

## 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 34 major beaches surveyed in 1986 were found to have fecal coliform levels per 100 ml. ranging from 2.0 to 116, and all of them 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 almost one billion cubic yards of lava by July 1987. 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 Water withdrawn for use in 1985 averaged 1.4 billion gallons per day, compared with 2.9 billion in 1980 and 2.8 billion in 1975.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: 1987, Section 6.

Table 153.-- GREAT CIRCLE DISTANCES BETWEEN SPECIFIED PLACES

Place	Statute miles	Kilometers
DISTANCES FROM HONOLULU INTERNATIONAL AIRPORT		
Hawaiian Islands locations:		
Hilo, Hawaii .....	214	344
Kailua, Kona, Hawaii .....	168	270
Kahului, Maui .....	98	158
Lanai Airport .....	72	116
Molokai Airport .....	54	87
Lihue, Kauai .....	103	166
Puuwai, Niihau .....	152	245
Nihoa .....	283	455
Necker Island .....	520	837
French Frigate Shoals .....	556	895
Gardner Pinnacles .....	688	1,107
Maro Reef .....	851	1,369
Laysan Island .....	936	1,506
Lisianski Island .....	1,065	1,714
Pearl and Hermes Atoll .....	1,208	1,944
Midway Islands .....	1,309	2,106
Kure Atoll .....	1,367	2,200
Other Pacific locations:		
Apra Harbor, Guam .....	3,806	6,124
Auckland, New Zealand .....	4,393	7,068
Hong Kong .....	5,541	8,915
Johnston Atoll .....	820	1,319
Kingman Reef .....	1,073	1,726
Kiritimati (Christmas Island), Kiribati .....	1,344	2,163
Majuro, Marshall Islands .....	2,271	3,654
Manila, Philippines .....	5,293	8,516
Nuku Hiva, Marquesas Islands .....	2,400	3,864
Pago Pago, American Samoa .....	2,606	4,193
Palmyra Atoll .....	1,101	1,772
Papeete, Tahiti .....	2,741	4,410
Suva, Fiji .....	3,159	5,083
Sydney (Port Jackson), Australia .....	5,070	8,158
Tokyo, Japan .....	3,847	6,190
Wake Island .....	2,294	3,691
North and South American locations:		
Anchorage, Alaska .....	2,781	4,475
Cape Horn, Chile .....	7,457	11,998

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Table 153.-- GREAT CIRCLE DISTANCES BETWEEN SPECIFIED PLACES -- Con.

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

Source: U. S. Department of the Interior, Geological Survey, Elevations and Distances in the United States (1973), pp. 22-23, and distance computations prepared for the Department of Planning and Economic Development.

Table 154.-- LATITUDES AND LONGITUDES OF SELECTED PLACES

Island and place	Latitude (North)	Longitude (West)
Hawaii:		
Hilo (General Lyman Field) .....	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°52'
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. Department of Commerce, National Climatic Data Center, Local Climatological Data, Annual Summary with Comparative Data, 1984 for Hilo, Kahului, Honolulu, and Lihue; U.S. Geological Survey, Elevations and Distances in the United States (1973), pp. 22-23; Bernice P. Bishop Museum, Geography and Map Division, information provided April 29, 1986.

Table 155.-- 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-Maroo Reef .....	155.5	250.3	12,300	3,749
Maroo 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 156.-- 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
Niihau .....	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 157.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1982

[See maps on page 6]

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> .....	620.9	596.7	24.2
Kauai <u>5/</u> .....	629.4	619.4	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	-

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Table 157.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1982 -- 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> .....	1,608.1	1,545.4	397,376	381,888
Kauai <u>5/</u> .....	1,630.1	1,604.2	402,816	396,416
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.

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Table 157.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1982 -- 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/ Revised to reflect inclusion of Kaula in the City and County of Honolulu rather than in the County of Kauai, as formerly shown; see Hawaii State Department of the Attorney General, "County Jurisdiction Over Kaula," memorandum to Kent M. Keith, August 18, 1986.

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

7/ Includes Lehua, previously 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 158.-- 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]

Category	Square nautical miles	Square statute miles	Square kilometers
Total ....	634,023	839,623	2,174,626
Land area .....	4,852	6,425	16,641
Water area ....	629,171	833,198	2,147,985

Source: Charles E. Harrington, Chief Geographer, Marine Surveys and Maps, National Ocean Survey, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, information supplied September 15, 1978.

Table 159.-- 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 for Midway Islands supplied by Lee S. Motteler, Bishop Museum.

Table 160.-- 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 Adele M. Carpenter, Land Use Division, DBED.

Table 161.-- ELEVATIONS OF MAJOR SUMMITS

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

Island and mountain	Feet	Meters
<b>Hawaii:</b>		
Mauna Kea 1/ .....	13,796	4,205
Mauna Loa 2/ .....	13,679	4,169
Hualalai .....	8,271	2,521
Kaumu o Kaleihoochie .....	5,480	1,670
Kilauea (Uwekahuna) .....	4,093	1,248
Kilauea (Halemaumau Rim) .....	3,660	1,116
<b>Kahoolawe:</b>		
Puu Moaulanui .....	1,483	452
Puu Moaulaiki .....	1,434	437
Molokini .....	160	49
<b>Maui:</b>		
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
<b>Lanai:</b>		
Lanaihale .....	3,370	1,027
<b>Molokai:</b>		
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
<b>Oahu:</b>		
Kaala .....	4,017	1,224
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 161.-- ELEVATIONS OF MAJOR SUMMITS -- Con.

Island and mountain	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 .....	1,281	390
Lehua .....	699	213
Kaula .....	550	168
Nihoa:		
Millers Peak .....	910	277
Necker Island:		
Summit Hill .....	277	84
French Frigate Shoals:		
La Perouse Pinnacles .....	135	41
Gardner Pinnacles .....	190	58
Maro Reef .....	Awash	Awash
Laysan Island .....	35	11
Lisianski Island .....	20	6
Pearl and Hermes Atoll .....	10	3
Midway Islands .....	12	4
Kure Atoll .....	20	6

1/ According to the 1986 Guinness Book of World Records (p. 94), "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. 94) describes Mauna Loa as having "dimensions, but not height, [which] exceed those of Mt Everest .... The axes of its elliptical base, 16,322 ft below sea level, have been estimated at 74 mi and 53 mi."

Source: U.S. National Cartographic Information Center, data provided October 11, 1978; U.S. Geological Survey topographic maps; E. D. Baldwin, 1883 Molokini figure on Hawaiian Government Survey Reg. Map No. 1276; National Geodetic Survey 1969 figure for Kaala, provided by U.S. Geological Survey, Honolulu office, July 23, 1984; U.S.S. Tanager survey, 1923 (for Pearl and Hermes Atoll). Data compiled with assistance of Lee S. Motteler, Bernice P. Bishop Museum.

Table 162.-- MAJOR STREAMS, BY ISLANDS

Island	Feature or stream	Length or ave. discharge
Longest water feature (miles):		
Hawaii .....	Wailuku River .....	32.0
Maui .....	Kalialinui-Waiale Gulch ....	18.0
Kahoolawe .....	Ahupu Gulch .....	4.0
Lanai .....	Maunalei-Waiialala 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): <sup>1/</sup>		
Hawaii .....	Wailuku River .....	22.7
Maui .....	Palikea 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 .....	185
Maui .....	Iao Stream .....	50
Molokai .....	Wailau Stream .....	30
Oahu .....	Waikele Stream .....	25
Kauai .....	Hanalei River .....	150

<sup>1/</sup> 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 163.-- LAKES AND LAKE-LIKE WATERS, BY ISLANDS: 1987

Island and lake	Type	Elevation (feet)	Area 1/ (acres)	Maximum depth (feet)
<b>Hawaii:</b>				
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
<b>Maui:</b>				
Kanaha Pond .....	Marsh .....	(SL)	41	<3
Kealia Pond .....	Marsh .....	(SL)	500	(NA)
Violet Lake .....	Bog pool .....	5,020	0.02-1	(NA)
Wai Anapanapa .....	Pond .....	6,790	0.2	(NA)
Waieleele .....	Pond .....	6,690	0.5	21
<b>Molokai:</b>				
Kauhako .....	Pool .....	(SL)	0.9	814
Kualapuu Reservoir ..	Reservoir .....	821	100	50
Meyer Lake .....	Impoundment ..	2,021	6-10	5
<b>Oahu:</b>				
Kaelepulu Pond .....	Lake .....	(SL)	198	(NA)
Kawainui Marsh .....	Marsh .....	(SL)	1,000	(NA)
Salt Lake .....	Lake .....	(SL)	49	2
Wahiawa Reservoir ...	Reservoir .....	842	302	85
<b>Kauai:</b>				
Nomilu Fishpond .....	Pond .....	(SL)	20	66
Waita Reservoir .....	Reservoir .....	241	424	23
<b>Niihau:</b>				
Halalii Lake .....	Playa .....	(SL)	841-865	(NA)
Halulu Lake .....	Playa .....	(SL)	182-371	(NA)
<b>Laysan:</b>				
Unnamed closed lagoon	Closed lagoon	(SL)	161	16

NA Not available.

SL Sea level.

1/ Ranges shown for Violet Lake, 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 163.-- LAKES AND LAKE-LIKE WATERS, BY ISLANDS: 1987 - 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, data provided May 29, 1987; 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 (EIS No. 116, August 1981).

Table 164.-- MAJOR NAMED WATERFALLS, BY ISLANDS

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/ Sheer drop 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 165.-- MISCELLANEOUS GEOGRAPHIC STATISTICS, BY ISLANDS

Island	Extreme length (miles)	Extreme width (miles)	Miles of sea cliffs with heights 1,000 ft. or more <u>1/</u>	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	67.0
Niihau .....	18	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
Maui .....	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 (1986 edition, p. 99) 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 166.-- VOLCANIC ERUPTIONS: 1969 TO 1987

[Complete through July 14, 1987. 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 during the past decade 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 (1,000 cubic yards)
Mauna Loa:						
1975: July 5	301	<1	S	13,000	5.2	35,000
1984: March 25	104	22	S, ER	13,200-9,400	11±	230,000
Kilauea:						
1969: Feb. 22	4.0	6	ER	3,100-2,900	2.3	22,000
May 24	2.0	867	ER	3,150	19.3	242,000
1971: Aug. 14	-	<1	C	3,660-3,600	0.8	12,400
Sept. 24	-	5	C, SWR	3,740-2,730	1.5	10,500
1972: Feb. 4	4.3	455	ER	3,150	13.5	163,800
1973: May 5	-	<1	ER	3,340-3,250	0.1	1,600
Nov. 10	-	30	ER	3,250-2,900	0.4	3,700
Dec. 12	0.1	203	ER	3,150	3.1	39,300
1974: July 19	-	3	C, ER	3,600-3,520	1.2	9,000
Sept. 19	2.0	<1	C	3,680	0.4	14,000
Dec. 31	3.4	<1	C	3,600	2.9	19,600
1975: Nov. 29	11.0	<1	C	3,600-3,520	0.1	300
1977: Sept. 13	21.5	18	ER	2,080-1,600	3.0	45,000
1979: Nov. 16	26.3	1	ER	3,270-3,200	0.1	800
1982: April 30	29.5	<1	C	3,630	0.1	260
Sept. 25	4.9	<1	C	3,620	0.3	3,900
1983: Jan. 3 <u>2/</u>	3.3	1,652	ER	2,560-2,120	19.3	965,000

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

2/ Still in progress, July 14, 1987. As of that time, there had been 48 separate episodes.

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, July 14, 1987.

Table 167.-- EARTHQUAKES OF MAGNITUDE 5 OR GREATER: 1957 TO 1987

[Complete to July 30, 1987]

Date and time	Location	Magnitude (Richter Scale)
1957: Aug. 18 .....	E. of Hana, Maui .....	5.6
1961: Sept. 25 .....	Hawaii .....	5.75-6
1962: June 27 .....	Hawaii .....	6.1
June 28 .....	Hawaii .....	5.75
1963: Oct. 23 .....	Hawaii .....	5.4
1964: Oct. 11 .....	W. of S. Kona .....	5.3
Dec. 10 .....	Hawaii .....	5
1969: May 9 .....	Hawaii .....	5
1971: Aug. 1 .....	S.E. of Hawaii .....	4.5-5
1972: Dec. 23 .....	W. of Kona .....	5
1973: Apr. 26 .....	Hawaii .....	6.2
Oct. 9 .....	Hawaii .....	4.8-5
1974: Nov. 30 .....	Hawaii .....	5.5-6
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

Source: Augustine S. Furumoto, N. Norby Nielsen, and William R. Phillips, A Study of Past Earthquakes, Isoleismic Zones of Intensity and Recommended Zones for Structural Design for Hawaii (University of Hawaii, Center for Engineering Research, June 15, 1972), pp. 16-19. 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, July 31, 1987.

Table 168.-- EARTHQUAKES WITH HONOLULU INTENSITIES OF  
V OR GREATER: 1859 TO 1983

[Based on data for 113 earthquakes observed in Honolulu,  
from 1859 through 1983]

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
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. 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 like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to weak masonry, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles cornices. Some cracks in ordinary masonry. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

Source: Doak C. Cox, "Earthquake Experience and Seismic Risk in Honolulu" (paper presented to the Hawaiian Historical Society, Honolulu, March 6, 1986), and letter dated June 23, 1986.

Table 169.-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE:  
1946 TO 1987

[Correct to August 20, 1987]

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 170.-- MAJOR DAMS: 1987

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
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 171.-- 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 172.-- WATER SERVICES AND CONSUMPTION, FOR COUNTY WATERWORKS:  
1982 TO 1986

Subject and geographic area	1982	1983	1984	1985	1986
NUMBER OF SERVICES, JUNE 30					
State total .....	179,648	181,980	185,044	188,271	192,261
City and County of Honolulu	126,400	127,540	129,080	130,884	132,775
Honolulu 1/ .....	58,159	58,173	58,462	58,801	59,237
Rest of Oāhu .....	68,241	69,367	70,618	72,083	73,538
Hawaii County .....	23,682	24,218	24,834	25,315	26,031
Kauai County .....	10,823	11,049	11,501	11,872	12,360
Maui County .....	18,743	19,173	19,629	20,200	21,095
Maui .....	17,607	18,007	18,413	18,964	19,807
Molokai .....	1,136	1,166	1,216	1,236	1,288
CONSUMPTION 2/ (MILLION GALLONS)					
State total .....	56,719	59,724	63,670	65,298	61,432
City and County of Honolulu	42,646	44,535	47,389	48,308	44,125
Honolulu 1/ .....	24,317	25,658	26,636	27,218	24,454
Rest of Oāhu .....	18,329	18,877	20,753	21,090	19,671
Hawaii County .....	4,753	5,066	5,409	5,666	6,039
Kauai County .....	2,805	3,240	3,492	3,531	3,667
Maui County .....	6,515	6,883	7,380	7,793	7,601
Maui .....	6,235	6,592	7,073	7,493	7,314
Molokai .....	280	292	307	300	287

1/ Maunaloa to Moanalua.

2/ Year ended June 30.

Source: Data compiled by Hawaii State Department of Planning 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 173.-- POLLUTION ABATEMENT COSTS AND EXPENDITURES:  
1984 AND 1985

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

Subject	1984	1985
Total pollution abatement capital expenditures .	6.8	4.9
Gross annual cost of pollution abatement .....	10.8	13.3
Payments to government units .....	0.8	0.6
Operating costs, total .....	10.0	12.6
Cost recovered through abatement activities ....	0.6	0.4
Operating costs by form of pollutants abated:		
Air .....	2.3	3.7
Water .....	5.1	5.3
Solid waste, hazardous .....	0.3	0.2
Solid waste, non-hazardous .....	2.3	3.4
Operating costs by kind of cost:		
Depreciation .....	1.6	2.0
Labor .....	2.4	2.9
Materials and supplies .....	3.3	4.1
Services, equipment leasing, and other costs .	2.7	3.6

Source: U.S. Bureau of the Census, "Pollution Abatement Costs and Expenditures, 1984," Current Industrial Reports, MA-200(84)-1 (May 1986), pp. 16, 34, and 49; "Pollution Abatement Costs and Expenditures, 1985," Current Industrial Reports, MA-200(85)-1 (April 1987), pp. 18, 37, and 52.

Table 174.-- WATER QUALITY AT SPECIFIED PUBLIC BEACHES: 1983 TO 1986

Island and beach	Number of samples, 1986	Fecal coliform density 1/ (geometric mean, MPN/100 ml)			
		1983	1984	1985	1986
Hawaii (Hilo Shoreline Area):					
Exit of Ice Pond .....	10	27.5	15.6	78.2	15.1
Leileiwi Beach Park .....	9	121.1	109.7	182.1	116.0
Onekahakaha .....	9	6.4	5.6	8.8	7.4
Puhi Bay No. 3 .....	11	12.6	12.9	286.1	48.8
Hawaii (Kona Shoreline Area):					
Hapuna Beach .....	7	15.2	5.3	3.9	3.6
Kahaluu Beach .....	7	6.4	2.6	2.8	2.8
Kealakekua Bay (curio stand) .....	8	3.9	3.3	4.6	3.9
Kealakekua Bay (canoe landing) ...	8	4.4	4.4	3.9	4.7
Magic Sands Beach .....	7	3.4	5.4	4.7	2.3
Puako Beach Lots (middle) .....	7	21.4	9.5	11.6	4.5
Puako Beach Lots (south end) .....	7	21.2	46.2	20.6	14.1
Spencer Beach Park .....	7	4.7	9.8	6.7	7.6
Maui:					
Hukilau Hotel shoreline .....	7	3.3	3.0	7.4	3.7
Oahu:					
Ala Moana Park (ewa end) .....	20	6.8	5.7	6.7	3.6
Ala Moana Park (center) .....	11	2.0	2.7	3.3	2.5
Ala Moana Park (diamond head) .....	11	6.2	3.1	7.9	3.8
Elks Club Beach .....	9	4.0	5.4	6.2	2.3
Ewa Beach .....	7	4.4	4.8	5.1	5.7
Ft. DeRussy Beach .....	9	5.6	6.8	5.0	4.6
Gray's Beach .....	17	5.7	5.4	7.3	6.2
Hanauma Bay .....	9	6.8	9.5	17.7	5.4
Kahana Park Beach .....	9	24.0	58.2	54.1	23.1
Kahanamoku Beach .....	10	3.4	2.4	3.7	3.2
Kahanamoku Lagoon (diamond head) .	17	23.3	16.8	77.0	12.1
Kailua Bay outfall shoreline .....	9	2.0	3.8	2.8	3.2
Kailua Beach Park .....	9	3.1	2.5	5.0	3.9
Kokokahi Pier .....	9	29.8	12.1	114.5	40.6
Kuhio Beach .....	9	9.7	8.4	22.5	7.8
Public Bath Beach .....	17	2.5	3.3	4.8	4.0
Tavern Beach .....	9	4.4	6.1	9.1	4.6
Sand Island, Pt. No. 3 .....	10	2.9	2.3	4.2	2.1

Continued on next page.



Table 174.-- WATER QUALITY AT SPECIFIED PUBLIC BEACHES: 1983 TO 1986 - Con.

Island and beach	Number of samples, 1986	Fecal coliform density $\frac{1}{}$ (geometric mean, MPN/100 ml)			
		1983	1984	1985	1986
Kauai:					
Brennecke Beach .....	2	4.1	2.5	2.0	2.0
Hanalei Bay Landing .....	3	86.0	42.8	51.2	76.9
Poipu Beach .....	2	2.0	4.4	2.0	2.0

MPN Most probable number.

$\frac{1}{}$  The geometric mean standard for fecal coliform density is 200 MPN per 100 ml.

Source: Hawaii State Department of Health, Pollution Investigation and Enforcement Branch, data supplied April 29, 1987.

Table 175.-- LITTER ALONG OAHU HIGHWAYS: 1978 TO 1985

Measure	1978	1979	1981	1985
Visible litter items per mile:				
35 sites .....	2,128	1,369	1,471	1,110
52 sites $\frac{1}{}$ .....	2,135	1,452	1,576	1,261
Visible beer/soft drink containers per mile:				
35 sites .....	367	187	93	60
52 sites $\frac{1}{}$ .....	292	148	71	51
Indiscriminate dumps per 1,000 miles of driving ....	(NA)	8.2	15.7	19.6
Abandoned vehicles per 1,000 miles of driving .....	(NA)	4.9	23.6	57.4

NA Not available.

$\frac{1}{}$  1978 and 1979 estimated.

Source: Daniel B. Syrek, Hawaii Litter: 1985 (Sacramento: The Institute for Applied Research, for the Hawaii State Department of Health, Litter Control Office, May 23, 1985).

Table 176.-- REFUSE AND SEWAGE STATISTICS FOR OAHU: 1980 TO 1986

[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

  

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

1/ Excludes small landfill controlled by armed forces.

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 177.-- AIR QUALITY IN DOWNTOWN HONOLULU:  
1976 TO 1986

[Sampling is conducted approximately 46 ft. above ground on the roof of the State Health Department building, 1250 Punchbowl Street, Honolulu, Hawaii]

Year	Annual arithmetic means ( $\mu\text{g}/\text{m}^3$ )	
	Total suspended particulates	Sulfur oxides
1976 .....	34	23
1977 .....	31	17
1978 .....	29	18
1979 .....	32	22
1980 .....	37	18
1981 .....	40	19
1982 .....	29	11
1983 .....	26	<5
1984 .....	25	<5
1985 .....	24	<5
1986 .....	25	<5
Standards: <u>1/</u>		
Primary .....	75	80
Secondary .....	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, Pollution Investigation and Enforcement Branch, data supplied April 29, 1987.

Table 178.-- AIR QUALITY AT SPECIFIED LOCATIONS: 1986

[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>	7	66	26	<5	10	<5
Downtown Honolulu	11	61	25	<5	6	<5
Liliha .....	17	60	32	...	...	...
Pearl City .....	17	65	30	...	...	...
Waimanalo .....	10	72	28	...	...	...
Maui:						
Kihei <u>2/</u> .....	32	167	61	...	...	...
Hawaii:						
Kona <u>3/</u> .....	4	28	16	<5	12	<5
Kauai:						
Lihue <u>1/</u> .....	11	42	20	...	...	...

1/ Particulate data from PM<sub>10</sub> samplers (measuring inhalable particulates of less than 10 $\mu$ ).

2/ Site re-established in September 1986. Data based on four months of sampling.

3/ Site discontinued in September 1986. Data based on eight months of sampling.

Source: Hawaii State Department of Health, Pollution Investigation and Enforcement Branch, data supplied April 29, 1987.

Table 179.-- 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 April 30, 1987.

Table 180.-- NOISE LEVELS DURING DAYLIGHT HOURS IN SPECIFIED NEIGHBORHOODS  
ON OAHU: 1981-1982

Neighborhood	Noise levels (in decibels) exceeded --					
	Manual sampling			Automatic sampling		
	10 percent of time	50 percent of time	90 percent of time	10 percent of time	50 percent of time	90 percent of time
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 181.-- 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	
<b>Hawaii:</b>						
Hilo Airport .....	30	71.1	75.8	53	94	129
Hawaii Volcanoes Nat. Park Hdq. .	3,970	57.6	63.2	37	85	101
Naalehu .....	675	70.2	75.2	(NA)	(NA)	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
<b>Maui:</b>						
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	19
Lahaina .....	45	71.5	78.0	52	93	15
<b>Molokai:</b>						
Kaunakakai .....	10	(NA)	(NA)	(NA)	(NA)	14
Molokai Airport .....	450	70.2	77.6	48	90	27
<b>Lanai:</b>						
Lanai City .....	1,620	65.8	72.8	46	88	37
<b>Oahu:</b>						
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 181.-- 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)
		Coollest 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	71.2	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 2, 1987.



Table 182.-- 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 .....	71.1	71.5	72.6	71.2
Warmest month .....	75.8	79.2	81.0	79.1
Annual .....	73.5	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	57	56	66
Wind speed (m.p.h.):				
Mean .....	7.1	12.8	11.5	12.0
Fastest observation, 1 minute <u>1</u> /	35	44	46	65
Percent of possible sunshine .....	41	68	68	56
Mean number of days:				
Clear .....	35.9	130.5	87.5	53.7
Partly cloudy .....	128.8	144.3	179.3	179.8
Cloudy .....	200.6	90.5	98.4	131.8
Precipitation .01 inch or more .	278.3	97.4	99.8	200.9

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, 1986 for Hilo, Kahului, Honolulu, and Lihue.

Table 183.-- 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	72.8	88	53	2.72	13.68	0.06	6.88
March .....	81.4	67.3	74.3	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	90	60	1.21	7.23	0.05	3.44
June .....	86.2	71.9	79.1	91	65	0.49	2.46	T	2.28
July .....	87.1	73.1	80.1	92	67	0.54	2.01	0.03	1.38
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	12.09	0.06	8.14
Annual ....	84.2	69.7	77.0	94	53	23.47	20.79	T	17.07

Continued on next page.

Table 183.-- 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. ...	82	62	9.7	32	62	5.4	9.4	8.8	9.9
Feb. ...	78	59	10.4	30	64	5.6	7.5	8.1	9.3
Mar. ...	73	58	11.6	30	68	5.9	7.2	9.7	9.1
Apr. ...	70	56	12.1	31	67	6.2	5.4	10.6	9.2
May ....	67	54	12.0	30	69	6.0	6.3	9.5	7.2
June ...	67	53	12.8	26	70	5.7	5.7	6.9	5.9
July ...	68	52	13.4	28	73	5.3	7.5	5.4	7.5
Aug ....	69	53	13.1	28	75	5.3	7.8	6.4	6.4
Sept. ..	68	52	11.4	26	75	5.3	7.9	6.0	7.1
Oct. ...	69	55	10.7	25	68	5.6	7.4	8.4	8.9
Nov. ...	75	59	10.8	46	61	5.7	7.0	9.3	9.3
Dec. ...	79	61	10.6	29	59	5.5	8.4	9.2	9.9
Ann. ...	72	56	11.5	46	68	5.6	87.5	98.4	99.8

T Trace amount.

1/ Fastest observation, 1 minute, during 6-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, 1986.

Table 184.-- CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT: ANNUALLY,  
1976 TO 1986

Year	Average temperature (°F)			Extreme temp. (°F)		Precipitation (inches)
	Annual	Coolest month	Warmest month	Lowest	Highest	
1976 ...	76.8	72.0	80.8	53	91	12.90
1977 ...	78.2	73.7	82.2	59	92	12.36
1978 ...	76.8	72.4	80.5	57	91	25.05
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
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	Fastest mile <u>1</u> /		
1976 ...	64	52	11.5	38	60	105
1977 ...	71	55	12.2	37	68	81
1978 ...	74	58	11.9	34	69	90
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

1/ 1984, 1985, and 1986 figures refer to peak gust.

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 185.-- 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 <u>1/</u> .....	91.9
Highest monthly average daily temp. (°F.) ...	September .....	Kawaihae <u>I/</u> .....	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 <u>2/</u>	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. <u>3/</u> ..	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 2, 1987.

Table 186.-- RAINFALL AT SPECIFIED LOCATIONS: ANNUALLY,  
1976 TO 1986

[In inches]

Year	Hawaii			Maui		
	Hilo Airport	Wai-me <u>a</u> <sup>1/</sup>	Kona Village	Kahului Airport	Kihei	Lahaina
1976 ...	114.67	11.10	7.04	12.83	8.84	8.86
1977 ...	90.38	5.42	3.40	11.50	7.88	8.28
1978 ...	119.09	14.83	8.68	19.15	9.91	11.97
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

  

Year	Oahu			Kauai		
	Waikiki	Univ. of Hawaii	Nuuanu Res. 4	Koloa	Lihue Airport	Princeville
1976 ...	13.59	26.83	86.44	62.60	32.83	109.34
1977 ...	15.73	32.83	88.96	52.51	40.34	84.55
1978 ...	27.18	41.56	124.42	70.64	39.11	130.82
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

NA Not available.

<sup>1/</sup> 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 187.-- MAJOR HURRICANES: 1950 TO 1987

[Complete to August 24, 1987]

Hurricane name	Date <sup>1/</sup>	Islands most affected	Maximum winds ashore (m.p.h.)		Deaths	Property damage (\$1,000)
			Sus-tained	Gusts		
Hiki .....	Aug. 12-16, 1950	Kauai .....	68	(NA)	1	200
Della .....	Sept. 1-17, 1957	French Frig. Shoals	82	109	-	Minor
Nina .....	Nov. 29-Dec. 7, 1957	Kauai .....	92	(NA)	4	1,056
Dot .....	Aug. 1-8, 1959	Kauai .....	81	103	-	5,500+
Fico .....	July 17-28, 1978	Hawaii .....	(NA)	58+	-	188
Iwa .....	Nov. 19-25, 1982	Kauai, Oahu .....	65	117	-	234,000

NA Not available.

<sup>1/</sup> Total duration, including period outside Hawaiian waters.

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

Table 188.-- TRADE WINDS, HIGH SURF, AND TEMPERATURES IN HAWAIIAN WATERS,  
BY MONTHS

Month	Trade wind frequency <sup>1/</sup> (percent)	Expected days of strong trade winds <sup>2/</sup>	Highest surf <sup>3/</sup> (average number of days)		Water temperature <sup>4/</sup> (°F.)	
			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. ...	65	92	71	110	78.6	74.8

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

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

<sup>3/</sup> 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.

<sup>4/</sup> 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.



Table 189.-- 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 190.-- SUNRISE, SUNSET, AND HOURS OF DAYLIGHT AT HILO, HONOLULU, AND LIHUE, FOR SELECTED DATES

[Hawaiian Standard Time]

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

Source: Nautical Almanac Office, U.S. Naval Observatory, Tables of Sunrise and Sunset, No. 1083 and 1084 and records.

Table 191.-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF THE  
HONOLULU AREA: 1983 TO 1986

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

Species <u>1/</u>	1983	1984	1985	1986
All species:				
Species .....	46	46	51	50
Individual birds ..	22,279	25,809	28,803	28,690
Endemic species:				
'Apapane .....	106	96	66	85
Hawaiian Coot .....	135	40	23	23
Hawaiian Stilt .....	110	87	118	103
Oahu 'Amakihi .....	140	59	125	110
Indigenous species:				
Great Frigatebird .....	37	17	194	6
Red-footed Booby .....	370	624	531	402
Introduced species:				
Cattle Egret .....	384	477	656	988
Common Myna .....	3,080	3,611	3,586	5,420
House Sparrow .....	2,518	2,169	2,793	2,633
Japanese White-eye .....	1,706	1,235	1,628	1,078
Red-vented Bulbul .....	2,195	2,051	1,972	2,023
Spotted Dove .....	1,606	2,650	2,774	2,533
Zebra (Barred) Dove .....	3,840	7,624	7,299	7,860
Migratory species:				
Lesser Golden-Plover ...	1,747	1,359	1,846	1,482
Ruddy Turnstone .....	269	295	268	317

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, The 'Elepaio (monthly).

Table 192.-- HAWAII AUDUBON SOCIETY BIRD COUNT OF THE HONOLULU AREA, BY TYPE OF SPECIES: DECEMBER 1986

Type of species <u>1/</u>	Number of species	Number of individuals
All species .....	50	28,690
Endemic .....	7	354
Indigenous .....	7	496
Introduced .....	29	26,013
Migratory .....	7	1,827

1/ For definitions, see preceding table, footnote 1.  
Source: Hawaii Audubon Society, "Honolulu Christmas Count -- 1986," 'Elepaio, May 1987, pp. 51-53.

Table 193.-- TREES ALONG STREETS OR IN PARKS UNDER THE JURISDICTION OF THE CITY AND COUNTY OF HONOLULU: 1982 TO 1986

[As of June 30]

Location	1982	1983	1984	1985	1986
Along City and County streets and highways <u>1/</u> ...	113,489	114,320	117,133	118,437	120,029
In City and County parks ....	96,296	96,504	96,873	96,727	96,896

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

Table 194.-- THREATENED, ENDANGERED, AND EXTINCT SPECIES OF NATIVE FAUNA AND FLORA: NOVEMBER 1986

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	-	41	4/ 88
Plants .....	2,734	787	-	19	<u>47</u> 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 records; 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.