
Chapter 3: Appendix 1

Hazard Maps for the County of Kauai

Hazard Map Explanation

The following maps were copied directly from the Coastal Hazard Atlas (**Source:** Fletcher III, Charles, Eric Grossman, and Bruce Richmond. *Atlas of Natural Hazards in the Hawaiian Coastal Zone*. 2000. Funded by State of Hawaii Office of Planning, Coastal Zone Management Program and Coastal and Marine Geology Program U.S. Geological Survey) for use in planning hazard mitigation activities that should occur in these areas.

The summary maps for Kaua'i show four general types of hazards that may be linked with stronger hazard events. These maps show tsunami inundation, stream flooding, high winds, and damaging high waves, and provide a general history of these event occurrences collected through extensive research from various sources. Although the histories only go back to the 1800s and are not exhaustive, they do show that certain areas in Kaua'i have an increased likelihood of certain types of hazard occurrences. (Given the small size of Hawai'i State, an area that does not have a prerecorded history of a natural hazard occurrence does not preclude it from being affected in the future).

The second set of maps show the communities of Kaua'i in sections approximately 5 to 7 miles in length, with colored bands that rank the relative intensity of each hazard at the adjacent shoreline. Darker sections of the band indicate higher intensity. These bands have been labeled as follows, from the inner coastal band to the outer band:

- G:** Geology - **B=Beach; S=Stream; R=Rocky; H=Headland; D=Developed; fr=fringing reef; br=barrier reef; e=embayed coast; w=wetland.**
- CS:** Coastal Slope
- T:** Tsunami
- SF:** Stream Flooding
- W:** High Waves
- S:** Storms
- E:** Erosion
- SL:** Sea Level
- V/S:** Volcanic/Seismic

The intensity readings are APPROXIMATIONS, based on the best available scientific evidence. In many cases, data is limited or not available, which is the reason that the authors of the hazard atlas did not pinpoint the exact location of the hazards, but used the intensity bars to show likelihood. Table 2 explains the intensity rankings. Again, the lack of evidence or data does not mean that a specific hazard will never occur in the area. Therefore, it is important to prepare inclusive hazard mitigation plans that will deal with a variety of contingencies.

The coastal hazard maps provide information on several hazards that should be considered when engaging in hazard mitigation planning. The maps show general detail about the geology of an area.

Table A3-1. Hazard Intensity Rank Definitions

	Low (1)	Moderately Low (2)	Moderately High (3)	High (4)
Tsunami Inundation	No history of tsunami activity and no reasonable basis for expected activity.	History of Minor flooding (<10 ft. elev.); future flooding hazard is low because of a steep coastal zone (>45%) or some other mitigating factor (tsunami barrier).	History of major flooding (>10 ft. elev.) but historical damage, and expected future damage is slight because the steep coastal zone slope ($\geq 45\%$) makes development unlikely.	History of major flooding (>10 ft. elev.) with significant damage because of a moderate slope.
Coastal Stream Flooding	No history of coastal stream flooding and no reasonable basis for expected flooding due to low seasonal rainfall in watershed (monthly max. <5 in); or steep coastal slope (>45%).	History of nondamaging flooding where streams or highlands w/seasonal high rainfall are present (monthly max. >8 in) and coastal slope >20%; or history of flood damage with full mitigation since last major flood.	Abundance of streams and high seasonal rainfall in watershed (monthly max. >8 in) and history of damaging floods with partial mitigation; or no mitigation where slope >20% and <45%.	Historically high flood damage on gentle slope, watershed rainfall monthly max. >8 in, no mitigation efforts or improvements since last damaging flood.
High Waves	No reasonable basis to expect high waves.	Seasonal high waves 4-6 ft.	Seasonal high waves 6-8 ft.	Seasonal high waves > 12 ft., characterized by rapid onset.
Storm Overwash and/ or High Winds	No history of overwash or high winds, and no reason to expect them.	Minor historical overwash (<10 ft), and/or high winds (-40 mph gust).	Historical overwash >10 ft on steep slope, and/or high winds with localized (isolated cases) structural damage (-40 mph sustained).	Historical overwash >10 ft on moderate to gentle slope, and/or high winds with widespread structural damage (-75 mph gust).

Coastal Erosion	Long-term accretion (>10 yr) with no history of erosion, or dynamic cycles with consistent annual accretion.	Long-term stable, or minor erosion/ accretion cycles with erosion fully recovered by accretion; low rocky coasts; perched beaches.	Long-term erosion rate ≤ 1 ft/yr; or highly dynamic erosion/ accretion cycles with significant lateral shifts in the shoreline.	Chronic long-term erosion >1 ft/yr, or beach is lost, or seawall at water-line for portions of the tidal cycle.
Sea-Level Rise	Steep coastal slope where rise >0.04 in/yr or gentle slope where rise <0.04 in/yr.	Gentle or moderate slope where rise >0.04 in/yr or steep slope where rise >0.08 in/yr.	Gentle or moderate slope, where rise >0.08 in/yr or steep slope where rise >0.12 in/yr.	Gentle or moderate slope where rise >0.12 in/yr.
Volcanism and/or Seismicity	No history of volcanic or seismic activity; seismic probability zone 0.	No volcanic activity in recent recorded history; seismic probability zone 1, minor historic seismic damage.	Limited history of volcanism, seismic probability zones 2 or 3 recommended (historic seismic damage).	Frequent volcanism, seismic probability zones 2 or 3 (frequent historic damage).

Kauai Stream flooding

Islandwide stream flooding because of heavy rains

- 1963 Apr 15
- 1968 Nov 28 24" in 24 hrs
- 1972 Apr 19
- 1974 Apr 19 10" rain
- 1975 Jan 30-31
- 1978 Oct 30-31 8.5" in 24 hrs
- 1980 Jun 16
- 1981 Aug 3-4 5-10" rain
- 1981 Dec 23-24 9-7" rain
- 1982 Feb 11
- 1982 Oct 28-30 15-20" in 5 days
- 1982 Dec 23-24 9-7" rain
- 1989 Nov 10-11 Flash flooding
- 1987 Oct 15 Flash flooding
- 1987 Nov 4 Flash flooding
- 1988 Jan 28-29 10" rain
- 1988 Aug 2-11
- 1989 Jan 10-12 Flash flooding
- 1989 Feb 21-23 5-15" rain
- 1989 Apr 24
- 1990 Nov 20
- 1992 Feb 13-4
- 1992 Oct 12 Flash flooding
- 1993 Jul 21-23 Flooding H, Dora



- Lakes and reservoirs
- 0-1000 feet
- 1000-2000 feet
- 2000-3000 feet
- 3000-4000 feet
- 4000-5000 feet
- over 5000 feet
- Urban areas
- Highways
- Streams
- Canals
- 11" Max. rainfall from storm (inches)
- 1070 cfs Max. peak discharge (ft³ per sec)
- 5 ft Max. height of flooding (feet)
- 30" Mean annual rainfall (inches)
- [H, hurricane; R, river; Str, stream]

Wainiha / Lumahai R

- since 1959-8 damaging floods of 2-3 ft
- 1956 Feb 40,000 cfs, 20" in 24 hrs
- 1988 Nov/Dec 15" in 24 hrs
- 1971 Apr 6-7
- 1974 Apr 19 10" rain at Wainiha
- 1975 Jan 30-31 Wainiha
- 1978 Jun 7 16.2" in 2 days at Hanakapiai Str
- 1981 Oct 27-28 Wainiha R
- 1989 Nov 10-11 Lumahai R
- 1989 Jul 22-23 Wainiha

Western watershed

- flooding is primarily due to overland flow
- 1963 Apr 15 3-3 ft
- 1969 Jan 5
- 1973 Dec 1 Kekaha

Makaweli / Waimea

- flooding is due to overland flows after storms
- 1916, 1921, 1927, 1945—major floods
- 1949 Feb 7 3-6 ft, 48,000 cfs at Waimea R
- 1973 Dec 1
- 1993 Oct 2 3-6 in, flash flood

Hanapepe R, Waihiwa Str, Kalaheo Gulch

- 1919 Jan Hanapepe
- 1924-1959 11 damaging floods at Hanapepe R
- 1949 Dec 17 Flash flood, 4-6 ft at Hanapepe R
- 1983 Mar 14 Flash flood
- 1983 Apr 15 5-6 ft at Hanapepe R
- 1987 Nov 24-27 Hanapepe R
- 1988 Dec 29-31 3-6 ft at Hanapepe R
- 1974 Apr 19 10" rain at Hanapepe R
- 1975 Jan 30-31

Hanalei R / Waioili, Waipa Strs

- 1866, 1877, 1885, 1905, 1921, 1948, 1952, 1983—serious floods
- 1893 Feb 14 Flash flood, Kilauea Str
- 1944-1983-5 damaging floods
- 1956 Nov 11-12 26.1" rain, 8 ft flooding
- 1956 Jan 24-25 -7 ft, 44,000 cfs
- 1967 May 21-22 Hanalei R
- 1967 Nov 24-27 7.25" in 5.5 hrs at Hanalei R
- 1967 Dec 5 Hanalei R
- 1971 Apr 6-7 5 ft at Hanalei R
- 1975 Jan 30-31 Hanalei R
- 1981 Oct 27-28 Hanalei R
- 1982 Dec 6-7
- 1988 Aug 11 Hanalei R
- 1988 Aug 4-11
- 1989 Jul 22-23
- 1990 Nov 16-17
- 1994 Apr 12-13 10", Flash flood, mudslide
- 1996 Sep 7 9" in 12 hrs, Hanalei Bridge closed

Kahiliwai / Anahola

- 1914 Sep 21 at Anahola Str
- 1932 Feb Anahola Str
- 1948 Apr 1 Anahola Str
- 1956 Jan 24-25 42" in 30 hrs; 10 ft of flooding at Kahiliwai, Anian, Kilauea, Midway, Papaia Strs; 6 ft at Anahola Str
- 1964 Dec Anahola Str
- 1965 May Anahola Str, 6 ft, overland flows
- 1968 Nov 28 24" in 24 hrs at Anahola Str
- 1990 Nov 19-17 15" rain
- 1991 Dec 14 20" in 12 hrs at Anahola Str
- 1992 Feb 13-14 Anahola Str
- 1993 Oct 2 3-4" rain, flash flood
- 1994 Apr 13 heavy rain, flash flood

Kapaa Str / Waialua R

- 1916 Jan 7 Flash flood
- 1920 Jan Waialua R
- 1940 May 13-14 Waialua R
- 1955 Nov 11-12 Kapaa Str, Waialua R 85,000 cfs, 5 ft
- 1956 Jan 24-25 Kapaa Str, Waialua R
- 1983 Apr 15 Waialua R
- 1985 Apr Kapaa Str, 5 ft
- 1987 May Kapaa Str
- 1987 Nov 24-27 Waialua R
- 1988 Dec 29-31 Kapaa Str, 12,800 cfs, 7 ft, 15-27" in 24 hrs
- 1975 Jan 30-31 Waialua R
- 1981 Oct 27-28 Waialua R
- 1991 Dec 14 Kapaa, flash flood

Hanamaulu, Nawiliwili, Huleia Strs

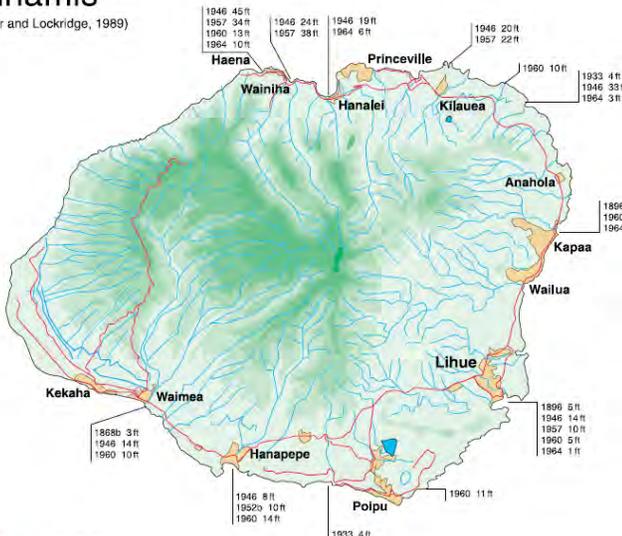
- flooding is primarily due to runoff/overland flows
- 1965 Aug 2 4.5" in 1 hr at Hanamaulu Str
- 1968 Dec 5-10 at Hanamaulu, Nawiliwili, Huleia Str
- 1975 Jan 30-31 Nawiliwili Str
- 1978 Oct 30-31 8.5" in 24 hrs at Nawiliwili Str

Koala / Poipu

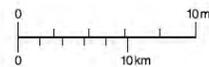
- flooding is due to overland flow
- 1954, 1955, 1957, 1983, thrice 1965, 1968—major floods
- 1965 Aug 13 Poipu
- 1972 Apr 15 Poipu
- 1989 Aug 20-21 Flash flood, Poipu

Kauai Tsunamis

(after Lander and Lockridge, 1989)



- Lakes and reservoirs
- 0-1000 feet
- 1000-2000 feet
- 2000-3000 feet
- 3000-4000 feet
- 4000-5000 feet
- over 5000 feet
- Urban areas
- Highways
- Streams
- Canals
- 10 ft Height of runup (feet)



Large tsunamis* (>1m, 3.3 ft) with reported damage in the Hawaiian Islands

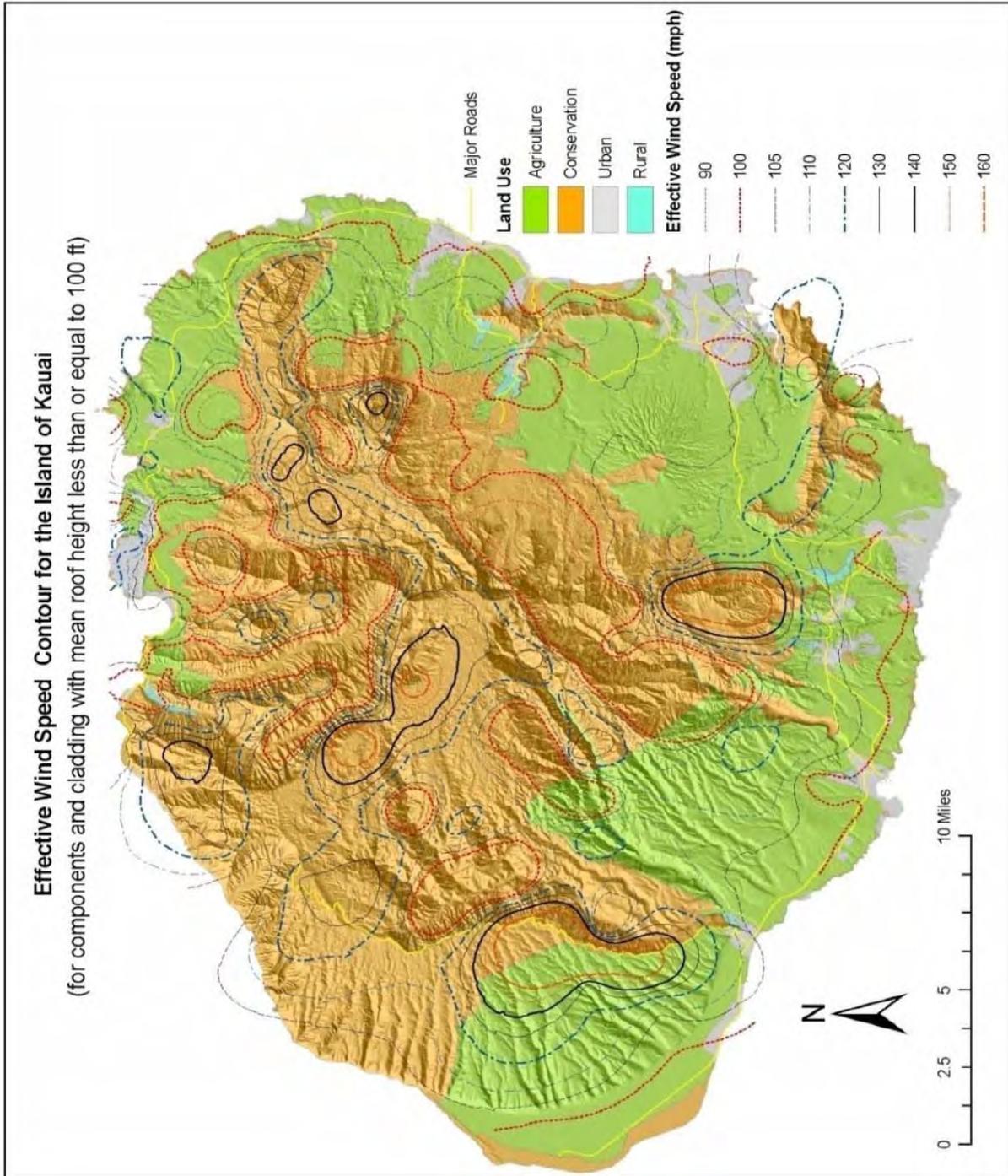
Year	Date	Area of origin	Magnitude**
1819	Apr 12	N Central Chile	M = 2.0
1835	Feb 20	Southern Chile	M = 4.0
1837	Nov 7	Southern Chile	M = 3.0
1841	May 17	Kamchatka	M = 2.0
1868a	Apr 3	SE Hawaii	M = 4.1
1868b	Aug 13	Northern Chile	M = 4.3
1868c	Oct 2	South Pacific	
1869	Jul 24	South Pacific	
1877	May 10	Northern Chile	M = 4.0
1878	Jan 20	Aleutian Is (?)	
1896	Jun 15	Japan	M = 4.0
1901	Aug 9	Tonga	
1906a	Jan 31	Colombia/Ecuador	M = 1.0
1906b	Aug 17	Central Chile	M = 2.0
1918	Sep 7	Kurils	M = 3.6
1919	Oct 2	Hawaii (H = 14 ft)	
1922	Nov 11	N Central Chile	M = 3.0
1923	Feb 3	Kamchatka	M = 3.0
1933	Mar 2	Japan	M = 3.0
1946	Apr 1	Eastern Aleutian Is	M = 5.0
1952a	Mar 17	Hawaii (H = 10 ft)	
1952b	Nov 4	Kamchatka	M = 4.0
1957	Mar 9	Central Aleutian Is	M = 3.5
1960	May 22	Chile	M = 4.5
1964	Mar 28	Gulf of Alaska	M = 4.5
1975	Nov 29	Big Island/Hawaii (H = 47 ft)	

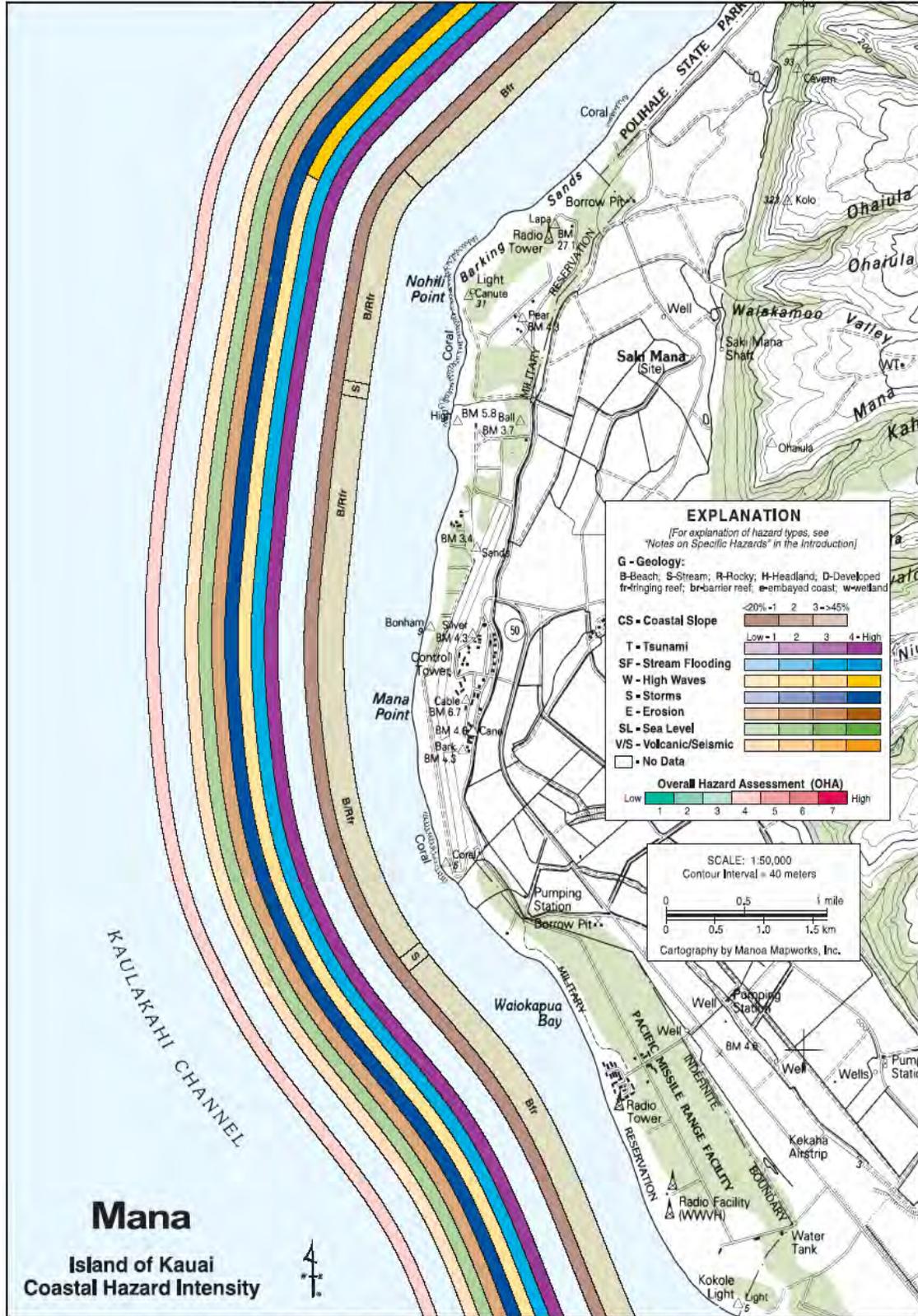
*Reliability of ≥ 3 (of 4) (Lander and Lockridge, 1989), runup > 1m (3.3 ft), and reported damage.

** Tsunami magnitude is defined by $M = \log_2 H$ as revised by Iida and others (1967), where H is the maximum runup height or amplitude on a coastline near the generating area.

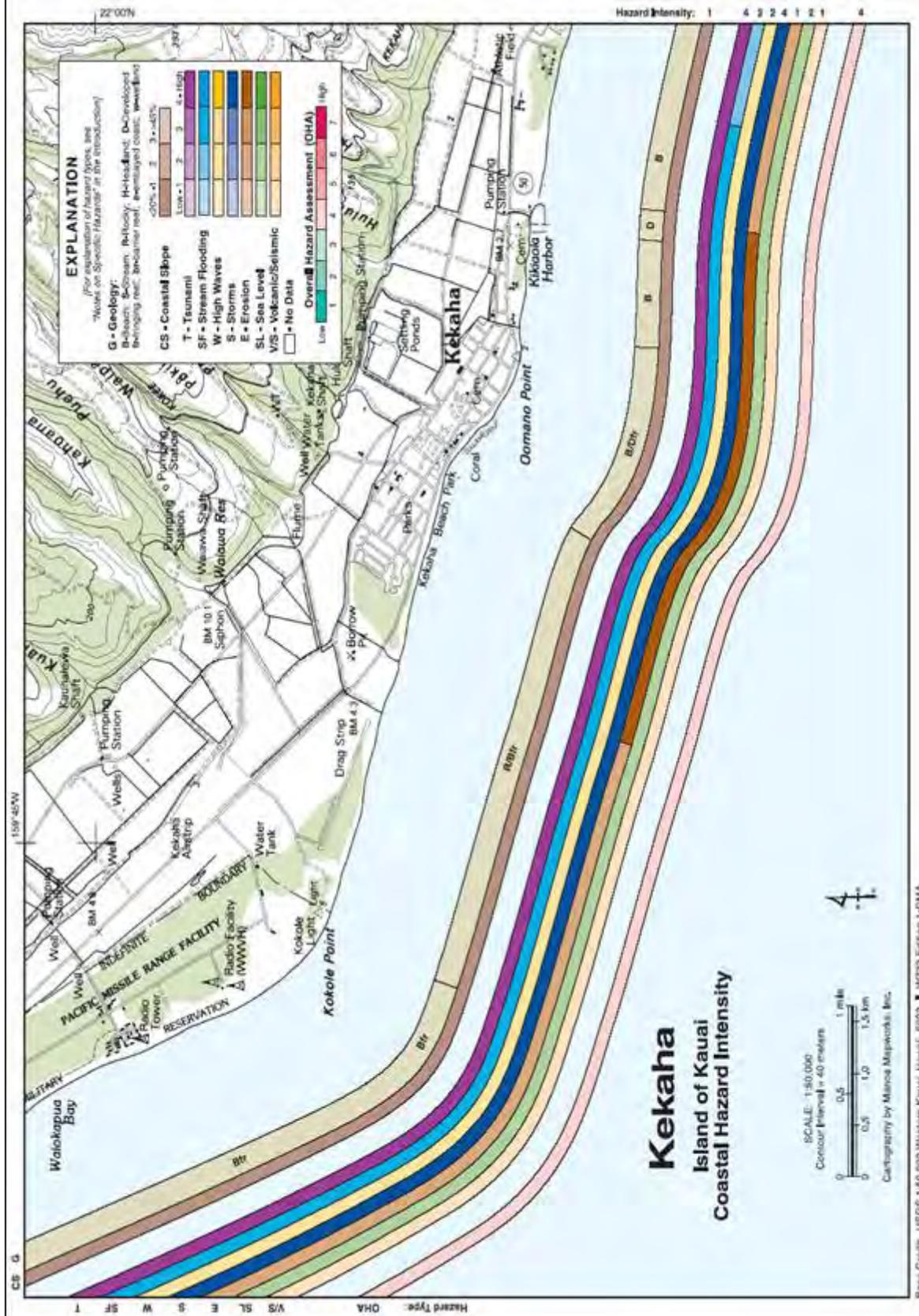
Other tsunamis have occurred, such as that of Oct 1994, however, because of their low (< 1 m) runup, insignificant damage, and/or uncertainty surrounding their timing and magnitude as noted in Lander and Lockridge (1989), they were not included here.

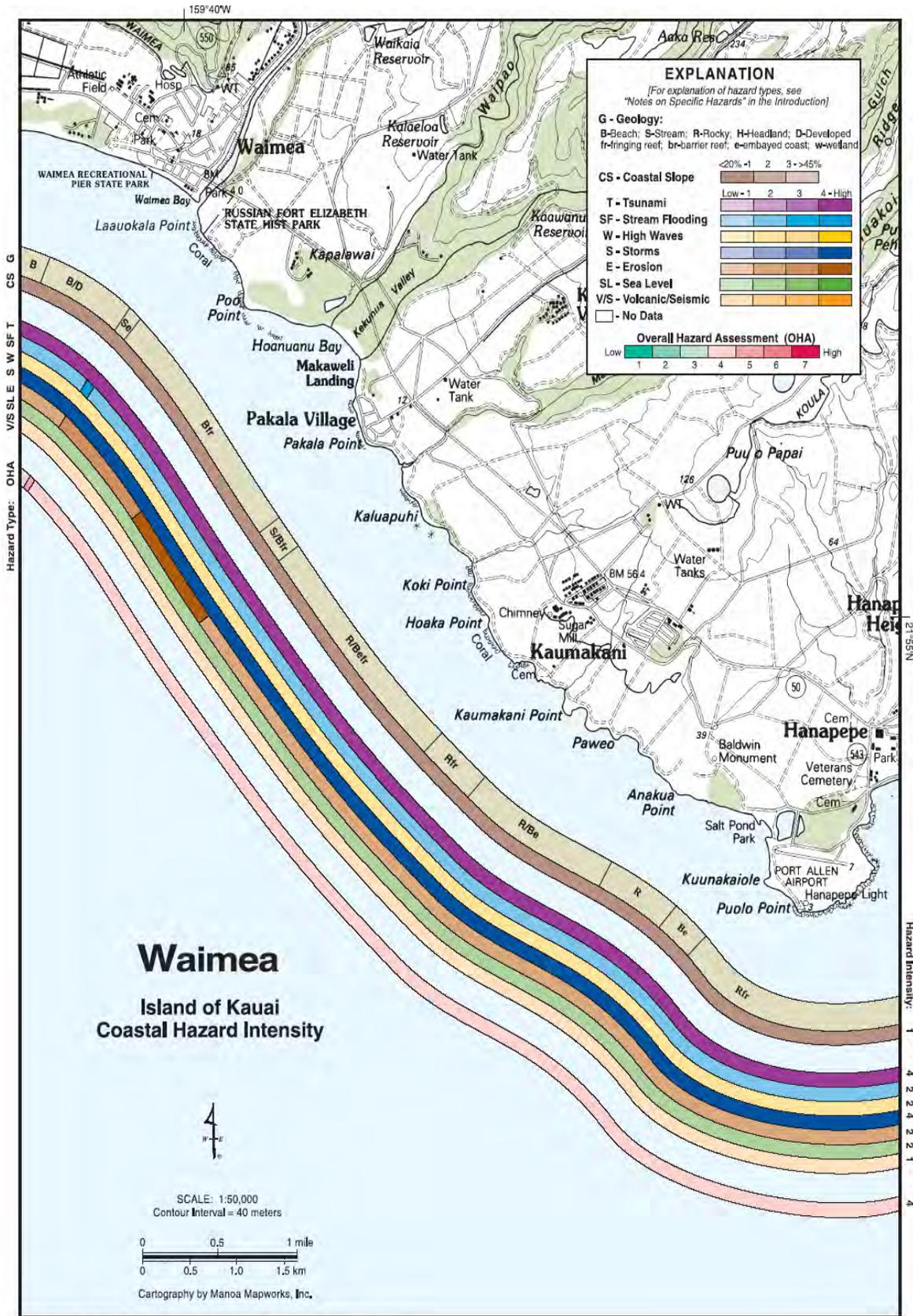
Effective Wind Speed: Micro-zoned Design Maps of Topographic Wind Effects and Exposure in the State of Hawaii Building Code (Martin & Chock, 2009)



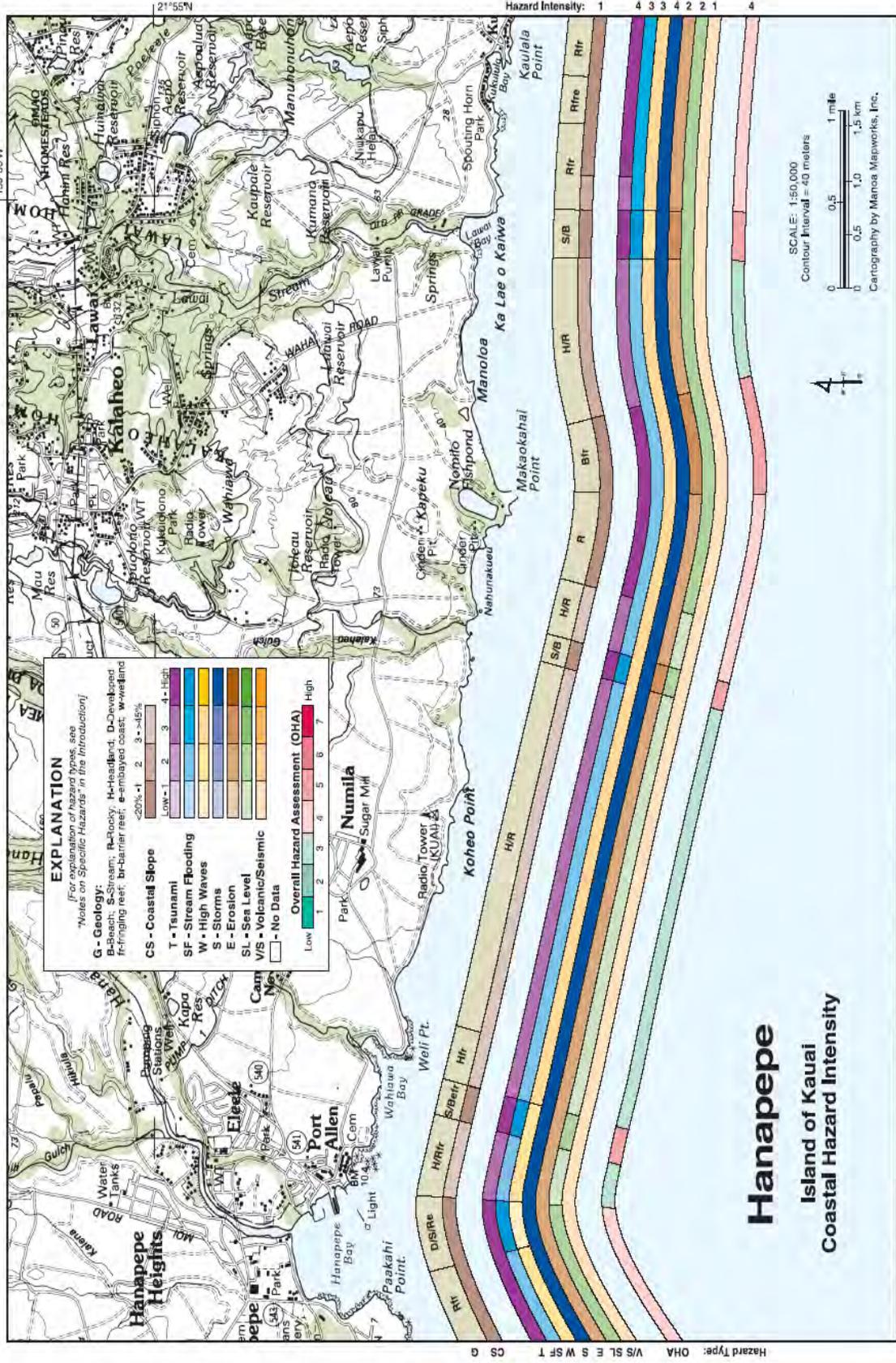


Base Credit: USGS 1:50,000 Western Kauai, Hawaii 5022 II W733 Edition 1-DMA 4 1 2 2 4 2 3 4 1 :Hazard Intensity

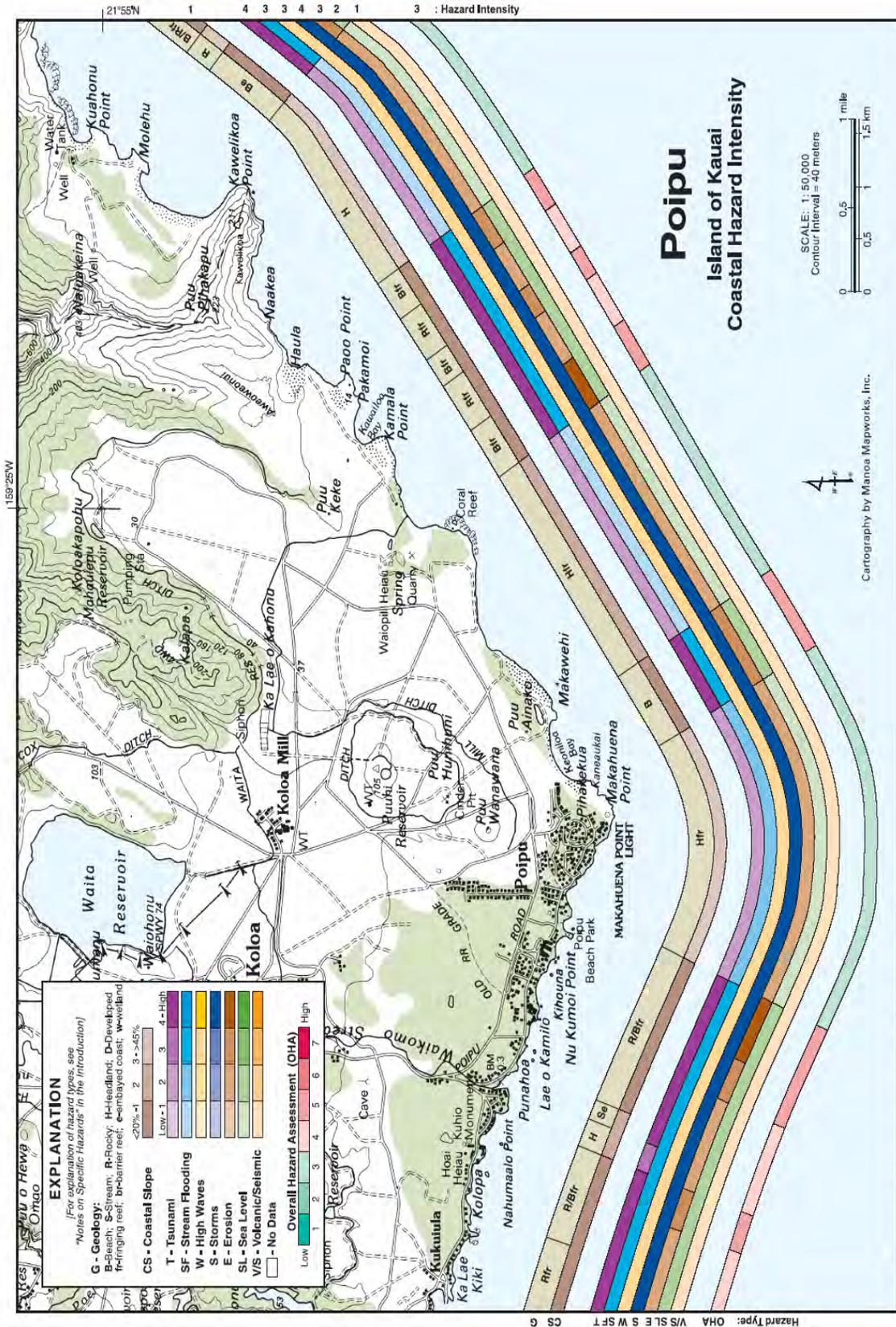


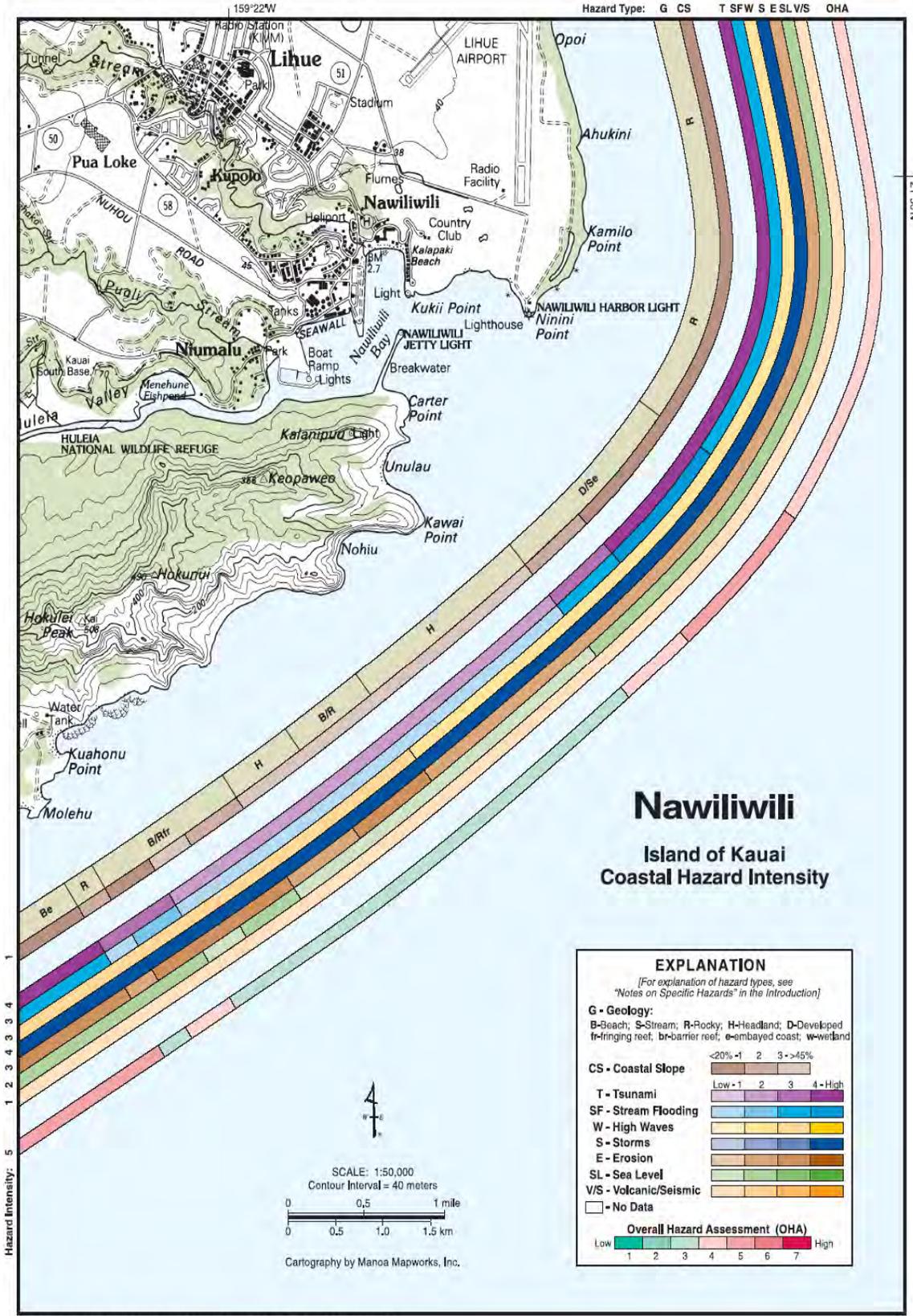


Base Credit: USGS 1:50,000 Western Kauai, Hawaii 5022 II W733 Edition 1-DMA

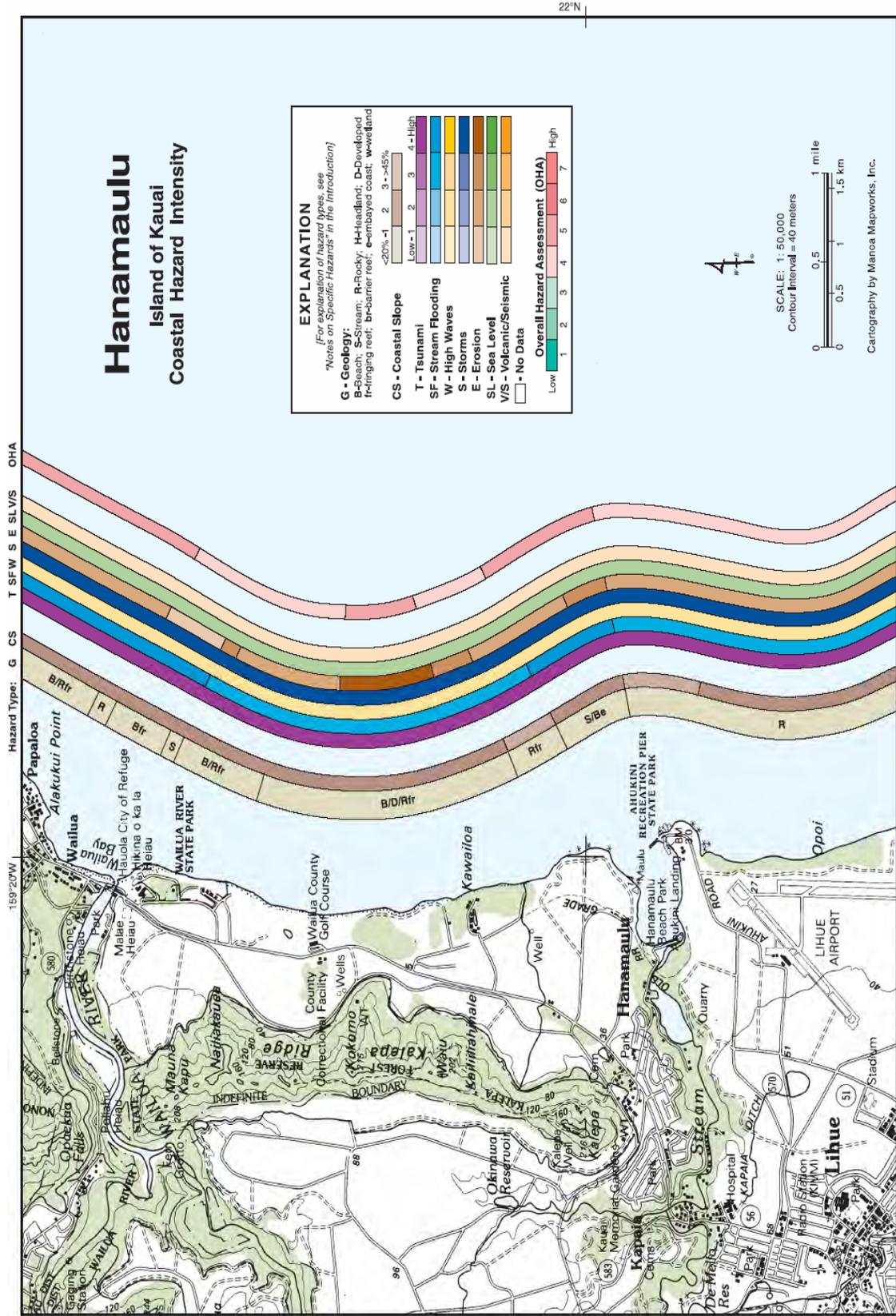


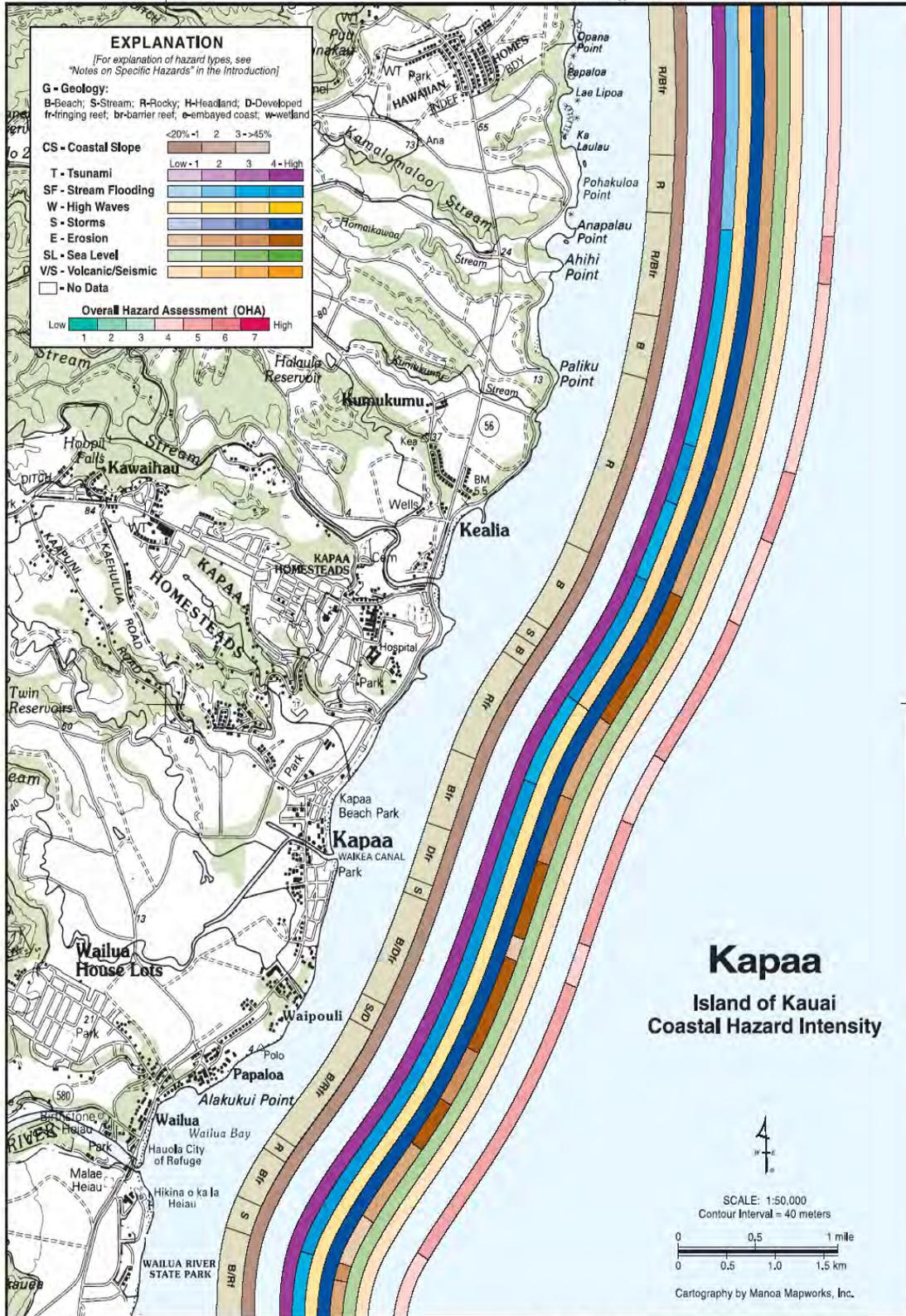
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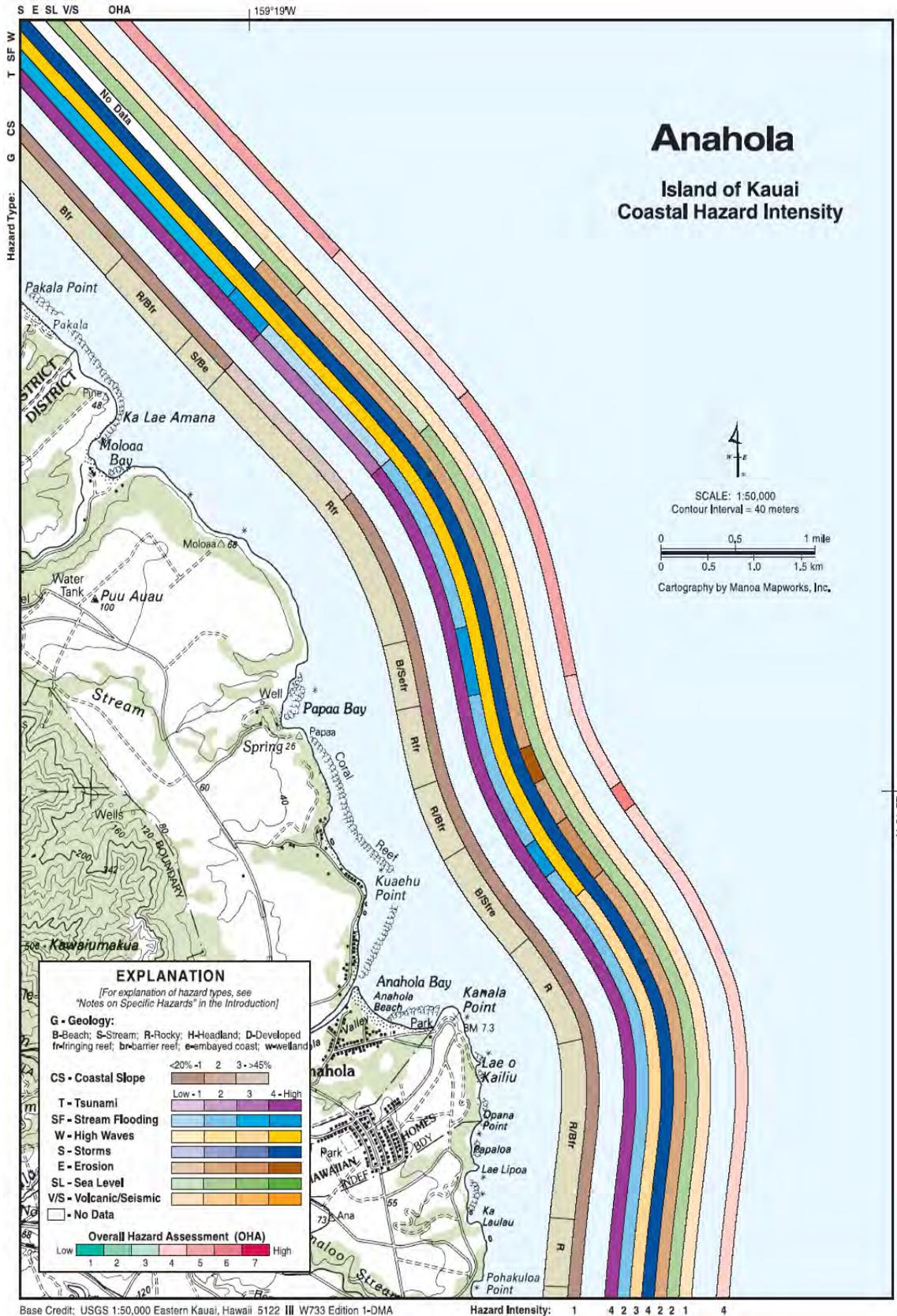
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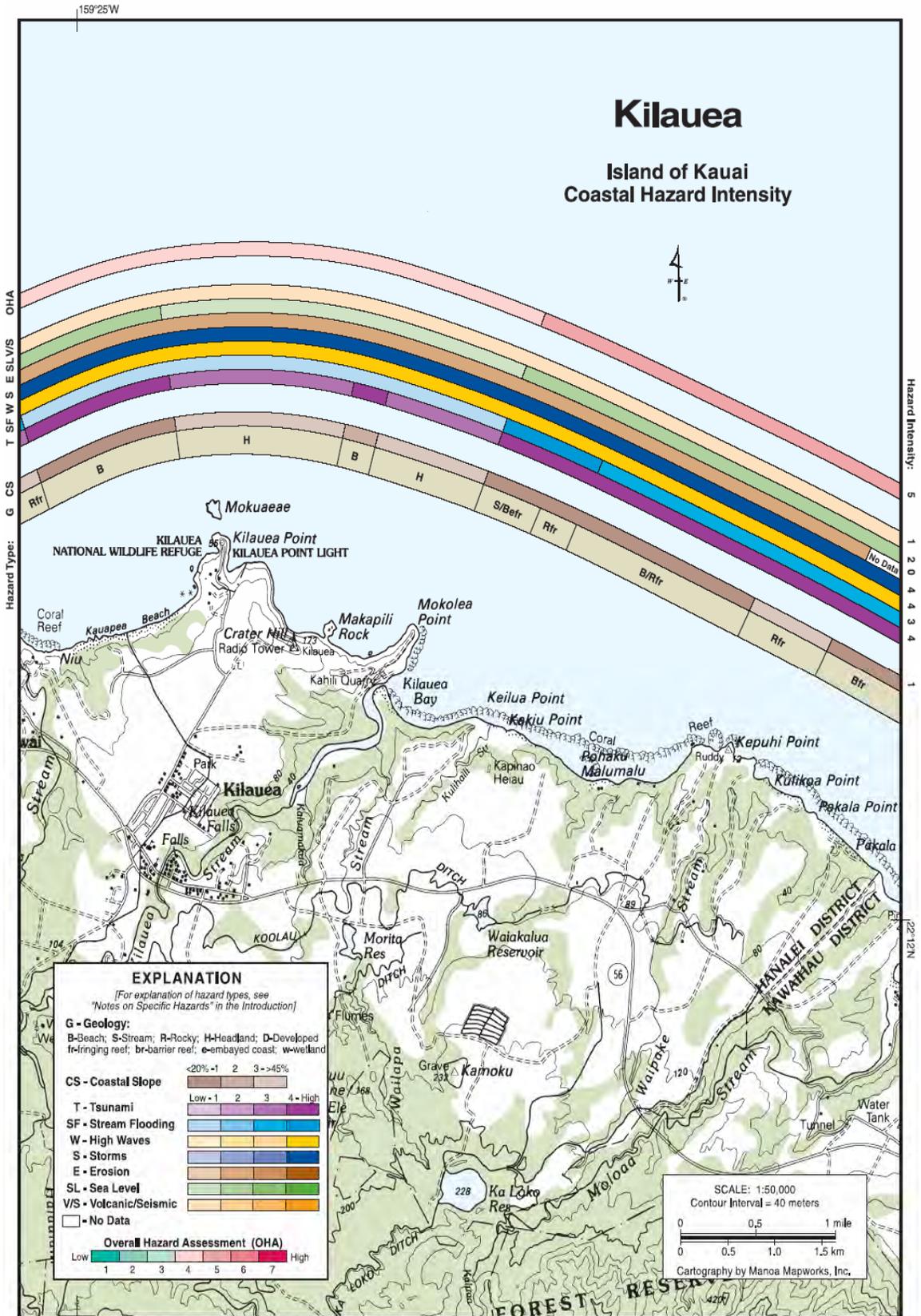


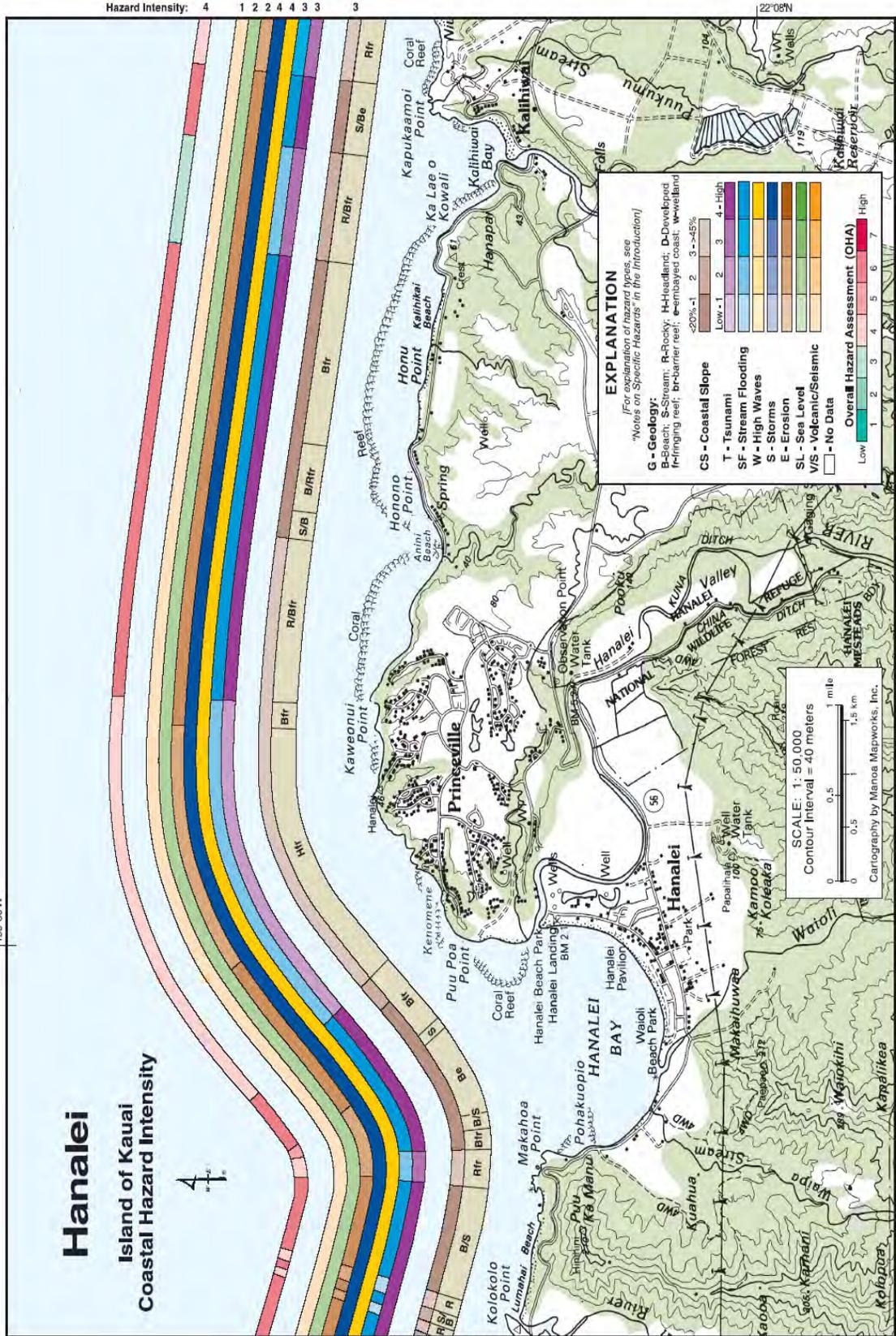


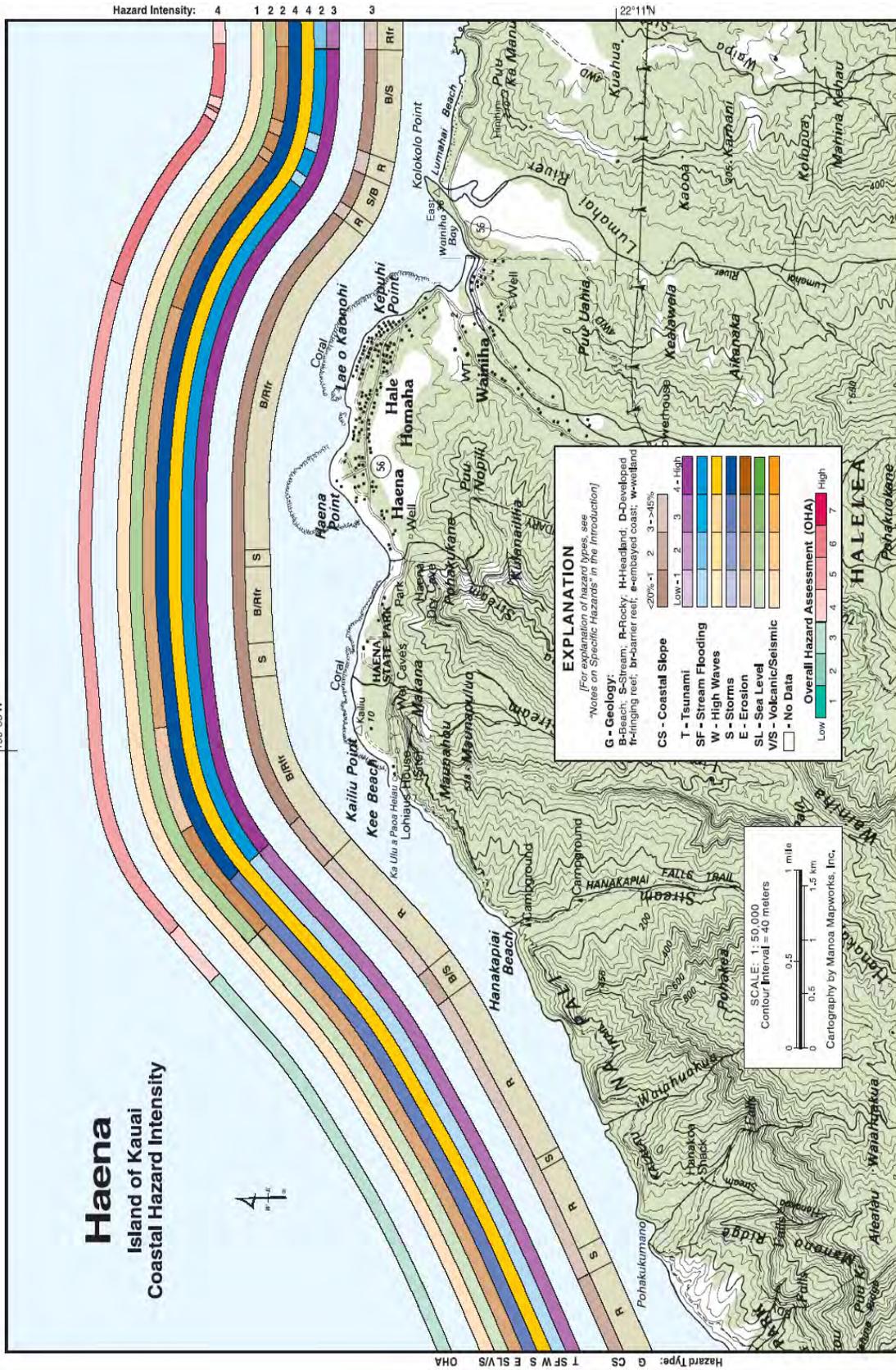
Hazard Intensity: 1 4 3 2 4 2 2 1 4

Base Credit: USGS 1:50,000 Eastern Kauai, Hawaii 5122 III W733 Edition 1-DMA









Base Credit: USGS 1:50,000 Western Kauai, Hawaii 5022 II W733 Edition 1-DMA

