39.3
1974: July 19	-	3	C, ER	3,600-3,520	1.2	9.0
Sept. 19	2.0	<1	C	3,680	0.4	14.0
Dec. 31	3.4	<1	C	3,600	2.9	19.6
1975: Nov. 29	11.0	<1	C	3,600-3,520	0.1	.3
1977: Sept. 13	21.5	18	ER	2,080-1,600	3.0	45.0
1979: Nov. 16	26.3	1	ER	3,270-3,200	0.1.	.8
1982: April 30	29.5	<1	C	3,630	0.1	.26
Sept. 25	4.9	<1	C	3,620	0.3	3.9
1983: Jan. 3 <u>2/</u>	3.3	2,767	ER	2,560-2,120	27.0	1,650

1/ C, caldera; ER, east rift; S, summit; SWR, southwest rift.

2/ Still in progress, August 1, 1990. As of that time, there had been 48 separate episodes. These had destroyed 168 housing units and added over 150 acres to the area of the island.

Source: Gordon A. Macdonald and Douglass H. Hubbard, Volcanoes of the National Parks in Hawaii, 8th edition (Hawaii Natural History Association, 1982), pp. 10, 19, 34, and 58, as updated by the staff of the Hawaiian Volcano Observatory.

Table 141.-- EARTHQUAKES OF MAGNITUDE 5 OR GREATER: 1975 TO 1990

[Complete to August 24, 1990]

Date and time (HST)	Location	Magnitude (Richter scale)
1975: Jan. 2, 3:27 AM ...	Near Pahala, Hawaii	5.0
Nov. 29, 3:35 AM ..	Puna, Hawaii	5.7
Nov. 29, 4:47 AM ..	Puna, Hawaii	7.2
1976: Feb. 20, 7:51 PM ..	Between Maui and Hawaii ..	5.1
1977: Jan. 22, 12:36 PM .	100 miles S. of Kauai	5.1
Apr. 20, 6:49 PM ..	Hamakua, Hawaii	5.0
Jun. 5, 11:42 PM ..	Puna, Hawaii	5.1
1979: Mar. 29, 11:06 PM .	40 miles S.W. of Oahu	5.5
Sept. 21, 9:59 PM .	Puna, Hawaii	5.5
1981: Mar. 5, 4:09 AM ...	Molokai area	5.3
Nov. 10, 3:02 AM ..	Kilauea, Hawaii	5.3
1982: Jan. 21, 11:52 AM .	Mauna Loa, Hawaii	5.5
Jan. 21, 12:29 PM .	Mauna Loa, Hawaii	5.5
May 14, 6:26 AM ...	Off Kawaihae, Hawaii	5.0
1983: Mar. 20, 5:18 PM ..	Off Kalapana, Hawaii	5.0
Sept. 9, 6:30 AM ..	Off Kalapana, Hawaii	5.4
Nov. 16, 6:13 AM ..	S.E. flank of Mauna Loa ..	6.7
1984: Jun. 8, 5:34 PM ...	80 miles S. of Honolulu ..	5.3
1986: Apr. 26, 7:19 AM ..	28 miles N.E. of Maui	5.1
1987: Feb. 3, 4:22 PM ...	26 miles S. of Kahoolawe .	5.0
1988: March 24, 2:30 PM .	30 miles S. of Kahoolawe .	5.0
March 27, 5:33 PM .	30 miles S. of Kahoolawe .	5.5
June 7, 12:49 AM ..	S. flank of Kilauea	5.0
July 3, 7:38 PM ...	Near Pahala	5.3
July 22, 10:29 AM .	Near French Frigate Shoals	5.0
1989: June 25, 5:27 PM ..	Kalapana area	6.1
Dec. 27, 11:13 PM .	Kilauea East Rift Zone ...	5.1
1990: Aug. 8, 4:06 PM ...	Kilauea East Rift Zone ...	5.4

Source: Hawaii Institute of Geophysics, records; Hawaii Volcano Observatory Summaries; U.S. Geological Survey, National Earthquake Information Service. Data provided by Professor Augustine S. Furumoto, Hawaii Institute of Geophysics, University of Hawaii at Manoa, August 24, 1990.

Table 142.-- EARTHQUAKES WITH HONOLULU INTENSITIES OF V OR GREATER: 1859 TO 1990

[Complete to August 24, 1990]

Date	Epicentral location	Magnitude (Richter scale)	Honolulu average intensity (Modified Mercalli Scale <u>1/</u>)
1861: Dec. 5 ..	Molokai-Lanai vic. (?) .	(NA)	Mid V
Dec. 15 .	Molokai-Lanai vic. (?) .	(NA)	Lower V - mid V
1868: Apr. 2 ..	SE coast of Hawaii	7.5	Upper IV - lower V
Apr. 4 ..	Maui group vicinity (?)	(NA)	Lower V
1871: Feb. 19 .	S coast of Lanai	7.0	Upper VI - lower VII
1895: Dec. 8 ..	Oahu vicinity (?)	(NA)	Mid V
1926: Mar. 19 .	N of Kohala, Hawaii	(NA)	Upper IV - lower V
1929: Oct. 5 ..	W of Kona, Hawaii	6.5	Lower V
1938: Jan. 22 .	N of Maui	6.8	Upper V - lower VI
1948: June 28 .	S coast of Oahu	4.8	Mid VI
1964: Oct. 11 .	Ka Lae, Hawaii	5.5	Upper IV - lower V
1973: Apr. 26 .	Hamakua coast, Hawaii ..	6.2	Mid V
1981: Mar. 5 ..	Kalohi Channel	5.0	Mid V

NA Not available.

1/ Modified Mercalli Scale of 1931, 1956 abridged version further simplified. This scale, which extends from I to XII, reads in part:

IV. Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt. Standing autos rock. Windows, dishes, doors rattle. Crockery clashes. In the upper part of range wooden construction creaks.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors, shutters, pictures swing. Pendulum clocks stop.

VI. Felt by all. Many frightened, run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books thrown off shelves, pictures off walls. Furniture moved, overturned. Weak plaster and masonry cracked. Small bells ring. Trees, bushes noticeably shaken.

VII. Difficulty in standing. Noticed by drivers of autos. Hanging objects quiver. Furniture broken. Damage to weak masonry. Weak chimneys broken at roof line. Fall of plaster, loose bricks, etc. Some cracks in ordinary masonry. Waves on ponds. Small slides on sand and gravel banks. Large bells ring. Irrigation ditches damaged.

Source: Doak C. Cox, "Earthquake Experience in Honolulu," The Hawaiian Journal of History, Vol. 21 (1987), pp. 98-109, as updated by Augustine S. Furumoto, Hawaii Institute of Geophysics, University of Hawaii at Manoa, August 24, 1990.

Table 143.-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE:
1946 TO 1990

[Complete to August 24, 1990]

Date	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii (dollars)
	Meters	Feet		
1946: April 1	17.0	55.8	159	26,000,000
1952: Nov. 4	6.1	20.0	-	1,000,000
1957: March 9	16.0	52.5	-	5,000,000
1960: May 22	10.5	34.5	61	23,000,000
1964: March 27	4.8	15.7	-	67,590
1975: Nov. 29	14.6	48.0	2	1,500,000

Source: George Pararas-Carayannis, Catalog of Tsunamis in the Hawaiian Islands (U.S. Coast and Geodetic Survey, May 1969); Harold G. Loomis, The Tsunami of November 29, 1975 in Hawaii (Hawaii Institute of Geophysics, December 1975), pp. 1 and 10; D.C. Cox and J. Morgan, Local Tsunamis and Possible Local Tsunamis in Hawaii (Hawaii Institute of Geophysics, Report HIG 77-14, November 1977); Doak C. Cox, Tsunami Casualties and Mortality in Hawaii (University of Hawaii, Environmental Center, June 1987), p. 39; Hawaii Institute of Geophysics, records.

Table 144.-- MAJOR DAMS: 1990

Name	Location	Height (ft.)	Length (ft.)	Volume of water impounded (acre-ft.)
Wahiawa Dam ...	Wahiawa, Oahu	98	460	7,671
Waita	Koloa, Kauai	28	3,250	6,500
Kualapuu	Kualapuu, Molokai .	58	7,100	4,265
Alexander Dam .	Kalaheo, Kauai	119	600	2,500
Ho'omaluhia Dam	Luluku, Oahu	132	2,200	2,500
Nuuanu No. 4 ..	Honolulu, Oahu	73	1,730	1,420

Source: Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 145.-- WATER USE, BY TYPE, BY ISLANDS: 1985

[Million gallons per day]

Use	State total	Hawaii	Maui	Lanai	Molo-kai	Oahu	Kauai	Niihau
Total	1,405.14	165.80	471.96	2.99	12.76	401.56	349.53	0.54
Ground water	649.43	72.89	149.72	2.99	5.31	358.14	59.84	0.54
Domestic	182.81	15.71	14.09	0.41	1.32	140.53	10.48	0.27
Agricultural ..	333.35	0.30	135.04	2.58	3.99	144.62	46.55	0.27
Industrial	16.19	5.26	0.59	-	-	10.03	0.31	-
Thermoelectric	86.04	51.62	-	-	-	34.42	-	-
Commercial	31.04	-	-	-	-	28.54	2.50	-
Surface water ...	755.71	92.91	322.24	-	7.45	43.42	289.69	-
Domestic	16.96	9.00	7.56	-	0.07	-	0.33	-
Agricultural ..	567.86	46.12	310.26	-	7.38	43.42	160.68	-
Industrial	2.70	-	-	-	-	-	2.70	-
Thermoelectric	3.80	-	-	-	-	-	3.80	-
Hydroelectric .	164.39	37.79	4.42	-	-	-	122.18	-

Source: Data compiled by the U.S. Geological Survey and provided by the Hawaii State Department of Land and Natural Resources, Division of Water and Land Development.

Table 146.-- WATER SERVICES AND CONSUMPTION, FOR COUNTY WATERWORKS:
1985 TO 1989

Subject and geographic area	1985	1986	1987	1988	1989
NUMBER OF SERVICES, JUNE 30					
State total	188,271	192,261	197,188	201,253	205,442
City and County of Honolulu	130,884	132,775	135,418	137,323	139,144
Honolulu 1/	58,801	59,237	59,590	60,007	60,249
Rest of Oāhu	72,083	73,538	75,828	77,316	78,895
Hawaii County	25,315	26,031	26,939	27,832	28,775
Kauai County	11,872	12,360	12,799	13,274	13,788
Maui County	20,200	21,095	22,032	22,824	23,735
Maui	18,964	19,807	20,708	21,474	22,372
Molokai	1,236	1,288	1,324	1,350	1,363
CONSUMPTION 2/ (MILLION GALLONS)					
State total	65,298	61,432	63,186	66,361	68,543
City and County of Honolulu	48,308	44,125	44,839	47,379	49,135
Honolulu 1/	27,218	24,454	24,857	25,826	26,624
Rest of Oāhu	21,090	19,671	19,982	21,553	22,511
Hawaii County	5,666	6,039	6,503	6,575	6,620
Kauai County	3,531	3,667	3,472	3,787	3,974
Maui County	7,793	7,601	8,372	8,620	8,814
Maui	7,493	7,314	8,068	8,311	8,510
Molokai	300	287	304	309	304

1/ Maunaloa to Moanalua.

2/ Year ended June 30.

Source: Data compiled by Hawaii State Department of Business and Economic Development from Honolulu Board of Water Supply, Hawaii County Department of Water Supply, Kauai Department of Water, and Maui Department of Water Supply.

Table 147.-- POLLUTION ABATEMENT COSTS AND EXPENDITURES:
1986 AND 1988

[Millions of dollars. Statistics cover manufacturing establishments with 20 employees or more]

Subject	1986	1988
Total pollution abatement capital expenditures	1.8	7.9
Gross annual cost of pollution abatement	15.3	16.2
Payments to government units	0.7	0.5
Operating costs, total	14.6	15.7
Cost recovered through abatement activities	0.5	<u>1/</u> 0.8
Operating costs by form of pollutants abated:		
Air	3.8	4.8
Water	5.6	5.5
Solid waste, hazardous	1.1	1.3
Solid waste, non-hazardous	4.1	4.2
Operating costs by kind of cost:		
Depreciation	2.3	2.4
Labor	3.4	3.6
Materials and supplies	3.8	4.7
Services, equipment leasing, and other costs	5.1	4.9

1/ For water and solid waste pollution only.

Source: U.S. Bureau of the Census, "Pollution Abatement Costs and Expenditures, 1986," Current Industrial Reports, MA-200 (86)-1 (April 1989), pp. 20, 37, and 53, and "Manufacturers' Pollution Abatement Capital Expenditures and Operating Costs, Final Report for 1988," Current Industrial Reports, MA 200 (88)-1 (September 1990), pp. 14, 31, and 48.

Table 148.-- WATER QUALITY AT PUBLIC BEACHES: 1989

Island and beach	Number of samples	Enterococci density $\bar{1}$ / (geometric mean, number/100 ml)
Hawaii (Hilo Shoreline Area):		
Coconut Island	1	5.0
Exit of Ice Pond	10	6.4
Hilo Bay (boat landing)	3	.7
Hilo Bay (lighthouse)	3	5.2
Hilo Bay (Mooheau Park)	3	3.4
Hilo Bay (offshore)	19	2.0
Honolii Cove (ocean)	1	48.5
Kolekole Gulch (stream)	3	138.9
Leleiwi Beach Park	10	11.5
Onekahakaha Beach (swimming area)	10	5.3
Puhi Bay #3	10	2.5
Richardson Ocean Center	10	8.4
Hawaii (Kona Shoreline Area):		
Banyan's Surfing Area	6	1.9
Hapuna Beach	12	1.5
Kahaluu Beach	12	1.0
Kailua Pier Station A	6	1.0
Kailua Pier Station B	6	1.3
Kailua Pier Station C	6	1.2
Kealakekua Bay (off canoe landing)	12	1.1
Kealakekua Bay (off curio stand) .	12	1.5
Magic Sands Beach	12	1.0
Puako Beach Lots (far end of lot)	12	4.7
Puako Beach Lots (middle of lot) .	12	2.2
Spencer Beach Park	12	6.5
Maui:		
Fleming (Kapalua) Beach	3	1.1
Hale Onoloa condominium shore	4	1.6
Hana Bay	2	4.2
Honomanu Bay	2	6.5
Hukilau Hotel shoreline	8	1.1
Kaa shoreline	4	.9
Kahului Bay	4	.7
Lahaina outfall	1	.7
Lahaina Small Boat Harbor	3	13.0
Maalaea Small Boat Harbor	2	1.4
Mahinahina condominium shorline ..	4	.8
Makena Beach	4	.7
Mala Wharf	2	42.5

Continued on next page.

Table 148.-- WATER QUALITY AT PUBLIC BEACHES: 1989 -- Con.

Island and beach	Number of samples	Enterococci density 1/ (geometric mean, number/100 ml)
Maui--con.:		
Olowalu shore front	2	5.9
Paia outfall	4	1.7
Seven Pools	2	16.7
Sheraton Kaanapali shoreline	5	0.8
Waiehu Stream mouth	4	3.8
Waihee farm shoreline	3	1.1
Wailuku Breakwater	3	2.3
Lanai:		
Hulopoe Bay	2	6.5
Manele Small Boat Harbor	2	52.1
Molokai:		
Kalaeloa Harbor	2	6.3
Kaunakakai Harbor	2	26.4
Oahu:		
Ala Moana Bridge	38	119.7
Ala Moana Park (center)	12	1.8
Ala Moana Park (diamond head end)	24	2.8
Ala Moana Park (ewa end)	30	1.4
Elk's Club Beach	11	1.1
Ewa Beach Park	21	1.8
Ft. DeRussy Beach	9	1.7
Gray's Beach	28	2.1
Hanauma Bay	29	8.3
Heeia Kea Small Boat Harbor	16	1.8
Kaelepulu Stream	26	13.7
Kahala Beach	1	16.8
Kahana Beach Park	10	7.8
Kahanamoku Beach	22	3.9
Kahanamoku Lagoon (diamond head)	28	3.3
Kaiaka Bay	13	5.1
Kailua Bay Outfall (shoreline)	20	0.8
Kailua Beach Park	26	4.2
Kalama Beach	27	2.6
Kaneohe Bay (central region)	2	.5
Kaneohe Bay (northern region)	2	.5
Kaneohe Bay (southern region).....	3	8.1
Kawela Bay	13	5.1
Kewalo Basin	1	1.2

Continued on next page.

Table 148.-- WATER QUALITY AT PUBLIC BEACHES: 1989 -- Con.

Island and beach	Number of samples	Enterococci density 1/ (geometric mean, number/100 ml)
Oahu--con.:		
Kokokahi Pier	18	17.1
Kuhio Beach	22	4.9
Mamala Bay (Sand Island offshore)	9	0.6
McCully Street Bridge	27	105.2
Oneawa Beach	26	2.6
Public Bath Beach	25	1.6
Sand Island Point #1	1	1.6
Sand Island Point #2	13	2.6
Sand Island Point #3	22	1.8
Sand Island Point #4	1	3.2
Tavern Beach	9	1.1
Waimanalo Bay	25	2.3
Waimanalo Beach	27	1.7
Waimanalo Surfers' Beach	17	1.2
Kauai:		
Anahola Bay Pavilion	4	20.2
Anini Park Pavilion	4	6.0
Brennecke Beach	5	1.9
Hanalei Bay landing	1	3.5
Hanalei Bay Pavilion	3	4.4
Hanamaulu Beach (middle)	5	62.7
Hanapepe Salt Pond	5	1.9
Kalapaki Beach (middle)	5	21.8
Kapaa Pavilion	4	1.9
Kealia Beach	4	.9
Kekaha (Oomano Point)	5	.8
Poipu Beach Pavilion	5	2.2
Port Allen Pier	3	.7
Wailua Beach (north end)	4	4.7
Wailua River	4	150.3
Waimea Bay	3	4.9
Waimea Bay Beach (near river)	1	.7
West of Lydgate Park wading pool .	4	3.3

1/ The geometric mean standard for Enterococci density is 7 per 100 ml. The Water Quality Standards for the State of Hawaii have recently been revised. Enterococci density is now considered to be a better indicator of water quality than Fecal Coliform density used in earlier tables.

Source: Hawaii State Department of Health, Clean Water Branch, data supplied April 26, 1990.

Table 149.-- REFUSE AND SEWAGE STATISTICS FOR OAHU: 1980 TO 1989

[Fiscal years]

Year	Tons of refuse delivered <u>1/</u>			Sewage treated <u>2/</u> (millions of gallons)
	Total	City and County refuse vehicles	Other vehicles	
1980	686,438	221,774	464,664	36,885
1981	708,164	258,600	449,634	35,945
1982	669,120	244,826	424,294	34,830
1983	645,889	244,812	401,077	37,395
1984	707,473	235,767	471,706	38,283
1985	655,790	216,685	439,105	37,817
1986	729,611	252,081	477,530	37,608
1987	724,448	254,699	469,749	38,199
1988	847,873	262,477	585,396	39,757
1989	778,673	302,851	475,822	39,918

Year	Sewage pumped <u>2/</u> (millions of gallons)	Miles of sewers <u>2/</u>	City and County pump stations	City and County treatment plants
1980	45,165	1,592	47	19
1981	43,744	1,623	48	19
1982	44,687	1,646	50	21
1983	48,442	1,670	52	20
1984	48,320	1,691	51	18
1985	49,361	1,711	51	17
1986	48,559	1,736	55	17
1987	49,542	1,752	57	17
1988	51,713	1,769	59	17
1989	50,369	1,805	59	14

1/ Excludes small landfill controlled by armed forces. Palailai landfill closed in 1988. Data for 1989 exclude refuse delivered to other private landfills.

2/ Data limited to system maintained by the City and County of Honolulu Public Works Department.

Source: City and County of Honolulu, Departmental and Agency Reports (annual), and City Refuse Division, records.

Table 150.-- HAZARDOUS WASTE SITES ON THE NATIONAL
PRIORITY LIST: 1989

Category	Number	Rank <u>1/</u>
All sites	7	42
Non-Federal sites	6	42
Federal sites	1	25

1/ Among the 50 States (ranks are the same if the District of Columbia is included). The national total was 1,219 sites.

Source: EPA data cited in Statistical Abstract of the United States: 1990, p. 205.

Table 151.-- LITTER ALONG OAHU HIGHWAYS: 1979 TO 1988

Measure	1979	1981	1985	1988
Visible litter items per mile	1,381	1,672	1,038	892
Visible beer/soft drink containers per mile	144	80	49	26
Indiscriminate dumps per 1,000 miles of driving	8.2	15.7	19.6	14.1
Abandoned vehicles per 1,000 miles of driving	4.9	23.6	57.4	6.8

Source: Daniel B. Syrek, Hawaii Litter: 1988 (Sacramento: The Institute for Applied Research, for the Hawaii State Department of Health, Litter Control Office, May 13, 1988).

Table 152.-- AIR QUALITY IN DOWNTOWN HONOLULU:
1979 TO 1989

[Annual arithmetic means, in micrograms per cubic meter, for total suspended particulates and sulfur oxides. Sampling is conducted about 46 feet above ground on the roof of the State Health Department building, 1250 Punchbowl Street, Honolulu, Hawaii]

Year	Particulates	Sulfur oxides	Year	Particulates	Sulfur oxides
1979	32	22	1987	26	<5
1980	37	18	1988	26	<5
1981	40	19	1989	30	<5
1982	29	11	Standards: <u>1/</u> Primary ... Secondary .	75	80
1983	26	<5			
1984	25	<5			
1985	24	<5			
1986	25	<5			
				60	...

1/ Primary and secondary national ambient air quality standards have been promulgated by the Federal government. Primary standards are designed to prevent adverse effects on public health, while secondary standards are designed to prevent adverse effects on public welfare, including the effects on comfort, visibility, vegetation, animals, aesthetic values, and soiling and deterioration of materials.

Source: Hawaii State Department of Health, Clean Air Branch, data supplied April 26, 1990.

Table 153.-- AIR QUALITY AT SPECIFIED LOCATIONS: 1989

[24-hour sampling, in micrograms per cubic meter]

Sampling station	Total suspended particulates			Sulfur dioxide		
	Annual range		Arith- metic average	Annual range		Arith- metic average
	Minimum	Maximum		Minimum	Maximum	
Oahu:						
Barbers Point <u>1/</u>	10	44	26	<5	20	<5
Downtown Honolulu	16	48	30	<5	8	<5
Liliha	23	60	32	...	...	...
Pearl City <u>1/</u>	8	21	15	...	...	...
Waimanalo <u>2/</u>	15	57	25	...	...	...
Maui:						
Kihei <u>1/</u> , <u>3/</u>	9	38	22	<5	<5	<5
Lahaina <u>1/</u> , <u>4/</u> ...	6	25	14	...	...	...
Kauai:						
Lihue <u>1/</u>	8	34	17	...	...	...

1/ Particulate data from PM₁₀ samplers (measuring inhalable particulates of less than 10 micrograms).

2/ Six months of data.

3/ Eight months of data.

4/ Nine months of data.

Source: Hawaii State Department of Health, Clean Air Branch, data supplied April 26, 1990.

Table 154.-- ATMOSPHERIC CARBON DIOXIDE MEASUREMENTS AT MAUNA LOA:
ANNUAL MEAN VALUES, 1958 TO 1989

[Parts per million]

Year	Annual average	Year	Annual average	Year	Annual average
1958 ...	<u>1/</u> 315.17	1969 ...	323.93	1980 ...	338.72
1959 ...	315.83	1970 ...	325.27	1981 ...	340.12
1960 ...	316.75	1971 ...	326.17	1982 ...	341.21
1961 ...	317.49	1972 ...	327.26	1983 ...	342.87
1962 ...	318.30	1973 ...	329.45	1984 ...	344.48
1963 ...	318.83	1974 ...	<u>1/</u> 329.72	1985 ...	345.85
1964 ...	<u>2/</u> 319.04	1975 ...	<u>3/</u> 331.14	1986 ...	347.21
1965 ...	319.87	1976 ...	332.04	1987 ...	348.98
1966 ...	321.21	1977 ...	333.79	1988 ...	351.34
1967 ...	322.02	1978 ...	335.35	1989 ...	352.75
1968 ...	322.83	1979 ...	336.73		

1/ Based on data for 8 months.

2/ Based on data for 9 months.

3/ Based on data for 11 months.

Source: National Oceanic and Atmospheric Administration, Geophysical Monitoring for Climatic Change, records; provided by Saul Price, National Weather Service, Pacific Region, Honolulu.

Table 155.-- SOURCES OF AIR POLLUTANT EMISSIONS, BY COUNTIES: 1980

[Percent distributions for the sums of weights of sulfur oxides, particulate matter, carbon monoxide, hydrocarbons, and nitrogen oxide emissions]

Source	State total	Hawaii	Honolulu	Kauai	Maui
All sources	100.0	100.0	100.0	100.0	100.0
Transportation	43.0	38.1	47.4	40.6	35.8
Motor vehicles	40.1	36.2	43.9	35.7	33.1
Aircraft	2.3	1.1	2.9	2.3	1.6
Vessels	0.6	0.8	0.6	2.6	1.1
Fuel combustion in					
stationary sources	29.7	34.9	26.7	32.2	35.3
Steam electric	23.1	19.8	24.6	18.5	22.4
Gas utilities	0.1	(N)	0.1	(N)	(N)
Agricultural fuel	6.5	15.1	2.0	13.7	12.9
Industrial process losses ..	14.6	7.7	20.3	3.2	3.5
Refinery	4.8	(N)	6.5	(N)	(N)
Petroleum storage	0.7	1.1	0.8	(N)	0.5
Metalurgical	0.1	(N)	0.1	(N)	(N)
Mineral products	6.9	3.9	10.8	0.9	1.1
Off-highway const., farms and industries	2.1	2.7	2.1	2.3	1.9
Municipal incinerator	0.9	(N)	1.3	(N)	(N)
Agricultural burning	11.7	19.3	4.3	24.2	25.4

N Less than 0.05 percent.

Source: Hawaii State Department of Health, Environmental Permits Branch, information provided May 10, 1989.

Table 156.-- NOISE LEVELS DURING DAYLIGHT HOURS IN SPECIFIED NEIGHBORHOODS
ON OAHU: 1981-1982

[Noise levels, in decibels, exceeded 10, 50, and 90 percent of the time]

Neighborhood	Manual sampling			Automatic sampling		
	10	50	90	10	50	90
Aina Haina	45.6	42.1	39.5	53.5	46.2	43.2
Aina Koa	48.1	43.1	40.1	52.9	45.8	42.5
Downtown	57	55	54	60	57	55
Hawaii Kai	46.5	41.6	38.9	53.5	46.9	42.9
Kahala	48.0	44.5	42.4	-	-	-
Kaimuki	51.8	44.6	41.7	57.2	47.6	43.3
Kalihi	53.5	49.6	47.4	-	-	-
Kapahulu	47.2	45.0	42.0	-	-	-
Kapalama-Liliha	46.4	45.1	42.5	-	-	-
Kuliouou	48.6	45.9	43.4	52.5	47.9	45.4
Liliha	46	45	43	-	-	-
Makiki	52.7	46.9	45.3	56.5	50.5	48.6
Manoa	45.4	42.6	40.7	51.5	46.0	43.4
Moiliili	53.7	50.2	46.9	60.0	53.4	48.9
Nuuanu	46.6	43.6	40.8	-	-	-
Palolo	49.3	44.6	41.6	65.0	52.4	45.4
Pawaa	59.8	57.1	55.2	60.8	57.1	54.7
Salt Lake	56	52	49	-	56	51
Waikiki	57.8	55.4	54.1	61.6	57.5	55.3
Waialae Iki ...	46.4	43.1	40.6	54.6	44.8	41.7
Aiea	58	54	52	59	56	54
Halawa	52	46	44	55	50	47
Hauula	53	48	45	56	51	47
Kailua	49.2	45.5	42.9	54.9	49.6	45.2
Kaneohe	43.8	40.9	38.9	49.7	43.5	40.9
Mililani	44	37	34	53	46	41
Nanakuli	54	50	47	58	52	48
Pearl City	51	47	45	55	50	48
Wahiawa	47.1	44.7	42.4	51.8	47.3	43.9
Waimanalo	53	50	48	55	51	49
Waipahu	54.1	50.5	47.4	58.8	53.6	50.4

Source: Hawaii State Department of Health, Environmental Protection and Health Services Division, Noise and Radiation Branch, records.

Table 157.-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES

Island and station	Ground elevation (feet)	Average temperature (°F.)		Extreme temperature of record (°F.)		Average annual precipitation (inches)
		Coolest month	Warmest month	Lowest	Highest	
Hawaii:						
Hilo Airport	30	71.2	75.9	53	94	128
Hawaii Volcanoes Nat. Park Hdq. .	3,970	57.6	63.2	37	85	101
Naalehu	675	70.2	75.2	55	90	47
Kailua	30	72.1	77.3	54	93	25
Puako 1/	5	73.1	79.8	52	98	10
Waimea (Kamuela)	2,670	61.3	66.8	34	90	31
Honokaa	1,070	67.6	75.5	(NA)	(NA)	86
Mauna Kea summit 2/	13,796	31.3	42.5	11	66	20
Maui:						
Hana	120	71.3	76.8	50	90	69
Haleakala summit	10,025	42.6	50.0	14	73	44
Kihei 3/	85	70.9	78.4	49	98	13
Kahului Airport	40	71.5	79.2	48	96	20
Lahaina	45	71.5	78.0	52	93	15
Molokai:						
Kaunakakai	10	(NA)	(NA)	(NA)	(NA)	14
Molokai Airport	450	70.2	77.6	48	90	27
Lanai:						
Lanai City	1,620	65.8	72.8	46	88	37
Oahu:						
Honolulu International Airport ..	10	72.6	81.0	53	94	23
Waikiki (Honolulu Zoo)	10	71.9	80.6	51	93	25
Manoa (Lyon Arboretum)	500	69.4	75.2	(NA)	(NA)	158
Kaneohe MCAS	10	72.9	79.1	58	90	40

Continued on next page.

Table 157.-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES -- Con.

Island and station	Ground elevation (feet)	Average temperature (°F.)		Extreme temperature of record (°F.)		Average annual precipitation (inches)
		Coolest month	Warmest month	Lowest	Highest	
Oahu (con.):						
Kahuku	25	71.6	78.8	49	95	40
Wheeler AFB	845	68.2	75.5	52	89	40
Waianae	10	72.1	79.7	45	96	20
Kauai:						
Kilauea (town)	315	68.7	75.6	49	94	68
Lihue Airport	100	71.3	79.1	50	90	44
Poipu (Makahuena Pt.)	50	72.4	79.4	50	93	35
Kokee (Kanalohuluhulu)	3,600	54.9	65.5	31	83	70
Waialeale	5,075	(NA)	(NA)	(NA)	(NA)	444
Northwestern Hawaiian Islands:						
Midway	10	65.0	78.6	52	89	44

NA Not available.

1/ Temperature data are for Mahukona.

2/ Based on incomplete and non-continuous data for 1966-1972. Precipitation estimated.

3/ Temperature data refer to Puunene Airport.

Source: Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data supplied September 25, 1990.

Table 158.-- CLIMATIC NORMALS, MEANS, AND EXTREMES FOR HILO, KAHULUI, HONOLULU, AND LIHUE AIRPORTS

Subject	Hilo	Kahului	Honolulu	Lihue
Normal temperatures (°F.):				
Daily maximum	81.2	83.8	84.2	81.1
Daily minimum	65.9	67.2	69.7	69.3
Monthly: Coolest month	71.2	71.5	72.6	71.3
Warmest month	75.9	79.2	81.0	79.1
Annual	73.6	75.5	77.0	75.2
Extreme temperatures (°F.):				
Record highest	94	96	94	90
Record lowest	53	48	53	50
Normal degree days, base 65°F.:				
Heating	-	-	-	-
Cooling	3,134	3,851	4,389	3,758
Precipitation (inches):				
Normal	128.15	19.85	23.47	44.02
Maximum monthly	50.82	14.46	20.79	22.91
Minimum monthly	0.28	0.00	T	T
Relative humidity (percent):				
8 A.M.	80	75	72	78
2 P.M.	68	58	56	66
Wind speed (m.p.h.):				
Mean	7.2	12.8	11.4	12.1
Fastest observation, 1 minute <u>1</u> /	35	44	46	65
Percent of possible sunshine	41	67	68	56
Mean number of days:				
Clear	35.9	131.8	88.0	54.2
Partly cloudy	129.7	143.0	180.5	181.7
Cloudy	199.7	90.4	96.7	129.4
Precipitation .01 inch or more .	278.1	98.2	99.0	201.0

T Trace amount.

1/ Kahului figure refers to fastest mile.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary with Comparative Data, 1989 for Hilo, Kahului, Honolulu, and Lihue.

Table 159.-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT

Month	Normal temperature (°F)			Extreme temperature (°F)		Precipitation (inches)			
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum monthly	Minimum monthly	Maximum in 24 hours
January ...	79.9	65.3	72.6	87	53	3.79	14.74	0.18	6.72
February ..	80.4	65.3	72.9	88	53	2.72	13.68	0.06	6.88
March	81.4	67.3	74.4	88	55	3.48	20.79	0.01	17.07
April	82.7	68.7	75.7	89	57	1.49	8.92	0.01	4.21
May	84.8	70.2	77.5	93	60	1.21	7.23	0.05	3.44
June	86.2	71.9	79.1	92	65	0.49	2.46	T	2.28
July	87.1	73.1	80.1	92	67	0.54	2.33	0.03	2.20
August	88.3	73.6	81.0	93	67	0.60	3.08	T	2.35
September .	88.2	72.9	80.6	94	66	0.62	2.74	0.05	1.40
October ...	86.7	72.2	79.5	94	64	1.88	11.15	0.11	7.57
November ..	83.9	69.2	76.6	93	58	3.22	14.72	0.03	9.15
December ..	81.4	66.5	74.0	89	54	3.43	17.29	0.06	8.25
Annual	84.2	69.7	77.0	94	53	23.47	20.79	T	17.07

Continued on next page.

Table 159.-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT -- Con.

Month	Relative humidity (percent)		Wind (miles/hour)		Percent of possible sunshine	Mean sky cover, sunrise to sunset <u>2/</u>	Mean number of days		
	8 A.M.	2 P.M.	Mean speed	Fastest obs. <u>1/</u>			Sunrise to sunset		Precip. .01 inch or more
							Clear	Cloudy	
Jan. ...	81	62	9.6	32	63	5.4	9.4	8.6	9.8
Feb. ...	79	59	10.3	30	65	5.6	7.9	7.9	9.3
Mar. ...	73	57	11.4	30	70	5.8	7.2	9.4	8.9
Apr. ...	70	56	12.0	31	67	6.2	5.3	10.5	9.1
May	67	54	11.9	30	69	6.0	6.3	9.5	7.3
June ...	66	52	12.7	26	71	5.6	5.9	6.7	5.8
July ...	67	51	13.3	28	74	5.3	7.5	5.3	7.4
Aug	68	53	12.9	28	75	5.3	7.9	6.2	6.4
Sept. ...	68	52	11.4	26	76	5.2	7.8	5.9	7.0
Oct. ...	70	55	10.6	25	68	5.7	7.3	8.4	8.8
Nov. ...	75	58	10.8	46	61	5.7	7.0	9.2	9.2
Dec. ...	79	61	10.4	30	59	5.5	8.5	9.1	10.1
Ann. ...	72	56	11.4	46	68	5.6	88.0	96.7	99.0

T Trace amount.

1/ Fastest observation, 1 minute, during 8-year period of record.

2/ Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, Honolulu, 1989.

Table 160.-- CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT: ANNUALLY,
1979 TO 1989

Year	Average temperature (°F)			Extreme temp. (°F)		Precipitation (inches)
	Annual	Coolest month	Warmest month	Lowest	Highest	
1979 ...	77.0	69.9	81.1	57	93	16.93
1980 ...	77.5	71.9	81.6	56	91	26.90
1981 ...	77.1	73.2	80.7	53	90	13.41
1982 ...	76.9	71.7	81.4	56	92	34.92
1983 ...	77.2	71.3	82.4	53	92	5.03
1984 ...	78.1	74.1	81.7	57	94	17.08
1985 ...	76.9	71.4	81.9	54	93	17.38
1986 ...	78.3	72.6	82.9	56	94	13.93
1987 ...	77.9	71.2	82.9	55	94	23.53
1988 ...	78.5	73.1	82.1	57	94	16.47
1989 ...	77.5	72.9	81.9	56	92	27.52
Year	Relative humidity (percent)		Wind speed (miles/hour)		Percent of possible sunshine	Days with precipitation .01 inch or more
	8 A.M.	2 P.M.	Annual average	Peak gust <u>1/</u>		
1979 ...	74	57	11.4	34	68	89
1980 ...	75	59	11.9	35	69	115
1981 ...	76	59	10.7	30	72	97
1982 ...	73	59	10.4	46	56	124
1983 ...	75	52	9.8	23	64	78
1984 ...	72	53	10.2	40	71	81
1985 ...	72	55	10.6	46	69	87
1986 ...	74	55	10.1	41	77	88
1987 ...	70	54	9.9	41	73	99
1988 ...	71	53	9.8	39	75	88
1989 ...	72	55	10.5	41	79	82

1/ Before 1984, figures refer to fastest mile.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii (annual).

Table 161.-- CLIMATIC DATA FOR THE PERIOD OF RECORD

Subject	Date	Place	Magnitude
Long-term averages:			
Lowest monthly average minimum temp. (°F.) ..	February	Mauna Kea summit ..	23.5
Lowest monthly average daily temp. (°F.)	February	Mauna Kea summit ..	31.3
Highest monthly average maximum temp. (°F.) ..	September	Kawaihae 1/	91.9
Highest monthly average daily temp. (°F.) ...	September	Kawaihae 1̄/	80.8
Lowest average annual rainfall (inches) .....	.....	Kawaihae	8.7
Highest average annual rainfall (inches) .....	.....	Waialeale	444
Single events:			
Lowest temperature of record (°F.)	Jan. 20, 1970 ...	Mauna Kea summit 2/	1.4
Highest temperature of record (°F.)	April 27, 1931 ..	Pahala	100
Lowest annual rainfall of record (inches) ...	1953	Kawaihae	0.2
Highest annual rainfall of record (inches) ..	1982	Waialeale	666
Highest wind speed of record (m.p.h.)	Nov. 23, 1982 ...	Makahuena Pt. 3/ ..	117

1/ Puukohola Heiau National Historical Site, Kawaihae, Hawaii.

2/ Recorded by Dr. Alfred Woodcock 60 meters inside the Mauna Kea summit cone, at 6:50 a.m. The rim at that time had a temperature of 39° F.

3/ Makahuena Point Coast Guard Station, Poipu, Kauai.

Source: Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data supplied September 25, 1990.

Table 162.-- RAINFALL AT SPECIFIED LOCATIONS: ANNUALLY,
1979 TO 1989

[In inches]

Year	Hawaii			Maui		
	Hilo Airport	Wai-me <u>a</u> 1/	Kona Village	Kahului Airport	Kihei	Lahaina
1979 ...	158.77	29.23	16.00	26.82	21.32	20.85
1980 ...	127.74	28.31	16.90	27.87	20.27	22.69
1981 ...	89.91	13.30	7.02	12.85	9.72	8.13
1982 ...	170.36	56.29	26.88	34.04	29.11	34.36
1983 ...	68.09	12.95	8.51	13.05	8.60	9.70
1984 ...	100.08	8.87	8.15	8.56	5.64	6.30
1985 ...	112.96	16.58	8.60	20.00	13.86	13.48
1986 ...	171.03	34.67	12.41	18.39	7.25	7.38
1987 ...	142.41	19.43	10.24	24.31	14.03	19.72
1988 ...	140.19	12.52	11.70	26.79	17.03	14.91
1989 ...	166.71	(NA)	13.32	40.63	27.00	26.95
Year	Oahu			Kauai		
	Waikiki	Univ. of Hawaii	Nuuanu Res. 4	Koloa	Lihue Airport	Princeville
1979 ...	26.22	46.74	111.56	55.98	37.09	93.19
1980 ...	28.50	48.52	140.70	78.78	54.64	130.55
1981 ...	19.09	31.71	112.46	66.26	38.14	130.72
1982 ...	39.96	57.98	168.16	96.75	74.40	241.22
1983 ...	9.80	19.77	74.32	50.69	16.40	46.93
1984 ...	19.35	33.13	71.32	48.82	30.12	71.58
1985 ...	25.61	42.19	101.20	48.70	28.91	55.22
1986 ...	22.39	32.39	120.60	64.64	27.99	90.28
1987 ...	27.56	46.52	134.29	72.53	42.95	94.61
1988 ...	24.50	(NA)	124.42	63.23	43.06	77.10
1989 ...	(NA)	39.53	129.50	87.81	56.77	116.65

NA Not available.

1/ Lalamilo Field Office.

Source: U.S. Department of Commerce, National Climatic Data Center, Climatological Data, Annual Summary, Hawaii and Pacific (annual); and Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 163.-- MAJOR HURRICANES: 1950 TO 1990

[Complete to September 26, 1990]

Hurricane name	Date ^{1/}	Islands most affected	Maximum winds ashore (m.p.h.)		Deaths	Property damage (mil. dol.)
			Sustained	Gusts		
Hiki	Aug. 15-17, 1950	Kauai	68	(NA)	1	0.2
Della	Sept. 4, 1957	French Frig. Shoals	82	109	-	Minor
Nina	Dec. 1-2, 1957	Kauai	(NA)	92	1	0.1
Dot	Aug. 6, 1959	Kauai	81	103	-	5.5+
Fico	July 18-20, 1978	Hawaii	(NA)	58+	-	0.2
Iwa	Nov. 24, 1982	Kauai, Oahu	65	117	1	234.0
Estelle ...	July 22, 1986	Maui, Hawaii	(NA)	55	-	2.0

NA Not available.

^{1/} Period affecting the Hawaiian Islands.

Source: Samuel L. Shaw, A History of Tropical Cyclones in the Central North Pacific and the Hawaiian Islands, 1832-1979 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, September 1981); Hawaii State Department of Defense, Civil Defense Division, Catalogue of Natural and Man-Caused Incidents and Disasters in the Hawaiian Islands (December 1978); The Governor's Ad Hoc Committee on the Economic Impact of Hurricane Iwa, Hurricane Iwa's Economic Impact on Hawaii (January 1983); "The History of Hurricanes in Hawaii," Honolulu Star-Bulletin, July 18, 1983, p. A-5; "20-Foot Waves Hit Big Isle As Storm Brushes Coastline," Honolulu Advertiser, July 23, 1986, pp. A-1, A-2; "Hawaii Hurricanes," Honolulu Star-Bulletin, August 4, 1988, p. A-8; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data provided September 25, 1990.

Table 164.-- TRADE WINDS, HIGH SURF, AND TEMPERATURES IN HAWAIIAN WATERS,
BY MONTHS

Month	Trade wind frequency <u>1/</u> (percent)	Expected days of strong trade winds <u>2/</u>	Highest surf <u>3/</u> (average number of days)		Water temperature <u>4/</u> (OF.)	
			Flat or 1 foot	6 feet or more	Mean maximum	Mean minimum
Jan. ...	42	9	1	19	74.7	71.1
Feb. ...	55	7	1	16	75.6	70.3
March ..	61	10	1	12	76.5	71.8
April ..	74	10	3	7	77.7	73.0
May	86	7	8	3	79.5	74.7
June ...	91	7	15	-	81.1	77.7
July ...	95	10	16	-	81.1	78.3
Aug. ...	94	7	15	-	81.9	79.2
Sept. ..	83	4	10	2	81.9	78.4
Oct. ...	71	4	1	12	81.1	77.2
Nov. ...	64	8	-	19	79.3	74.5
Dec. ...	57	9	-	20	75.9	71.4
Ann. ...	73	92	71	110	78.6	74.8

1/ Mean monthly frequency of trade winds in Hawaiian waters.

2/ Expected number of hazardous days in Hawaiian waters due to strong trade winds.

3/ Observations at Sunset Beach, Oahu. Annual averages were: flat or 1 foot, 71 days; 2-5 feet, 184 days; 6-10 feet, 71 days; 11-15 feet, 26 days; 16 feet or higher, 13 days.

4/ Observations at Kaneohe, Oahu. The mean ranged from 73.0 in January and February to 80.2 in August. Absolute maximums and minimums were respectively 84 (in July, August, and October) and 68 (December and February).

Source: Paul Haraguchi, Weather in Hawaiian Waters (Honolulu: Pacific Weather, Inc., 1979), pages 14, 22, 56, and 74; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data provided September 25, 1990.

Table 165.-- AVERAGE WATER TEMPERATURES AT WAIKIKI BEACH

[In Fahrenheit degrees]

Month	Morning	Afternoon
March	75	77
August	77	82

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii, 1983.

Table 166.-- SUNRISE, SUNSET, AND HOURS OF DAYLIGHT AT SELECTED LOCATIONS, AT BEGINNING OF EACH SEASON

[Hawaiian Standard Time]

Subject	Hilo	Kahului	Honolulu	Lihue	Barking Sands
Sunrise (A.M.):					
March 21	6:24	6:29	6:35	6:41	6:42
June 21	5:42	5:45	5:50	5:55	5:56
Sept. 23	6:09	6:15	6:21	6:26	6:28
Dec. 22	6:51	6:58	7:05	7:12	7:14
Sunset (P.M.):					
March 21	6:32	6:37	6:43	6:49	6:51
June 21	7:02	7:10	7:16	7:23	7:25
Sept. 23	6:16	6:21	6:27	6:33	6:35
Dec. 22	5:47	5:50	5:55	6:00	6:01
Hours of daylight:					
March 21	12:08	12:08	12:08	12:08	12:09
June 21	13:20	13:25	13:26	13:28	13:29
Sept. 23	12:07	12:06	12:06	12:07	12:07
Dec. 22	10:56	10:52	10:50	10:48	10:47

Source: Nautical Almanac Office, U.S. Naval Observatory, Tables of Sunrise and Sunset, No. 1083 and 1084, and records. Data provided by Saul Price, Staff Meteorologist, National Weather Service, Pacific Region.

Table 167.-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF THE
HONOLULU AREA: 1986 TO 1989

[Counts are made in late December, in a circle, 15 miles
in diameter, centered near Nuuanu Pali]

Species <u>1/</u>	1986	1987	1988	1989
All species:				
Species	50	50	48	48
Individual birds ..	28,690	29,009	29,909	25,405
Endemic species:				
'Apapane	85	79	173	21
Hawaiian Coot	23	10	38	34
Hawaiian Stilt	103	149	135	149
Oahu 'Amakihi	110	155	108	107
Indigenous species:				
Great Frigatebird	6	15	24	62
Red-footed Booby	402	785	748	1,359
Introduced species:				
Cattle Egret	988	1,009	789	289
Common Myna	5,420	5,752	5,417	2,756
House Sparrow	2,633	2,156	1,426	1,642
Japanese White-eye	1,078	1,455	1,024	1,061
Red-vented Bulbul	2,023	2,361	2,256	2,196
Spotted Dove	2,533	2,398	2,284	1,972
Zebra (Barred) Dove	7,860	5,830	8,739	7,047
Migratory species:				
Lesser Golden-Plover ...	1,482	1,673	2,046	1,601
Ruddy Turnstone	317	272	373	230

1/ Separate data are shown for endemic birds averaging more than 25 individuals in 1975-1979, indigenous birds more than 200, introduced birds more than 500, and migratory species and stragglers more than 100. Endemic birds are those peculiar to a particular region, in this case Hawaii, and therefore found nowhere else in the world; indigenous birds are those native to a given region, in this case Hawaii, but with a total range of distribution encompassing a much wider area. The classification is that in Andrew J. Berger, Hawaiian Birdlife (1972).

Source: Hawaii Audubon Society, 'Elepaio (monthly).

Table 168.-- HAWAII AUDUBON SOCIETY BIRD COUNT OF THE HONOLULU AREA, BY TYPE OF SPECIES: DECEMBER 17, 1989

Type of species <u>1/</u>	Number of species	Number of individuals
All species	48	25,405
Endemic	7	321
Indigenous	8	1,542
Introduced	27	21,605
Migratory	6	1,937

1/ For definitions, see preceding table, footnote 1.
Source: Hawaii Audubon Society, records.

Table 169.-- TREES ALONG STREETS OR IN PARKS UNDER THE JURISDICTION OF THE CITY AND COUNTY OF HONOLULU: 1985 TO 1989

[As of June 30]

Location	1985	1986	1987	1988	1989
Along City and County streets and highways <u>1/</u> ...	118,437	120,029	121,100	122,253	123,533
In City and County parks	96,727	96,896	97,101	97,434	97,672

1/ Excludes Federal, State, and private thoroughfares.
Source: City and County of Honolulu, Department of Parks and Recreation, records.

Table 170.-- THREATENED, ENDANGERED, AND EXTINCT SPECIES OF NATIVE FAUNA AND FLORA: JANUARY 1989

Type of fauna or flora	Native species	Candidate <u>1/</u>	Threatened <u>1/</u>	Endangered <u>1/</u>	Extinct <u>2/</u>
Land mammals	1	-	-	1	-
Marine mammals	18	-	-	8	-
Reptiles and amphibians ..	5	-	3	2	-
Birds	87	-	1	29	23
Freshwater fish	6	1	-	-	-
Invertebrates	(3/)	150	-	1	4/ 88
Plants	2,734	787	-	19	4/ 100

1/ Categories of the Federal List of Endangered and Threatened Species, as published in the Federal Register. Candidate species are those being officially considered for listing as threatened or endangered.

2/ Since 1778.

3/ Not known, but nearly 10,000 native species of insects and more than 1,000 native species of land snails have been estimated.

4/ Incomplete and probably much higher.

Source: U.S. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants (January 1989); P. Q. Tomich, Mammals in Hawaii (1969); Robert L. Pyle, "Checklist of Birds of Hawaii," The 'Elepaio, November 1983; correspondence from W. C. Gagne, Entomology Department, Bishop Museum, July 3, 1985; H. St. John, List and Summary of the Flowering Plants in the Hawaiian Islands (1973), p. 519; University of Hawaii Department of Geography, Atlas of Hawaii (1983), pp. 80 and 83.