Multi-Hazard Mitigation and Resilience Plan

May 2021

Volume 2 of 2—Appendices

TETRA TECH

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

May 2021

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NOTE:
This document uses spelling for Hawaiian geographic names, including diacritical marks (‘okina or kahakō), as currently included in spreadsheets developed by the Hawai‘i Board of Geographic Names. These are available online at https://planning.hawaii.gov/gis/hbgn/

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ABBREVIATIONS

Abbreviation	Definition	Abbreviation	Definition
%g	Percent force of gravity (a measure of acceleration)	**Hazmat**	Hazardous materials
44 CFR	Code of Federal Regulations, Title 44	**Hazus**	Hazards U.S.
AMBER	Areal Mean Basin Estimated Rainfall	**HMP**	Hazard Mitigation Plan
BEACH Act	Beaches Environmental Assessment and Coastal Health Act of 2000	**IAL**	Important Agricultural Lands
BRIC	Building Resilient Infrastructure and Communities	**IBC**	International Building Code
CARW	Communities at Risk from Wildfires	**IRC**	International Residential Code
CIP	Capital Improvement Plan	**KEMA**	Kaua‘i Emergency Management Agency
CO2	Carbon dioxide	**KFD**	Kaua‘i Fire Department
CRS	Community Rating System	**LiMWA**	Limit of Moderate Wave Action
CWPP	Community Wildfire Protection Plan	**MM**	Modified Mercalli Scale
DAR	Division of Aquatic Resources	**NEHRP**	National Earthquake Hazards Reduction Program
DFIRM	Digital Flood Insurance Rate Maps	**NFIP**	National Flood Insurance Program
DHS	U.S. Department of Homeland Security	**NOAA**	National Oceanic and Atmospheric Administration
DLNR	Department of Land and Natural Resources	**NWS**	National Weather Service
DMA	Disaster Mitigation Act of 2000	**PDI**	Palmer Drought Index
DOFAW	Division of Forestry and Wildlife	**PGA**	Peak Ground Acceleration
EAP	Emergency Action Plan	**PIRCA**	Pacific Islands Regional Climate Assessment
EPA	U.S. Environmental Protection Agency	**ppm**	Parts per million
ESA	Endangered Species Act	**SFHA**	Special Flood Hazard Area
FEMA	Federal Emergency Management Agency	**SLOSH**	Sea, lake, and overland surges from hurricane
FERC	Federal Energy Regulatory Commission	**SPI**	Standardized Precipitation Index
FIRM	Flood Insurance Rate Map	**STAPLEE**	Social, technical, administrative, political, legal, environmental, and economic
FIS	Flood Insurance Study	**USDA**	U.S. Department of Agriculture
GIS	Geographic Information System	**USGS**	U.S. Geological Survey
HAR	Hawai‘i Administrative Rules	**WUI**	Wildland urban interface

Appendix A. Status of Actions Recommended in Previous Plan

A. STATUS OF ACTIONS RECOMMENDED IN PREVIOUS PLAN

MITIGATION ACTIONS

The 2015 County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan identified 61 mitigation actions for implementation. These actions were reviewed for the current update, and for each action it was determined whether the action had been completed, was in progress or had not been started. Incomplete actions were reviewed to determine if they should be carried over to the 2020 update or removed from the plan due to a change in priorities, capabilities, or feasibility. Table A-1 lists the status of all 61 actions from the 2015 plan.

Three of the identified actions (5 percent) have been completed, 48 (79 percent) are carried over to the 2020 update, and 10 (16 percent) have been withdrawn. The reasons for withdrawal of actions ranged from the action no longer being considered feasible to the action being identified as a repeat entry in the 2015 plan.

While some of the prior actions have been carried over, all have been reframed and re-prioritized to a different schedule from prior plans. Each carried over has an action number assigned to it for the 2020 update, and many were reworded to more clearly state their intent.

PLAN INCORPORATION ACTIONS

As a demonstration of progress in local hazard mitigation efforts, plan updates must describe completed steps to incorporate the mitigation plan into other planning mechanisms as appropriate. The maintenance strategy for the 2015 County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan called for incorporation into other planning mechanisms, but no clear actions or metrics were identified to measure successful incorporation. The capability assessment performed for this update identifies some links between the County’s hazard mitigation planning and its core capabilities, but no information is available on specific actions related to incorporation during the past performance period for this plan.

Of the 61 mitigation actions in the 2015 plan, one action relates to incorporation of the mitigation plan into other planning mechanisms. The 2018 General Plan update incorporated recommendations from the 2015 plan in subsection actions.

This plan update identifies actions for plan incorporation with clear metrics to monitor their completion; therefore, meeting federal requirements for future updates should be easier for the County.

Table A-1. Prior Action Status

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Promote widespread awareness of actions for reducing disaster risks and mitigating impacts of hazards in policies, planning, and program implementation. Encourage training of personnel and communities on preparedness, community outreach/awareness, resilience, and mitigation.			✓	KC20
Comment: *Ongoing; KEMA turnover; position vacated & reclassified*				
Ensure hazard mitigation is incorporated into the Kaua'i County General Plan (ten-year plan, 2015-2025).	✓			
Comment: *The General Plan was updated in 2018. The plan includes an entire sector dedicated to public safety and hazards resiliency (Sector IX). Within the sector are three subsections: (1) Police, fire, ocean safety, and emergency services, (2) Hazards resiliency, and (3) Global warming and climate change adaptation. Recommendations from the 2015 COK Multi-Hazard and Mitigation Plan were incorporated into the subsection actions (see pages 195-197 of the General Plan).*				
For new construction of public buildings, designate areas to serve as a shelter.			✓	KC11
Comment: *Ongoing*				
Review and ensure agreements are in place among private utilities, the executive government agencies, Kaua'i Emergency Management Agency (KEMA), and the Red Cross to ensure that high priority facilities and shelters are maintained.				KC41
Comment:				
Consider options to secure funds to retrofit facilities with hurricane shutters, roof tie-downs, and other improvements, such as emergency power generation equipment.			✓	KC8
Comment: *Ongoing*				
Continue to develop agreements with hotels and resorts to house their own guests and worker families during hurricanes and other major natural disasters.			✓	KC41
Comment: *Ongoing*				
Identify sheltering requirements and facilitate dialogue with key segments of the population to ensure that there are places for these populations to shelter and remain safe during disasters. For example, sheltering in place options may be preferred for mental health clinics with patients requiring specific medications and care, elderly care home may have non-ambulatory patients, or domestic violence centers may have women who would be unsafe in another facility.			✓	KC37
Comment: *Ongoing COVID-19 issues.*				
Continue to develop County of Kaua'i plans that integrate national goals and initiatives for disaster risk management. Ensure synergy in programs to maximize resources and benefits from disaster funding. Ensure compliance with NIMS.			✓	KC41
Comment: *Ongoing*				
Integrate agricultural planning and coordination into disaster risk management to improve local food security, sustainability, and community resilience to hazards.			✓	KC45
Comment: *Ongoing coordination with OED*				
Develop a post-disaster recovery plan that incorporate mitigation considerations. Enable mitigation objectives in rehabilitation and reconstruction to prevent additional problems from improper development, land use, or further environmental degradation during the chaos of post-disaster recovery. Identify policies and programs ahead of time so that when a disaster occurs, time will not be wasted in determining the best course of action.			✓	KC18
Comment: *Ongoing Planning Department and Resilience Plan*				

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Continue to work with community, faith-based, and government facilities to identify and survey shelters to meet the demand for sheltering during crises, and to meet the needs for specific populations. Coordinate with ARC.			✓	KC11
Comment: *Ongoing*				
Look for funding and planning opportunities to promote disaster resistant affordable housing in Kaua'i County.			✓	KC8
Comment: *Ongoing*				
Update GIS mapping of residences to ensure identification of risks and vulnerable residences to develop and prioritize risk reduction actions.			✓	KC40
Comment: *Ongoing*				
Provide alternate distribution feed to the Līhu'e Airport with the installation of auto transfer switchgear, and underground conduits and cables.			✓	KC7
Comment: *Ongoing pending HMGP funding*				
Procure new 4,000 gallon capacity water truck to assist in providing the public with potable water as well as assist other state and county agencies efforts in disaster management activities.			✓	KC6
Comment: *Not yet purchased.*				
Continuity of building operations while they serve as emergency shelters. Purchase of 5 diesel generators and installation of generator tie-ins to the electrical system for 5 buildings. Per the Community Wildfire Protection Plan development process, DLNR DOFAW, along with KFD require a water bladder (already acquired) to assist with helicopter water sources for water drops during wildland fires.			✓	KC41
Comment:				
Install public address system to ensure effective emergency communications to the KCC campus and surrounding areas.			✓	KC39
Comment:				
Installation of a 500 kWdc photovoltaic ground mount and canopy renewable power generation systems ("PV") and renewable energy storage system ("RESS") at KCC.			✓	KC5
Comment:				
Continue to review and update building codes and distribute wind risk information to those considering building permits.	✓			
Comment: *The wind risk study was completed with FEMA funding and is in the 2012 IBC State Building Code Amendments. It is also being used in the 2018 IBC SBC Amendments that are pending.*				
Hardening of the Kalāheo gymnasium for hurricane shelter purpose: install structural hardening measures to allow the gymnasium to serve as an emergency shelter during natural disaster evacuations.	✓			
Comment: *Substantially complete.*				
Hardening of the Kīlauea gymnasium for hurricane shelter purpose: install structural hardening measures to allow the gymnasium to serve as an emergency shelter during natural disaster evacuations.			✓	KC8
Comment: *Ongoing.*				
Hardening of the Kaua'i War Memorial Conventional Hall Exhibition Hall: install a hurricane shutter system to protect all exhibit hall windows & glass doors to allow use of the exhibit hall as a disaster shelter during natural disaster evacuations.			✓	KC3
Comment: *Ongoing.*				

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Provide DLNR managed lands with productive watershed values and vegetative ground cover to prevent soil erosion. Reforestation and restoration of watershed resources on DLNR-DOFAW lands that were consumed by 3 Wildfires in 2012. Remove Wildfire damaged trees and provide appropriate vegetative ground cover to enhance watershed values while protecting near shore aquatic resources and public use. Plant native and non-native plant species appropriate for Puʻu Ka Pele, and Na Pali-Kona Forest Reserve locations on Kauaʻi.			✓	KC34
Comment: *DOFAW is currently in the process of drafting a contract with a vendor to assist in the removal of hazardous fuel loads within the previously burnt areas. DOFAW is also focusing on the firebreaks and fire safety zones in the Pu'u Ka Pele high risk areas.*				
Harden State DLNR radio repeater sites (3) and base station on Kauaʻi. Purchase and construction of inter-operability radio system and wind storm resistant structures that provide DLNR staff a safe operating system to implement incident management procedures. Repair and Replace existing equipment and structures to meet new FCC compliance standards at Pu'u Ka Pele, Kāhili, Kīlauea, and Līhuʻe DLNR Baseyard locations on Kauaʻi.			✓	KC4 KC32
Comment: *DLNR is working with a vendor to get 5 repeater sites up and running to allow for island wide communications. These sites include Kōkeʻe/NASA, Kukui, Kāhili, Kukuiolono, Kilohana and Kīlauea. Basestation phones have been installed at DOFAW baseyard, DOFAW office, DSP office and DOCARE offices to enable better emergency response communications.*				
Hardening of Kālepa Village. To update the County EEP plan to be consistent with the State EEP Plan. Provides plan to address disaster situations and market disruptions and to hasten economic recovery.			✓	KC8
Comment: *Ongoing.*				
Hardening of Paʻanau Village. Provide exterior sheathing to increase wall strength, harden windows, doors and glass doors and/or provide hurricane shutters to reduce structural failures in the event of a hurricane. Provides 60 families with a secure facility and reduces impact on Kōloa area shelters.			✓	KC8
Comment:				
County of Kaua'i is already addressing compliance with NFIP as required. This policy recommendation is that attention to NFIP compliance continues.			✓	KC47
Comment: *Complete and ongoing.*				
Work with the State NFIP coordinator to develop the program for participation in the Community Rating System.				KC48
Comment: *Ongoing.*				
Ensure public awareness of flood risks and ways to mitigate flood hazards, including participation in the National Flood Insurance Program.			✓	KC19
Comment: *Ongoing.*				
Hardening of the Kalāheo gymnasium for hurricane shelter purpose: install structural hardening measures to allow the gymnasium to serve as an emergency shelter during natural disaster evacuations.		✓		
Comment: *Duplicate.*				
Hardening of the Kīlauea gymnasium for hurricane shelter purpose: install structural hardening measures to allow the gymnasium to serve as an emergency shelter during natural disaster evacuations.		✓		
Comment: *Duplicate.*				

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update	
			Check if Yes	Enter Action #
Hardening of the Kaua'i War Memorial Conventional Hall Exhibition Hall install a hurricane shutter system to protect all exhibit hall windows & glass doors to allow use of the exhibit hall as a disaster shelter during natural disaster evacuations. ***Comment:*** *Duplicate.*		✓		
Improve data gathering and accounting for risk and vulnerability assessments for drought and wildfires. ***Comment:***			✓	KC41
Implement the County drought mitigation strategies. **Currently, drought mitigation plans exist for the State of Hawai'i and the County of Kaua'i. The plans need to be implemented at a local level and updated regularly to address new needs. The projects have been updated every two years, but the overall plan needs to be updated to reflect changes.** ***Comment:***			✓	KC45
County-Wide Conservation and Education Program. ***Comment:***		✓		
Emergency Interconnection-DOW Kōloa Water System-Grove Farm Kōloa System. Water source protection of this facility will be a proposed new project. ***Comment:***		✓		
Engage in public education programs with schools and communities. These programs include: 1) Smokey Bear material/fire prevention radio and TV spots; 2) Talks to schools, civic organizations, etc.; 3) Public notices/news releases declaring high fire danger periods; 4) Posting of fire prevention/high fire danger warning signs and posters; 5) KFD Annual Brushfire Mitigation Meeting; and, 6) the Kaua'i Drought Committee annual meeting. ***Comment:*** *Ongoing.*			✓	KC20
Identify and reduce hazardous fuels. Identify areas with potentially hazardous fuels. Reduce "flash" fuels in high use areas. Engage in programs for conversion of "flashy" fuels in high use areas. **Currently: Community Wildfire Protection Plan development is underway, with completion targeted for 2016, and public awareness meetings to be conducted with information from new plan.** ***Comment:*** *Ongoing.*			✓	KC34
Minimize fires through land use policies and control. Determine appropriate restriction of the general public use within a fire hazard. Encourage land use that reduces fire dangers, such as vegetation clearing and clean-up programs. Require fire plans for all appropriate land use activities within the DLNR Department of Forestry & Wildlife's Management jurisdictions. ***Comment:*** *Ongoing.*			✓	KC34

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Purchase D-4 Dozer to enhance DLNR/DOFAW capabilities to manage wildfire activities and implement forest recovery management objectives. Procuring D-4 dozer will be used to broaden firebreaks and provide for safe evacuation routes for the public. It will also be used in the reforestation and restoration efforts after the wildfires to repair the damaged watershed and lessen effects of soil erosion. Construct and repair firebreaks, open access routes in Pu'u Ka Pele and Na Pali-Kona Forest Reserves on Kaua'i.			✓	KC33
Comment: *Ongoing. DOFAW is also in the process of receiving 4 pieces of new equipment to assist in fire and emergency response around the island:* - *T880 Dump truck* - *Grader 150* - *Excavator 325 w/Fecon mulcher* - *D6 track type tractor*				
Provide DLNR managed lands with productive watershed values and vegetative ground cover to prevent soil erosion. Reforestation and restoration of watershed resources on DLNR-DOFAW lands that were consumed by 3 Wildfires in 2012. Remove Wildfire damaged trees and provide appropriate vegetative ground cover to enhance watershed values while protecting near shore aquatic resources and public use. Out plant native and non-native plant species appropriate for Pu'u Ka Pele, and Na Pali-Kona Forest Reserve locations on Kaua'i.		✓		
Comment: *Duplicate.*				
Upgrade fire alarm system throughout the KCC campus and retrofit existing fire sprinkler systems in buildings designated as emergency shelters.		✓		
Comment:				
Consider the impacts of climate change (higher temperatures, sea level rise, extremes in rainfall as floods or drought, and potential increases in tropical storm frequency or severity) in land use, development, and planning. **Kaua'i Climate Change and Coastal Hazards Assessment Sea Grant included such considerations (minus higher temperatures) with a focus on coastal hazards. This information will also be incorporated into three community plans.**			✓	KC17
Comment: *Ongoing. Since 2016, the following projects integrated climate change impacts and concerns:* *<u>General Plan Update</u>: The General Plan integrated climate change considerations in several ways. One of the plan's 19 policies is Policy #14: Prepare for climate change. The policy states: "Prepare for impacts to the island economy, food systems, and infrastructure that will caused by climate change." The plan also includes a subsection called "Global Warming and Climate Change Adaptation" with an objective to prepare for and adapt to the impacts of climate change on the natural and build environments. Within the subsection are 19 actions that are divided across 4 actions types: permitting and code change, plans and studies, projects and programs, and partnership needs. Additionally, the future land use map did not designate greenfield areas susceptible to sea level rise as future growth areas.* *<u>Draft West Kaua'i Community Plan</u>: The plan builds upon the General Plan's future land use map and developed town plan maps for each West Side community. Coastal properties vulnerable to sea level rise, located makai of the public road, were identified on the map as "Coastal Edge." The draft plan is proposing to create a new zoning district called "Special Treatment Coastal Edge" which will require a use permit/public hearing for all development.*				

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Consider potential socioeconomic impacts from climate change for Kaua‘i. Many sectors will be impacted by climate change: water resource management, disaster risk management, public health, agriculture, and tourism. Impacts will be felt first in communities, and sustainability of these communities should be considered. **The Ha`ena to Hanalei Community Disaster Resilience Plan includes considerations for impacts from climate change.** **Governor Abercrombie held a series of "climate resilience forums" on all islands (including one w/PRiMO), for which Kaua'i County departments participated. Climate projects are also being conducted by the Pacific RISA (funded by NOAA) and NWS, and the Pacific Islands Climate Change Cooperative is developing resources for forested areas, especially.** **Additional departmental observations & ongoing initiatives: Accelerated erosion along shorelines is among the first impacts of sea level rise.** **Additional climate change-related issues include Invasives – such as Albizia trees—with increased risk from storms/strong winds—as well as the invasive Madagascar lizard putting stress on the Hawaiian gecko.**			✓	KC18
Comment: *Ongoing. The General Plan includes a sector entitled "Opportunity and Health for All." Within the sector is a subsection that focuses on social equity whose objective is to recognize and address inequities in health and well-being among Kaua‘i's diverse ethnic, racial, and income groups. One action in the subsection is to: "Ensure all residents have an opportunity to have a voice in County initiatives by making special efforts to reach low-income people, youth, non-English speaking immigrants, people with criminal records, and other traditionally underserved groups."* *The General Plan also includes a Social Equity Map (Figure 3-21) that identifies communities with high levels of poverty and minorities. The priority areas identified by the map include Anahola, Hanamā‘ulu, Puhi, Kōloa, Hanapēpē, ‘Ele‘ele, and Kaumakani.*				
Educate leaders and the public about sea level rise, increased disaster risks, and ecosystem impacts from climate change that will ultimately affect the livelihood of the people in Kaua‘i. Integrate the findings of scenarios and assessments (especially those conducted by State and Federal partners in risk management) into county policies. **Sea Grant Extension conducts community presentations around coastal management, SLR, erosion, coastal planning, etc. and presentations at County Council, governmental departments**			✓	KC18
Comment: *Ongoing. The General Plan supports this action. In the General Plan's subsection for Global Warming and Climate Adaptation, the permitting action is to: "Use the best available climate and hazard science to inform and guide decisions. Determine a range of locally relevant sea level rise projections for all stages of planning, project design, and permitting reviews. At the time of this General Plan Update publication, the science suggests a planning target of three feet of sea level rise."*				

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Participate in State training and assistance in the use of modern codes and retrofit guidelines for county officials and design professionals. Encourage sponsorship and collaboration in training with the Contractors' Association of Kauaʻi. Attend annual Hawaiʻi Association County Building Officials. Trainings w/CAK and with the Structural Engineers Association of Hawaiʻi (SEAOH), who aid in providing training on updated building codes and amendments. Extend training and education to local engineers in Kauaʻi County. Trainings conducted – HACBO seminars: 2015 Kona 2016 Honolulu 2017 Kaua'i 2018 Maui 2019 Kona All HACBO seminars covered IBC/IRC training as well as the NEC and UPC/IPC for Kauaʻi electrical and plumbing inspectors. Kauaʻi also had stand-alone training for: 2017 NEC (Kaua'i) 12/3/2018 2015 IECC (Kaua'i) 4/18/2018 ***Comment:*** *Ongoing.*			✓	KC2
Continue education and awareness about tsunami warnings and evacuation routes. Continue to work with communities to identify safe areas for immediate evacuation and mass sheltering for longer term needs. Continue to maintain signage and sirens that were installed as part of the updated maps for tsunami evacuation zones. ***Comment:*** *Ongoing.*			✓	KC35 KC37
Community Education & Hazard Publication Distribution. Purchase and distribute University of Hawaiʻi, Sea Grant publications, Purchasing Coastal Real Estate in Hawaiʻi (http://hawaii.gov/dlnr/occl/manuals-reports/Purchasing%20Coastal%20Real%20Estate.pdf) and Homeowner's Handbook to Prepare for Natural Hazards at any opportunity, including community meetings, annual Contractor's Expo, County Fair and the front counter of the Planning Department. Some of these types of activities have been done and are Ongoing by Economic Development, KVB, KIUC, KCDA, Sea Grant, FD through CERT, and Contractor's Association, County Fair (August) by Economic Development. KCDA conducted extensive community outreach related to 2014 tsunami evacuation zone update. Community meetings, website and phone book/yellow book updates were preformed, along with brochure development and a supporting evacuation signage project along roads/highways. Greater Aleutian Tsunami scenario work for expanded zones is the next project that is nearing completion and should be by April 2015. ***Comment:*** *Ongoing*			✓	KC19
Hardening of the Kalāheo gymnasium for hurricane shelter purpose: install structural hardening measures to allow the gymnasium to serve as an emergency shelter during natural disaster evacuations. ***Comment:*** *Duplicate.*		✓		

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
Install a Civil Defense outdoor warning siren on Ni‘ihau. ***Comment:*** *In-process, Equipment received (by KEMA?) Robinson Family to "plant" pole*			✓	KC38
Hardening of the Kīlauea gymnasium for hurricane shelter purpose: install structural hardening measures to allow the gymnasium to serve as an emergency shelter during natural disaster evacuations. ***Comment:*** *Duplicate.*		✓		
Hardening of the Kaua‘i War Memorial Conventional Hall Exhibition Hall install a hurricane shutter system to protect all exhibit hall windows & glass doors to allow use of the exhibit hall as a disaster shelter during natural disaster evacuations. ***Comment:*** *Duplicate.*		✓		
The landslides in Kaua‘i have predominantly impacted highways, which are the responsibility of the Department of Transportation Highways Division. KCDA and Fire are participating in statewide task forces and meetings to plan for addressing impacts through mitigation measures along highway corridors. ***Comment:*** *Ongoing.*			✓	KC49
Review studies on erosion and sea level rise, and plan for variable setbacks. Minimize coastal development, especially in areas of high erosion risk. Plan for development using the best available knowledge. Work with the State OCCL to update the Coastal Erosion Mitigation Plan for the county. ***Comment:*** *Ongoing. The Planning Department is updating its shoreline setback ordinance with updated coastal erosion data developed by Chip Fletcher, University of Hawai‘i.*			✓	KC42
Participate in the inspection, repair, and maintenance of dams and levees. The County should work with State and Federal agencies to secure resources for repair and maintenance of dams and levee systems to reduce potential disasters. **Action adjusted as this pertains to County dams only, the State handles majority of the dams. Culverts under roadways were not done properly – County roads division/Public Works is currently working on this effort.** **U.S. Army Corps of Engineers did a 2013 study and recommended in conformance that the levees need to be raised. There is a need to propose mitigation actions to raise the height of the levees for Waimea and Hanapēpē. Would require $16 Million. Dept. Public Works will continue to look at maintenance requirements to see if existing levees are in compliance. The levees have been raised with ongoing maintenance to be done, which has an effect on flood insurance to public.** ***Comment:***			✓	KC25 KC46
Collection of household hazardous waste materials is done on an annual basis for all residents of Kaua‘i. This includes but is not limited to batteries, paint, pesticides, chemicals and other hazardous materials. **The County has a comprehensive hazardous waste disposal program for County-generated waste.** ***Comment:*** *Ongoing.*			✓	KC41

Action Item	Completed	Removed; No Longer Feasible	Carried Over to Plan Update: Check if Yes	Carried Over to Plan Update: Enter Action #
The Critical Infrastructure Program (CIP) needs to be integrated with hazard mitigation programs in the county, hazardous materials management in the Department of Health, and localized for protection at the county level. Some of these actions have been done, including the assessment of critical infrastructure. The local emergency planning committee previously put vulnerabilities on their public website, but this is now confidential. **Ongoing. Some of these actions have been done, including the assessment of critical infrastructure. The local emergency planning committee previously put vulnerabilities on their public website, but this is now confidential. FEMA CIKR protection trainings and exercises (AWR213 and MGT414) were brought to Kaua'i in 2014, with further training set to occur in 2015.** ***Comment:***			✓	KC8
Engage in public education, outreach, and partnerships with non-traditional institutions, agencies, commissions, retail, etc., and also work through the volunteer agencies ensuring the citizens and businesses are integrated with the existing capacity of the emergency management community. ***Comment:*** *Ongoing.*			✓	KC20
Secure cyber information and technology, which are critical to support of economy, lifelines, and government operations. ***Comment:*** *Ongoing.*			✓	KC22
Enhance the multi-hazards exercise and training programs to ensure integrated risk reduction for hazards that consider additional threats. ***Comment:*** *Ongoing*			✓	KC28
Research links between health, climate change, and disaster risk. Build findings into public health programs to ensure adequate medicine and medical resource availability. Following a disaster or extreme climate event, such as a hurricane or drought, the public is at risk from water-borne diseases. Additional threats occur from increased temperatures related to heat stroke. There are links in diseases such as malaria, dengue, and leptospirosis from extremes in flooding and drought. ***Comment:*** *Ongoing*			✓	KC16

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix B. Changes in This Plan Update

B. CHANGES IN THIS PLAN UPDATE

Table B-1. Plan Changes Crosswalk

44 CFR Requirement	2015 Plan Update	2020 Plan Update

§201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
	Chapter 2 of the plan provides a description of the planning process. The Plan lays out a multi-step planning process that included the following steps:
	• Briefed County Officials and invited participation from public and private agencies, organizations, and groups.
	• Assessed available county social, economic, government, critical lifeline and infrastructure
	  • Recorded mitigation activities of the Contractors Association of Kauaʻi which demonstrates Commitment to hazard mitigation
	• Consulted community-based organizations
	• Continued to maintain and build the GIS system with additional asset data and updated Hazard layers
	• Updated the Risk and Vulnerability Analysis using GIS information
	• Used meetings and media to educate the public about Hazard Mitigation, Risk and Vulnerability Assessment, Resilience, and the overall planning process
	• To support the risk and vulnerability assessment and map updates, public forums and Meetings were held
	  • Debuted the Plan Update Draft at a Countywide public forum
	• Provided website for distributing documents and for receiving public input
		This planning process was facilitated through a process centered on community stakeholder engagement. The update was facilitated through a Steering Committee made up of stakeholders within the planning area. The Steering Committee was responsible for review of relevant plans and programs, agency coordination, review and identification of goals and objectives, confirmation of a public involvement strategy, development of a plan implementation maintenance strategy, and review and approval of the draft plan.
		All Steering Committee meetings were open to the public. Additional public input was received through several public meetings held early and late in the planning process and through a public survey. A 30-day public comment period was held before the draft plan was submitted for review.
		Agency coordination occurred through several avenues, including the development of the risk assessment and mitigation initiative action plan, the composition of the Steering Committee and the dissemination of the draft plan for public comment.

§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.	The plan profiles 13 identified hazards of concern in Chapter 3. Chapter 5 of the plan includes a qualitative discussion of risk and vulnerability.	A comprehensive risk assessment for the planning area looks at 10 hazards of concern: tropical cyclone and other high winds; wildfire; climate change; inland flood; high surf, coastal flood and erosion; tsunami; landslide; dam failure; earthquake; and heat and drought. Hazards that could be profiled in similar context (i.e. heat and drought) were assessed as a single hazard. This was a quantitative assessment that used the best available data and science with the Hazus (version 4.2) risk assessment software and GIS analysis.

44 CFR Requirement	2015 Plan Update	2020 Plan Update
§201.6(c)(2)(i): [The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.	Chapter 3 of the plan profiles 13 identified hazards of concern. Each profile includes discussion of extent and location of the hazard. Each hazard profiles included the following components: • Description of Hazard • Historic events • Qualitative summary of loss • Hazard Mapping	Comprehensive risk assessments of each hazard of concern are presented in Chapters 4 through 13. Each chapter includes the following: • Hazard profile, including extent and location, historical occurrences, frequency, severity and warning time • Secondary hazards • Exposure of people, property, critical facilities and environment • Vulnerability of people, property, critical facilities and natural environment • Future trends in development • Scenarios • Issues The hazards are compared to each other via a risk ranking methodology described in Appendix F of Volume 2.
§201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i). This description shall include an overall summary of each hazard and its impact on the community.	Chapter 5 of the plan includes a qualitative vulnerability assessment that utilized the principle of "Average Annualized Loss", of the profiled hazards of concern. Most of the data presented was statewide scale data. No modeling was performed.	Vulnerability was assessed for all hazards of concern. The Hazus computer model (version 4.2) was used for the dam failure, earthquake, flood, and tropical cyclone hazards. These were Level-2 (user-defined) analyses using coordinating agency and County data. Critical facilities were defined and inventoried using the Hazus Comprehensive Data Management System and other available datasets. Outputs were generated for other hazards by applying an estimated damage function to affected assets when available. The asset inventory was extracted from the Hazus model. Best available data were used for all analyses.
§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods.	Chapter 3, section 3.2.3 addresses the NFIP, and NFIP insurance coverage on the island. Chapter 5, section 5.2.2 qualitatively assesses the vulnerability of NFIP insured structures and addresses identified Repetitive Loss Properties in Kauaʻi.	The description of the National Flood Insurance Program and repetitive loss discussion is included in Volume 1, Section 7.2. The update includes a comprehensive analysis of repetitive loss properties. For these properties, the type of structure was determined and causes of flooding were cited, and the information was reflected on maps. National Flood Insurance Program capability is also assessed.
§201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.	The vulnerability assessment in Chapter 5 includes exposure analyses of both general building stack and critical facilities and infrastructure. Loss estimation was varied by hazard and was mostly qualitative.	A complete inventory of the numbers and types of buildings exposed was generated for each hazard of concern. The Steering Committee defined "critical facilities" as they pertain to the planning area, and these facilities were inventoried by exposure. Each hazard chapter provides a discussion of future development trends as they pertain to the hazard. Detailed risk assessment results are provided in Volume 2, Appendix M.

44 CFR Requirement	2015 Plan Update	2020 Plan Update
§201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) and a description of the methodology used to prepare the estimate.	Chapter 5 includes average annual loss calculations for Hurricanes and earthquake hazards.	Dollar loss estimations were generated for all hazards of concern. These were generated by Hazus for the dam failure, earthquake, flood, and tropical cyclone hazards and tsunami hazards. For the other hazards, loss estimates were generated by applying a regionally relevant damage function to the exposed inventory. In all cases, a damage function was applied to an asset inventory. The asset inventory was the same for all hazards and was generated in the Hazus model.
§201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land-use decisions.	The plan does not directly address this requirement but does quasi address indirectly thorough the core capabilities assessment in Chapter 6, table 6-1.	There is a discussion on future development trends as they pertain to each hazard of concern in Section 2.6. Further detail is provided in Volume 2, Appendix G. This discussion looks predominantly at the existing land use and the current regulatory environment that dictates this land use.
§201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing tools.	Chapter 7 presents a mitigation strategy. This strategy builds on the revised and updated goals and objectives for hazard mitigation and resilience, approved by the Mayor and Disaster Management Committee (DMC).	Chapter 14 contains a hazard mitigation action plan that was developed for the County via a facilitated process that included: • Goals and objectives • Alternatives analysis • Recommended actions • Benefit-cost review • Action plan prioritization • Classification of mitigation actions
§201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.	Chapter 1, Section 1.1 includes a mitigation strategy that includes mitigation goals and objectives. The plan identifies 6 goals with objectives thar are subsets of each goal. The plan identifies no mission or vision statement.	Chapter 14 identifies 7 updated goals and 16 new objectives that stand on their own merit. Objectives were selected that meet multiple goals, and initiatives were selected and prioritized based on meeting multiple objectives.
§201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.	The plan identified a range of future mitigation projects for each hazard. Projects were summarized by hazard type and policy type.	A catalog of Mitigation best practices (Appendix N) was utilized by the Steering Committee to represent a range of alternatives by hazard. The selected alternatives provide a baseline of actions that are backed by a planning process, are consistent with the established goals and objectives, and are within the capabilities of Kaua‘i County to implement. A table in the initiative action plan section analyzes each action by mitigation type to illustrate the range of actions selected. This is detailed in Section 14.6.
§201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program, and continued compliance with the program's requirements, as appropriate.	Chapter 3, section 3.2.3 includes a profile on the County's NFIP status as well as discussion on repetitive loss.	The capability assessment in Section 3.2 includes an assessment of capabilities related to NFIP requirements. This is augmented by data provided in Appendix K. The action plan in Chapter 14 includes actions supporting continued compliance and good standing under the program.

44 CFR Requirement	2015 Plan Update	2020 Plan Update
§201.6(c)(3)(iii): [The mitigation strategy shall describe] how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	Chapter 7, Section 7.2 identifies a prioritization scheme for the plan. The criteria for determining inclusion in the plan were based on a series of practical questions: • Effectiveness: Will this project reduce hazard risks in the county? • Focused: Is the project supportive of the goals and objectives for mitigation approved by the DMC? • Feasible, Appropriate, and Equitable/Just: If we apply a STAPLEE analysis, where we look at Social, Technical, Administrative, Political, Legal, Environmental, and Economic aspects of the proposed project, will this project be beneficial to Kaua‘i County? • Will these actions reduce hazard risks and build resilience? • Beneficial and Cost-Effective: Is there a greater benefit than cost ratio for the applied project? If not, is there an unaccountable social benefit for reducing risks that merit inclusion of the project in the plan? • Achievable and Sustainable: Will this mitigation action be achievable with local knowledge and resources or will external assistance be required? (Where external assistance is required, the efforts were separated in the list in Section 7.2 so that a funding strategy can be considered.)	Each of the recommended initiatives is prioritized using a qualitative methodology that looked at the objectives the project will meet, the timeline for completion, how the project will be funded, the impact of the project, the benefits of the project and the costs of the project. This prioritization scheme is detailed in Section 14.5.
§201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a 5-year cycle.	Chapter 8 of the plan included a plan maintenance protocol that recommended an ongoing hazard mitigation planning committee intended to meet and produce reports on a quarterly basis to support an annual review.	A detailed plan maintenance strategy, found in Chapter 14 includes the following: • Annual review and progress reporting • Defined role for Steering Committee • Plan update triggers • Plan incorporation guidelines • Strategy for continuing public involvement • Grant coordination protocol.
§201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.	The plan did not include this discussion.	This is contained in the detailed plan maintenance and implementation strategy in Chapter 14.

44 CFR Requirement	2015 Plan Update	2020 Plan Update
§201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.	The plan did not include this discussion.	This is contained in the detailed plan maintenance and implementation strategy in Chapter 14.
§201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commission, Tribal Council).	The plan included a letter of adoption dated June 19, 2015, signed by the County of Kaua‘i Mayor.	Kaua‘i County will seek DMA compliance with this plan update. Appendix P contains the adoption resolution.

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix C. Plan Update Development Methodology

C. PLAN UPDATE DEVELOPMENT METHODOLOGY

FORMATION OF THE CORE PLANNING TEAM

Kauaʻi County hired Tetra Tech, Inc. to assist with development and implementation of the 2020 *County of Kauaʻi Multi-Hazard Mitigation and Resilience Plan*. The Tetra Tech project manager assumed the role of the lead planner, reporting directly to the Kauaʻi County project manager. A Core Planning Team was formed to lead the planning effort, made up of the following members:

- David Kennard, Kauaʻi County Emergency Management Agency, Disaster Assistance Project Manager
- Chelsie Sakai, Kauaʻi County Emergency Management Agency, Senior Staff Officer
- Kaliko Kabasawa, Kauaʻi County Emergency Management Agency, Emergency Management Staff Specialist
- Alan Clinton, Kauaʻi Emergency Management Agency, Disaster Assistance Recovery, Mitigation, & GIS Officer
- Diane DeHart, Kauaʻi County Emergency Management Agency, Staff Specialist
- Ruby Pap, Kauaʻi County Planning Department, University of Hawaiʻi Sea Grant Extension Agent
- Marie Williams, Kauaʻi County Planning Department, Long Range Planning Division Manager
- Rob Flaner, Tetra Tech, Project Manager
- Cindy Rolli, Tetra Tech, Project Planner
- Carol Baumann, Tetra Tech, Risk Assessor
- Megan Brotherton, Tetra Tech, Planner

DEFINING THE PLANNING AREA

The planning area was defined as the entire County of Kauaʻi. For evaluation in this hazard mitigation plan, some analyses were broken down by district, using the boundaries defined for planning districts in the County. The Island of Niʻihau is also part of Kauaʻi County but, as in the Kauaʻi County General Plan, it is not analyzed in this hazard mitigation plan due to its predominantly private ownership and management.

THE STEERING COMMITTEE

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A Steering Committee was formed to oversee all phases of the plan. The members of this group included key Kauaʻi County staff, citizens, and other stakeholders from within the planning area. The Core Planning Team assembled a list of candidates representing interests within the planning area that could have recommendations for the plan or be impacted by its recommendations. The team confirmed a Steering Committee of 13 members—seven representing government agencies and six representing non-government interests or groups. Some members chose to designate alternates to attend on their behalf. Table C-1 lists the Steering Committee members.

Table C-1. Steering Committee Members

Agency	Name	Title
Kauaʻi Island Utility Cooperative	Jan TenBruggencate (Chairperson)	Communications Consulting, Island Strategy LLC
Hawaiʻi Department of Health - Kauaʻi District Health Office	Lauren Guest (Vice Chairperson) **Alternate:** Janet Berreman	Public Health Preparedness Planner District Health Officer
Kauaʻi County Office of Economic Development	Ben Sullivan	Energy/Sustainability Coordinator
Mayor's Office	Polly Phillips	Policy Analyst
Hawaiʻi Visitors and Convention Bureau	Sue Kanoho	Executive Director
Kauaʻi Parks & Recreation	Patrick Porter	Director
Kauaʻi County Public Works Department	Doug Haigh Stanford Iwamoto	Building Division Chief Floodplain Manager
Līhuʻe Business Association	Pat Griffin	President
Hanapēpē - ʻEleʻele Hawaiʻi Hazards Awareness and Resilience Program	Jean Souza	Hanapēpē - ʻEleʻele Hawaiʻi Hazards Awareness and Resilience Program Volunteer
University of Hawaiʻi	Mehana Vaughan	Assistant Professor
Kapaʻa Business Association	Mike Hough **Alternate:** Rayne Regush	President Chairperson Wailua-Kapaʻa Neighborhood Association
Kauaʻi Emergency Management Agency	Chelsie Sakai	Senior Staff Officer
Hawaiʻi Emergency Management Agency	Larry Kanda (Ex-Officio Member)	State Hazard Mitigation Officer

Meetings

Leadership roles and guidelines were established during the Steering Committee's meeting on May 14, 2020. The Steering Committee agreed to meet monthly as needed throughout the course of the plan's development. The Core Planning Team facilitated each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the plan update. The Steering Committee met nine times from May 2020 through December 2020. Meeting agendas, notes, and attendance logs are provided in Attachment C-1 at the end of this appendix. All Steering Committee meetings were open to the public, and agendas and meeting notes were posted to the hazard mitigation and resilience plan website.

COORDINATION WITH OTHER AGENCIES

Under federal requirements for hazard mitigation planning, opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.6(b)(2)). The Steering Committee met this requirement as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee as indicated above.
- **Public Outreach and Requested Data**—The following agencies assisted with public outreach efforts, provided data that supported the risk assessment portion of the plan, or reviewed the mitigation catalog used for the development of the mitigation initiative action plan:
  - FEMA Region IX
  - Hawaiʻi Emergency Management Agency
  - Hawaiʻi State Department of Land and Natural Resources
  - The Pacific Disaster Center
  - National Weather Service
  - National Oceanic and Atmospheric Association

- University of Hawaiʻi
- Kauaʻi County Planning Department

- **Pre-Adoption Review**—All agencies listed above were invited by direct e-mail to review and comment on this plan during the public comment period. Access to the draft plan was primarily through the hazard mitigation and resilience plan website. The complete draft plan was sent to the Hawaiʻi Emergency Management Agency, which, after completing its review, forwarded the plan to FEMA Region IX for review and approval pending adoption.

REVIEW OF EXISTING PROGRAMS

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.6(b)(3)). The following plans and programs can affect mitigation within the planning area:

- Hawaiʻi Hazards Awareness and Resilience Program
- Hawaiʻi State Plan
- Hawaiʻi State Grants-in-Aid for Capital Improvement Projects
- Hawaiʻi State Hazard Mitigation Plan
- Kauaʻi County Capital Improvement Program
- Kauaʻi Kākou—Kauaʻi County General Plan
- Kauaʻi County Code

PUBLIC INVOLVEMENT

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR, Section 201.6(b)(1)). The Community Rating System expands on these requirements by making CRS credits available for optional public involvement activities.

Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Identify and involve planning area stakeholders.
- Include members of the public on the Steering Committee.
- Use a survey to determine the public's perception of risk and support of hazard mitigation.
- Invite public participation at open-house public meetings.
- Attempt to reach as many planning area citizens as possible using multiple media.

Stakeholders and the Steering Committee

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation and resilience plan. The effort to include stakeholders in this process included stakeholder participation on the Steering Committee. Stakeholders targeted for this process included the following:

- County of Kauaʻi departments relevant for hazard mitigation planning
- State of Hawaiʻi departments relevant for hazard mitigation planning
- Local disaster-preparedness and relief organizations
- Local utilities.

Survey

The Core Planning Team developed a hazard mitigation plan survey with guidance from the Steering Committee. The survey was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards. The answers to the survey's 12 questions helped guide the Steering Committee in affirming goals and objectives and developing mitigation actions. Multiple methods were used to solicit survey responses:

- A web-based version of the survey was made available on the plan website (see Figure C-1).
- Attendees at public meetings and open houses were asked to complete a survey.
- A press release was distributed to local media urging residents to participate.
- Kaua'i County Planning Department advertised the survey on social media and by email blast.

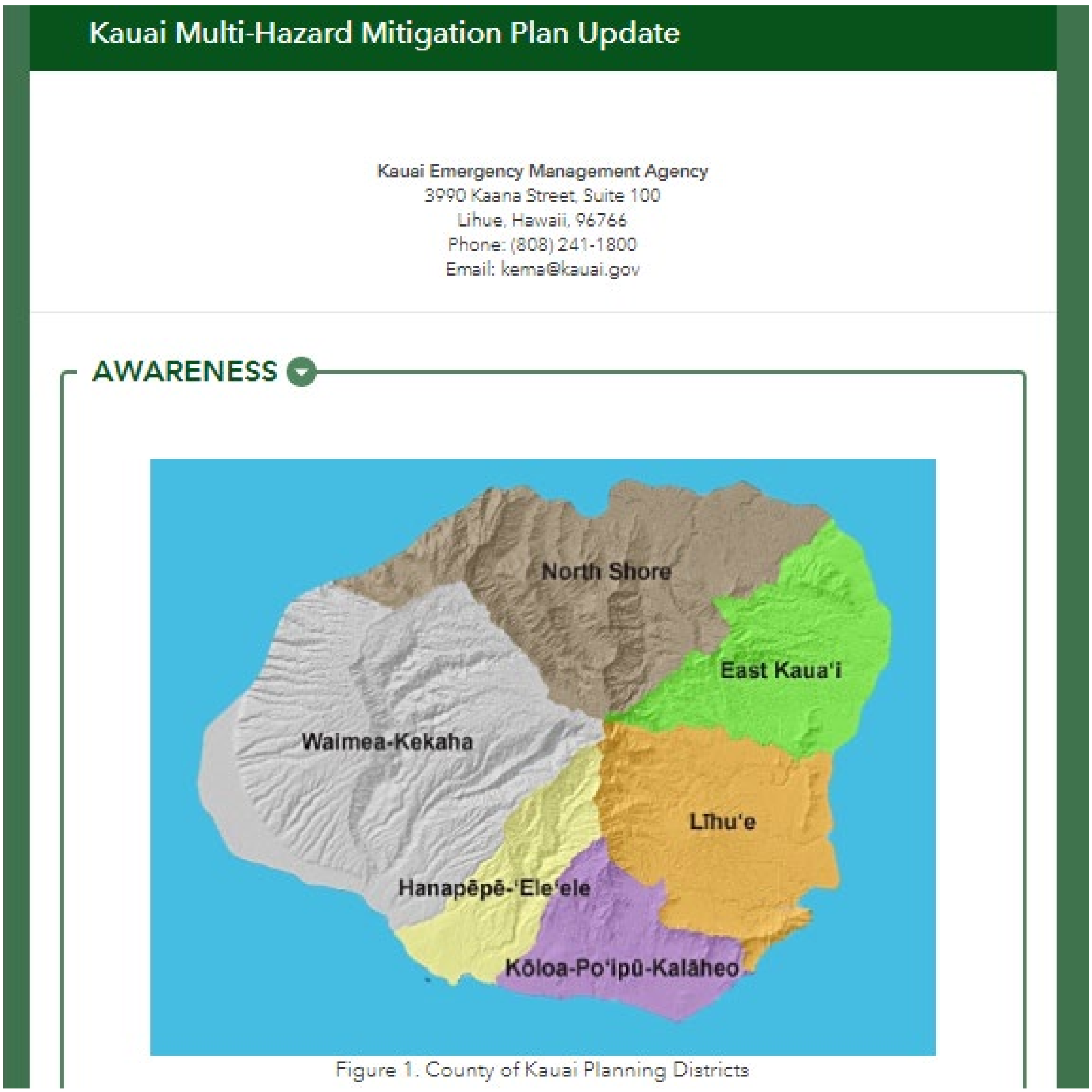

Figure C-1. Sample Page from Survey Distributed to the Public

Public Meetings

Due to COVID-19 restrictions on large gatherings, four public meetings were held virtually via Zoom:

- Thursday, September 24, 2020 at 5:00 pm
- Saturday, September 26, 2020 at 2:00 pm
- Thursday, January 14, 2021 at 6:00 pm
- Saturday, January 16, 2021 at 1:00 pm

The September 2020 meetings followed a StoryMap presentation format (see Figure C-2), which allowed attendees to examine maps and have direct question and answer sessions with project staff (see Figure C-3). Reasons for planning were shared with attendees during the presentation. All attendees were asked to complete a survey and encouraged to submit additional questions or comments to the Core Planning Team. The January 2021 meetings also followed a StoryMap presentation of the final hazard analysis results, included a question and answer session, and allowed for public comment on the draft plan. Local media outlets were informed of the public meetings by press releases from the Core Planning Team.

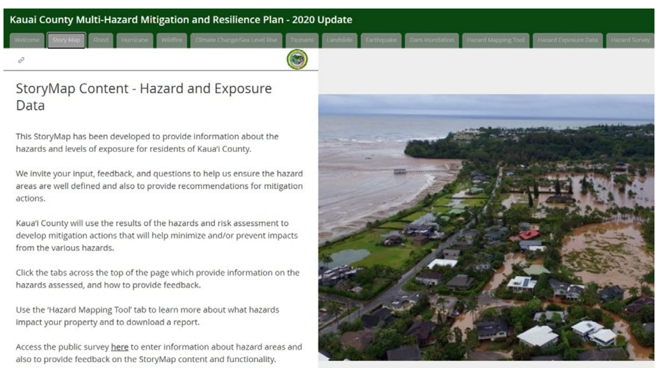

Figure C-2. Planning Overview Presentation at the September 26, 2020 Public Meeting

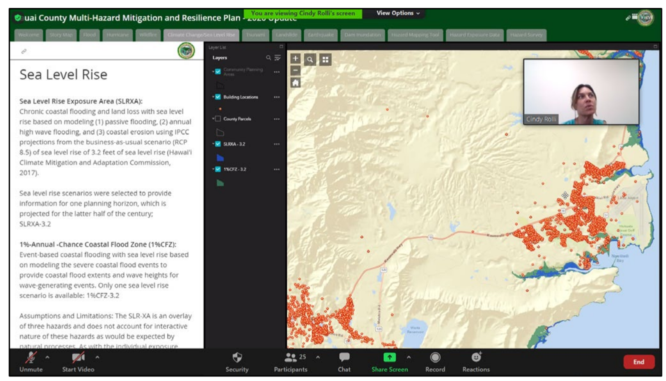

Figure C-3. Hazard Map Presentation at the September 26, 2020 Public Meeting

Media Outreach

Press Releases

Press releases were distributed over the course of the plan’s development as key milestones were achieved and prior to each public meeting. The planning effort received the following press coverage:

- Jun 23, 2020 article on the KFMN-FM97-96.9 website, “Public invited to participate in the 2020 update of the County of Kaua‘i Multi-Hazard Mitigation and Resiliency Plan” (https://kauaifm97.com/?p=913)
- July 4, 2020 article on TheGardenIsland.com, “Input sought on hazard mitigation, resilience plan” (https://www.thegardenisland.com/2020/07/04/hawaii-news/input-sought-on-hazard-mitigation-resilience-plan/)
- September 23, 2020 article on TheGardenIsland.com, “Hazard mitigation, resilience meetings set” (https://www.thegardenisland.com/2020/09/23/hawaii-news/hazard-mitigation-resilience-meetings-set/) (see Figure C-4).

Internet

At the beginning of the plan update process, the County created a new hazard mitigation website (https://kauai-multi-hazard-mitigation-plan-update-kauaigis.hub.arcgis.com/) to include information about the update process (see Figure C-5).

Hazard mitigation, resilience meetings set

By The Garden Island | Wednesday, September 23, 2020, 12:05 a.m.

Share this story

LIHU'E — The Kaua'i Emergency Management Agency invites residents of Kaua'i County to participate in virtual public meetings this week in support of the 2020 Multi-Hazard Mitigation &Resilience Plan update.

The meetings are Thursday, Sept. 24, from 5 to 7 p.m., and Saturday, Sept. 26, from 2 to 4 p.m. The Zoom link for the Thursday meeting is us02web.zoom.us/j/89467738243?pwd=Wm4yL3pOQXJYSXBVeHdDK3dDT3lmdz09. The meeting ID is 894 6773 8243, and the passcode is Kauai2020.

The link for the Saturday meeting is us02web.zoom.us/j/87433172336?pwd=a3UwNTi6Z2k0enorVWZvSzZNWGNJdz09, and the passcode is Kauai2020.

Once approved by the Federal Emergency Management Agency, the plan makes the county eligible for pre- and post-disaster mitigation-project grant funding through FEMA's Hazard Mitigation Assistance programs, and other non-emergency disaster assistance.

The plan is the county's hazard and risk assessment that looks at how the county can lessen the impact of natural hazards and become more resilient in the face of future disasters. During this planning process, county and local leaders, communities and individuals work in tandem to identify risks, assess capabilities and formulate a strategy to reduce disaster vulnerability in our county.

Public participation and feedback are vital parts of the hazard-mitigation planning process. KEMA is holding the virtual meetings to present the results of the hazard-risk assessment. The meetings are an opportunity for the community to review, validate and update the hazard and risk information.

Figure C-4. Display of September Press Release on The Garden Island

Figure C-5. Landing Page from Hazard Mitigation Plan Website

Throughout the process, the website was used to keep the public informed on milestones and to solicit relevant input. The site's address was publicized in all press releases, mailings, surveys and public meetings. Information on the plan development process, the Steering Committee, the survey and phased drafts of the plan was made available to the public on the site throughout the process. Kauaʻi County intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

Radio

On December 14, 2020, David Kennard of KEMA was interviewed by Makaʻala Kaʻaumoana on the KKCR radio show "Makai Watch." He answered questions about how the public could participate in the plan update process by reviewing and commenting on the draft plan and by attending upcoming virtual public meetings. He also explained some of the FEMA requirements for the plan update, the components of the plan, and why the plan is being updated. (https://www.kkcr.org/onair/schedules/kkcr-archives/)

Public Comment Period

A draft of the hazard mitigation plan was released for public comment during a 30-day period from January 4 to February 2, 2020. The Core Planning Team provided a press release notifying the public about the review period. The draft was made available on the hazard mitigation plan website. Because the public review period occurred during the stay-at-home period for the COVID-19 pandemic, public opportunity to learn about the plan was provided through two on-line public meetings on January 14 and 16, 2020. The meetings included a presentation given by a planning team member and information on hazards and general preparedness. Attendees were given the opportunity to provide written or verbal feedback on the draft plan. A recording of the presentation at these meetings was posted on the website.

Public Involvement Results

Survey Outreach

A total of 534 respondents completed the online survey for this plan—all but one identified themselves as Kauaʻi County residents; the other did not indicate residency. Detailed survey results are provided in Attachment C-2 at the end of this appendix. Key findings are as follows:

- Hazards about which the most respondents said they are most concerned are hurricane (87 percent), health-related (38 percent), tsunami (37 percent), high windstorm (33 percent), climate change (37 percent), and rainfall flooding (32 percent).
- The greatest number of respondents do not know if their home is located within a natural hazard area (28 percent), but many know they live in a tsunami evacuation zone (20 percent) or a FEMA flood zone (14 percent).
- Respondents prefer to receive information via automated messages from the Emergency Management Agency (67 percent), social media (64 percent), and government websites (59 percent).
- Many respondents would like to have hazard information more readily available for the following, in order of preference: hurricane, tsunami, flood, health-related hazards, rainfall flooding, and high windstorms.
- Respondents mostly describe themselves and their family as being able to support themselves in the event of a natural disaster, with 28 percent who can support themselves, their family and neighbors; and 21 percent who can support themselves, their family and anyone in need of assistance. However, 12 percent will need to turn to the community for support.
- The most common preparedness methods for which respondents need additional information or resources include the following:

- ➢ Whether to shelter in place or evacuate (46 percent)
- ➢ First aid/CPRT training (31 percent)
- ➢ Purchase and learn how to program a NOAA Weather Radio (32 percent)
- ➢ Subscribe to Emergency Civil Defense Alerts (24 percent)
- ➢ Personal preparation plan (20 percent)
- ➢ 14-day supply of food (21 percent)
- ➢ Prepare an emergency survival kit (20 percent).

- Many of the respondents are interested in strengthening their home from a natural disaster if they receive assistance in the form of tax incentives (46 percent), personal property tax reduction to retrofit (45 percent), or insurance premium discounts for retrofits (38 percent).
- Respondents carry insurance policies primarily to cover high/hurricane winds (68 percent) and floods (28 percent).
- Some respondents face obstacles that prevent them from strengthening their home for the next disaster. The greatest obstacles are that it costs too much (40 percent), respondents do not know what to strengthen or how to do it (32 percent), they rent their home (25 percent), or they cannot find a contractor to do the work (11 percent).
- Respondents ranked government-sponsored risk reduction projects in the following order of preference:

- ➢ Infrastructure retrofits
- ➢ Projects that restore the natural environment's ability to absorb the impacts from natural hazards
- ➢ Projects focused on reducing climate change impacts
- ➢ Retrofits to essential facilities
- ➢ Better public information about risk.

- In the time of disasters, respondents expect the government to provide emergency health services (82 percent), cleanup and reconstruction (74 percent), and basic services for those most in need (62 percent).

Public Meetings

By engaging the public through the public involvement strategy, the concept of mitigation was introduced to the public and the Steering Committee received feedback that was used in developing the components of the plan. Details of attendance and comments received are summarized in Table C-2. Due to lack of attendance by members of the public, the meeting on January 16, 2021, ended after 30 minutes.

Table C-2. Summary of Public Meetings

Date	Location	Number of Citizens in Attendance
9/24/2020	Virtual via Zoom	8
9/26/2020	Virtual via Zoom	15
01/14/2021	Virtual via Zoom	6
01/16/2021	Virtual via Zoom	0
Total		**29**

PLAN DEVELOPMENT CHRONOLOGY/MILESTONES

Table C-3 summarizes important milestones in the development of the plan.

Table C-3. Plan Development Milestones

Date	Event	Description	Attendance
2020			
	Initiate consultant procurement	• Seek a planning expert to facilitate the process	N/A
April	Select Tetra Tech to facilitate plan development	• Facilitation contractor secured	N/A
May	Identify Core Planning Team	• Formation of the Core Planning Team	N/A
5/01	Core Planning Team Meeting	• Identification of potential Steering Committee members • Confirm agenda for Steering Committee meeting • Identify guidelines	10
May	Steering Committee formed	• Potential Steering Committee members contacted	N/A
5/14	Steering Committee Meeting #1	• Introduce potential Steering Committee members to planning process • Discuss the role of the Steering Committee • Review and discuss proposed guidelines for Steering Committee • Review update process and schedule • Introduce and discuss public involvement strategy	21
5/21	Core Planning Team Meeting	• Steering Committee kickoff meeting review • Discuss public engagement strategy	9
6/04	Core Planning Team Meeting	• Public engagement strategy (website, survey, press release, public meeting planning) • Discuss critical facilities/lifelines	11
6/18	Steering Committee Meeting #2	• Confirm mission and goals • Adopt hazards of concern • Discuss hazard scenarios • Review public outreach strategy	21
6/23	Core Planning Team Meeting	• Steering Committee meeting debrief • Review survey and initial feedback • Vision, mission, goals and objectives review • Review scenarios • Discuss objectives exercise	10
7/02	Core Planning Team Meeting	• Discuss public engagement strategy • Review objectives exercise • Discuss scenario update • Critical facility/lifeline discussion • Review capability assessment • Set Steering Committee agenda	12
7/9	Steering Committee Meeting #3	• Objectives exercise, finalize objectives • Discuss public engagement strategy	21
8/13	Steering Committee Meeting #4	• Hazard scenario discussion • Mitigation actions discussion • Guest presentation – Dr. Mehana Vaughan: Hālana ka Man'ao: Lessons & Recommendations from the 2018 Kaua'i Floods	20
9/10	Steering Committee Meeting #5	• Risk assessment and exposure analysis presentation • Mitigation actions discussion • Public meeting preparation	20
9/16	Public Outreach	• Press release announcing public meetings	N/A
9/24	Public Outreach	• Public meeting via Zoom	8
9/26	Public Outreach	• Public meeting via Zoom	15

Date	Event	Description	Attendance
10/08	Steering Committee Meeting #6	• Hazard exposure/mitigation action discussion: Flood, Hurricane, Sea Level Rise/Climate Change, Tsunami	18
10/15	Interim Steering Committee Meeting #7	• Hazard exposure/mitigation action discussion: Wildfire, Dam Inundation, Landslide, Health Hazards, Earthquake, Multi-Hazards • Review draft action plan • Discuss options for public meeting • Project timeline update	13
11/12	Steering Committee Meeting #8	• Reviewed risk ranking • Achieved consensus on actions	20
12/10	Draft Plan	• Internal review draft of plan provided by Core Planning Team to Steering Committee	N/A
12/10	Steering Committee Meeting #9	• Overview of the draft plan organization • Plan review guidelines	19
2021			
1/4	Public Comment Period	• Initial public comment period of draft plan opens. Draft plan posted on plan website with press release notifying public of plan availability.	N/A
1/14	Public Outreach	• Online public meeting on draft plan via Zoom	6
1/16	Public Outreach	• Online public meeting on draft plan via Zoom	0
2/2	Public Comment Period	• Initial public comment period of draft plan closes	N/A
2/9	Plan Approval	• Final draft plan submitted to the Hawai'i Emergency Management Agency, FEMA Region IX, and the Insurance Services Office for review and approval.	N/A
4/21	Adoption	• Plan adopted by Kaua'i County	N/A
4/30	Final Plan Approval	• Final plan approved by FEMA	N/A

Attachment C-1. Steering Committee Meeting Materials

County of Kauai
Meeting Agenda

Purpose of Meeting:	Kauai County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date of Meeting:	05.14.2020

Attendees:

David Kennard	Benjamin Sullivan	Doug Haigh	Jean Souza
Marie Williams	Mike Hough	Pat Griffin	Polly Phillips
Ruby Pap	Stanford Iwamoto	Sue Kanoho	Jan TenBruggencate
Kaliko Kabasawa	Pat Porter	Janet Berreman (alt)	Lauren Guest
Alan Clinton	Cindy Rolli	Megan Brotherton	
Chelsie Sakai	Rob Flaner		

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	**Welcome and Introductions** • Introductions • Review Agenda	No Actions
2	**The Steering Committee (SC) Role** • SC Purpose ○ Bringing in different perspectives from many sectors for advisement of the plan update. Identify hazards, risks, projects to prioritize. Projects identified in HMP are eligible for funding. • SC Expectations • SC Organization/Guidelines ○ Self-select a chair to moderate the process as needed ○ Self-select a vice chair as an alternate ○ Spokesperson will be chair of Steering Committee and will be media contact. ○ Quorum 7. 13 voting members. ○ Meet once per month initially, then may meet every other month. Identify alternate if SC member cannot attend all meetings. Email David and Cindy to discuss alternatives. ○ Decision making – consensus of SC members. Vote if consensus cannot be achieved and record dissenting views. ○ The Core Planning Team (CPT) is a small team to work through agendas and logistics made up of David Kennard, Chelsie Sakai, Alan	Decision: Steering Committee Meetings will be the 2nd Thursday of every month from 1-2:30pm via Teams or another avenue Decision made by consensus: Chair – Jan TenBruggencate Vice Chair – Lauren Guest Pat Griffin motion Ben Sullivan second motion Lauren Guest will become SC member, with Dr. Janet Berreman serving as her alternate. Action: Core Planning Team to edit the Guidelines for public engagement after determining virtual options available and circulate to the Steering Committee for review, input and consensus

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County of Kauai
Meeting Agenda

	Clinton, Christian Kabasawa, Ruby Pap, Marie Williams, facilitated by Cindy Rolli with TetraTech ○ Public involvement will be determined by ground rules. Will need to register to attend. Can comment on upcoming agenda. ○ Q & A, Comments: ▪ Jean – Will comments be allowed on the current agenda? Yes, with 3-5-minute time constraint. Can submit written testimony. If public comments after a meeting, decision-making should be held at subsequent meeting, not at the meeting where the agenda item is presented. Decision-making will be delayed until public has had a chance to comment. Jan – Don't vote the first time an item is discussed. Alan - Table this discussion until virtual platform and communication is determined. ▪ For public awareness, agendas should state whether an item is for discussion or decision-making. • Confirm SC guidelines ○ Once approved, guidelines will be posted on the website. ○ Meeting minutes are taken for SC meetings, uploaded to website and included in plan ○ Ben – Do SC members engage public for opinions or is it just the designated spokesperson? All SC members can individually engage the public. Spokesperson is only one to represent SC as a whole and speak to the media.	
3	**Public Involvement Strategy Table until virtual meeting platform is determined.** ○ Public involvement needs to feel genuine and be meaningful. • Press release announcing commencement of the plan update process ○ County website will house any information from SC meetings, links to previous KHMP and State HMP, public survey to gauge risk	Gain consensus on Public Involvement Strategy potentially via email before the next Steering Committee meeting. Jean to send Cindy and David a link for outreach examples. SC members to share other outreach avenues.

2

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awareness, draft risk assessment for public review, draft plan for public review
To engage those without internet access potentially use flyers with QR codes, Garden Island Newspaper, Eye on Kauai, email lists from previous and ongoing plans: West Kauai, Hanapepe and others. Use as many types of outreach as possible to get best sampling of community.
Marie – Websites are not a powerful tool for engagement. Email lists, newspaper ads, direct outreach, island wide mailings are most effective. Leverage personal relationships. IG and FB reach different groups of people. Existing Kauai IG account from Planning Department may be used.
Jean – Educational webinars or films by experts in a field also promoting involvement in HMP update.
Ruby – Dennis Hwang webinar through Sea Grant in late May/early June. May be able to put in a plug for the Kauai HMP update.
Must have a speaker who is tech savvy with virtual platform. Engaging presentation.
FAQ sheet upload to website will give SC members solid guidance on what to share
Branding. SC contest. Latch on to existing brand? Send ideas to Cindy and David.

Update the HMP website with information on the plan update
Additional Outreach Capabilities (suggestions welcomed)

Website
Survey-Should we do one again?
Press/media
Social Media

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<tr><td>4</td><td>
Steering Committee Review

Review prior Kauai County HMP 2015
Review Hawaii State HMP

Review risk assessment section, hazards of concern, vision and goals.
County plan has to align with State plan.
County goals need to align with State goals. Show how Kauai made an effort to be consistent with State plan.
Update is an opportunity to make the plan better than the last one.

</td><td>SC to review Kauai County HMP 2015 and State HMP for risk assessment, hazards of concern, vision and goals.

David will share scope of work with SC.

Janet to send State pandemic plan to SC.</td></tr>
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County of Kauai
Meeting Agenda

	○ David worked on State Plan and will pull out and send sections that are most relevant. ○ Ben – should scope of work be considered when reviewing plans? Multiple copies of previous County plan? ○ State of Hawaii pandemic plan to SC for review Specifically review the plans with specific focus on: 1) Vision, goals and objectives 2) Hazards of Concern 3) Framework and structure of state plan 4) Critical facilities and lifelines definition	
5	**Action Items and Next Steps** **Meeting #2: June 11th, 2020** • Confirm hazards of concern • Start Vision and Goal setting – are these old goals ones that you want to use • Introduce the new framework (give TOC of the plan update) ○ Over the next 5 months we will be working with the SC to complete the information in the plan **Meeting #3 – July 9th** • Confirm vision, goals and objectives • Core Capability Exercise: Steering Committee • Polling exercise (3rd meeting)	Revise guidelines for virtual public input. Attempt to get consensus before next SC meeting. Agendas for future meetings will be sent out a week in advance.
6	**Adjourn**	

4

County of Kauai
Meeting Minutes

Purpose of Meeting:	Kauai County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date of Meeting:	06.18.2020

Attendees:

David Kennard	Benjamin Sullivan	Doug Haigh	Jean Souza
Marie Williams	Mike Hough	Pat Griffin	Polly Phillips
Ruby Pap	Stanford Iwamoto	Sue Kanoho	Jan TenBruggencate
Diane DeHart	Mehana Vaughn	Fred Fennell (public)	
Alan Clinton	Cindy Rolli	Megan Brotherton	
Chelsie Sakai	Rob Flaner	Barbara Kaaumoana (public)	

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and Agenda Overview	
2	05.14.20 SC Meeting Minutes • Edits or changes needed ○ Notes from each Steering Committee (SC) meeting will be posted on the website and documented in HMP ○ Chair and vice-chair positions passed by consensus at last meeting, not by vote. No objections. ○ No objections were made to meeting minutes getting posted on website	Action: Edit 5.14.20 meeting minutes to indicate the selection of chair and vice-chair were passed by consensus, not by vote. No objections were made to meeting minutes getting posted on website.
3	Steering Committee Guidelines ○ Public will have access to recorded SC meetings on the website ○ Public can post comments on the website or email David directly ○ SC meeting notices will be posted on the website for the public to attend ○ Purpose – act as a point of contact; are “stakeholders” referring to everyone in the county or just County agencies? Delete the word “County” and add public ○ Recommendations section, Spokesperson section (update to stakeholders and the public)	• Action: Update Guidelines with recommended changes passed by consensus: ○ Use “public” rather than “county” when referring to stakeholders ○ In Recommendations and Spokesperson sections, update to “stakeholders and the public” ○ Alter Staffing Support to more accurately represent County staff ○ On last page, identify members as CPT or SC

1

County of Kauai
Meeting Minutes

	○ FEMA definition of Stakeholder: Entity covered by the plan or someone who has information on facilities and risk that can enhance the plan. ○ A suggestion was made to edit the list of members in Table 1 on page 2. The suggested change is to add a column indicating who is ex-officio, voting, non-voting, and what agency is represented by each member. ○ The Core Planning Team (CPT) is KEMA and Planning Department listed in the organization column at the end of guidelines. Suggestion to identify members as CPT and the others as SC. ○ A request was made to the SC to email address and phone number in an email to David if you wish to have contact info available to all, including the public. All were in agreement to the request. ○ David will also ask if any wish to add thumbnail photos for inclusion in the list. Personal decision. ○ No objections to stakeholder definitions. ○ A recommendation was made for public involvement to also be allowed at the beginning of each meeting and in last 15 minutes of each meeting. This does not preclude someone submitting a written statement. ○ Suggestion from Rob: limit comment time to 2 minutes. ○ No objections from the SC. ○ Public input before and after virtual meetings will be via the chat function. ○ Teams app can be downloaded on phones for those who may need that form of connectivity. ○ No other comments on SC guidelines.	• Action: David to compile list of members who want themselves identified on the list by (any or all): ○ Email address ○ Phone number ○ Thumbnail photo No objections to revised stakeholder definitions Decision: No objections to public input at the beginning and end of each SC meeting, within bounds of SC Guidelines
4	Hazards of Concern ○ Hazards profiled vs. modeled. Must address natural hazards, may address other hazards.	Action: Add column designating which hazards will be: • Fully assessed

	○ Supply disruption is not a hazard that can be mapped for extent and severity. It is an impact from hazard events. It will be included in profiles as an impact in other hazards. ○ Two types: Profiled hazards and fully assessed hazards (including models for vulnerability analysis). Designate which hazards will be profiled or assessed. ○ Is climate change not fully assessed because it is human caused? Can do a standalone chapter for Climate Change, but much of it is subjective. Climate change element can be included in each of the other hazards. FEMA does not require local plans to include Climate Change hazard. ○ County initiative on Climate Change – launch climate advocation and action plan. It is still being scoped, but funding is secure and hope to launch the project in the next fiscal year. It will be a community-based process with many County departments involved. The HMP vulnerability assessment model will be used for the County initiative. ○ Health related hazards will include mosquito and pandemic, among others ○ Make the hazards of concern list all plural or all singular ○ Within each major hazard, discuss anticipation of results of climate change. Also handle in its own chapter. Sea level rise analysis will be modeled in HAZUS. ○ Motion to approve ▪ Motion: Mehana Vaughn ▪ Second: Pat Griffin ○ Consensus	• Profiled Climate Change to be standalone chapter as well as included in other hazards. HMP will be used in coordination with County initiative on Climate Change. Suggestion to make the list of hazards all singular or all plural. Decision: • Motion to approve Hazards of Concern ○ Motion: Mehana Vaughn ○ Second: Pat Griffin
5	Vision, Mission and Goals • Vision, Mission - several wording changes included below • Suggested change to Vision: ○ The county of Kaua'i commits to a long-term strategy to enhance Kaua'i's ability to thrive while adapting to changing	• Decision: Motion to approve the edited vision statement and turn over to consultants for revisions: ○ Motion: Mehana Vaughn ○ Second: Jean Souza

County of Kauai
Meeting Minutes

conditions, to reduce risks and losses from natural and man-made hazard events and acute shocks through actions outlined in this Multi-Hazard Mitigation and Resilience Plan.

- Goals – will direct objectives.
    - Goal 1 – no objectives to as written
    - Goal 2 – "resiliency" Non-hardening solutions. No other comments
    - Goal 3 – No questions or comments
    - Goal 4 – Move "local knowledge" right after "Utilize"
    - Goal 5 – No questions or comments
    - Goal 6 – No questions or comments
    - Add Goal 7 – Devolve and streamline decision making in disaster situations to empower on the ground action adapted to evolving impacts and needs.
    - Add an objective to Goal 1 – Proactively manage and care for natural infrastructure and resources such as stream channels and mountain slopes to enhance their ability to withstand natural disasters and minimize public safety risks.
    - Good mitigation does more than improve the response, it lessens the need. (first line a bit unclear)

- Capacity and capability building are a new FEMA initiative.
- Rob will create goal wording to circulate to the SC for possible inclusion.
- Separate hazard mitigation from long term disaster recovery.
- Barbara Kaaumoana chat comment:
    - "Please find a place to mention security pukas such as small airports and Hanalei Bay, boats arrived with no plan to address threat."

- Motion to approve the edited vision statement and turn over to consultants for revisions:
    - Motion: Mehana Vaughn

4

	○ Second: Jean Souza	
6	Public Engagement Strategy • Website launch ○ (Comment) Website opens with link to another website rather than providing additional information. (Response) Working within available functionality and will work to improve, but options are limited ○ Suggestion to add something substantial to make it "public friendly". Opening line before the survey that emphasizes helping Kaua'i be safe and prepared together, inviting people to give their input and help out. ○ Add links to State plan and single file County plan rather than multiple files. • Public Survey Update ○ 17 persons have taken the survey as of this meeting (6.18.20). Results will help during the next meeting when discussing objectives. ○ Comment: Survey is very infrastructure heavy. Light on social, personal and community preparedness. Response: Options to do additional surveys as needed. ○ Survey/website should include an email opt-in for public notice of future meetings.	Action: Add to website: • Link to State HMP • Link to County HMP (one document) • Additional language to engage public • Email opt-in for meeting notifications
7	Next Steering Committee Meeting – July 9th • A suggestion was made to explore the option of including guest speakers, experts in various studies. Add 10-minute segments in regularly scheduled meetings. • SC will provide suggestions of guest speakers.	

County of Kauai
Meeting Minutes

Purpose of Meeting:	Kauai County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date of Meeting:	07.09.2020

Attendees:

David Kennard, Chelsie Sakai, Ruby Pap, Diane DeHart, Doug Haigh, Patrick Porter, Benjamin Sullivan, Kaliko Kabasawa, Stanford Iwamoto, Mehana Vaughn, Kitty Courtney, Dr. Janet Berreman, Pat Griffin, Alan Clinton, Rob Flaner, Megan Brotherton, Jean Souza, Jan TenBruggencate, Lauren Guest, Maka'ala Kaaumoana (public), Polly Phillips

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and Agenda Overview No adjustments to agenda	
2	06.18.20 SC Meeting Minutes • Edits or changes needed None • Motion to approve: Dr. Janet Berreman, Second: Jean Souza	Decision: Motion to approve 06.18.20 SC Meeting Minutes Motion: Dr. Janet Berreman Second: Jean Souza
3	Public Input Maka'ala Kaaumoana, Hanalei Watershed Hui: Important to take ownership as part of the hazard mitigation process. Will participate in process as able with community led planning. Community led, government supported. Perception of community assisting each other has changed due to prevalence of vacation rentals in Hanalei. Vast difference between how people in different communities can respond to disaster. Leave individuality for communities.	
4	Review action Items from previous meeting: • Steering Committee Guidelines updated One requested change incorporated • Hazards of Concern information updated with definitions and clarifications Done • Final Vision, Mission and Goals Approved last meeting	
5	Objectives Exercise: Define Objectives • Review Steering Committee exercise results • Q: Mehana Vaugh: Assuming goals were approved, objectives seem very similar and repetitive. Key areas seem to be left out, such as strengthening natural resources proactively. Is there potential for alternate goals?	

	• A: Kitty Courtney: Objectives drive what the actions will be. Goals are overarching. Need solid objectives that will address goals. David Kennard: Consider input from SC to improve the goals and put in additional ones as needed. Rob Flaner: Disaster Mitigation Act is the driver for the plan to be eligible for funding. Very specific for mitigation. Need baseline component clearly defined for mitigation. Strategies targeted toward mitigation are essential in order for the plan to be approved by the HIEMA and FEMA. Objectives are measurable component of the plan. Very few objectives about environmental sustainability, but those are not required. Meet minimum requirement first, then add additional as needed. Capital improvement projects need to be added. Online Chat Input: [1:31 PM] Mehana Vaughan IF the rest of steering committee members are great with the goals, maybe you can just register that in chat or some way and we can move on. [1:33 PM] David Kennard I will ask folks to input any objections, otherwise we will move on . . . • Finalize Objectives • 1 & 2: Ben prefers #2. Rob: #1 contains performance measures that should be combined into #2. Jean: stakeholder and public engagement are different. Public wants to receive info *and* be engaged meaningfully. People of the county are different from the county government. David: use FEMA term " the whole community". • Delete #1 and wordsmith the rewritten #2. • 3: Permitting is included in construction regulations. Repetitive losses for flood must be included. Call out specific hazards. • Repetitive loss includes actual and potential. Jean: New strategies will need to be undertaken to allow people to shelter in place in communities where structures are older. Keep 3 and 4. • 4 Doug: Keep. Different than 3. Regulations differ from mitigation measures. Online Chat Input: [1:55 PM] Pat Griffin I agree with Doug	

County of Kauai
Meeting Minutes

	[1:52 PM] Mehana Vaughan ADD - and incorportating mitgation measure into repairs and redevelopment. [1:59 PM] Mehana Vaughan I also feel the land use language is really important. [2:01 PM] Pat Griffin I still agree with Doug. They're two different concepts. • 5 – 7 opportunity to consolidate. Stress integration with other plans. (7) [2:01 PM] Benjamin Sullivan What do we gain from reducing the numbr of objectives if a primary purpose is covering bases with FEMA? • Leave 6, but delete 5. Open opportunities for communities to develop plans, but encourage integration. Ruby to find terminology in General Plan. David: Add integration with climate adaptation policies and plans. [2:14 PM] Mehana Vaughan I think Ben's question is really important. If we are fine with more objectives, than it would be great to keep each one simpler and clear what the main point of it is. Because we lose track that repetitive property loss are key words when there are too many others. [2:19 PM] Ruby Pap The General Plan uses the term, "community-based disaster resilience plans" [2:20 PM] Ruby Pap Here are the two policies: 1. Encourage community-based disaster resilience plans and incorporate components into future Community Plan updates. Plans should include an assessment of risks and vulnerabilities in the local economy to hazards. 4. Identify and index communities that have existing disaster resilience plans. Provide support to current and ongoing community hazard risk reduction, mitigation, and planning efforts. • Reword 7 • Remove 8 and include training in planning process objective • Reword 9. Too general. Need objective specific to BRIC. • 10 BRIC says climate change/future conditions. • 11 Leave for different types of funding. Reword. • 12 & 13. Combine and remove 13. • 14. Why call out businesses and employers? Continuity of operations. Remove 14. • 15 & 16. Combine and remove 16. • 17. Leave as is. • Add Mehana's 3 objectives for review.	

3

	• 18 additions including beaches and reefs Online Chat Input: [2:44 PM] Ruby Pap also, coral reefs? [2:46 PM] Jean Souza reefs? Not all of them are coral reefs [2:52 PM] Mehana Vaughan Implement means of streamlining communication and decision making in advance of disaster events. • Social and cultural equity addition? Ben to propose objective. • Tt to **bold** the most important word in each objective and number the goals. • Alan will put together a survey so SC can vote on approving revised objectives. • Motion to Approve (not needed at this time)	Action Items: Ben Sullivan to propose objective on social and cultural equity for SC review. Tt to compile rewritten objectives. **Bold** the most important word in each objective and number the goals. Alan Clinton to compile proposed objectives in survey for SC input.

6	Public Engagement Strategy
	• Guest Speaker Presentation updates
	  ○ Additional suggestions Mehana to present at next meeting. Next meeting will be scheduled for 2 hours to allow for presentation.
	[2:56 PM] Benjamin Sullivan
	okay for two hours!
	  ○ No objectives to 2-hour meeting
	• Website updates - Not discussed
	• Public Survey Update
	  ○ Additional questions for survey Not discussed
		Decision:
		Future SC meetings will be 2 hours to allow for guest presenters.

7	Public Comment Maka'ala Kaaumoana: Big thank you! Encourage community initiative. Other community plans need to be integrated such as watershed plans. Impact of tourists on community is dangerous, expensive, and frightening because they do not do what they are told. Please keep that in mind. [2:58 PM] Benjamin Sullivan Agree with Maka'ala and think that one of our many objectives did address her point	
8	Next Steering Committee Meeting – August 13th	

County of Kaua'i
Meeting Minutes

Purpose of Meeting:	Kaua'i County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date of Meeting:	08.13.2020

Attendees:

David Kennard	Benjamin Sullivan	Dr. Janet Berreman	Jean Souza
Polly Philips	Kaliko Kabasawa	Pat Griffin	Jan TenBruggencate
Ruby Pap	Stanford Iwamoto	Marie Williams	Lauren Guest
Patrick Porter	Mehana Vaughn	Rob Flaner	Maka'ala Kaaumoana (public)
Doug Haigh	Cindy Rolli	Megan Brotherton	Steve Parsons (public)

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and Agenda Overview • No adjustments to agenda	
2	07.09.20 SC Meeting Minutes • No edits or changes needed o Steering Committee approved the minutes by consensus	07.09.20 SC Meeting Minutes approved by consensus
3	Public Input • Maka'ala Kaaumoana provided input on Objective #1: Recommendation to incorporate 'science-based understanding' as part of the objective. Steering Committee agreed to incorporate and adjusted language on Objective #1 • Steve Parsons provided input on mitigation strategies to be inclusive of support for electric vehicles, battery storage power rather than fossil fuel generation. • Steering Committee member comment (Jean Souza): Many residents rely on electricity for medical purposes and would benefit from household generation of power.	Objective #1 input were incorporated, and the Objectives were updated to reflect the recommendation.
4	Hazard Scenarios: • FEMA requires jurisdictions to identify one actionable item for each hazard of highest impact. Need to assess risk and compare. Models available for some hazards. Others are qualitatively assessed. Each is ranked high, medium, low. • Via chat: [1:23 PM] bsullivan@kauai.gov - How is the threshold between high-medium-low determined? • Rob: Assessed value and tax base, per capita thresholds, many comparisons and computations. Weight can be shifted if needed.	

1

	• Jean Souza: Are drought and mosquito-borne illness being addressed? • Rob: Drought is exposure analysis. Economic weight. Assessed, not modeled because drought does not damage structures. • Extreme heat is related to public health • Janet: Public health is referring to pandemic, not extreme heat. Keep hazards separate. • Rob: Extreme heat can be part of Climate Change section.	

5	Mitigation Grant Update (David)
	David provided an overview of funding programs. No questions or discussions.
	• BRIC:
	  o https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
	• FMA:
	  o https://www.fema.gov/grants/mitigation/floods
	• HMGP:
	  o https://www.fema.gov/grants/mitigation/hazard-mitigation	

6	Action Items from previous meeting: • Objectives updated; sent out for review, feedback incorporated (consensus needed) • Jean: Supports Maka'ala Kaaumoana recommendations to modify Objective #1 to include science based understanding. • Jean: Discussion on where capacity to shelter in place is included in the objectives and it was determined that this is covered in both Objective #2 and #3. • Jean: Recommendation to modify the wording of Objective #5 to "including visitors". • Jean: Does the numbering of objectives denote priority? 1. David: No. Order of objectives will be considered when writing draft plan. • Maka'ala: Is land acquisition included in any of the objectives? Agreed that this is covered in Objective #2. Motion to approve objectives as reworded? Motion: Pat Griffin Second: Doug Haigh No objections	Decision: Motion to approve Objectives as reworded during meeting (#1, #2, and #5) Motion: Pat Griffin Second: Doug Haigh No objections
7	Public Survey Results Did not discuss during the meeting due to time constraints. We will discuss during September SC meeting	Discuss during September SC meeting

County of Kaua'i
Meeting Minutes

8	**Guest Presentation – Dr. Mehana Vaughan presentation:** Hālana ka Man'ao: Lessons & Recommendations from the 2018 Kaua'i Floods Link to a YouTube video that was developed and posted as part of the project is here. https://www.youtube.com/watch?v=-GASw02SYA4&authuser=1 Comments regarding presentation: • Jan: Captures importance of HMP planning and value of community • Ben: It is important to look at how the bridge between community and government can be strengthened. Capacity building include self-directed decision making in each community. • Maka'ala: Importance of bridge between community and government at all times, not just during disasters. • David: Make connections during blue-sky times. • Rob: New grant programs are for capacity building. • Doug: Provided feedback on elements of community "hearsay" regarding slope remediation as part of the presentation. Should be a science-based understanding. • Mehana: Community observation is connected to scientific studies. Applying for funding to bridge knowledge. • Jean: Capacity building perspective; others outside affected areas stood ready to help; better bridge needed between resources; CERT. • Cindy: Think about actions to support the big picture. Bridging the gaps, resilience hubs. • David: North Shore proposal for a hub. • Maka'ala: Funding is available for Wainiha-Hanalei projects. • Maka'ala: HMP will inform the community. Support ongoing trust in isolated communities. • Polly: Cultural and historical management needs to be addressed in scientific part of Wainiha-Hanalei plan. • Cindy: A project in the HMP can be communication of science based tools for individual communities. • Maka'ala: Share lessons learned with other communities. • Ben: Resilience hubs as community-led programs are most important. • Mehana: What are suggestions to build a bridge? • Rob: CERT. Understand and communicate risk. • Jean: Strong CERT in Kaua'i.	

3

	• Comments in chat: CERT funding concerns	
9	Mitigation Actions Discussion Jean suggested creating and sharing a Google Doc to start to identify mitigation actions. Mehana began a list of recommendations and shared as a starting point for building 'bridge of communication, collaboration and action in planning for disaster response.' The Core Planning Team (Cindy) will generate a google doc for proposed actions and share with the Steering Committee when the meeting minutes are sent to the group.	Set up google docs for the SC to post proposed actions.
10	Public Engagement Strategy • Public Meeting Format Discussion • Social and Cultural Equity Presentation The SC did not discuss during the meeting due to time constraints. We will discuss during September SC meeting	Discuss during September SC Meeting
11	Public Comment Maka'ala: Wainiha [community resilience center] is a County supported project. FEMA push alerts included instructions to tourists not to go to the North Shore. That action saved lives.	
12	Next Steering Committee Meeting – September 10th	

County of Kauai
Meeting Minutes

Purpose of Meeting:	Kaua'i County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date of Meeting:	09.10.2020

Attendees:

David Kennard	Benjamin Sullivan	Pat Griffin	Jean Souza
Polly Philips	Kaliko Kabasawa	Jan TenBruggencate	Maka'ala Kaaumoana (public)
Ruby Pap	Stanford Iwamoto	Lauren Guest	Chelsie Sakai
Doug Haigh	Mehana Vaughan	Rob Flaner	Diane DeHart
Ruby Pap	Cindy Rolli	Carol Baumann	Megan Brotherton

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	**Welcome and Agenda Overview** • No adjustments to the agenda	

2	**08.13.20 SC Meeting Minutes**
	• No edits or changes needed
	  ○ Steering Committee approved the minutes by motion
	  ○ No objections to approve the minutes
		Approved 08.13.20 SC Meeting Minutes
		Motion: Jean Souza
		Second: Pat Griffin
		No objections

3	**Public Input** • Maka'ala Kaaumoana provided input that Objectives 3 & 4 have the potential to include enforcement and compliance of flood zones and should include flood zones, not just building codes. County enforcement of flood zones is not yet included. • Comment from David Kennard: Floodplain management ordinances are being updated. BRIC or other funds may be available to strengthen the training and enforcement of codes. • Steering Committee member comment (Stanford Iwamoto): Strides are being made in compliance issues.	Action: CPT to review the objectives and determine the inclusion of the recommended update.

4	**Risk Assessment Results (Results were presented at the meeting)**
	• PPT Presentation of Exposure Analysis
	  ○ Tsunami –
	    ▪ Via Chat: [1:23 PM] bsullivan@kauai.gov - value exposed = all public infrastructure - roadways, etc, plus private structures?
	    ▪ Carol: The exposed value is based on assessor data from the County. The data we are presenting today currently do not include roads or County-owned infrastructure, just building replacement costs.
		Action: Ensure the community boundary lines are correct.

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- David: For Public meetings, consider using insets on the hazard maps since the bulk of impacts are in coastal areas.
- Maka'ala: 85% of the island's taro production is in the Hanalei Valley. Agriculture is not a structure, but a huge economic impact would result from a tsunami hazard.
- Jean: Change the boundary between Hanapepe-Eleele and South Kauai. Make sure the Planning department looks at the map to verify the boundary.
- Via Chat: [1:29 PM] Mehana Vaughan - Kalihiwai had most deaths island-wide in 1957 tsunami, small green line trailing mauka from the bay to the left of name Kilauea. Staggered by potential for damage in Waimea - Kekaha, seems like more localized maps showing area heterogeneity might be useful.
  How much of Waimea issue is coastal flood pain of Mana? Also a bit surprising that South Kaua'i is not more impacted.
- Carol: The tsunami model is based on historical tsunamis.
- David: UH, the Tsunami Center and emergency managers decided to take the five largest, most recent tsunamis to represent risk.
- It would be helpful to have references on where people can go for more details on maps and hazard data.

- 100-yr Flood event –
  - Doug: Is the Waimea/Kekaha flood data based on levees?
  - Carol: Preliminary DFIRM and effective DFIRM from FEMA were used for flood data. The DFIRM shows two decertified levees.
  - Stanford: Is there an overlap of damage assessment data if depth damage functions are based on older events?
  - Rob: Depth damage curves are updated every year and will go into HAZUS models. No loss estimations have been presented yet.
- 500-yr Flood event –

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	▪ Similar trends to 100-yr flood ▪ FEMA does approximate mapping for 500-yr flood events ○ SLR Exposure Area (SLRXA) – ▪ Via Chat: [1:53 PM] rpap@kauai.gov - Mehana makes an interesting point. We have divided it by planning area, but the planning areas don't follow hazard boundaries. Perhaps taking a deeper dive into individual communities would be helpful for developing mitigation actions especially. ▪ Via Chat: [1:53 PM] Makaala - Or do it by ahupuaa or moku ▪ Via Chat: [1:55 PM] David Kennard - yes. Let's think bout the best way to present. We have more flexibility in presenting the data on-line ▪ Via Chat: [1:56 PM] Mehana Vaughan - Those approaches would capture more of the heterogeneity of Kaua'i geography. Ruby, do you know if Sea Grant's research and tools are being captured in this analysis, would help not to reinvent the wheel! ▪ Via Chat: [2:04 PM] rpap@kauai.gov - this is a FEMA approach, but as David said we can present the info in different ways and is flexible. Sorry, FEMA approach using planning district boundaries, which makes sense for alignment across county plans. But would also make sense to highlight loss in specific communities; we would just have to discuss where to draw the boundaries ▪ Maka'ala: Saltwater intrusion in lower parts of the valley will occur before the coastal roads and homes are impacted. Mapping has not started for saltwater intrusion. SLR means more than just seawater coming over the coastal berms. ▪ Ruby: A research need is identified for groundwater with SLR mapping. The passive flood model can be used to identify some areas and has been used as a proxy, but there is a need for advanced groundwater research.	

	▪ David: Include a groundwater study as a mitigation action. ▪ Ben: The timeline and perception of SLR need to be a very different approach. Mitigation efforts over five years are not realistic for SLR. ▪ Via Chat: [2:06 PM] Makaala - If we need/seek community engagement, buy in to mitigation, they must be able to relate to the map locations. ▪ David: Actions and infrastructure development done today will be impacted over the next 100 years. ▪ Ben: SLR 3.2 is not static, so we need to plan and present SLR as an ever-increasing threat. ▪ Via Chat: [2:08 PM] Mehana Vaughan - Katy Hintzen at UH Sea Grant could be a helpful resource, she has worked extensively on developing the Hawaii sea level rise viewer, and is very thoughtful about how to present maps and data on sea level rise in ways that help people comprehend what is being shown, and respond in proactive ways, and not just overwhelm. And again, vital to show at more local resolution. That tool is useful in that viewers can control the resolution themselves. ▪ Jean: It would be very helpful for Ruby Pap to be available for the Public Meetings. ▪ Ruby: Planning District boundaries might not be relatable to the public when smaller areas within districts have very different impacts. ▪ Makaala: Make new information easier for the public to obtain so they can handle disasters. ▪ David: Break the info down so it's easy to assimilate, but aggregate for actions. ▪ Via Chat: [2:21 PM] bsullivan@kauai.gov - Cindy this is another area like SLR where climate will increase the risk over time - how do we communicate that? ○ Landslide – ▪ The landslide hazard needs to be further researched and assessed.	

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	▪ Mehana: The landslide threat affects infrastructure more than the population. ○ Wildfire – ▪ Makaala: A major fire in the mauka lands of Hanalei in the 1960's results in landslide problems now. Ask DOFAW for research. ▪ Mehana: A potential mitigation project is the restoration of native ecosystems to mitigate landslides and wildfires. ○ Dam Failure – ▪ Sensitivity will be needed in the presentation of dam failure data. ▪ Jean: Consider that the public may ask why other dams were not included in the analysis. ▪ Makaala: Many other dams are in various stages of health and repair.	
5	Mitigation Action Discussion: • Public Survey Results • Previous Mitigation Actions • Google Docs with proposed actions ○ Tsunami/Flood/SLRXA actions: ▪ The current North Shore disaster plan establishes ten zones with trained captains in small areas between gullies for disaster shelter relief. ▪ Polly: The community has asked for clear trails or paths to higher ground that are well-known so people can go to higher ground on foot. The potential mitigation action is to establish land-based evacuation routes. ▪ Rob: FEMA has been doing vertical evacuation sanctuaries on roofs of schools. Hardening facilities and making shelters at the same time. ▪ Doug: State building code of 70' height for tsunamis exceeds the County ordinance. ▪ Makaala: Hanalei school has been considered in the past as a shelter. ▪ Via Chat: [2:40 PM] Mehana Vaughan - Kalihiwai was hit so hard because its a bay and the waves funneled, whereas Wanini Kalihikai just around the corner, have protective reef, so homes and families fared better. Just an example of how	The Steering Committee members may use the Google doc to submit proposed mitigation actions, or they may email proposed actions to David and Cindy.

		heterogeneity could operate island wide. Polly's right in past tsunamis in Haena and these other areas, people survived by running mauka. Having capacity for people to interact with maps and zoom in to areas they are concerned about or know well, sounds great, and just to explore on their own and make it more interactive. People will come from all over and it won't be possible to address all their areas in large group so the plan and tool sound wonderful Cindy! ▪ Via Chat: [2:41 PM] Jan T - All new government facilities to be built hurricane resistant and shelter-capable, existing appropriate structures retrofitted, legal authority for use of any government facility for shelter in emergency, legal authority to trespass for evacuation in declared emergencies. ▪ Via Chat: [2:41 PM] pphillips@kauai.gov - And not impacting the solar panels. ▪ Ben: Occupied roof shelters could also be planted as a green roof to mitigate additional hazards. Actions could serve to mitigate more than one hazard. ▪ Ben: Waimea needs a place to get cars off the road onto high ground. ▪ Ruby: There is a need for shelter if bridges are washed out on Waimea and Hanapepe rivers. ▪ Mehana: Focus on multi-hazard objectives, including the protection of water supplies and safe, fresh water after a disaster. ▪ Jean: After a tsunami or storm surge, consider not allowing structures to be rebuilt in areas where they were destroyed. Have improved coastal access in those areas for the community; open spaces. ▪ Via Chat: [2:46 PM] rpap@kauai.gov - West Kauai community vulnerability assessment has many mitigation actions, including evacuation route planning, shelters, improving ford crossings.	

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	Relocate fire and police stations out of the tsunami zone. ▪ Via Chat: [2:50 PM] Mehana Vaughan - Could we incorporate Jan's recommendation above, Jean's on not rebuilding. And mitigation recs from west kauai vulnerability assessment and Haena to Hanalei plan. And others that may exist for other areas. Drawing upon things that have already been vetted through public process, then consolidating and adding to those lists, would be really helpful.	
6	Public Meeting • Virtual Meeting: Zoom o Each hazard will be on a story map for public review. The story maps will be posted on the mitigation website and the link will be published in the press release. o An open chat forum will follow the 30-minute narrated PPT presentation. o A survey will be available to get public input on problem areas. • Press Release, September 14th and reminders • Thursday, September 24, 5-6:30 pm • Saturday, September 26, 2-3:30 pm • Steering Committee role and participation o Give feedback on how the meeting goes and give suggestions on reaching folks who cannot attend virtual meetings or provide input. o Ben would like a short flyer to use in promoting the public meetings. o Chelsie: The press release will go out as soon as this afternoon.	Action: send out the press release and discuss the option of preparing a graphic/flyer to send out.
7	Public Comment	
8	Next Steering Committee Meeting – October 8th	

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Purpose of Meeting:	Kaua'i County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date, Time of Meeting:	10.08.2020, 1:00-3:00 pm

Attendees:

David Kennard	Benjamin Sullivan	Doug Haigh	Jean Souza
Polly Phillips	Kaliko Kabasawa	Pat Griffin	Jan TenBruggencate
Ruby Pap	Stanford Iwamoto	Marie Williams	Chelsie Sakai
Kitty Courtney	Patrick Porter	Rob Flaner	Maka'ala Kaaumoana (public)
Cindy Rolli	Megan Brotherton		

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and Agenda Overview	
2	09.10.20 SC Meeting Minutes • Edits or changes needed • No objections to minutes. • Future minutes will include meeting time	Minutes from 09.10.20 SC Meeting stand approved.
3	Public Input Maka'ala Kaaumoana: Shared appreciation for September public meeting forums and received these follow-up comments from community members after the public meetings: 1. There is a strong community interest in having an early warning system for the North Shore. The Watershed Action Plan from 2000 had the original proposal in it, but a warning system has not yet been established. 2. An evacuation plan is needed for the North Shore when an event is impending. The evacuation time of 6 hours has been calculated. 3. Proposed Hydraulic/Hydrologic study of the North Shore, Waimea, and Wailua, which will produce a project list that can be turned into proposals for funding. 4. A survey reply commented on opening river mouths, but it is not viewed as a solution for flooding or pollution control without a hydrologic study. However, moving sand can negatively impact native species and estuary zones. 5. Clarity is needed on the jurisdiction of ditch and stream cleaning and maintenance. 6. Consider toxoplasmosis as a health hazard. No animals should be allowed in, abandoned, or fed at small harbors and county parks.	
4	Mitigation Action Discussion: • Public Meeting Input	

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- Jean Souza: Tap into email lists from agencies (KEMA, KFD, CERT) to notify a broader group when public meetings will be held.
  Make sure all notices and press releases include links to Zoom meetings.
- Ben Sullivan: Excellent job of presenting the public meeting StoryMap and relating a lot of information in a short amount of time.
  Brief project examples would make the data process more understandable to the community.
- David Kennard: State mitigation projects could be used as examples.
- Via chat: [1:20 PM] Polly Phillips - Great idea, Ben about examples of projects.

- Public Survey Results
  - Keep in mind as mitigation actions are reviewed, so public input is incorporated in the proposed actions.
- Hazard Exposure/Mitigation Actions – StoryMap
  - Jean Souza added to the Google Doc matrix of mitigation actions earlier today. Proposed actions will be added to the StoryMap.
  - Some hazards are modeled and have maps; other hazards will be discussed but cannot be modeled.

Flood

- David Kennard: Levee height adjustment recommendations are being considered. The community will be made aware of changes in flood maps.
- Maka'ala Kaaumoana: There is an ongoing concern about flood hazards in regard to vacation rentals outside of visitor destination areas. Confirm that advertising and the units themselves will be identified as in a flood zone. Propose a public awareness campaign project.
- David Kennard: O'ahu had a multi-language campaign to inform visitors of hazards. Consider modeling that example for Kaua'i.
- Via chat: [1:37 PM] Marie Williams - Regarding TVRs, I think there is a requirement for hazard zone disclosure already... I will check with TVR enforcement though. I also think hotels can more effectively provide safety information to guests than TVRs do. Most TVRs have no on-site manager.
- Via chat: [1:40 PM] Jan T. - Thanks Marie. The lack of oversight at TVRs has also been a management issue for Covid-19

	○ Ben Sullivan: Is it a standard practice for ACOE to have a cost-benefit analysis before starting a levee project? ○ Stanford Iwamoto: Projects need congressional approval to get funded, then they are required to meet a cost-benefit analysis. ○ Rob: If ACOE is funding levee projects, FEMA will not duplicate benefits. Consider FIA. ○ Via chat: [1:41 PM] Benjamin Sullivan - no need to discuss but can someone clarify what FIA is again so I can educate myself on how it differs from cost-benefit? ○ Via chat [1:44 PM] Rob Flaner - FIA Is the USACE term for and economic analysis that uses a Monte-Carlo simulation to evaluate the economic benefits of a project. It is different than the FEMA BCA methodology in that benefits are defined differently. https://www.hec.usace.army.mil/software/hec-fia/ ○ Jean Souza: Are flood hazard projects covering relocation of the Hanapēpē fire station? The fire captain stated that the current location is ideal for reaching residents quickly. Feasibility is not the same as desirability. The fire station and armory are in the flood inundation area. ○ Via chat: [1:45 PM] Ruby Pap - Hanapēpē fire station is not in a SLR inundation area ○ Cindy Rolli: Relocation is part of the multi-hazard actions. A post-disaster recovery plan would address concerns with rebuilding critical infrastructure in a hazard area. ○ Doug Haigh: The 2012 State building code will come into effect on November 13. Fire stations/critical facilities within tsunami inundation zones will not be able to get permits to make building improvements. ○ Rob Flaner: BRIC funding could be available for an action in the plan to adopt the international building code. ○ David Kennard: Add an education/outreach action for professionals: builders, architects, structural engineers. ○ Jean Souza: Add a hazard education/outreach program in schools. ○ David Kennard: Look at the Big Island Sea Save curriculum for examples of education on multiple hazards. ○ Jean Souza: Add a flood hazard action: Address sheet flooding, not just riverine and coastal flooding. Hanapēpē and other areas have sheet flow flooding caused by inadequate maintenance and repairs of grass swales and drains.	

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	○ Stanford Iwamoto: Swales and drainage within the County right of way are maintained by Public Works. ○ Ruby Pap: The West Kauai Community Vulnerability Assessment may have flooding actions that can be reviewed. ○ Ruby Pap: Repair on the Waimea levee sluice gate is a concern for the communities on Menehune Road. ○ Ruby Pap: Add nature-based, green infrastructure, and wetland restoration actions that may qualify for BRIC. ○ Via chat: [2:02 PM] Benjamin Sullivan - Thanks Ruby! Let's figure out a way forward on implementing nature-based solutions!!! ○ Maka'ala Kaaumoana: Flooding events do not always come from waterways. Non-native species in mauka lands do not allow the soil to hold water. The plan should include idiosyncrasies of the island's geology. ○ Maka'ala Kaaumoana: Add an action for a PR campaign to help community members identify where they live in relation to hazards. ○ Jean Souza: HHARP has identified Hanapēpē bridges as a weak point. Major projects are in place for both bridges, but they are not taking into account SLR for the life of the bridges. ○ Stanford Iwamoto: The State bridge is being funded by State and Federal Highways. The County bridge is just being repaired, not replaced. ○ Rob Flaner: FEMA will fund substantial repairs to critical infrastructure to meet increased resilience due to codes and standards. ○ Via chat: [2:12 PM] Jan T. - Re bridges, so we need to wait for them to be damaged in order to build them in a way to avoid damage. ○ Doug Haigh: Bridges are covered by the State book, not building codes. Public Works may need to modify the code for building wastewater facilities in inundation zones. Hurricane (High Winds & Storm Surge) ○ Ben Sullivan: Residential retrofits have also come up in the renewable energy sector. Consider PACE (Property Assessed Clean Energy) financing. Multiple benefits can be gained from one action. This requires recognition that the value stream has energy benefits. ○ Jean Souza: Added a safe room (retrofit or new separate structure) action to the Google doc matrix. Propose	

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	preapproved permits that would save homeowners money and time. A new emergency shelter is needed in Hanapēpē and ʻEleʻele. The school is the current shelter, but a parcel of state land on the west side of the Hanapēpē River could be used for a new shelter and rec center/multi-function facility. o Makaʻala Kaaumoana: Solar panels could become dangerous projectiles in high winds. Regulations on proper installation are needed. o Jean Souza: Resident medical needs require home energy solutions when power fails. Look at projects that would allow residential structures to hookup to e-vehicles as sources of power during a disaster event. o David Kennard: Power grids are cut-off during significant disaster events. Consider mobile generators to connect to sub-units to keep functionality, segmenting the grids to keep power active. There is a pilot program on the eastern part of Oʻahu to test this type of solution. o Via chat: [2:28 PM] Benjamin Sullivan – microgrids. Jan - maybe just note in your role as a KIUC director that grid resilience is a potentially qualifying BRIC project if there is interest from KIUC o Via chat: [2:34 PM] David Kennard - thanks Ben, The BRIC proposal I saw called them Critical Customer Hubs Sea Level Rise/Climate Change o Ben Sullivan: Does the plan incorporate existing damage to the Wailua bike path? o David Kennard: Yes, and it includes a project that extends to other affected areas. o Ruby Pap: Add beach park restoration projects for Kapaʻa and Poʻipū Beach. Vulnerability assessment and infrastructure projects: drainage and stormwater systems are vulnerable to groundwater rise/SLR. Assess capacity in low-lying areas. There is a gap in SLR data for groundwater rise impact. A groundwater study/mapping project is needed. o Makaala: Underground drainage areas deliver saltwater inland as much as they let freshwater out. Inland flooding is allowed by those routes. Survey assessment on whether underground drainage or overland drainage is better. o Kitty: The SLRXA passive inundation model "bathtub model" for Oʻahu is pretty accurate. Article for reference:	

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	https://iopscience.iop.org/article/10.1088/2515-7620/ab21fe Pick an urban or residential area to model. ○ Ruby Pap: The action shouldn't specify the type of modeling, but state that an assessment is needed for Kaua'i. This would allow for flexibility in the type of assessment that is done. Tsunami ○ David Kennard: There are building code update implications. Add an action for education/awareness or evaluation of at-risk infrastructures. ○ Jan TenBruggencate: Sheltering options are inadequate. There are short and long-term sheltering concerns and needs. ○ Jean Souza: Add an option for building relocation outside inundation areas. An interim SC meeting is needed to continue the discussion on actions. Consensus on adding an additional meeting. A poll will be sent out to SC members to establish a preferred day and time.	
5	MHMRP Milestones • Draft plan public release date – January 4th ○ Two week review period • Tentative public meetings January 14th and 16th • Final Draft to FEMA February 15th	
6	Public Comment None	
7	Future Guest Presentation Options: • Social Equity • Climate Change • Recovery Framework ○ David Kennard: Time constraints have not allowed presentations at every meeting. We are proposing an Advisory Group to supplement KEMA and other County agencies to keep the plan alive. Guest presentations could be part of the Advisory Group meetings. This can also qualify as a capacity-building mitigation project.	
8	Next Steering Committee Meeting – November 12th	

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Purpose of Meeting:	Kaua'i County Multi-Hazard Mitigation and Resilience Plan Steering Committee (Interim Meeting)
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date, Time of Meeting:	10.15.2020, 3:00-5:00 pm

Attendees:

David Kennard	Benjamin Sullivan	Doug Haigh	Jean Souza
Polly Phillips	Patrick Porter	Pat Griffin	Mehana Vaughn
Ruby Pap	Stanford Iwamoto	Rob Flaner	Cindy Rolli
Megan Brotherton			

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and StoryMap Review from 10.08.20 SC Meeting	
4	• Hazard Exposure/Mitigation Actions – Story Map: Wildfire o David Kennard: Recently verified with DOFAW, and they are working on developing firebreaks in high-risk areas, establishing repeater sites, and purchasing equipment. o Ben Sullivan: How does "remove hazardous fuel loads" fit into the plan when it is very general? o Ben Sullivan: Replace invasive species with native species to reduce fire risk. This is also a general project but useful. o A: Native species projects could also fit into the Landslide hazard. o A: General projects may be easier to fund since they allow for latitude when the specific area of need becomes known. o A: Projects can be prioritized in the plan. o Jean Souza: West side agricultural areas do burns regularly. There should be "no burn" rules and enforcement during declared droughts to prevent fires from entering residential areas. o Ruby Pap: Red flag day notices come from the County to alert the public of high fire dangers. o Doug Haigh: The State controls burning. o Jean Souza: Ag lands are exempt from burning regulations. o David Kennard: Follow up to learn the current standards and regulations of agricultural burns. o Via chat [3:28 PM] Benjamin Sullivan - thanks Jean! Let's put it on our brainstorm list and follow-up!	

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	Dam Inundation ○ Ruby Pap: Dam evacuation maps are located on the KEMA website, but there isn't much outreach to inform the public of dangers and evacuation areas. ○ Rob Flaner: EAPs for dams are not publicly facing, but outreach on inundation areas could be done. ○ Jean Souza: Why are EAPs not made public? ○ Rob Flaner: Dams are critical facilities and subject to potential threats. Security protocols and how the operators are monitoring the dams are not made public. ○ Jean Souza: A new affordable housing development is located below an agricultural dam. The public should be made aware of safe routes for evacuation. Landslide ○ David Kennard: 12-14 landslides occurred along the north shore during the 2018 flooding. ○ Polly Phillips: Landslides also occurred along Powerline Road. Currently, culverts are being installed. Grading was done, and native species were planted, but invasives overtook the area. ○ Doug Haigh: HDOT installed soil nails to remediate earth movement but ran out of funding to complete the project. Drainage improvements are being made on the North Shore. Lack of manpower and funding hamper landslide mitigation projects. ○ Mehana Vaughan: Is it possible to reach out to young people for staffing? ○ Via chat: [3:46 PM] Mehana Vaughan - Limit tourist traffic on vulnerable routes (particularly at vulnerable times). Provide for ongoing maintenance of plantings on slopes. ○ Via chat: [3:52 PM] Mehana Vaughan - Expand engineering capacity and staffing in county agencies to implement and plan mitigation actions. ○ Ben Sullivan: Native plantings in landslide-prone areas should be considered. ○ Mehana Vaughn: Implement emergency warnings to close roadways in advance of landslide risk. ○ Ruby Pap: Severe rains caused trees to come down in the Wailua River and scour the bridge. Community perception was that trees were cut in the watershed, and they came down. Does there need to be rules or enforcement on tree clearing? ○ Via chat: [3:56 PM] Pat Griffin - I'll confirm--it was A Lot of trees and logs.	

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	○ Doug Haigh: Will FEMA fund a project to remove invasive trees to minimize debris? Invasive trees grow on the river edges and fall into the river during storms. ○ Ruby Pap: Is vegetation debris cleanup a mitigation action? ○ Ben Sullivan: There is a debris management plan, but it is unknown whether it covers plant debris in stream areas. ○ Rob Flaner: Debris monitoring and management for all types of debris is a potential project. ○ David Kennard: Public Works and Parks & Rec are responsible for debris removal. Health Hazards ○ Jean Souza: Is there potential for community involvement projects or just DOH? Earthquake ○ Doug Haigh: Change wording of the project to be "most current IBC" since building codes update every few years. Multi-Hazard ○ Via chat: [4:17 PM] Mehana Vaughan - I have to leave but here are a few for multi-hazard, they are also in the google doc. ▪ Convert cesspools to septic or integrated biotreatment individual household waste systems in coastal and low-lying communities with no sewer. ▪ Provide for ecological studies and assessments of impacts on or recovery of natural resources post-disaster. ▪ Work with local non-profits across the island to plan for their roles in both pre-disaster mitigation and post-disaster response. ▪ Identify elders in each community on the island and avenues to respond to their safety and needs in any disaster situation. ○ Ben Sullivan: When we look at multiple benefits for projects, what does that mean for the plan? ○ A: There are benefits in combining actions that will achieve multiple outcomes. ○ David Kennard: Capture multi-hazard actions but continue to focus on specific hazard projects to set priorities. ○ Rob Flaner: Projects are typically prioritized by benefit vs. cost, but FEMA doesn't expect that level of detail in a hazard mitigation plan. The plan can give something a high priority, but it should also have benefit-cost analysis. There is latitude on what is considered a priority.	

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	○ Ruby Pap: How did the city of Portland list their social equity priorities? ○ Rob Flaner: Portland had two lenses for priorities: city priorities and FEMA priorities. ○ Rob Flaner: It's ok to add parameters to the prioritization, but minimum FEMA requirements need to be met. ○ Jean Souza: CERT project wording is ok but consider changing its support. CERT is currently housed in the fire department, but CERT's support is no longer active due to funding cuts. Can CERT be moved to KEMA? ○ Jean Souza: Some higher hazard areas are built in with substandard practices. Add to the vulnerability action the need to identify vulnerable geographic areas. Ok to separate social and geographic vulnerability into two actions. ○ Via chat: [4:43 PM] Benjamin Sullivan - only concern Jean - does that mean $10m beach homes in Poipu beachfront that get prioritized for funding? ○ Ruby Pap: Erosion is a hazard of concern, but the current maps depict erosion rates, not zones of erosion. Coastal erosion projects deserve a place in the plan, including continuing to update the shoreline setback ordinance. Beach and dune restoration projects can be added. Relocation of homes and critical infrastructure in areas subject to erosion are a long-range project, not a 5-year plan but could be a tiered approach. ○ Jean Souza: The shoreline setback ordinance is very important. There are different ways to define erosion, including erosion from seasonal events. The natural process for replenishment time might be longer due to climate changes.	
6	Next Steps: ○ David Kennard: Additional Hazards can be suggested after this meeting. ○ The next SC meeting (November 12) will focus on getting a consensus on all actions that will be included in the plan.	

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Meeting Minutes

Purpose of Meeting:	Kaua'i County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date, Time of Meeting:	11.12.2020, 1:00-3:00pm

Attendees:

David Kennard	Benjamin Sullivan	Pat Griffin	Jean Souza
Polly Philips	Kaliko Kabasawa	Jan TenBruggencate	Maka'ala Kaaumoana (public)
Ruby Pap	Stanford Iwamoto	Ruby Pap	Chelsie Sakai
Doug Haigh	Mehana Vaughn	Rob Flaner	Diane DeHart
Alan Clinton	Fred Fennell (public)	Cindy Rolli	Megan Brotherton

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and Agenda Overview • No adjustments to the agenda	
2	10.8.20 and 10.15.20 SC Meeting Minutes • Edits or changes needed ○ Jean Souza: Correction pg 5, 11.08.20 SC Meeting, second circle – delete two words "alternative solar".	Approved 10.08.20 and 10.15.20 SC Meeting Minutes Motion: Jean Souza Second: Pat Griffin No objections
3	Public Input Maka'ala Kaaumoana: There is new research regarding large solar arrays and their potential impact on native water birds. Occasionally, these arrays are perceived as lakes by water birds. When birds land, some have been injured. Solar energy is not without potential impacts. Some early studies are by the Native Waterbird Partnership.	
4	Risk Ranking Review and Input • PowerPoint Presentation ○ Jean Souza: How are risk rating and risk ranking distinguished? ○ Cindy Rolli: The terms have been used interchangeably but will defer to "risk ranking" for consistency. • Risk Ranking Discussion ○ Maka'ala Kaaumoana: Is ranking based on potential damage or condition of the dam? ○ Rob Flanner: Ranking is based on downstream impacts if the dam were to fail. ○ Jan Tenbruggencate: In the past, I would have pushed back on the dam ranking based on the Kaloko Dam failure,	

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	but the State has increased attendance to the issues, so the ranking is ok. ○ Ben Sullivan: How is this information used? Can ranking be changed? ○ Cindy Rolli: Mitigation actions identified with high-ranked risks need to be included in the plan for it to be approved by FEMA. ○ Ben Sullivan: If risks are identified in certain areas, do those areas get the mitigation funding? Social equity concerns should allow for funding to be spread to the areas most in need. ○ Rob Flaner: The highest-weight ranking value is based on impacts to people. Grant applications can also be made for risk, not ranked in the high category. ○ Cindy Rolli: Ranking can be changed if enough feedback is received from the SC on a hazard. ○ Jean Souza: Regarding impacts on people vs. impacts on property, how are life or death situations ranked compared to other impacts on people? Shouldn't life or death be ranked higher? ○ Rob Flaner: Some models attempt ranking injuries, but there is no consistent variable to estimate those impacts with certainty. ○ Jean Souza: So is the ranking based on anecdotal information, common sense? ○ Rob Flaner: The formula is based on the residential population count in each hazard zone. ○ Jean Souza: "Death or injury" should be added to the definition of impacts. ○ Via chat: [1:34 PM] Mehana Vaughan - Because of housing insecurity on our islands, impacts to people's homes, loss of housing are also very strongly felt (in addition to death or injury). ○ Jan Tenbruggencate: I object to the Earthquake ranking. It's too high. ○ Cindy Rolli: Earthquake data is looking County-wide. The probability of one occurring within 100 years is Medium. ○ Via chat: [1:42 PM] Mehana Vaughan - Less flood plains in Lihu'e which may be reflected in flooding risk ranking bars. I would support moving earthquake rankings down, definitely for Lihu'e and all to low if that is what group leans to.	

2

	◦ Rob Flaner: Soft soils in Lihu'e drive the risk ranking up in that area. ◦ Doug Haigh: Is the ranking consistent with ASCE and IBCs? ◦ Rob Flaner: Damage curves are based on IBCs. The fragility curve is based on when the structure was built. ◦ Doug Haigh: I'd move the Earthquake ranking to "Low" for all of Kaua'i. ◦ Cindy Rolli: The CPT will review the Earthquake ranking. ◦ Jean Souza: The built environment in Lihu'e encompasses liquefiable soils. Change the ranking to "Medium" for Lihu'e and "Low" for the rest of the island. ◦ Pat Griffin: I'm surprised to see Tsunami impacts in East Kaua'i ranked as Medium. ◦ David Kennard: The geography is aggregated. North Shore and East Kauai impacts are averaged between high and low elevations. ◦ Maka'ala Kaaumoana: Risk to life and limb and economic cost in 2018 were from the landslides. Mapping has been done on the North Shore for landslide areas. ◦ Mehana Vaughn: I agree with Maka'ala about the Landslide hazard being high on the North Shore. Can we see mapping in connection to the models? ◦ Doug Haigh: Consider Tsunami damage to the main port in Lihu'e. ◦ Via chat: [1:52 PM] Ruby Pap - great point, Doug! 90% of food is imported- through that port?	
5	**Mitigation Action Review and Consensus** • Spreadsheet Presentation ◦ Jan Tenbruggencate: Does it affect funding if all actions are listed as high priority? ◦ Cindy Rolli: The implementation priority is not at risk because funding is available. Grant pursuit priorities are rated high if there isn't funding yet. ◦ Via chat: [2:03 PM] Mehana Vaughan - By having funding do we mean that there are funding sources to apply to, or that the county has funding in hand? I imagine the former. ◦ Rob Flaner: High priority cannot be given if there is no eligible funding. All high priority projects in the plan already have a potential funding source. Each year, priorities change. The County will need to adjust priorities when the opportunity for funding presents itself.	Consensus achieved: • No additions to funded actions. • No additions to actions without funding. Approvals: • Remove the Grant Pursuit column and adopt the general language suggested by Rob Flaner. • Accept Actions List with noted edits.

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	- David Kennard: Can the last column be changed to Y/N rather than High/Medium/Low?
	- Rob Flaner: Defer to "Funding Available?" Column. The Grant Pursuit Priority column can be removed.
	- Via chat: [2:09 PM] Mehana Vaughan - That column seems useful.
	- Ben Sullivan: Ranking is beneficial, so an opportunity is not missed.
	- Rob Flaner: Grant Pursuit Priority can be changed to annualized columns to show the priorities' yearly changeability.
	- David Kennard: I'll defer to Rob and Ben and allow the column to stay "High".
	- Via chat: [2:13 PM] Benjamin Sullivan - Will the final plan define process for how & when projects can be added to this list? (hoping annually, when, etc?)
	- Via chat: [2:15 PM] Flaner, Rob - Yes. The Plan will include a plan maintenance strategy that includes annual progress reporting. That is when actions can be added and priorities can be changed.
	- Maka'ala Kaaumoana: The Watershed Action Plan of 1999 ranks potential funding and gets reorganized each year. The community understands ranking and reorganizing.
	    ▪ #20 "Publications" – Publications should also go to non-conforming use permit properties.
	    ▪ #27 "Identify elders" – add identification of those with serious health conditions. Can they be moved out of the hazard area preemptively when a disaster is looming?
	    ▪ #30 Why is Hubs plural? Is there is more than one Hub planned?
	- David Kennard: I'm not aware of any other in the works, but there is community perspective that having other Hubs around the island would be ideal.
	- Via chat: [2:16 PM] Benjamin Sullivan - Maka'ala we want more sharing on resilience hubs...and agree with your sentiment. Thanks!
	- Via chat: [2:26 PM] Makaala - Ben, we haven't been included in the planning for the Wainiha structure yet. What does the community want in the building, next to it, etc. Security of equipment and supplies, etc.	

	- Doug Haigh: #2 Education/Outreach and BCEGS Classification are funded. The department is close to finishing code amendments. - Doug Haight: The most important things are not always funded. - Via chat: [2:16 PM] Benjamin Sullivan - here here Doug! - Doug Haigh: If there is an opportunity, KEMA should identify grant pursuit priorities. - Via chat: [2:18 PM] Mehana Vaughan - Thank you Doug, I really agree that separating priorities in and of themselves based on risk and need and public input, from whether there is grant funding for it, seems important. In other words having rankings not based just on grant availability. - Ruby: The SC should weigh in if something is not a good project or if it shouldn't be a priority. The grant pursuit priority was added not to lose sight of applying for potential grants. - Cindy: If the SC wants to weigh in further on implementation priority or agency priority, we can discuss or issue a survey. - Polly Phillips: #8 Kilauea gym is funded. - Cindy Rolli: Do you want to change Grant Pursuit to Y/N? - Rob Flaner: We can remove the column and add a blanket statement that all funding opportunities will be pursued. - Via chat: [2:32 PM] Ruby Pap - I like leaving in the column G about 'grant funding options'. - Via chat: [2:33 PM] Mehana Vaughan - Can we keep implementation priority and rank it based on what it is called, the need for project. Then grant pursuit priority includes the availability of grants. - Via chat: [2:34 PM] Ruby Pap - Mehana- all the projects are eligible for grants - Via chat: [2:35 PM] Mehana Vaughan - Yes but what Rob just talked about (how many actions they meet etc.) should be included in a separate column. - Via chat: [2:35 PM] Benjamin Sullivan - Current ranking is based on 'resources available' vs 'mitigation priority' - but will leave this alone and trust the process from here. - Jean Souza: State that all funded projects are ranked high priority. - Rob: The full context of the ranking will be presented in the plan.	

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	○ Jean Souza: Explain that all projects listed as high have secured funding.
	○ Rob Flaner: Some may change to Medium based on factors other than funding.
	○ Via chat: [2:41 PM] Mehana Vaughan - # 10 - ADDRESS impacts of invasive species, vs. ASSESS
	○ Via chat: [2:52 PM] Mehana Vaughan - I am grateful also to see the inclusion of assessment of drainage systems into watersheds. This is something we don't do well as a county. Manage stormwater in a way that doesn't send pollutants and trash to the streams and ocean.
	○ Via chat: [2:54 PM] Ruby Pap - The other 'new' actions are from the West Kauai Community Vulnerability Assessment
	○ Maka'ala Kaaumoana: There's no reference to early warning systems. Advance notice of potential inundation is a high community priority.
	○ Cindy Rolli: Please forward the proposed written action to Cindy and David so it can be included accurately.
	○ Via chat: [2:54 PM] Mehana Vaughan - Maybe the suggestion of an advance warning system could be incorporated between numbers 46-47 (could be an action within 47) or language added to that action detail ("an evacuation plan AND EARLY WARNING SYSTEM" is needed for the North Shore...". only then it does not cover the rest of the island, which will likely also need it in the future. I'm ok with approving these and moving ahead.
	○ Cindy Rolli: Are there any additions to funded actions not on the list?
	    ▪ No additions. Achieved consensus.
	○ Cindy Rolli: Are there any additional projects not funded that have not been identified?
	    ▪ No additions. Achieved consensus.
	○ Jan Tenbruggencate: Remove Grant Pursuit column and adopt general language suggested by Rob Flaner.
	    ▪ No objections. Approved.
	○ Jan Tenbruggencate: Any objections to approving Actions List with noted edits?
	    ▪ No objections. Approved.
	○ Mehana Vaughn: The Master Action and Detail don't seem to line up on some of the actions.
	○ Ruby Pap: I reorganized the list to align HMP actions with vetted General Plan actions.	

6

	○ Via chat: [2:50 PM] Mehana Vaughan - I absolutely support that Ruby, thank you for doing that. That helps in understanding it.
	○ Cindy Rolli: Mehana, please send a list of the actions that seem disconnected.
	○ Jan Tenbruggencate: Tetra Tech and CPT will edit the Actions list.
	  ▪ No objections to edited Actions list
	  ▪ No additional comments
	○ CPT will discuss priorities.	

6	**Public Comment** Maka'ala Kaaumoana: Thank you for your generosity in allowing me to participate freely as a member of the public. I will produce the early warning proposal and an evacuation plan.	
7	**MHMRP Milestones** • **Draft plan public release date – January 4th** • **Tentative public meetings January 14th and 16th** • **Final Draft to FEMA February 15th**	
8	**Next Steering Committee Meeting – December 10th** • **Review Draft Plan**	

County of Kaua'i
Meeting Agenda

Purpose of Meeting:	Kaua'i County Multi-Hazard Mitigation and Resilience Plan Steering Committee
Location of Meeting:	Virtual/KEMA Emergency Operations Center
Date/Time of Meeting:	12.10.2020, 1:00-3:00 pm

Attendees:

David Kennard	Mayor Derek Kawakami	Elton Ushiro	Jean Souza
Polly Phillips	Kaliko Kabasawa	Pat Griffin	Jan TenBruggencate
Benjamin Sullivan	Stanford Iwamoto	Lauren Guest	Chelsie Sakai
Fred Fennell (public)	Diane DeHart	Alan Clinton	Alden Alayvilla
Rob Flaner	Cindy Rolli	Megan Brotherton	

Agenda Summary:

Item No.	Description	Action/Decision item(s):
1	Welcome and Agenda Overview • Address by Kaua'i County Mayor Derek Kawakami: Let's focus on love, joy, hope and compassion as we work on mitigating hazards. Thank you to all who worked on this plan update. • Address by KEMA Administrator Elton Ushiro: We've been through so much this year with COVID, flooding, disaster warnings and other challenges. I appreciate the hard work done for this plan by the Core Planning Team, Steering Committee, Tetra Tech, and the public participants.	
2	11.12.20 SC Meeting Minutes • Edits or changes needed o Jean Souza: Pg 1, item 4, 1st bullet, 2nd open circle: Attribute ranking/rating comment to Cindy.	
3	Public Input • None	

4	Draft Plan Review
	• Overview of the plan organization
	• Review Guidelines
	  o David Kennard: The plan has a specific format based on FEMA review and approval guidelines. They are looking for specific information presented in a specific way. The structure reflects the format that will be easiest for FEMA to review and accept.
	  o Ben Sullivan: For the next plan update, consider having two different drafts: a FEMA draft and a community draft.
	  o Rob Flaner: This plan is formatted in a similar way according to what the County requested. Volume I is a simplified version for the general public which contains	

1

	less detailed data. Volume II includes all the data details which meet the FEMA requirements for the plan. ○ Jean Souza: Would prefer to have one more SC meeting to do a plan review together. Looking forward to when more communities like Hanapēpē-ʻEleʻele work together so what they do can benefit others. Appreciate how the public and those who are not professional in the hazard mitigation field have been treated during this process and look forward to a more robust public engagement in the next plan update. ○ Cindy Rolli: Your input and contribution is much appreciated. Please reach out if you have any questions when reviewing the plan. ○ Jan Ten Bruggencate: Thank you all committee members. This will be a remarkable document to inform other community planning efforts to prepare for future hazard events. ○ Pat Griffin: If there are changes in the plan over the course of the five years, do the changes go back to FEMA for approval? ○ David Kennard: The County acknowledges changes in the interim, but at the end of the five-year cycle, the County will submit the changes to FEMA. ○ Rob Flaner: See Appendix Q for the Plan Maintenance Strategy for annual progress reporting. • SC Comment Period – 12/10-12/21 ○ Comments to be received by 12/21	
5	Public Comment • None	
6	MHMRP Milestones • Draft plan public release date – January 4th ○ Public Comment Period – January 4th to February 3rd • Public meetings January 14th and 16th • Final Draft to FEMA February 15th	
7	Thank you Steering Committee! • Jan TenBruggencate: No additional comments. Meeting adjourned.	

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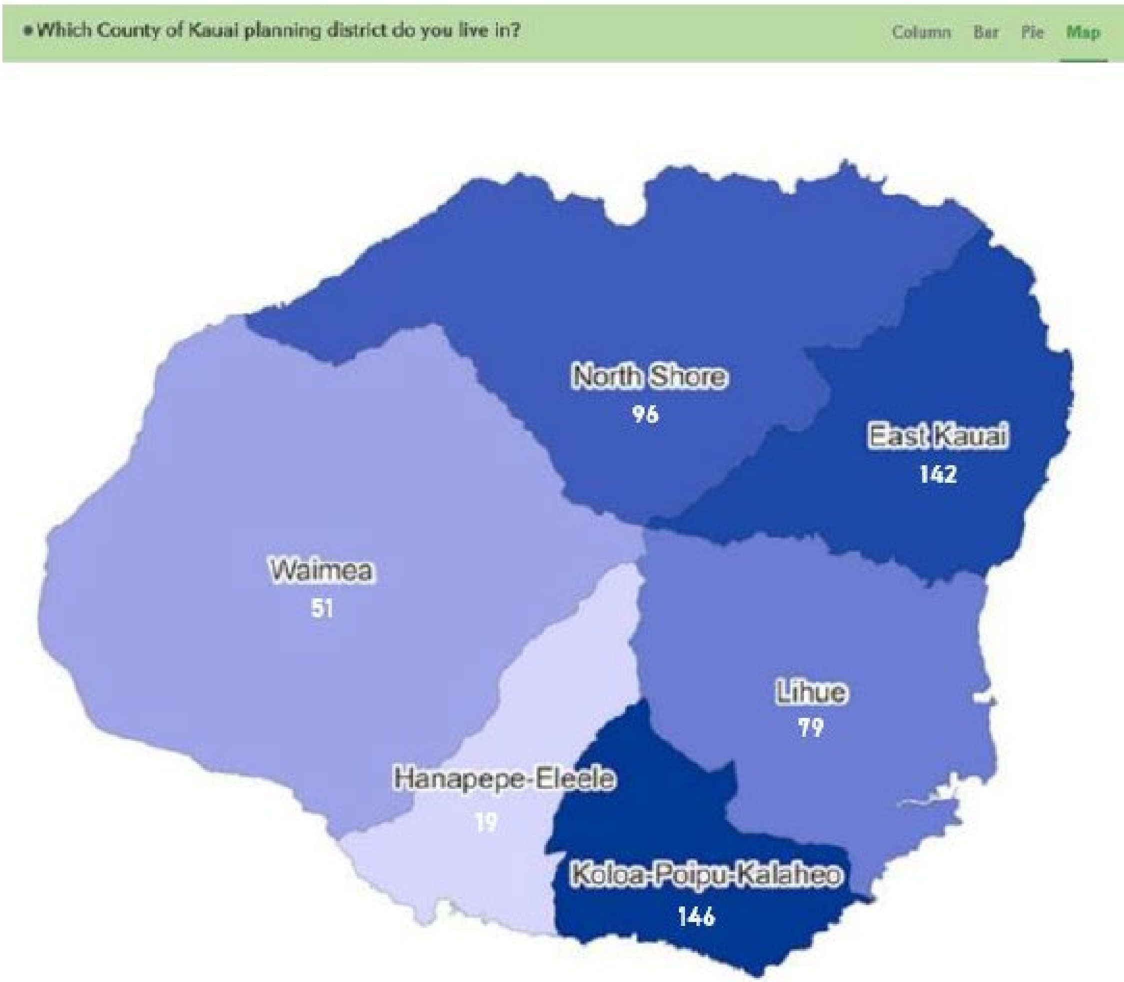
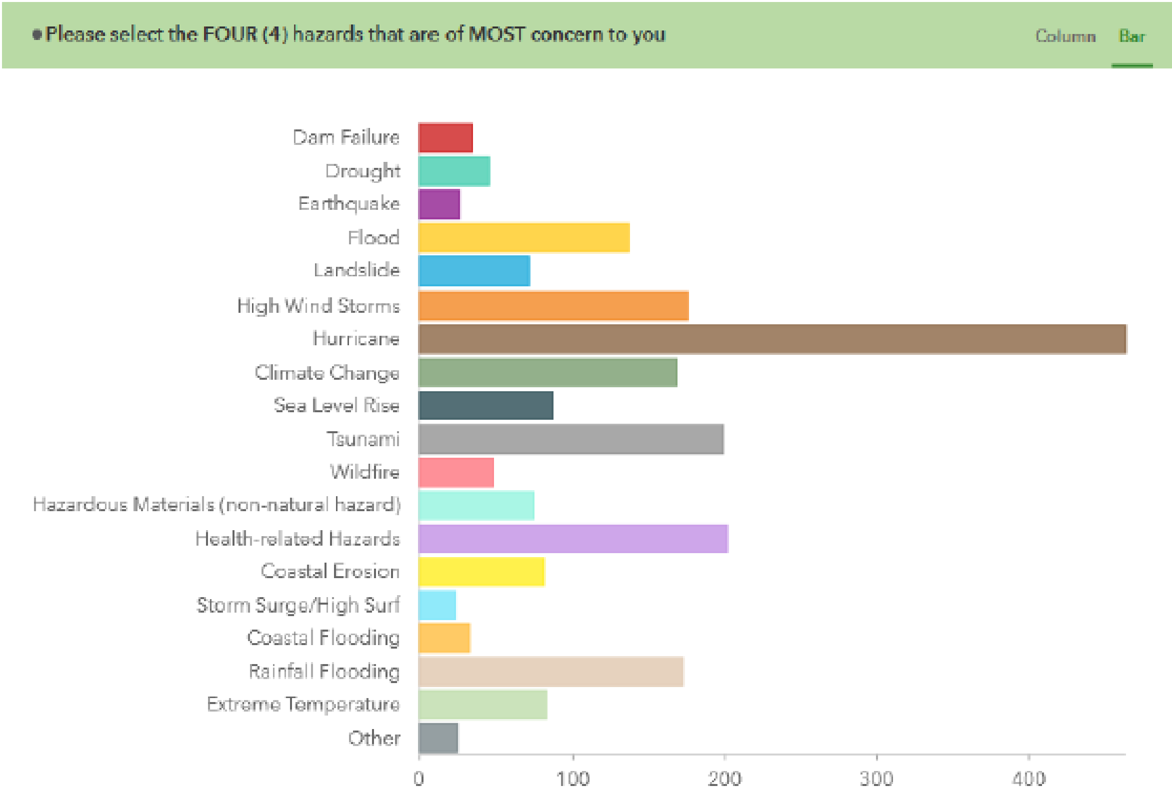
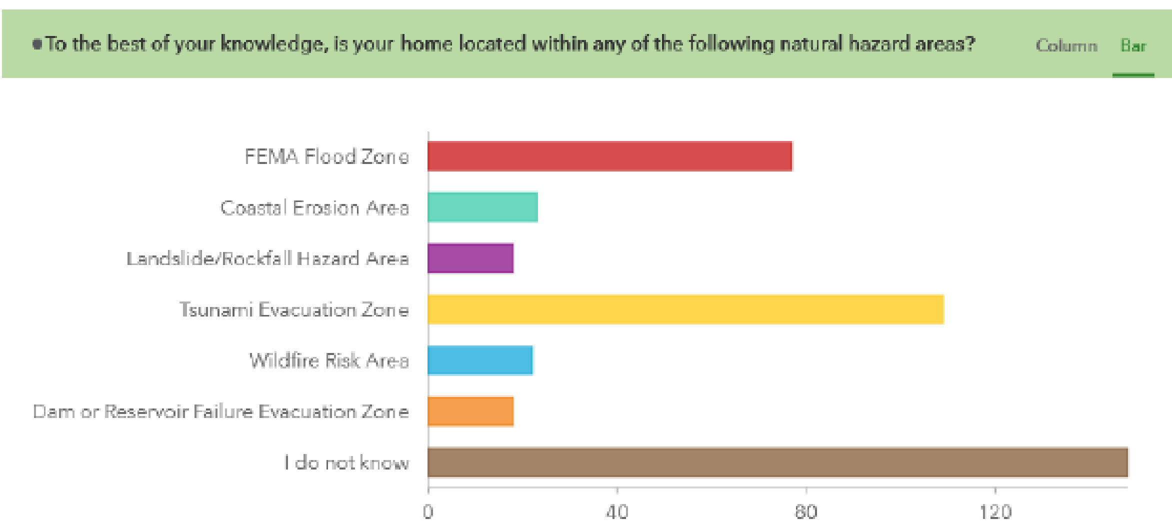
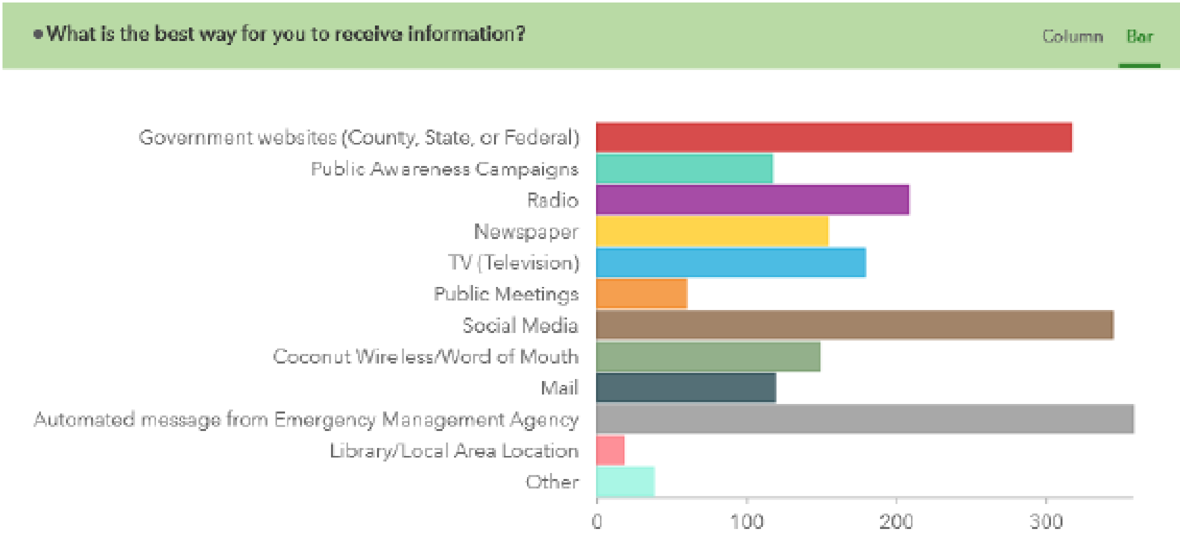
Attachment C-2. Survey Results



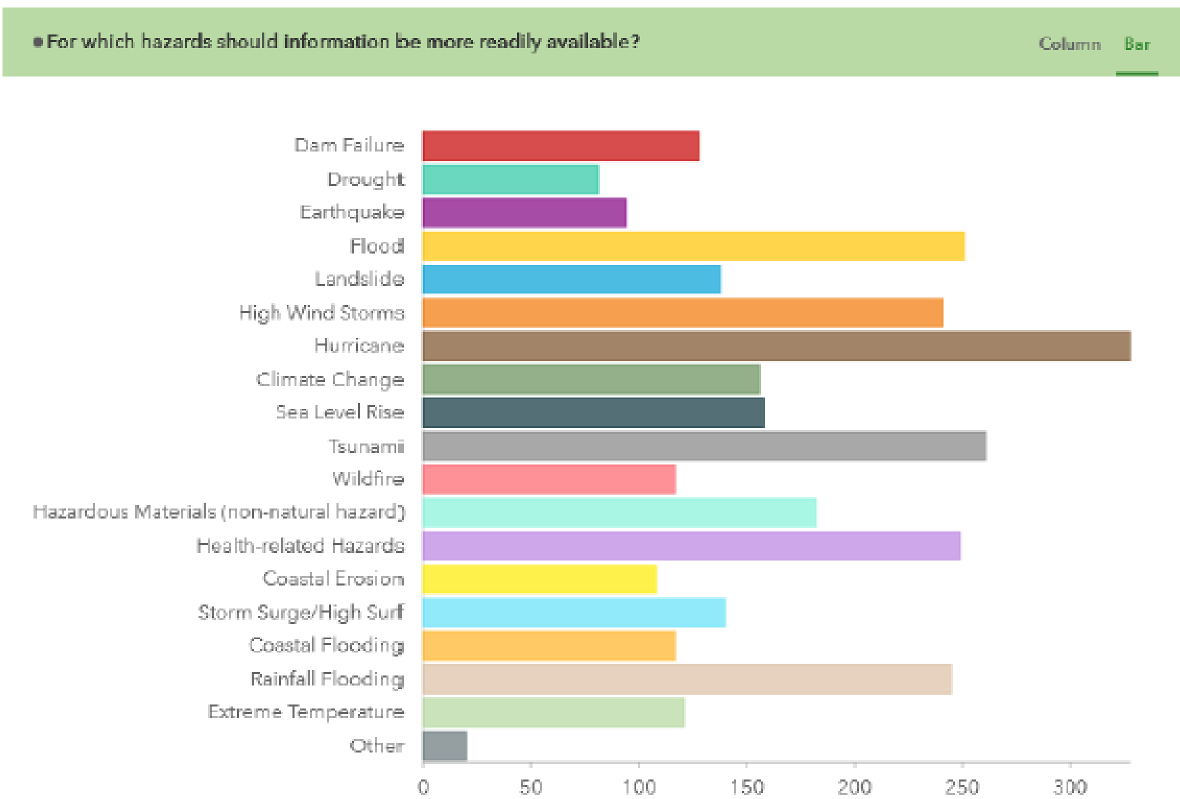
534 Total Records: 8/4/2020


Please select the FOUR (4) hazards that are of MOST concern to you
Column
Bar
Dam Failure
Drought
Earthquake
Flood
Landslide
High Wind Storms
Hurricane
Climate Change
Sea Level Rise
Tsunami
Wildfire
Hazardous Materials (non-natural hazard)
Health-related Hazards
Coastal Erosion
Storm Surge/High Surf
Coastal Flooding
Rainfall Flooding
Extreme Temperature
Other
0
100
200
300
400


To the best of your knowledge, is your home located within any of the following natural hazard areas?
Column
Bar
FEMA Flood Zone
Coastal Erosion Area
Landslide/Rockfall Hazard Area
Tsunami Evacuation Zone
Wildfire Risk Area
Dam or Reservoir Failure Evacuation Zone
I do not know
0
40
80
120

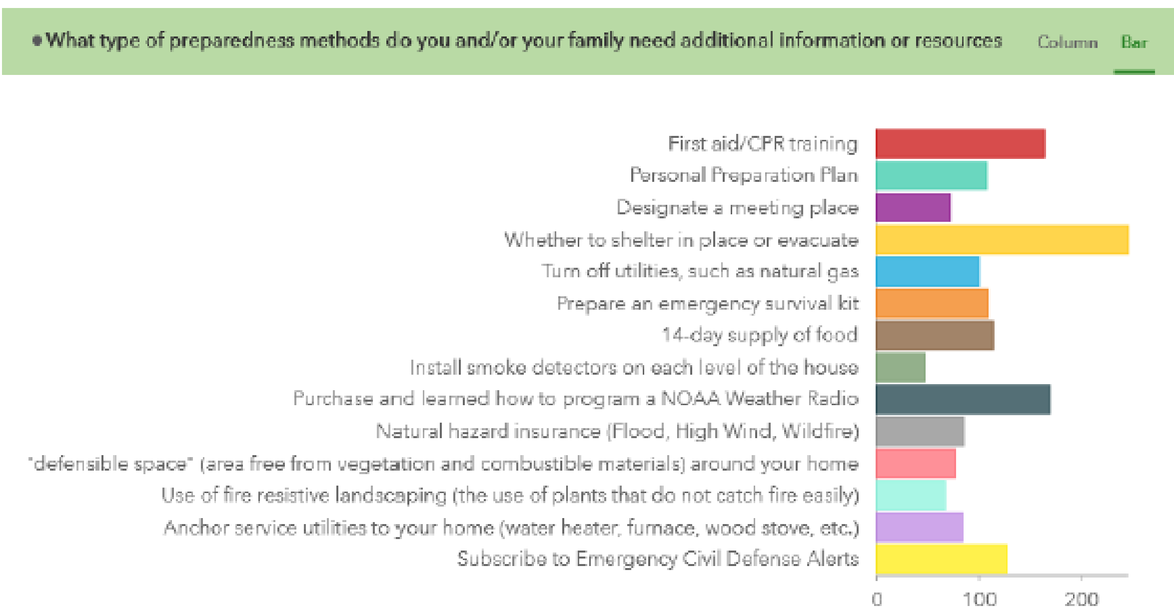


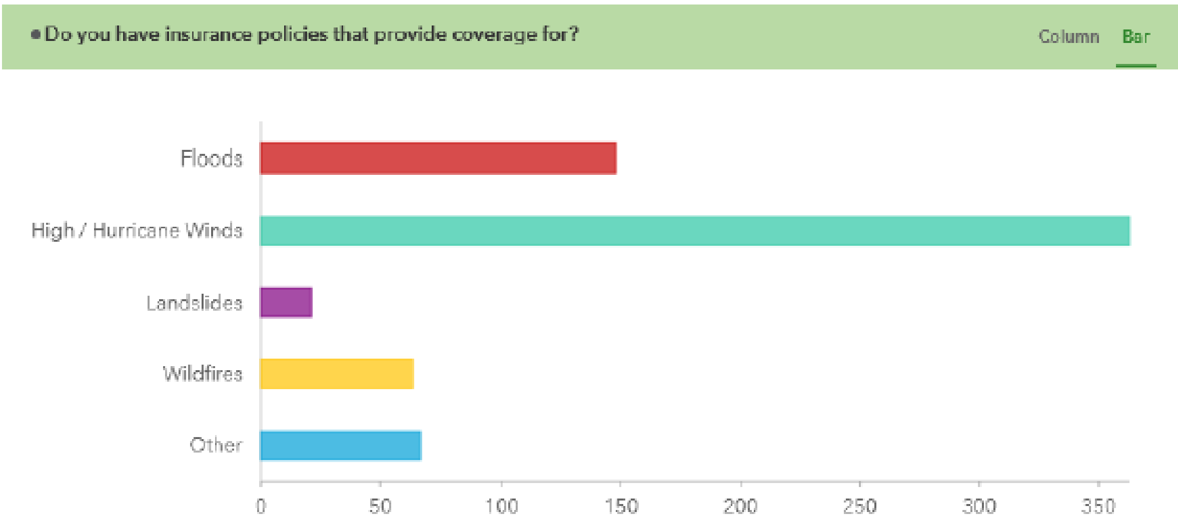
What is the best way for you to receive information?
Column
Bar
Government websites (County, State, or Federal)
Public Awareness Campaigns
Radio
Newspaper
TV (Television)
Public Meetings
Social Media
Coconut Wireless/Word of Mouth
Mail
Automated message from Emergency Management Agency
Library/Local Area Location
Other
0
100
200
300

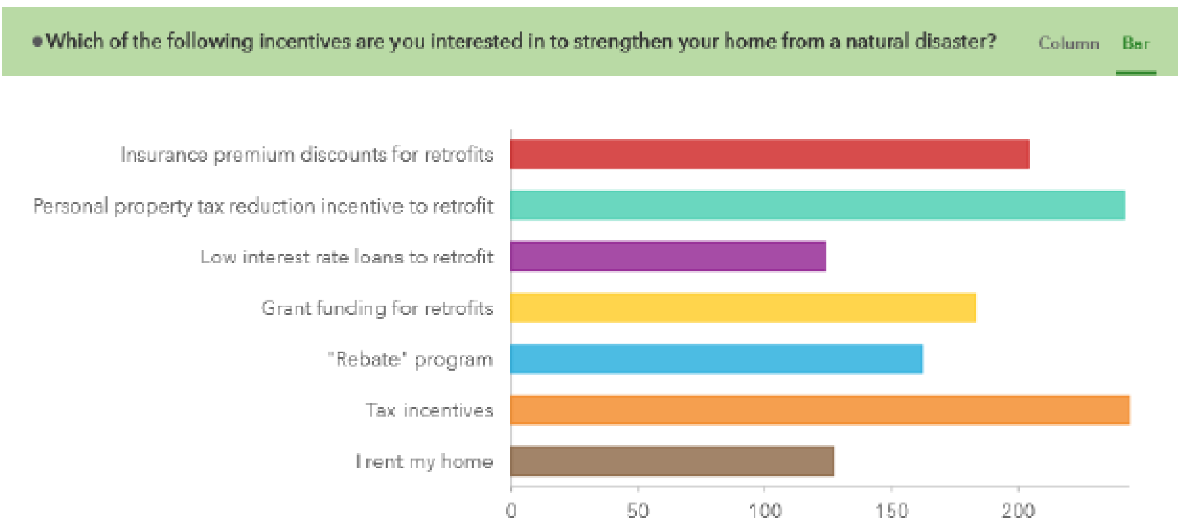


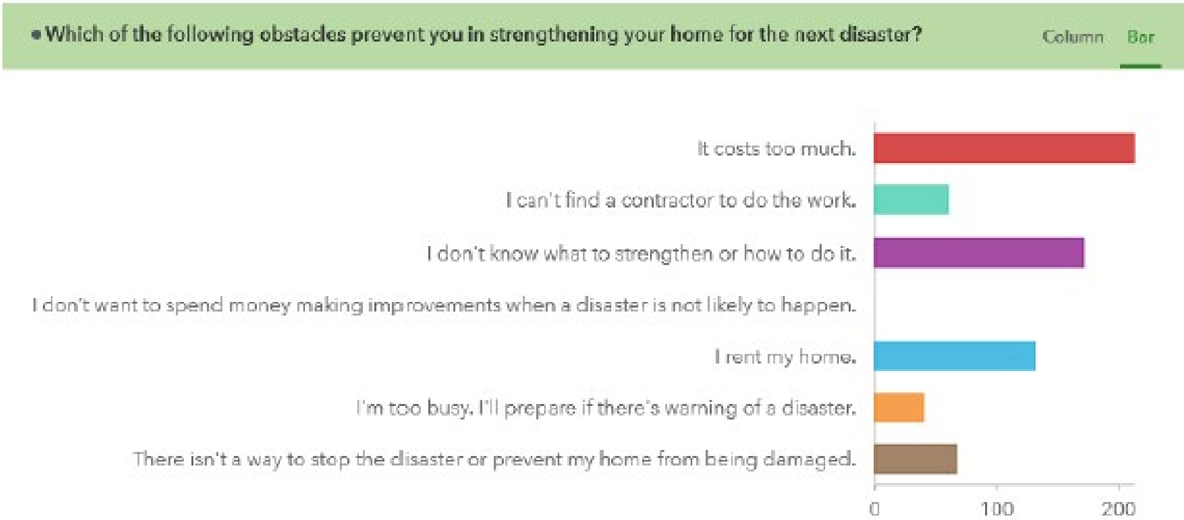
For which hazards should information be more readily available?
Column
Bar
Dam Failure
Drought
Earthquake
Flood
Landslide
High Wind Storms
Hurricane
Climate Change
Sea Level Rise
Tsunami
Wildfire
Hazardous Materials (non-natural hazard)
Health-related Hazards
Coastal Erosion
Storm Surge/High Surf
Coastal Flooding
Rainfall Flooding
Extreme Temperature
Other
0
50
100
150
200
250
300

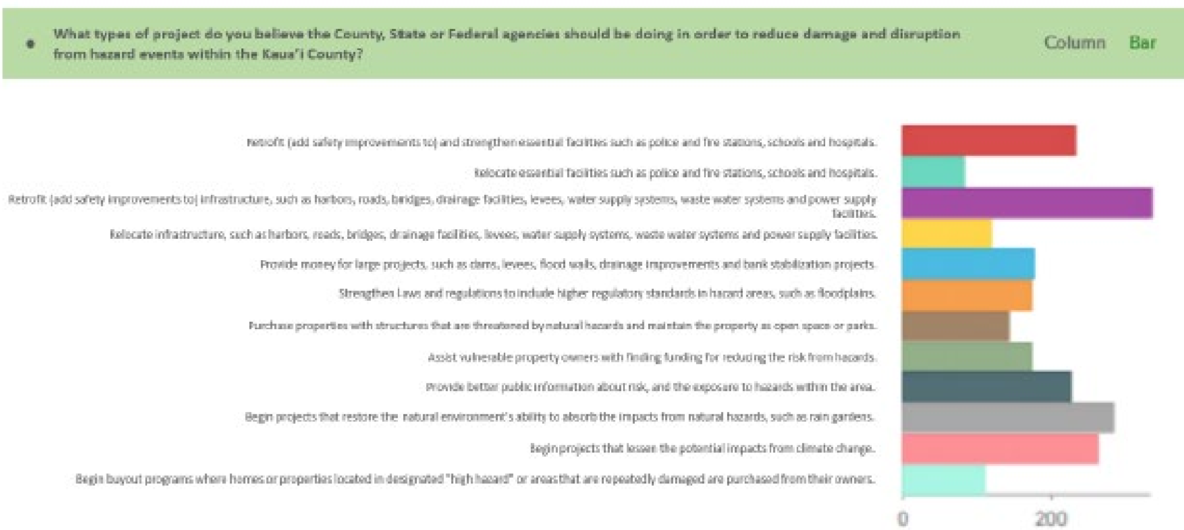

In the event of a natural disaster, which of the following describes you/your family?
Column
Bar
Pie
Map
I will need to turn to the community for support
I can and will support myself/my family
I can and will support myself/my family and neighbors
I can and will support myself/my family and community at large
I can and will support myself/my family and anyone in need of assistance
0
50
100
150

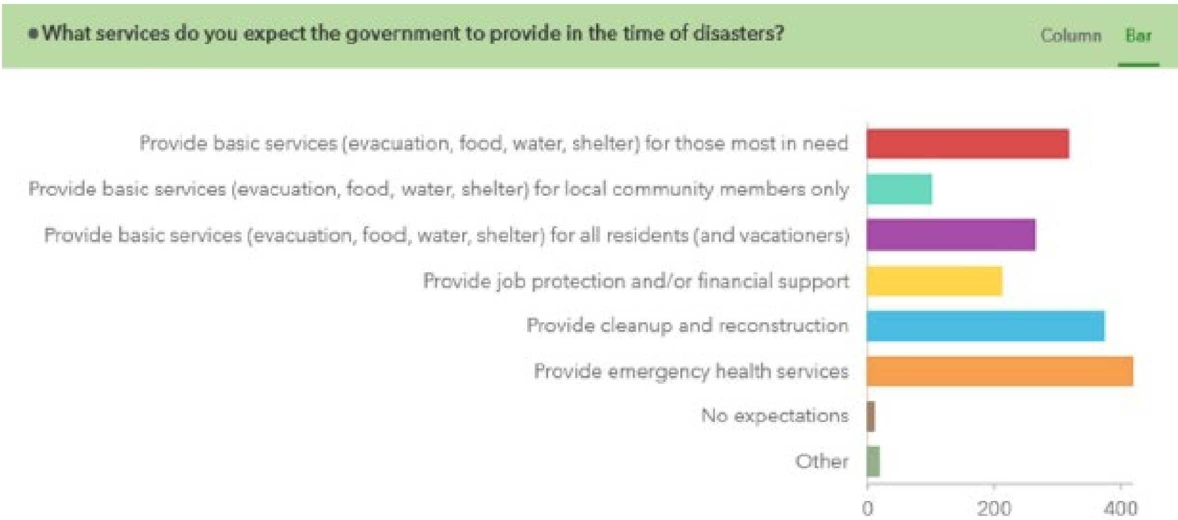

What type of preparedness methods do you and/or your family need additional information or resources
Column
Bar
First aid/CPR training
Personal Preparation Plan
Designate a meeting place
Whether to shelter in place or evacuate
Turn off utilities, such as natural gas
Prepare an emergency survival kit
14-day supply of food
Install smoke detectors on each level of the house
Purchase and learned how to program a NOAA Weather Radio
Natural hazard insurance (Flood, High Wind, Wildfire)
"defensible space" (area free from vegetation and combustible materials) around your home
Use of fire resistive landscaping (the use of plants that do not catch fire easily)
Anchor service utilities to your home (water heater, furnace, wood stove, etc.)
Subscribe to Emergency Civil Defense Alerts
0
100
200


Do you have insurance policies that provide coverage for?
Column
Bar
Floods
High / Hurricane Winds
Landslides
Wildfires
Other
0
50
100
150
200
250
300
350


Which of the following incentives are you interested in to strengthen your home from a natural disaster?
Column
Bar
Insurance premium discounts for retrofits
Personal property tax reduction incentive to retrofit
Low interest rate loans to retrofit
Grant funding for retrofits
"Rebate" program
Tax incentives
I rent my home
0
50
100
150
200


• Which of the following obstacles prevent you in strengthening your home for the next disaster?
Column
Bar
It costs too much.
I can't find a contractor to do the work.
I don't know what to strengthen or how to do it.
I don't want to spend money making improvements when a disaster is not likely to happen.
I rent my home.
I'm too busy. I'll prepare if there's warning of a disaster.
There isn't a way to stop the disaster or prevent my home from being damaged.
0
100
200


• What types of project do you believe the County, State or Federal agencies should be doing in order to reduce damage and disruption from hazard events within the Kaua'i County?
Column
Bar
Retrofit (add safety improvements to) and strengthen essential facilities such as police and fire stations, schools and hospitals.
Relocate essential facilities such as police and fire stations, schools and hospitals.
Retrofit (add safety improvements to) infrastructure, such as harbors, roads, bridges, drainage facilities, levees, water supply systems, waste water systems and power supply facilities.
Relocate infrastructure, such as harbors, roads, bridges, drainage facilities, levees, water supply systems, waste water systems and power supply facilities.
Provide money for large projects, such as dams, levees, flood walls, drainage improvements and bank stabilization projects.
Strengthen Laws and regulations to include higher regulatory standards in hazard areas, such as floodplains.
Purchase properties with structures that are threatened by natural hazards and maintain the property as open space or parks.
Assist vulnerable property owners with finding funding for reducing the risk from hazards.
Provide better public information about risk, and the exposure to hazards within the area.
Begin projects that restore the natural environment's ability to absorb the impacts from natural hazards, such as rain gardens.
Begin projects that lessen the potential impacts from climate change.
Begin buyout programs where homes or properties located in designated "high hazard" or areas that are repeatedly damaged are purchased from their owners.
0
200



What services do you expect the government to provide in the time of disasters?
Column
Bar
Provide basic services (evacuation, food, water, shelter) for those most in need
Provide basic services (evacuation, food, water, shelter) for local community members only
Provide basic services (evacuation, food, water, shelter) for all residents (and vacationers)
Provide job protection and/or financial support
Provide cleanup and reconstruction
Provide emergency health services
No expectations
Other
0
200
400

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix D. Risk Assessment Methodology

D. RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- **Hazard identification**—Use all available information to determine what types of disasters may affect a jurisdiction, how often they can occur, and their potential severity.
- **Vulnerability identification**—Determine the impact of natural hazard events on the people, property, environment, economy and lands of the region.
- **Cost evaluation**—Estimate the cost of potential damage or cost that can be avoided by mitigation.

The risk assessment for this hazard mitigation plan update evaluates the risk of natural hazards prevalent in the planning area and meets requirements of the DMA (44 CFR, Section 201.6(c)(2)).

RISK ASSESSMENT TOOLS

Mapping

A review of national, state, and county databases was performed to locate available spatially based data relevant to this planning effort. Maps were produced using geographic information systems (GIS) software to show the spatial extent and location of identified hazards when such data were available. These maps are included in the hazard profile chapters of this document.

Modeling

Overview

In 1997, FEMA developed the standardized Hazards U.S.-Multi-Hazard (Hazus) model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology, Hazus, with new models for estimating potential losses from hurricanes and floods.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.

- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

Hazus provides default data for inventory, vulnerability and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

RISK ASSESSMENT APPROACH

The risk assessments in this plan describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- **Identify and profile each hazard**—The following information is given for each hazard:
  - A summary of past events that have impacted the planning area
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity descriptions
  - Warning time likely to be available for response.
- **Determine exposure to each hazard**—Exposure was determined by overlaying hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard.
- **Assess the vulnerability of exposed facilities**—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and Hazus were used to perform this assessment for the dam failure, flood, earthquake, tropical cyclone, and tsunami hazards. Outputs similar to those from Hazus were generated for other hazards, using maps generated through GIS.

Hazard Profile Development

Hazard profiles were developed through research and review of previously developed reports and plans, including community general plans and state and local hazard mitigation plans. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists, and others.

Exposure and Vulnerability

Dam Failure, Earthquake, Flood, Tropical Cyclone, and Tsunami

The following hazards were evaluated using Hazus:

- **Dam Failure**—A Level 2 analysis was performed for general building stock and critical facilities in selected dam failure inundation areas. To estimate damage that would result from a flood, Hazus uses pre-defined relationships between flood depth at a structure and resulting damage, with damage given as a percent of total replacement value. Curves defining these relationships have been developed for damage to structures and for damage to typical contents within a structure. By inputting flood depth data and known property replacement cost values, dollar-value estimates of damage were generated.
- **Earthquake**—An advanced Engineering Building Model (AEBM) analysis was performed to assess earthquake exposure and vulnerability for the 500-year probabilistic earthquake.
- **Flood (Inland and Coastal)** —A Level 2 user-defined analysis was run using the flood methodology described under dam failure above. Current flood mapping for the planning area was used to delineate flood hazard areas and estimate potential losses from the 1-percent-annual-chance and 0.2-percent-annual-chance flood events.
- **Tropical Cyclone**—A Level 2 general building stock analysis was performed to assess tropical cyclone wind exposure and vulnerability for a Category 4 event with a storm track crossing the island from the southwest to the northeast.
- **Tsunami**— A Level 2 user-defined analysis was run using a modified version of the flood methodology described under dam failure above. Tsunami inundation area mapping for the planning area was used to estimate potential losses.

Sea Level Rise, Landslide, High Surf, and Wildfire

For most of the hazards of concern, historical data were not adequate to model future losses. However, areas and inventory susceptible to some hazards of concern were mapped by other means and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment.

Heat and Drought

The risk assessment methodologies used for this plan focus on damage to structures. Because drought and heat do not impact structures, the risk assessment for this hazard was more limited and qualitative than the assessment for the other hazards of concern.

SOURCES OF DATA USED IN HAZUS MODELING

Building and Cost Data

Replacement cost values and detailed structure information derived from tax assessor parcel, and residential and commercial building data provided by the County were loaded into Hazus. When available, an updated inventory was used in place of the Hazus defaults for critical facilities and assets.

Replacement cost is the cost to replace the entire structure with one of equal quality and utility. Replacement cost is based on industry-standard cost-estimation models published in *RS Means Square Foot Costs* (RS Means, 2020). It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure from the tax assessor data. The construction class and number of stories for single-family residential structures also factor into determining the square foot costs.

Hazus Data Inputs

The following hazard data sources were used for the analyses conducted for the risk assessment:

- **Dam Failure**— Dam failure inundation area data was provided by the Pacific Disaster Center. Original Individual Assessment Reports and accompanying data were prepared under contract for DLNR. The dam break scenarios depicted in the reports utilized the Danish Hydrological Institute's MIKE 21 model. Using the inundation area boundaries and a 3-meter DEM created for the project from NOAA 3-meter DEM and USGS 10-meter DEM data, inundation depth grids were generated and integrated into the Hazus model. Depth grids were generated for the following dam failure inundation areas and combined into one depth grid for analysis purposes:
  - Huinawai (National Dam ID HI00104)
  - Kapaia (NID HI00012)
  - Waita Reservoir (NID HI00099)
- **Earthquake**—Earthquake probabilistic data prepared by the USGS were used for the analysis of this hazard.
- **Flood**—The effective Digital Flood Insurance Rate Maps (DFIRM) for the planning area, replaced with the preliminary DFIRM data where applicable, was used to delineate flood hazard areas and estimate potential losses from the 1-percent-annual-chance and 0.2-percent-annual-chance flood events. The DFIRM is effective as of November 26, 2010 with LOMRs as September 8, 2016 incorporated. The preliminary DFIRM is dated May 25, 2019. Using the DFIRM floodplain boundaries and the 3-meter project DEM, flood depth grids were generated and integrated into the Hazus model.
- **Tropical Cyclone (wind)**—Category 4 wind field import files provided by the Pacific Disaster Center were used for the analysis of this hazard. The wind field files were created for the Hawaiʻi Catastrophic Hurricane Plan.
- **Tsunami**—Tsunami inundation area data was provided by the University of Hawaiʻi. The data was created for the 2009 Hawaiʻi Tsunami Mapping Project. The maximum flow depth area was computed from the 1946 Aleutian, 1952 Kamchatka, 1957 Aleutian, 1960 Chile and 1964 Alaskan Tsunamis simulated at both mean-sea-level (MSL) and high tide conditions.

Other Local Hazard Data

Locally relevant information on hazards was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. Data sources for specific hazards were as follows:

- **Climate Change**—Sea level rise data compiled for the Hawaiʻi Sea Level Rise Vulnerability and Adaptation Report was used for the exposure analyses. The Sea Level Rise Exposure Area (SLR-XA) 3.2-foot scenario represents future chronic coast flooding. The 1%-Annual-Chance Coastal Flood Zone (1%CFZ) + 3.2-foot SLR scenario represents event-based coastal flooding plus sea level rise.
- **Landslide**—Landslide susceptibility data was created by generating slope data from the 3-meter project DEM. Areas of slope were assigned susceptibility categories as follows:
  - Low – slope less than 20 degrees
  - Moderate – slope of 20 to 40 degrees
  - High – slope greater than 40 degrees

  Areas in the moderate and high categories were used for the exposure analysis.

- **Tropical Cyclone (storm surge)**—Sea, lake, and overland surges from hurricane (SLOSH) data provided by NOAA was used for the exposure analysis. The data is the maximum of maximums for a Category 4 hurricane. This data was created by running multiple analysis runs for hurricanes approaching from different directions and retaining the highest value at a given location. The storm surge inundation is from wave action and does not include freshwater inundation.
- **Wildfire**—Communities at Risk from Wildfire data was provided by the Hawai'i Wildfire Management Organization (HWMO). The data was categorized as high, medium and low fire risk ratings using the Communities at Risk from Wildfire map produced by Hawai'i Department of Land and Natural Resources' Division of Forestry and Wildlife (DOFAW) and HWMO. High and medium categories were used for the exposure analysis.

Data Source Summary

Table D-1 summarizes the data sources used for the risk assessment for this project.

Table D-1. Hazus Model Data Documentation

Data	Source	Date	Format
Property parcels	Kaua'i County	2020	Digital (GIS) format
Residential and commercial real property data (including use description, square footage, year built, number of stories, and foundation type)	Kaua'i County	2020	Digital (text) format
Building footprints	Kaua'i County	2020	Digital (GIS) format
Building replacement cost	RS Means	2020	Digital (text) format. Updated RS Means values
American Community Survey 5-year Population Estimates at the Census block group level	Hawai'i Statewide GIS Program Geospatial Data Portal	2015	Digital (GIS) format
Kaua'i General Plan land use	Kaua'i County	2018	Digital (GIS) format
Sea Level Rise Exposure Area (SLR-XA) 3.2-foot	Hawai'i Sea Level Rise Vulnerability and Adaptation Report	2017	Digital (GIS) format
1%-Annual-Chance Coastal Flood Zone (1%CFZ) + 3.2-foot SLR	Hawai'i Sea Level Rise Vulnerability and Adaptation Report	2017	Digital (GIS) format
Dam failure inundation areas	Provided by Pacific Disaster Center (original data prepared for DLNR)	2009	Digital (GIS) format
Probabilistic earthquake data	Hazus v4.2 SP03	2019	Digital (GIS) format
Effective DFIRM	FEMA	2016	Digital (GIS) format
Preliminary DFIRM	FEMA	2019	Digital (GIS) format
Landslide susceptibility	Tetra Tech	2020	Digital (GIS) format
Hazus wind field import files for the Hawai'i Catastrophic Hurricane Plan	Provided by Pacific Disaster Center	2015	Hazus import format
Sea, Lake and Overland Surges from Hurricanes (SLOSH) Model Data for the State of Hawai'i	NOAA National Hurricane Center, Storm Surge Unit	2018	Digital (GIS) format
2009 Hawai'i Tsunami Mapping Project tsunami inundation areas	Provided by University of Hawai'i	2013	Digital (GIS) format
Communities at Risk from Wildfire	Provided by Hawai'i Wildfire Management Organization (HWMO) (prepared in conjunction with DLNR Division of Forestry and Wildlife (DOFAW)	2013	Digital (GIS) format

Data	Source	Date	Format
Coastal 3-meter Digital Elevation Model (DEM)	NOAA Office for Coastal Management website	2013	Digital (GIS) format
10-meter Digital Elevation Model (DEM)	USGS	2016	Digital (GIS) format
Makani Pahili 2017 Emergency Power Prioritization Workshop Series Final Report (Critical facilities including airports, animal shelters, banks, communications sites, community health care facilities, emergency medical services, extended care facilities, fire stations, food banks, dialysis centers, LNG storage, motor vehicle fueling stations, petroleum product bulk terminals and offices, public health agencies, radio/TV stations, treatment centers, and waste water treatment plants.)	Hawai'i Emergency Management Agency (HI-EMA)	2017	Digital (GIS) format
County civic facilities (Critical facilities including police stations, fire stations, civic facilities, base yards and maintenance shops, post offices, schools, neighborhood centers, hospitals, airports, boat harbors, county parks, and landfill/transfer stations.)	Kaua'i County	2020	Digital (GIS) format
Street addresses for various critical facilities (Including community healthcare facilities, correction institutions, extended care facilities, hospice facilities, treatment centers, urgent care centers, and utility administrative offices.)	Kaua'i County	2020	Digital (text) format
Electric power facilities	Kaua'i County	2020	Digital (GIS) format
Waste water treatment plants	Kaua'i County	2019	Digital (GIS) format
Water pumps	Kaua'i County	2020	Digital (GIS) format
Water tanks	Kaua'i County	2020	Digital (GIS) format
Wells	Kaua'i County	2020	Digital (GIS) format
Waste water pump stations	Kaua'i County	2006 - 2015	Digital (GIS) format
Bridges	State of Hawai'i Office of Planning	2018	Digital (GIS) format
Facility Registry Service (FRS) - Toxic Release Inventory facilities	U.S. Environmental Protection Agency website	2020	Digital (GIS) format

LIMITATIONS

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk. Over the long term, Kaua‘i County will collect additional data to assist in estimating potential losses associated with other hazards.

Appendix E. Qualitative Assessment of Health-Related Hazards

E. Qualitative Assessment of Health-Related Hazards

The Steering Committee decided that this update of the *County of Kaua'i Multi-Hazard Mitigation and Resilience Plan* would include a profile of health-related hazards that could impact the planning area. These hazards are profiled, but a full risk assessment was not performed, and the hazards are not included in the risk ranking.

> **NOTE REGARDING COVID-19**
>
> As this planning process was underway, Kaua'i County, the State of Hawai'i and the remainder of the world was just beginning to deal with the impacts from the COVID-19 global pandemic. The impacts from this event will be long term and change the way society as a whole views, prepares for and responds to pandemics.
>
> Data on the impacts from this event and the development of policies to respond were in their infancy as of this writing and were not fully vetted enough to inform this plan update. It is anticipated that future updates to this plan will have well informed, expanded dialogue on this subject matter.

PLANNING CAPABILITY FOR PANDEMIC

Health-related hazards generally are seen at three levels of spread:

- An outbreak is defined by the U.S. Centers for Disease Control and Prevention (CDC) as the occurrence of more cases of disease than normally expected within a specific place or group of people over a given period of time. State and local regulations require immediate reporting of any known or suspected outbreaks by health care providers, health care facilities, laboratories, veterinarians, schools, child day care facilities, and food service establishments.
- An epidemic is a localized outbreak that spreads rapidly and affects a large number of people or animals in a community.
- A pandemic is an epidemic that occurs worldwide or over a very large area and affects a large number of people or animals.

The State of Hawai'i Department of Health's Disease Outbreak Control Division comprises the Disease Investigation Branch and Immunization Branch. These programs work together to monitor, investigate, prevent, and control infectious diseases in Hawai'i, especially those preventable through immunizations, and to ensure Hawai'i's ability to respond to emergencies that threaten the public's health. Toward these goals, they work to strengthen the relationships between the Department of Health and other partners, including laboratories, hospitals, schools, emergency response agencies, private organizations, and the military.

COVID-19

The Hawai'i State Department of Health has provided extensive information and resources to help individuals, communities, and counties during the COVID-19 pandemic. The COVID-19 State of Hawai'i Portal website recommends these steps for everyday prevention (State of Hawai'i, 2020a):

- Keep your hands clean
- Wear a mask
- Maintain physical distancing

- Keep objects and surfaces clean
- Protect kupuna and people with underlying conditions

LOCATION, EXTENT AND MAGNITUDE

Health hazards that affect the residents of Kauaʻi County may arise in a variety of situations, such as during a communicable disease outbreak, after a natural disaster, or as the result of a bioterrorism incident. All populations in Kauaʻi County are susceptible to bioterrorism or pandemic events. Populations who are young or elderly or have compromised immune systems are likely to be more vulnerable. The relative ease of world-wide travel in addition to the world's expanding global food industry ensures that all countries are vulnerable to pandemic events at any time.

IDENTIFIED HEALTH-RELATED HAZARDS IN HAWAIʻI

The Hawaiʻi Department of Health Disease Outbreak Control Division has identified the diseases described in Table E-1 as human diseases that could contribute to a serious epidemic in the state.

Table E-1. Naturally Spread Diseases Seen In Hawaiʻi

Description	Examples	
Animal Transmitted		
These are diseases that are transmitted to humans by domestic or non-domestic animals.	• Brucellosis (undulant fever) • Campylobacteriosis • Cat scratch disease • Cryptosporidiosis • Escherichia coli (E. coli) • Giardiasis • Middle Eastern Respiratory Syndrome (MERS) • Plague	• Psittacosis (ornithosis, parrot fever) • Q Fever • Rabies • Ringworm • Salmonellosis • Toxoplasmosis • Tularemia
Bloodborne		
Viruses, bacteria and parasites that can be carried in blood and cause disease are known as bloodborne pathogens. Transmission of these diseases may be from direct blood contact, needle sticks, intravenous drug use, sexual behavior, insects or other vectors.	• Ebola • Hepatitis C • Malaria	
Community-Acquired Infections		
Community-acquired infections are infections that are contracted outside of a hospital (or are diagnosed within 48 hours of admission) without any previous health care encounter.	• Adenovirus • Bed Bugs • Body Lice • Campylobacteriosis • Conjunctivitis (pink eye) • Common cold viruses • Enterovirus, non-polio • Hand, foot, and mouth disease • Head Lice (ʻukus) • Impetigo • Influenza (flu) • Invasive Group A Streptococcus (necrotizing fasciitis) • Legionnaires' Disease/Pontiac Fever	• Methicillin-Resistant Staphylococcus Aureus (MRSA) • Norovirus • Pinworm disease • Respiratory syncytial virus • Ringworm • Scabies • Smallpox • Staphylococcus aureus • Strep throat/scarlet fever • Streptococcus, Group B • Tularemia • Viral meningitis

Description	Examples
Foodborne	
Foodborne diseases can be spread when food becomes contaminated with fecal matter containing bacteria, viruses, or parasites. This contamination can happen at a farm, manufacturing plant, restaurant, or home. Foodborne diseases usually result in gastrointestinal illness, which can include symptoms such as diarrhea, vomiting, nausea, stomachache, and fever. People who are ill with a foodborne disease can give the infection to others, so proper hygiene and hand washing practices are essential to limit the spread of disease. People experiencing gastrointestinal symptoms should not prepare or handle food for others.	• Amebiasis • Angiostrongyliasis (rat lungworm) • Anisakiasis • Botulism • Brucellosis (undulant fever) • Campylobacteriosis • Cholera • Ciguatera fish poisoning • Cryptosporidiosis • Cyclosporiasis • Escherichia coli (E. coli) • Giardiasis • Listeriosis • Norovirus • Salmonellosis • Scombroid • Shigellosis • Tularemia • Typhoid Fever • Vibriosis • Yersinia enterocolitica
Influenza	
Influenza is an infectious viral disease of birds and mammals commonly transmitted through airborne aerosols such as coughing or sneezing. Symptoms are chills, headache, fever, nausea, muscle pain and occasionally pneumonia.	Flu pandemics in the late 19th and 20th centuries: • Russian flu • 1918 Spanish flu • Asian flu • Hong Kong flu • A/H1N1 or the swine flu. Avian flu strains H5N1 and H7N9 caused human deaths but did not escalate to pandemic proportions.
Mosquito-Transmitted	
Mosquito-borne diseases are not an immediate threat in Hawai'i because travelers are usually vaccinated (yellow fever) or disease spread requires an infected animal to travel all the way from the mainland (West Nile virus). Some mosquito-transmitted diseases (e.g., malaria or Japanese encephalitis) are not likely to ever be a threat because the mosquito species that spread them are not found in Hawai'i. However, travelers should be aware of these diseases and where they occur in the world so they may protect themselves.	
Respiratory Viruses	
Respiratory viruses are responsible for influenza-like illness. They can also cause the common cold. The virus that caused the Covid-19 pandemic is a respiratory virus. People at high risk (those with certain underlying conditions, the elderly, the very young, and pregnant women) can develop severe illness that results in hospitalization or death. The best way protection is proper hygiene and avoiding contact with sick individuals. The best way for those who are infected to protect others is to cover their nose and mouth when sneezing and coughing, use good hand hygiene, and stay home from work or school.	• Adenovirus • Coronaviruses (including SARS and MERS CoV) • Influenza • Parainfluenza • Parvovirus B19 • Respiratory Syncytial Virus • Rhinovirus (Common Cold) • Measles • Pertussis (whooping cough)
Waterborne Diseases	
Diseases caused by micro-organisms transmitted in water can be spread while bathing, washing, drinking water, or eating food exposed to contaminated water.	• Cholera • Giardiasis • Legionnaires' Disease /Pontiac Fever • Leptospirosis • Typhoid Fever • Vibriosis
Sexually Transmitted Disease	
HIV/AIDS, chlamydia, gonorrhea, and syphilis are the predominant sexually transmitted infections handled by the Hawai'i State Department of Health Harm Reduction Services Branch, whose responsibilities include awareness, prevention, and control of these infections.	• Chlamydia • Genital warts • Gonorrhea • Hepatitis A, B, and C • Herpes • Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) • Human papillomavirus • Syphilis • Zika

BIOTERRORISM-RELATED HEALTH HAZARDS

Bioterrorism threats to public health are divided into three categories based on their ease of spread and the severity of illness they cause:

- Category A pathogens—Organisms or biological agents that pose the highest risk to national security and public health because they:
  - Can be easily spread or transmitted from person to person
  - Result in high death rates and have the potential for major public health impact
  - Might cause public panic and social disruption
  - Require special action for public health preparedness.
- Category B pathogens—The second highest priority organisms/biological agents. They:
  - Are moderately easy to disseminate
  - Result in moderate morbidity rates and low mortality rates
  - Require specific enhancements for diagnostic capacity and enhanced disease surveillance.
- Category C pathogens—The third highest priority, including emerging pathogens that could be engineered for mass dissemination in the future because of:
  - Availability
  - Ease of production and dissemination
  - Potential for high morbidity and mortality rates and major health impact.

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Appendix F. Hazard Ranking Methodology

F. HAZARD RANKING METHODOLOGY

A risk ranking was performed for the hazards of concern described in this plan. This risk ranking assessed the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. The risk ranking methodology and results were reviewed, discussed, and approved by the Steering Committee.

Numerical ratings of probability and impact were based on the hazard profiles and exposure and vulnerability evaluations presented in Chapters 4 through 13 in Volume 1 of this hazard mitigation plan. Using that data, the County ranked the risk of all the natural hazards of concern described in this plan. When available, estimates of risk were generated with data from Hazus or GIS. For hazards with less specific data available, qualitative assessments were used. As appropriate, results were adjusted based on local knowledge and other information not captured in the quantitative assessments.

Risk ranking results are used to help establish mitigation priorities. The County used its risk ranking to inform the development of an action plan, identifying mitigation actions, at a minimum, to address each hazard with a "high" or "medium" risk ranking. Actions that address hazards with a low or no hazard ranking are optional.

PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- Medium—Hazard event is likely to occur within 100 years (Probability Factor =2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor =1)
- No exposure—There is no probability of occurrence (Probability Factor = 0).

The assessment of hazard frequency is generally based on past hazard events in the area. Table F-1 summarizes the probability assessment for each hazard of concern for this plan.

Table F-1. Probability of Hazards

Hazard Event	Probability (high, medium, low)	Probability Factor
Tropical Cyclone and Other High Winds	High	3
Wildfire	High	3
Climate Change	High	3
Inland Flood	High	3
High Surf, Coastal Flood and Erosion	High	3
Tsunami	Medium	2
Landslide	High	3
Dam Failure	Low	1
Earthquake	Low	1

IMPACT

Hazard impacts will be assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors are assigned as follows:

- **People**—Values are assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners could use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High—30 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—15 percent to 29 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—14 percent or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the population is exposed to a hazard (Impact Factor = 0).
- **Property**—Values are assigned based on the percentage of the total ***property value exposed*** to the hazard event:
  - High—25 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)
  - Medium—10 percent to 24 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2)
  - Low—9 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0).
- **Economy**—Values are assigned based on the percentage of the total ***property value vulnerable*** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total assessed value of the property exposed to the hazard. For some hazards, such as wildfire and landslide, vulnerability will be considered to be the same as exposure due to the lack of loss estimation tools specific to those hazards. Loss estimates separate from the exposure estimates will be generated for the earthquake, flood hazards, and tropical cyclones using Hazus.
  - High—Estimated loss from the hazard is 15 percent or more of the total exposed property value (Impact Factor = 3)
  - Medium—Estimated loss from the hazard is 5 percent to 14 percent of the total exposed property value (Impact Factor = 2)
  - Low—Estimated loss from the hazard is 4 percent or less of the total exposed property value (Impact Factor = 1)
  - No impact—No loss is estimated from the hazard (Impact Factor = 0).

The impacts of each category are assigned a weighting factor to reflect its significance: impact on people is given a weighting factor of 3; impact on property is given a weighting factor of 2; and impact on the economy is given a weighting factor of 1. Table F-2, Table F-3 and Table F-4 summarize the impacts for each hazard.

Table F-2. Impact on People from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (3)
Tropical Cyclone and Other High Winds	High	3	3x3=9
Wildfire	High	3	3x3=9
Climate Change	Medium	2	2x3=6
Inland Flood	Medium	2	2x3=6
High Surf, Coastal Flood and Erosion	Medium	2	2x3=6
Tsunami	Medium	2	2x3=6
Landslide	Low	1	1x3=3
Dam Failure	Low	1	1x3=3
Earthquake	Low	1	1x3=3

Table F-3. Impact on Property from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (2)
Tropical Cyclone and Other High Winds	High	3	3x2=6
Wildfire	High	3	3x2=6
Climate Change	High	3	3x2=6
Inland Flood	Medium	2	2x2=4
High Surf, Coastal Flood and Erosion	Medium	2	2x2=4
Tsunami	Medium	2	2x2=4
Landslide	Low	1	1x2=2
Dam Failure	Low	1	1x2=2
Earthquake	Low	1	1x2=2

Table F-4. Impact on Economy from Hazards

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (1)
Tropical Cyclone and Other High Winds	High	3	3x1=3
Wildfire	High	3	3x1=3
Climate Change	High	3	3x1=3
Inland Flood	Low	1	1x1=1
High Surf, Coastal Flood and Erosion	Low	1	1x1=1
Tsunami	Low	1	1x1=1
Landslide	Low	1	1x1=1
Dam Failure	Low	1	1x1=1
Earthquake	Low	1	1x1=1

RISK RATING AND RANKING

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors for people, property and operations, as summarized in Table F-5.

Table F-5. Hazard Risk Rating

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Tropical Cyclone and Other High Winds	3	9+6+3=18	3x18=54
Wildfire	3	9+6+3=18	3x18=54
Climate Change	3	6+6+3=15	3x15=45
Inland Flood	3	6+4+1=11	3x11=33
High Surf, Coastal Flood and Erosion	3	6+4+1=11	3x11=33
Tsunami	2	6+4+1=11	2x11=22
Landslide	3	3+2+1=6	3x6=18
Dam Failure	1	3+2+1=6	1x6=6
Earthquake	1	3+2+1=6	1x6=6

Based on these ratings, a priority of high, medium or low was assigned to each hazard. The hazards ranked as being of highest concern are tropical cyclone and other high winds, wildfire, climate change, inland flood, and high surf, coastal flood and erosion. Hazards ranked as being of medium concern are tsunami and landslide. The hazards ranked as being of lowest concern are dam failure and earthquake. Table F-6 shows the hazard risk ranking.

Table F-6. Hazard Risk Ranking

Hazard Ranking	Hazard Event	Score
High	Tropical Cyclone and Other High Winds	54
High	Wildfire	54
High	Climate Change	45
High	Inland Flood	33
High	High Surf, Coastal Flood and Erosion	33
Medium	Tsunami	22
Medium	Landslide	18
Low	Dam Failure	6
Low	Earthquake	6

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Appendix G. Kaua‘i County Development Profile

G. KAUA‘I COUNTY DEVELOPMENT PROFILE

In order to accurately evaluate ways to protect people and property from the potential impacts of hazards, hazard mitigation requires an understanding of how development has been spread across the planning area and how it is likely to change in the future. This appendix provides a detailed review of planning area development.

CURRENT LAND USE

Hawai‘i’s State Land Use Commission, established in 1961, has defined four land use districts that provide the basic framework for land uses in the state. Most recently updated in 2013, the distribution of these districts in Kaua‘i County is as follows (Hawai‘i Office of Planning, 2013):

- The Urban District consists of lands in urban use with sufficient reserve to accommodate foreseeable growth. In the County of Kaua‘i, this district covers 14,865 acres, 4.2 percent of the total land area.
- The Rural District consists primarily of small farms mixed with low-density residential lots that have a minimum lot size of 0.5 acres. In the County of Kaua‘i, this district covers 1,374 acres, 0.4 percent of the total land area.
- The Agricultural District includes lands with capacity for intensive cultivation. The minimum lot size is 1 acre. In the County of Kaua‘i, this district covers 144,317 acres, 40.6 percent of the total land area.
- The Conservation District includes lands in forest and water reserve zones. In the County of Kaua‘i, this district covers 194,459 acres, 54.8 percent of the total land area.

Land uses within the Urban Districts are administered exclusively by the County. In the Agricultural and Rural Districts, the State Land Use Commission establishes use regulations and the County is responsible for their administration. The County, however, may adopt more stringent controls than those imposed by the State within these two districts. Land use in the Conservation District is regulated by the State Board of Land and Natural Resources, except that the County has concurrent permitting power within the Special Management Area near the coast. The County has no land use control over federal property. The Hawaiian Homes Commission has control over uses of the Hawaiian homelands leased to native Hawaiians.

Within Kaua‘i, County, desired future land use patterns were set forth in 2015 by the Kaua‘i General Plan Update Technical Study Land Use Buildout Analysis. Zoning must be consistent with the future land use designations. In the 2018 Kaua‘i County General Plan, the 2015 land use boundaries are refined based on input from community plans and neighborhood analysis areas that were delineated according to subdivision boundaries, census block groups, place types, zoning designations and state land use designations. The future land use designations in the General Plan are as follows (County of Kaua‘i, 2018):

- Natural
- Agriculture
- Homestead
- Neighborhood Center
- Neighborhood General
- Residential Community
- Urban Center
- Resort
- Industrial and Transportation
- Military
- University Zone
- Parks and Golf Courses

Table G-1 and Figure G-1 summarize the area and location of current land uses in Kaua'i County. Nearly 28 percent of the total acreage of the County (98,917 acres acres) is presently being used for agriculture.

Table G-1. Land Use in the County of Kaua'i

Land Use Category	North Shore	East Kaua'i	Līhu'e	Kōloa-Po'ipū-Kalāheo	Hanapēpē-'Ele'ele	Waimea	Total
Agricultural	11,344	11,571	15,643	9,138	3,845	10,646	**61,188**
Agricultural (IAL)	0	0	10,266	5,559	7,097	13,798	**36,720**
Golf Course	624	0	853	720	0	0	**2,197**
Homestead	0	3,444	0	1,828	0	0	**5,271**
Industrial	0	38	0	162	68	0	**273**
Large Town	0	0	0	177	0	0	**177**
Military	0	0	0	0	0	2,039	**2,039**
Natural	61,339	26,155	22,223	9,308	13,907	82,517	**215,449**
Neighborhood Center	66	211	609	84	73	110	**1,153**
Neighborhood General	251	601	0	195	388	329	**1,764**
Parks and Recreation	6,162	639	1,125	362	43	6,551	**14,882**
Plantation Camp	0	0	0	42	76	41	**159**
Residential Community	354	2,265	1,008	3,252	553	509	**7,942**
Resort	635	140	162	684	0	266	**1,887**
Small Town	0	0	0	18	0	0	**18**
Transportation	56	0	949	0	23	0	**1,027**
University Zone	0	0	241	0	0	0	**241**
Urban Center	0	0	1,601	0	0	0	**1,601**
Total	**80,831**	**45,064**	**54,681**	**31,529**	**26,073**	**116,811**	**354,990**

Source: Kaua'i County General Plan, 2018 (including the December 2020 amendment to the General Plan)

BUILDING COUNT, OCCUPANCY CLASS AND ESTIMATED REPLACEMENT VALUE

Table G-2 presents planning area building counts by building occupancy class. The table also summarizes estimated replacement value for building structures and contents combined.

Table G-2. Planning Area Building Counts by Occupancy Class

	Number of Buildings								Estimated Total Replacement Value (Structure and Contents)[a]
	Residential	Commercial	Industrial	Agricultural	Religion	Government	Education	Total	
North Shore	5,587	150	36	0	17	1	4	5,795	$4,103,681,163
East Kaua'i	9,070	245	44	0	9	0	3	9,371	$3,684,931,500
Līhu'e	6,396	629	255	1	23	0	16	7,320	$6,484,552,718
Kōloa-Po'ipū-Kalāheo	7,800	252	54	2	13	0	2	8,123	$4,383,192,487
Hanapēpē-'Ele'ele	1,760	100	35	0	4	0	0	1,899	$890,307,898
Waimea	2,068	77	36	0	5	0	1	2,187	$853,099,377
Total	**32,681**	**1,453**	**460**	**3**	**71**	**1**	**26**	**34,695**	**$20,399,765,142**

a. Values based on 2019 County tax parcel and real property data.

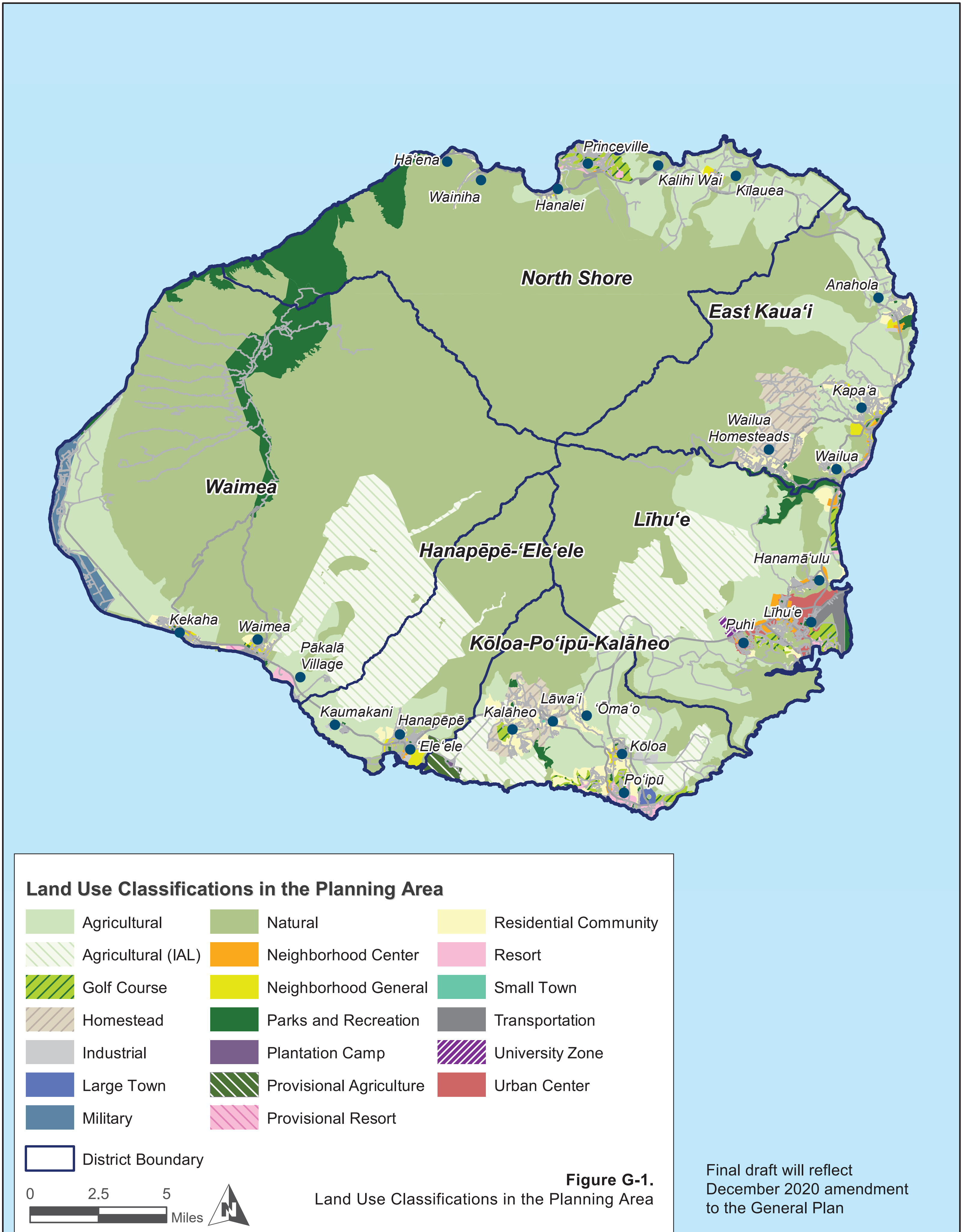


Figure G-1.
Land Use Classifications in the Planning Area

Final draft will reflect December 2020 amendment to the General Plan

CRITICAL FACILITIES

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. For this plan, the Steering Committee defined critical facilities as structures and infrastructure from which essential services and functions for victim survival, continuation of public safety actions, and disaster recovery are performed or provided.

Critical facilities provide indispensable services that enable the continuous operation of critical business and government functions and are critical to human health and safety or economic security. The risk assessment for each hazard in this plan discusses that hazard’s potential impact on critical facilities. For some hazards, potential damage to critical facilities was estimated using FEMA’s Hazards U.S. (Hazus) computer model. For this reason, the list of critical facilities in the County was distributed into the following categories defined in the Hazus model:

- **Safety and Security**—Law enforcement/security, search and rescue, fire services, government service, and responder safety
- **Food, Water and Sheltering—**Evacuations, schools, food/potable water, shelter, durable goods, water infrastructure, and agriculture
- **Health and Medical**—Medical care/hospitals, patient movement, public health, fatality management, health care, and supply chain
- **Energy—**Power grid, temporary power, and fuel
- **Communications**—Infrastructure, alerts, warnings, messages, 911 and dispatch, responder communications, and financial services
- **Transportation**—Highway/roadway, mass transit, railway, aviation, maritime, and pipeline
- **Hazardous Materials**—Facilities, hazardous debris, pollutants, and contaminants

Table G-3 summarizes the number of critical facilities by Hazus-defined category. Due to the sensitivity of this information, a detailed list of facilities is not provided. General locations of critical facilities and infrastructure in the planning area are shown in Figure G-2 and Figure G-3.

Table G-3. Critical Facilities in the Planning Area

	Number of Facilities							
	Safety and Security	Food, Water and Shelter	Health and Medical	Energy	Communications	Transportation	Hazardous Materials	Total
North Shore	12	78	3	1	3	13	0	**110**
East Kaua‘i	17	124	3	0	1	12	0	**157**
Līhu‘e	28	116	16	8	11	13	2	**194**
Kōloa-Po‘ipū-Kalāheo	14	89	4	0	0	10	1	**118**
Hanapēpē- ‘Ele‘ele	12	44	0	3	0	8	1	**68**
Waimea	17	114	4	1	2	11	2	**151**
Total	**100**	**565**	**30**	**13**	**17**	**67**	**6**	**798**

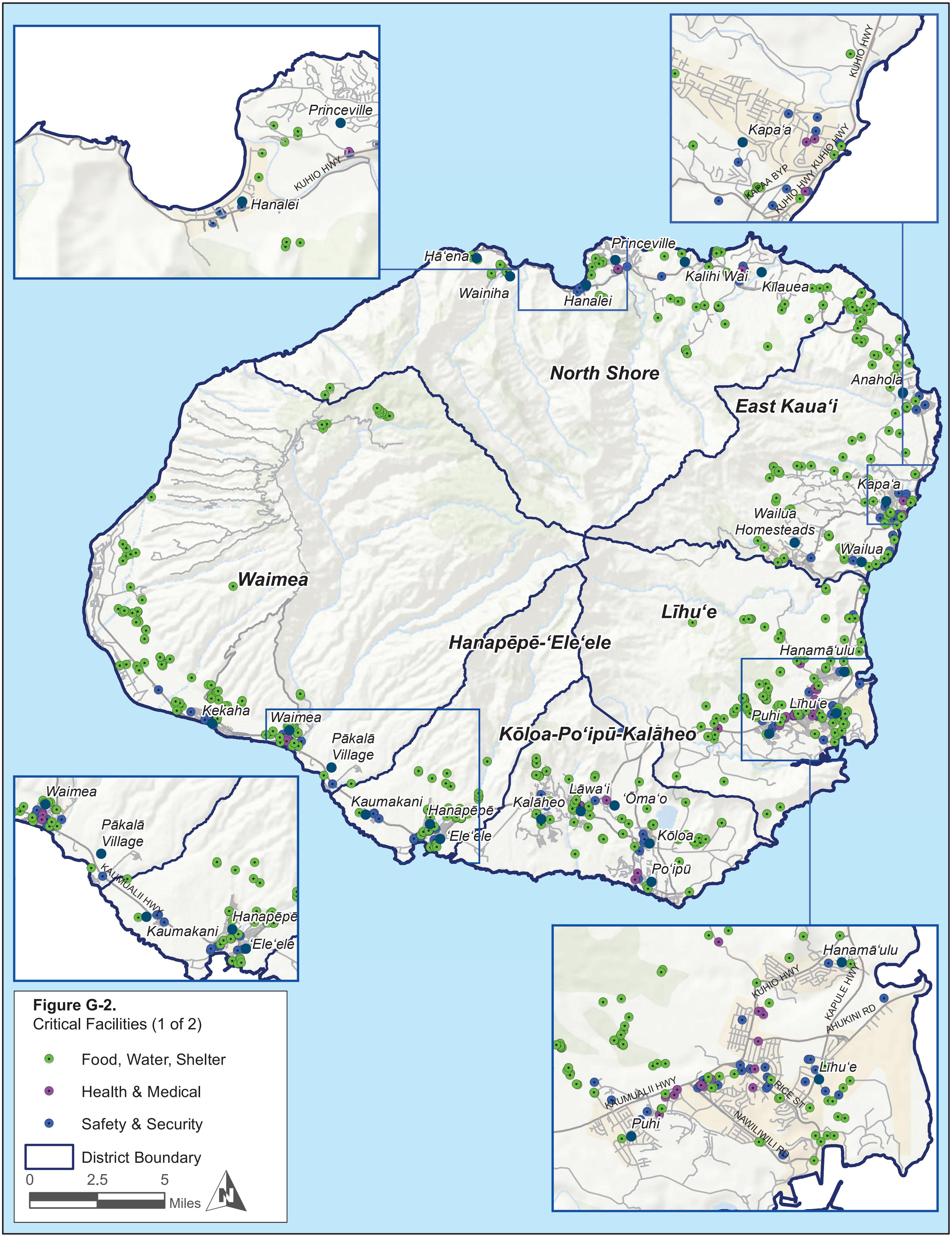


Figure G-2.
Critical Facilities (1 of 2)

- Food, Water, Shelter
- Health & Medical
- Safety & Security
- District Boundary

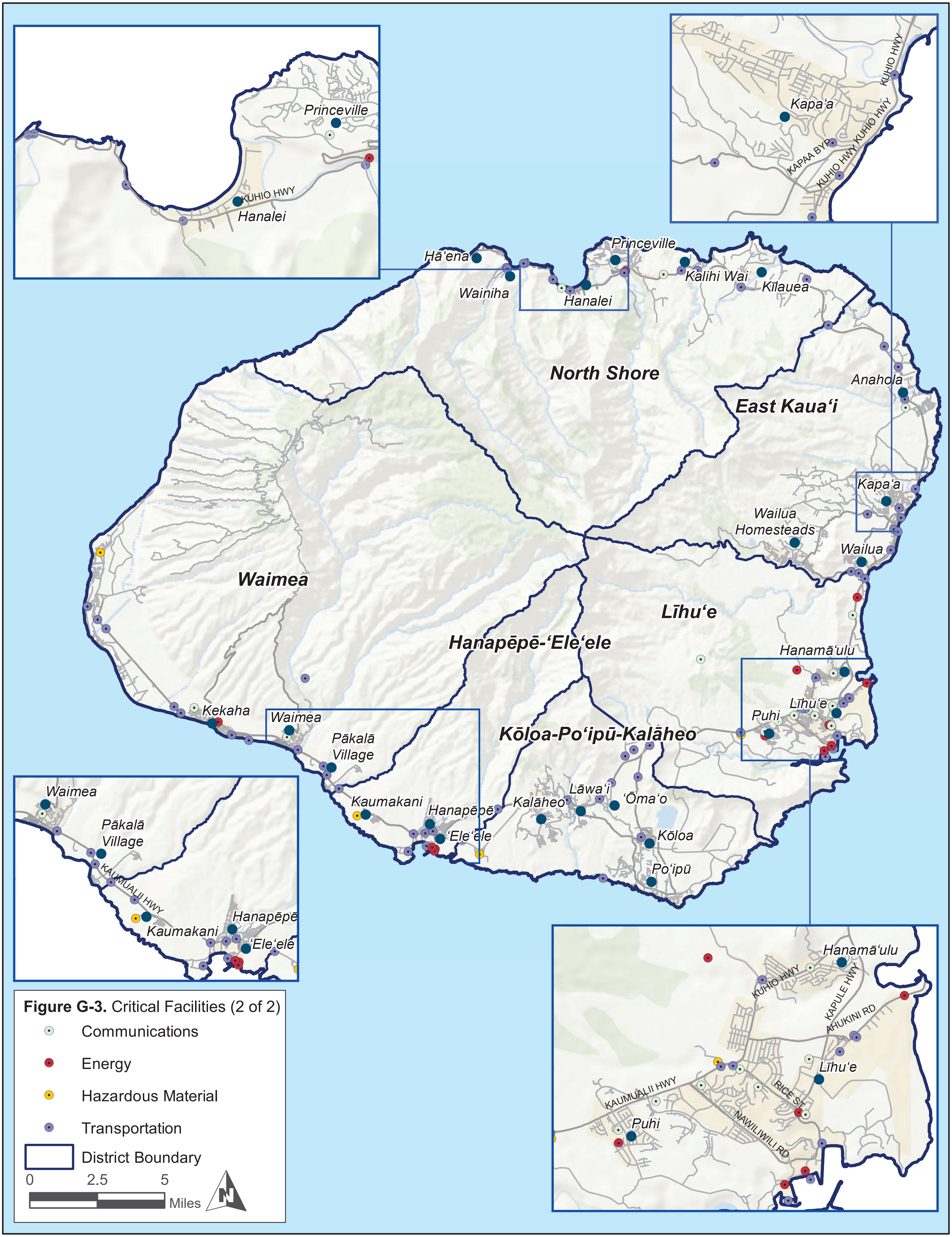


Figure G-3. Critical Facilities (2 of 2)

DEVELOPMENT TRENDS

Identifying recent development trends is achieved through a comprehensive review of permitting since completion of the previous plan and in anticipation of future development. Tracking previous and future growth in potential hazard areas provides an overview of increased exposure to a hazard within a community. Development trends are presented in Table G-4.

Table G-4. Recent and Expected Future Development Trends

Criterion	Response
Identify any areas targeted for development or major redevelopment in the next five years. Briefly describe, including whether any of the areas interface with known hazard risk areas.	Within the next five years (2020 – 2025), there are several areas where redevelopment or development may occur. The list below only includes major projects with existing zoning. Other areas seeking development require State Land Use District boundary amendments and zoning amendments, which are lengthy processes. • Līhu‘e Town Core—The Līhu‘e Town Core comprises four neighborhoods with the Special Planning Area designation. Infrastructure and facilities have been put in place that will facilitate private investment and residential development. A recent zoning amendment increased allowable residential density to 40 units per acre is some areas. The Līhu‘e Town Core is not in any known hazard areas. • Greater Līhu‘e—The greater Līhu‘e area includes greenfield development on Grove Farm-owned property with existing residential and commercial zoning. This area is outside of any known hazard zones. • Kōloa Town—The Kōloa Special Planning Area was established through the South Kaua‘i Community Plan. A form-based code was implemented to allow additional building types with a scale compatible to the existing historic town. Some parts of the Kōloa area are within the flood zone. It is out of the tsunami zone and sea level rise exposure areas. • Lima Ola—This is an affordable housing development located to the east of ‘Ele‘ele. The full buildout of the area will exceed 400 units.
How many permits for new construction were issued in the County since the preparation of the previous hazard mitigation plan?	(see permit table below)
Describe the level of buildout in the County, based on a buildable lands inventory. If no such inventory exists, provide a qualitative description.	The County's Buildout Analysis was conducted in 2015. In summary, most of the County's residentially zoned parcels that have been subdivided are developed (no longer vacant). Most of the County's vacant residentially zoned land without subdivision is in the Līhu‘e area. This area has the potential to accommodate approximately 1,000 or more units.

	2015	2016	2017	2018	2019
Single Family	205	205	192	175	181
Multi-Family	0	0	3	2	0
Other (commercial, mixed use, etc.)	2	1	5	3	4
Total	207	206	200	180	185

The most recent in-depth assessment of development trends in Kaua‘i County was the *Socioeconomic Analysis and Forecasts Report* finalized in 2014. No extensive analysis has been completed of trends since the previous hazard mitigation plan was adopted in 2015. However, the 2014 report projected trends from 2013 to 2035. Its key findings are summarized in the 2018 update to the County's General Plan, and include the following (County of Kaua‘i, 2018):

- The County is expected to grow by an average of 1 percent each year to a population of 88,013 by 2035. Seniors will make up 20 percent of the population by 2035, compared to only 10 percent in 2015.
- According to the General Plan estimates, the rate of job growth is expected to be less than population growth, with an average annual growth rate of 0.66 percent between 2020 and 2030; however, this rate will likely change due to economic impacts from COVID-19.

- Housing units are forecasted to increase proportionally with the population at a rate of about 1.2 percent per year. Growth rates are expected to vary considerable by planning district. The Līhuʻe Planning District is likely to see a larger increase than other districts, with 47 percent of total growth between 2010-2035, followed by South Kauaʻi at 26 percent of total growth. Other planning districts are expected to grow more slowly, with a total growth of 13 percent in East Kauaʻi, 8 percent in Hanapēpē-ʻEleʻele, 4 percent in Waimea-Kekaha, and 2 percent in the North Shore.
- Visitor arrivals are projected to have an overall growth rate of 1 percent per year to 2035, with significant ups and downs based on the historical pattern of some form of disrupting event in the visitor industry every five to ten years. COVID-19 has proved to be one of those disrupting events.

Appendix H. Kaua‘i County Demographic Profile

H. KAUA‘I COUNTY DEMOGRAPHIC PROFILE

POPULATION CHARACTERISTICS

The U.S. Census Bureau estimates Kaua‘i County’s total resident population at 72,293 as of July 2019. Table H-1 presents population estimates for the subdivision units within Kaua‘i County defined by the Census (the most recent data for these estimates is 2018).

Table H-1. 2018 Population of Kaua‘i County by Census-Defined County Subdivision

Subdivision	Population	Subdivision	Population
Hanalei	6,232	**Kōloa-Po‘ipū**	6,574
Wailua-Anahola	13,554	**‘Ele‘ele-Kalāheo**	9,246
Kapa‘a	7,926	**Kaumakani-Hanapēpē**	4,049
Puhi-Hanamā‘ulu	11,060	**Kekaha-Waimea**	5,524
Līhu‘e	7,212	**County Total**	**71,377[a]**

a. Total Kaua‘i County population for 2018 differs between this table and Table H-2 because data are from different sources.
Source: data.census.gov

Table H-2 shows the population in Kaua‘i County and the State of Hawai‘i from 1980 through 2019. The average growth rate over that period, for Kaua‘i County and for the state, is shown on Figure H-1. The County’s average 5-year population growth was nearly 16 percent in the late-1980s but dropped significantly in the late 1990s. It rose again in the first five years of the 2000s but has declined steadily since then. The state growth followed a similar trend, with a consistently lower growth rate than the County over the period shown.

Table H-2. Annual Population Data

	Population			Population	
	Kaua‘i County	State of Hawai‘i		Kaua‘i County	State of Hawai‘i
1980	39,400	968,500	**2012**	68,671	1,394,804
1985	44,634	1,039,698	**2013**	69,632	1,408,243
1990	51,676	1,113,491	**2014**	70,288	1,414,538
1995	57,068	1,196,854	**2015**	71,021	1,422,052
2000	58,568	1,213,519	**2016**	71,537	1,427,559
2005	62,863	1,292,729	**2017**	71,827	1,424,393
2010	67,205	1,363,963	**2018**	72,168[a]	1,420,593
2011	67,888	1,379,329	**2019**	72,293	1,415,872

a. Total Kaua‘i County population for 2018 differs between this table and Table H-1 because estimates for the two tables are from different sources.
Source: Hawai‘i Department of Business, Economic Development & Tourism

Source: Hawai'i Department of Business, Economic Development & Tourism

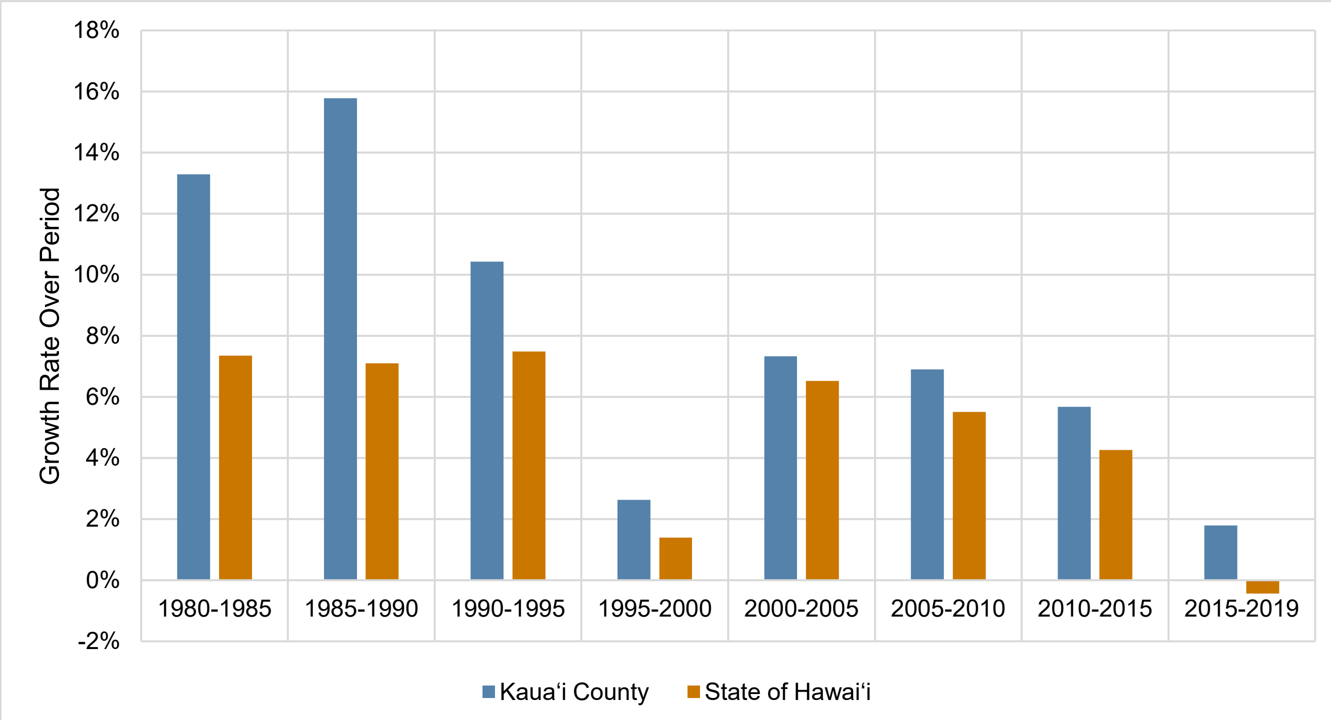


Figure H-1. State of Hawai'i and Kaua'i County Population Growth

DEMOGRAPHIC INDICATORS FOR SOCIAL VULNERABILITY

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. People living near or below the poverty line, the elderly, individuals with disabilities, women, children, ethnic minorities, and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members can help to extend focused public outreach and education to the most vulnerable citizens.

Indicators from Census data are commonly used to assess social vulnerability. For the social vulnerability component of the risk assessment for this plan, the following indicators were selected:

- **Population Under 15 Years of Age**—Children, especially in the youngest age groups, often cannot protect themselves during a disaster because they lack the necessary resources, knowledge, or life experiences to effectively cope with the situation. Hazard mitigation planning needs to be tailored such that the community is prepared to ensure that children are safe during disaster events and that families with children have access to necessary information and tools.
- **Population Over 65 years of Age**—People 65 years old and older are likely to require financial support, transportation, medical care, or assistance with ordinary daily activities, especially during disasters. They are more likely to be vision, hearing, and/or mobility impaired, more likely to experience mental impairment or dementia, and more likely to live in assisted-living facilities where emergency preparedness is at the discretion of facility operators. Hazard mitigation needs to account for such needs.

- **People of Color—**Social and economic marginalization of certain racial and ethnic groups, including real estate discrimination, has resulted in greater vulnerability of these groups to all types of hazards. Based on data from a number of studies, African Americans, Native Americans, and populations of Asian, Pacific Islander, or Hispanic origin are likely to be more vulnerable than the broader community. Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during disaster events. Post-disaster recovery often exhibits cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. Hazard mitigation plans need to identify the spatial distribution of these population groups and direct resources to reduce their vulnerability to hazards.
- **Limited English Speaking Households—**For populations with limited English proficiency, disaster communication may be difficult, especially in communities for whom translators and accurate translations of advisories may be scarce. Such households are likely to rely on relatives and local social networks (i.e., friends and neighbors) for information for preparing for a disaster event.
- **Persons with Disabilities—**Persons with disabilities or other access and functional needs are more likely to have difficulty responding to a hazard event than the general population. Family, neighbors, and local government are the first level of response to assist these individuals, and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. Emergency managers need to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with access and functional needs allows emergency management personnel and first responders to anticipate the services needed by that population.
- **Families Below the Poverty Level—**Economically disadvantaged families have limited ability to absorb losses due to hazard impacts. Wealth enables families to absorb and recover from losses more quickly, due to insurance, savings, and often the availability of low-cost credit. People with lower incomes tend not to have access to these resources. At the same time, poorer families are likely to inhabit poor quality housing and reside in locations that are most vulnerable to hazard events. Economically disadvantaged neighborhoods are also likely to have relatively poor infrastructure and facilities, which exacerbate the disaster consequences for residents there.

These factors were selected based on factors likely to influence vulnerability, the equity priorities established by the County, and the availability of datasets at a small enough resolution to determine probable characteristics of populations within identified hazard areas. The following sections estimate the age, race, language and disability indicators for Kaua'i County; poverty levels are presented in Appendix I.

Age Distribution

The overall age distribution for the County is shown in Figure H-2. Based on 2018 U.S. Census estimates, 20.1 percent of the County's population is 65 or older, higher than the state average of 18.4 percent. Census data show that 32.2 percent of the over-65 population has disabilities of some kind and 6.7 percent have incomes below the poverty line. The data show that 18.4 percent of the population is 14 or younger, about the same as the state average of 18.1 percent. Children under the age of 18 account for 21.6 percent of individuals living in households below the poverty line.

Source: Hawai'i Department of Business, Economic Development & Tourism

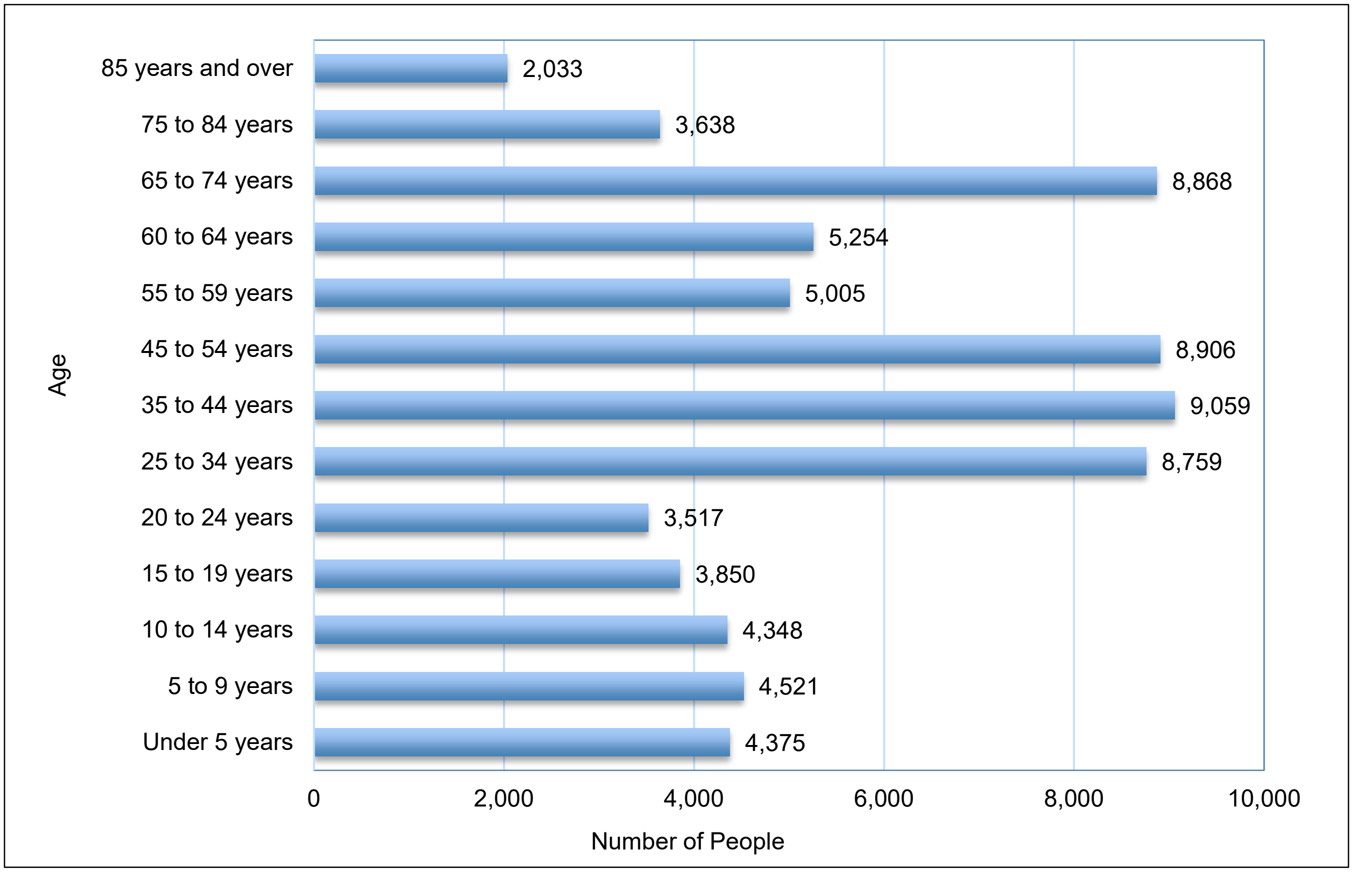


Figure H-2. Kaua'i County Age Distribution

Race, Ethnicity and Language

According to the U.S. Census, the racial composition of the County is predominantly Asian, at 34 percent, and white, at 33 percent. The largest minority population is Native Hawaiian or other Pacific Islander at 9 percent. Figure H-3 shows the racial distribution in the planning area. The Hispanic or Latino population, which is considered an ethnic designation rather than a race, is nearly 11 percent of the total.

The planning area has a 17.3 percent foreign-born population. Other than English, the most commonly spoken languages in the planning area are Asian and Pacific Island languages. The Census estimates 9 percent of the residents speak English "less than very well."

Persons with Disabilities or with Access and Functional Needs

According to the 2018 Census estimates, persons with disabilities or with access and functional needs make up 9.9 percent of the total civilian non-institutionalized population of Kaua'i County.

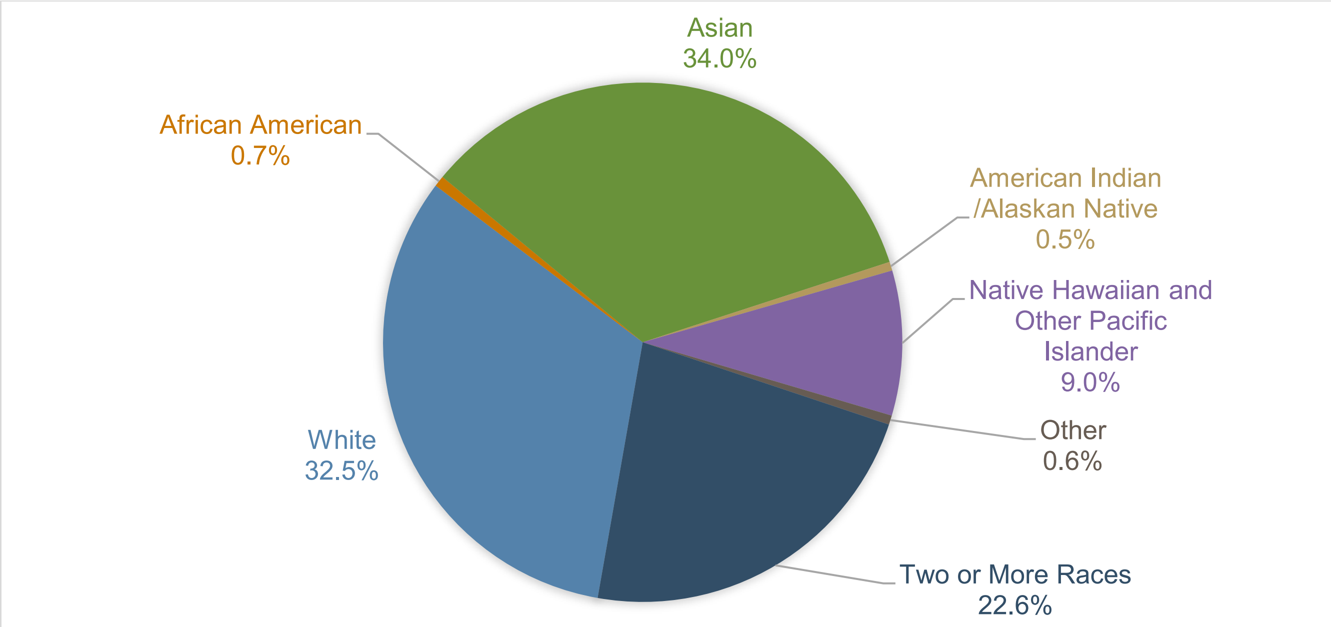


Figure H-3. Kaua'i County Race Distribution

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix I. Kaua‘i County Economic Profile

I. Kaua‘i County Economic Profile

The State of Hawai‘i is dependent on off-island sources for energy, food, construction materials, and common daily goods. The local community has expressed a desire for the local economy to be more self-reliant. This would mean expanding agriculture, aquaculture, manufacturing, and renewable-energy sectors. By working toward self-sufficiency, Hawai‘i's economy could diversify and offer additional opportunities for employment and income (TakePart, 2015). The County of Kaua‘i Office of Economic Development works in partnership with the community to create economic opportunities for balanced growth in the county (County of Kaua‘i, 2020).

Over the long-term, the County has a projected annual job growth rate of 1.12 percent. Tourism has made up 30 percent of all employment, but current growth projections in this sector are unknown as this plan is being updated during the COVID-19 pandemic. Despite the projected job growth, the high cost of living in the County offsets economic opportunity. Kaua‘i's median household income is typically less than the state average, so many residents work multiple jobs, supplement income with homegrown food or cottage industries, and have long work commutes from neighborhoods with affordable housing (County of Kaua‘i, 2018).

INCOME

To some extent, individual households are generally expected to use private resources to prepare for, respond to and recover from disaster events. This means that households living in poverty are disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters.

This means that residents below the poverty level have a great deal to lose during a natural-hazard event and are the least prepared to deal with potential losses. Past natural disaster events in the United States have shown that personal household economics significantly impact people's decisions on evacuation. If the level of risk is not perceived as high, people often choose to "ride out" the impacts of such events. Individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on U.S. Census Bureau estimates, the Kaua‘i County median household income was $78,482 in 2018. It is estimated that 21.5 percent of households receive an income between $100,000 and $149,999 per year and 15.4 percent of household incomes are above $150,000 annually. Households in the planning area making less than $25,000 per year are estimated at 15.5 percent.

Census data show that 6.3 percent of all families in the County and 19.7 percent of individuals had income that fell below the poverty line. As presented in the State of Hawai‘i's *Self-Sufficiency Income Standard* (Hawai‘i Department of Business, Economic Development & Tourism, 2018), Kaua‘i County had the second highest self-sufficiency income requirements of all counties in the state for two-adult couples without children and the third highest self-sufficiency income requirement in all other categories. Table I-1 illustrates the estimated self-sufficiency income requirements for 2018.

Table I-1. Self-Sufficiency Income Requirement— Kaua'i County (2018)

	One Adult	Two Adult Family	One Adult + One Preschooler	One Adult + One Preschooler + One School Age	Two Adult + One Preschooler + One School Age
Hourly	$16.48	$11.05	$26.16	$32.91	$18.54
Monthly	$2,901	$3,889	$4,605	$5,793	$6,527
Annual	$34,806	$46,669	$55,255	$69,513	$78,323

EMPLOYMENT BY SECTOR

Based on U.S. Census data, the County's economy is strongly based on the accommodation and food service sector, followed by the health care and social assistance industry. Food and agriculture, sustainable technologies, sport and recreation, and arts and culture follow in number of private sector jobs (County of Kaua'i, 2018). Figure I-1 shows the breakdown of industry types in Kaua'i County.

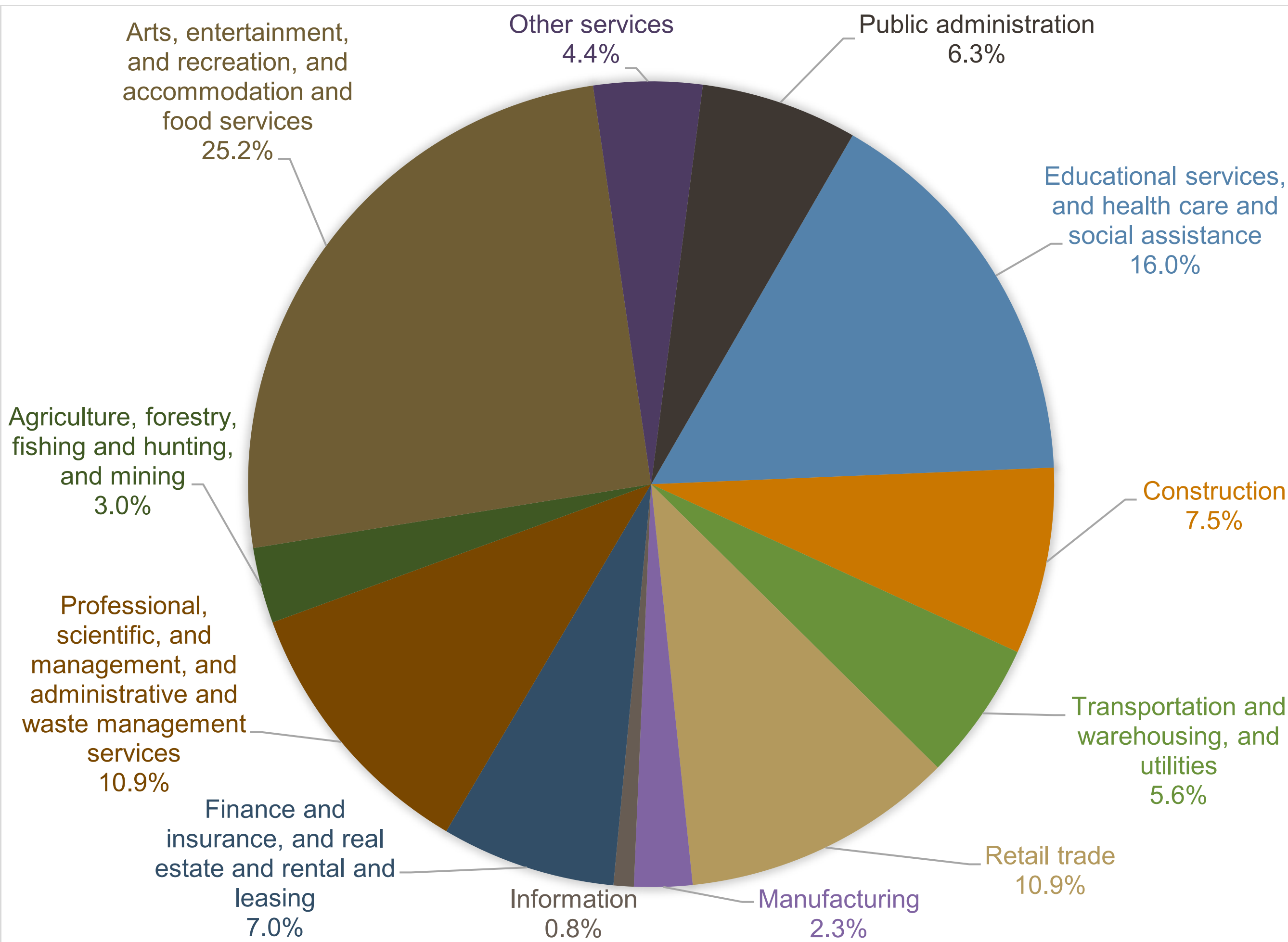


Figure I-1. Industry in Kaua'i County (Based on U.S. Census 2018 5-Year Estimates)

Agriculture is an important element in Kaua'i's identity as a rural place, and it represents the greatest opportunity for economic diversification and food self-sufficiency. The era of sugar and pineapple plantations has come to an end, but the remaining infrastructure and still undeveloped swaths of agricultural land provide for today's agricultural activity and opportunities for new enterprise to thrive. Traditional agricultural products such as taro, coconut, and breadfruit are still in demand and synonymous with regional identity (County of Kaua'i, 2018).

LARGE EMPLOYERS

Hawai'i state data lists 15 employers in Kaua'i County with 250 or more employees as of July 2017 (State of Hawai'i, 2020b):

- More than 1,000 employees:
  - Grand Hyatt Kaua'i Resort & Spa (including Ilima Terrace and Business Center)
- 500 to 999 employees:
  - Kaua'i Marriott Resort
- 250 to 499 employees:
  - Wilcox Memorial Hospital
  - St Regis Princeville Resort
  - Walmart
  - Samuel Mahelona Memorial Hospital
  - Wyndham Vacation Rentals
  - Sheraton Kaua'i Resort
  - Kaua'i Medical Clinic
  - Kaua'i Veterans Memorial Hospital
  - Kaua'i Coast Resort at the Beachboy
  - Quintas Resorts LLC
  - Aqua Kaua'i Beach Resort

EMPLOYMENT BY OCCUPATION

Service occupations, management/business/science/arts occupations, and sales/office occupations make up 31 percent, 28 percent and 21 percent of the jobs in the planning area, respectively. Only about 10 percent of employment in the County is in the production/transportation/moving occupations and natural resources/construction/maintenance (see Figure I-2). The U.S. Census estimates that about 79 percent of workers in the County commute alone (by car, truck or van) to work.

UNEMPLOYMENT

According to the American Community Survey, 66 percent of the County's population 16 and older is in the labor force. Figure I-3 compares unemployment trends from the State of Hawai'i and Kaua'i County from 2010 through 2019. For that time period, Kaua'i County's unemployment rate was highest in 2010, at 8.6 percent, dropped to a low of 2.4 percent in 2017, and then rose to 2.7 percent, in 2019. The state unemployment rate was consistently lower than that of the County until 2017 when they became equal. Data showing the impact of the COVID-19 pandemic on employment rates were not available at the time of preparing this plan.

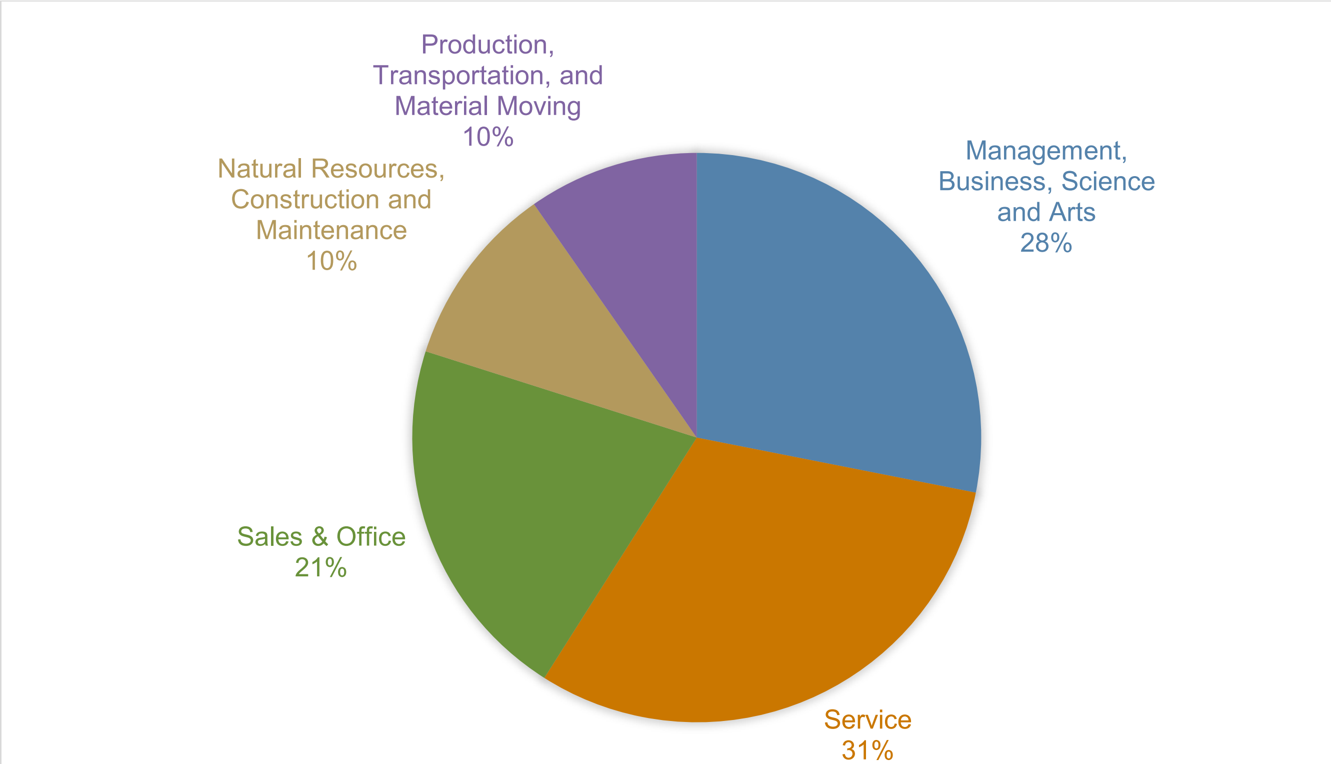


Figure I-2. Occupations in Kaua'i County (Based on U.S. Census 2018 5-Year Estimates)

Source: Department of Business, Economic Development & Tourism

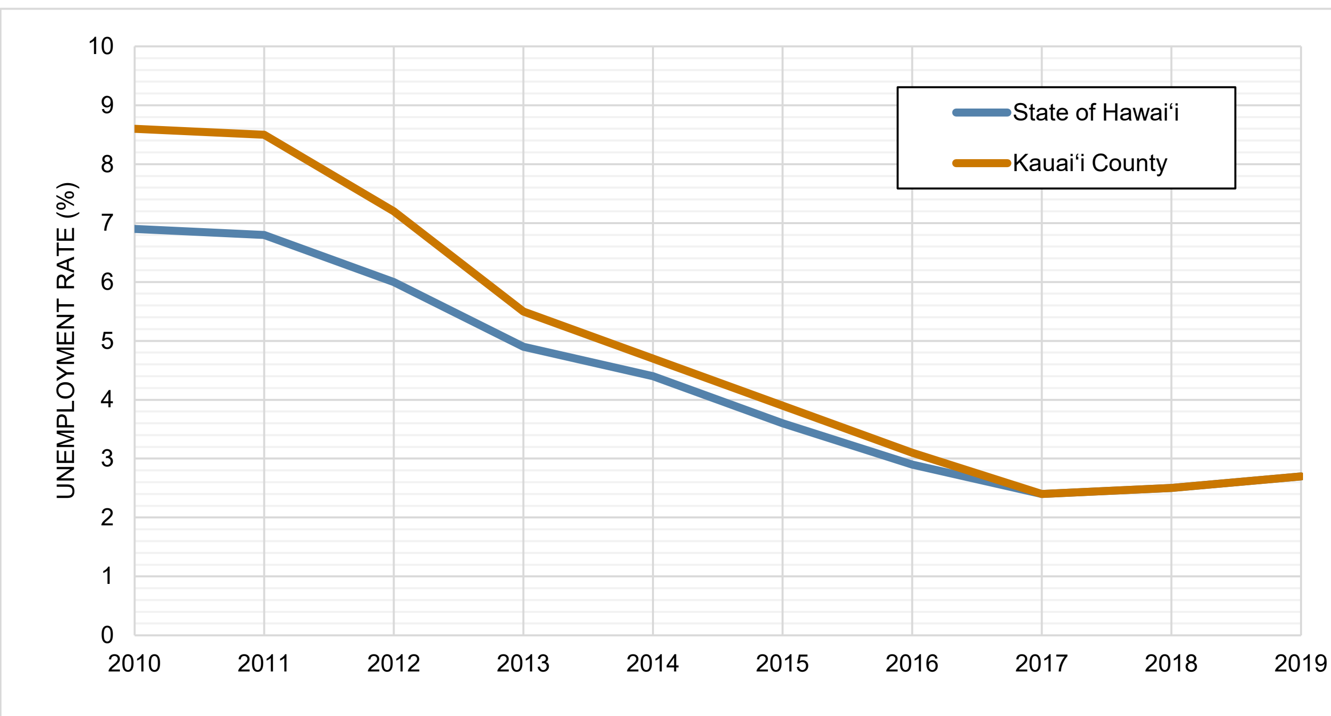


Figure I-3. State of Hawai'i and Kaua'i County Unemployment Rate

Appendix J. Relevant Agencies, Programs and Regulations

J. RELEVANT AGENCIES, PROGRAMS AND REGULATIONS

Existing laws, ordinances, plans and programs at the local, state and federal levels can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 CFR, Section 201.6(b)(3)). This appendix describes programs that may interface with the actions identified in this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan.

LOCAL

Kaua‘i Kākou—Kaua‘i County General Plan

Kaua‘i Kākou—Kaua‘i County General Plan, adopted in 2018, is a long-term comprehensive blueprint for the physical, economic, and environmental development and cultural identity of Kaua‘i County. The General Plan, adopted in 2018, outlines the County's vision for growth through 2035.

The General Plan contains goals and measurable sustainability objectives along with policies and actions to achieve these objectives. Decisions on land use will be governed by this and other County planning documents. The hazard mitigation plan will work together with these programs to support wise land use in the future by providing vital information on the risk associated with natural hazards in the planning area. The results of the risk assessment will be integrated into the "Public Safety & Hazards Resiliency" sector of the General Plan. This will ensure that all future trends in development can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan.

Community Plans

Kaua‘i County's community plans translate broad General Plan goals, policies, and standards into implementation actions as they apply to specific geographical regions around the island. Community plans also serve as a forum for community input into land use, delivery of government services, and any other matters relating to the planning area. Community plans cover the following areas:

- West Kaua‘i
- South Kaua‘i
- Līhu‘e
- East Kaua‘i
- North Shore

Kaua‘i County Code

The Kaua‘i County Code is a compilation of all ordinances of a general and permanent nature, with some exceptions. Ordinances relating to the County budget, appropriations, the issuance of bonds, state land use boundary amendments, improvement districts, salary ordinances, and emergency ordinances are not included in the code. Likewise, the Kaua‘i County General Plan and community plans are adopted by reference but published as separate documents. The 1987 Kaua‘i County Code, as amended, contains all ordinances enacted through October 9, 2020. It includes 10 chapters of code as well as a code adoption ordinance, an ordinance list and disposition table, and a code alert for recently passed ordinances.

Comprehensive Zoning Ordinance (Ordinance No. 935)

Kaua‘i County applies zoning (under Ordinance No. 935 of the County Code) to promote the health, safety, and general welfare of the County. County zoning regulates and restricts the height and size of buildings and other structures, the percentage of a building site that may be occupied, off-street parking, setbacks, size of yards, courts, and other open spaces, the density of population, and the location and use of buildings, structures, and land for trade, industry, residence, or other purposes. The zoning regulations are applied and administered within the framework of the Kaua‘i County General Plan.

The County building official enforces zoning provisions relative to building construction and occupancy. The County Planning Department director enforces all other provisions pertaining to land use. All County departments, officials, and public employees authorized to issue permits or licenses must conform to the provisions of zoning code, and no permit or license for any use, building, or other purpose may be issued where the license or permit would be in conflict with zoning provisions.

The zoning code divides the lands in the County into the following zoning districts:

- Residential - R:
  - R-1
  - R-2
  - R-4
  - R-6
  - R-10
  - R-20
- Resort - RR:
  - RR-10
  - RR-20
- Commercial - C:
  - Neighborhood Commercial - CN
  - General Commercial - CG
- Agriculture - A
- Industrial - I:
  - Limited Industrial - IL
  - General Industrial - IG
- Open - O:
- Special Treatment - ST:
  - Public Facilities - ST-P
  - Cultural/Historic - ST-C
  - Scenic/Ecological - ST-R
  - Open Space - ST-O
- Constraint - S:
  - Drainage - S-DR
  - Flood - S-FL
  - Shore - S-SH
  - Slope - S-SL
  - Soils - S-SO
  - Tsunami - S-TS

Kaua‘i County Capital Improvement Program

All County capital improvements are sanctioned and primarily funded by the County’s Capital Improvement Program and budget. The Capital Improvement Program and budget must clearly set forth the qualification of each budgeted item and its priority in the General Plan, community plan, or special purpose plans such as this hazard mitigation plan. The County Planning Department director prioritizes lists of capital improvement projects based on the following:

- Funding source—The capacity of a funding source available to a proposed improvement may be a factor in determining priority. The capital budget may not exceed prudent debt service limits that affect the borrowing capacity of the County.
- Action Committee recommendations—County action committees may provide their priorities for the fiscal year to the director.
- Project delivery phases—All phases of a project, including planning, land acquisition, design, construction, equipment and furnishing, must be addressed in the Capital Improvement Program.
- Deferred maintenance—Deferred maintenance of existing facilities should be considered a high priority for facilities intended to remain in active, long-term service.
- Level of service—The General Plan's level of service standards should be considered.
- Land use policies—Higher priority may be given to improvements that influence growth patterns consistent with the General Plan or community plans.

The 2018 Kauaʻi County General Plan calls for hazard mitigation projects to be prioritized in the County's capital improvements program (Appendix H – Issues and Opportunities).

STATE

Hawaiʻi Coastal Zone Management Program

In response to the federal Coastal Zone Management Act, the State of Hawaiʻi established its coastal zone management program in 1977 (Chapter 205A, Hawaiʻi Revised Statutes). Managed by the State Office of Planning, Hawaiʻi's CZM program provides a common focus for state and county actions dealing with land and water uses and activities. Under the CZM program, agencies must look at resources from a broader ecosystem perspective instead of individual species or resources. The CZM law builds upon the authorities and responsibilities of state and county agencies to form a network based on legal and operational compliance with the law's objectives and policies. All agencies must ensure that their statutes, ordinances, rules, and actions comply with the CZM objectives and policies (State of Hawaiʻi Office of Planning, 2015).

The CZM area encompasses the entire state because there is no point of land more than 30 miles from the ocean. What occurs on land, even on the mountains, impacts and influences the quality of coastal waters and marine resources. The CZM area extends seaward to the limit of the state's police power and management authority, to include the territorial sea. This legal seaward boundary definition is consistent with Hawaiʻi's historical claims over the Hawaiian archipelagic waters, based on ancient transportation routes and submerged lands.

Hawaiʻi Hazards Awareness and Resilience Program

The aim of the Hawaiʻi Hazards Awareness and Resilience Program (HHARP) is to help communities prepare to be self-reliant during and after natural hazard events, improve their ability to take care of their own needs, and reduce the negative impacts of disasters. HHARP can enhance community resilience through education and outreach sessions that build awareness and understanding of hazard mitigation, preparedness, response and recovery. State and county emergency management agencies have partnered to administer HHARP in support of community leaders willing to implement the program. The resources in the HHARP program and accompanying HHARP resource kit will help communities build resilience through:

- Increasing awareness of hazards
- Enhancing understanding of official warning information
- Educating residents about response actions
- Improving personal preparedness
- Helping communities identify useful skills and resources they already have

- Developing the understanding needed to select appropriate hazard mitigation measures
- Guiding communities in the development of emergency plans and exercises
- Providing support for community outreach events
- Identifying opportunities for additional training and education

Hawai‘i State Grants-in-Aid for Capital Improvement Projects

The Hawai‘i State Legislature makes appropriations for grants in accordance with Chapter 42F of the Hawai‘i Revised Statutes. The grants support events, programs, and facilities that benefit the community. There are two types of grants: operating and capital improvement project grants. Funds are available on a reimbursement basis and payments are contingent upon fulfillment of the terms and conditions of the grant agreement. Grantees must submit documents to verify that they meet the standards for the award of grants.

Hawai‘i State Plan

The Hawai‘i State Plan is a long-range comprehensive plan that includes an overall theme, goals, objectives, policies, priority guidelines, and implementation mechanisms. The Hawai‘i State Plan achieves the following:

- Serves as a guide for the future long-range development of the state
- Identifies the goals, objectives, policies, and priorities for the state
- Provides a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources
- Improves coordination of federal, state, and county plans, policies, programs, projects, and regulatory activities
- Establishes a system for plan formulation and program coordination to provide for an integration of all major state, and county activities

The State Plan is divided into three parts:

- Part I lists the State Plan’s overall theme and goals. Objectives and policies focus on general topic areas, including population, economy, physical environment, facility systems, and socio-cultural advancement.
- Part II establishes a statewide planning system to coordinate and guide all major state and county activities and to implement the overall theme, goals, objectives, policies, and priority guidelines. The system implements the State Plan through the development of functional plans and county general plans.
- Part III establishes overall priority guidelines to address areas of statewide concern. This part lays out the overall direction for the state in five major areas of statewide concern: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education.

Ocean Resources Management Plan

The Ocean Resources Management Plan is a comprehensive plan for conservation and sustainability of ocean and coastal resources (Chapters 205A and 225M, Hawai‘i Revised Statues). Hawai‘i is facing pressures that will have a significant impact on ocean and coastal environments, including urbanization, tourism, recreational and commercial ocean uses, sea level rise and other natural hazards to include beach erosion, inundation of land, increased flood and storm damage, saltwater intrusion into the freshwater lens aquifer, the rising of the water table, and more frequent or more powerful weather events, marine debris, and invasive species. The Ocean Resources Management Plan was updated in 2013 to address these issues.

State Building Code and Design Standards

In 2007, the State Legislature created State Building Code Council with the authority to establish codes applicable to all construction in the State of Hawai'i (Chapter 107, Hawai'i Revised Statues). The State Building Code Council evaluates model building codes and develops amendments necessary to make the codes appropriate for conditions in Hawai'i. Once the Council develops and approves a code for Hawai'i, it is legally adopted into the Hawai'i Administrative Rules (HAR). Counties have two years from the date of establishment of the HAR State Building Code to adopt the Hawai'i State Building Code as local county code, with the addition of any locally approved county amendments. The process has successfully enabled a unified set of nearly comprehensive building codes to be adopted by the state and the counties.

State General Flood Control Plan

As authorized by the Hawai'i Revised Statutes Chapter 179 Flood Control and Flood Water Conservation, the State General Flood Control Plan (SGFCP) serves as a guide for linking partnering agencies and community groups. The plan provides these stakeholders with the data and tools required to strategize flood improvement needs and goals.

The most recent update allows all stakeholders to view and analyze flood-prone areas and/or flood mitigation needs. The updated SGFCP also enables users to locate project partners and build on current or previously completed flood improvement efforts. The plan update increases each stakeholder's ability to complete projects by integrating best practices and lessons learned from other partner agencies and through resource sharing.

State of Hawai'i Hazard Mitigation Plan

The *State of Hawai'i 2018 Hazard Mitigation Plan* identifies the major natural hazards that affect Hawai'i, assesses the risk that each hazard poses, analyzes the vulnerability of people, property and infrastructure to the specific hazard, and recommends actions that can be taken to reduce the risk and vulnerability to the hazard. The State Hazard Mitigation Plan also contains a description of programs, policy, statues and regulations applicable to hazard mitigation statewide.

State of Hawai'i Land Use Law

The Hawai'i State Legislature adopted the State Land Use Law (Chapter 205, Hawai'i Revised Statutes) in 1961. The Land Use Commission administers statewide zoning established in the State Land Use law. The law classifies lands throughout the state into one of four districts:

- The Urban District generally includes lands characterized by "city-like" concentrations of people, structures and services. This district also includes vacant areas for future development. Jurisdiction of this district lies primarily with counties.
- The Rural District consists primarily of small farms intermixed with low-density residential lots with a minimum size of 0.5-acre. The Land Use Commission and County governments share jurisdiction over rural districts. Permitted uses include those relating or compatible with agricultural use and low-density residential lots.
- The Agricultural District includes land with significant potential for agriculture uses as well as lands used for the cultivation of crops, aquaculture, raising livestock, wind energy generation, timber cultivation, and agriculture-support (mills, employee quarters, etc.). Uses permitted in the highest productivity agricultural categories (A or B) are governed by statute. Uses in lower-productivity categories (C, D, E, or U) include those allowed on A or B lands as well as uses stated under Section 205-4.5, Hawai'i Revised Statutes.
- The Conservation District consists primarily of lands in existing forest and water reserve zones. These include areas necessary for protecting watersheds and water sources; scenic and historic areas; parks,

wilderness, open space and recreational areas; habitats of endemic plants, fish and wildlife; submerged lands seaward of the shoreline; and lands subject to flooding and soil erosion. The State Board of Land and Natural Resources administrates conservation districts.

FEDERAL

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) seeks to prevent discrimination against people with disabilities in employment, transportation, public accommodation, communications, and government activities. Title II of the ADA deals with compliance with the Act in emergency management and disaster-related programs, services, and activities. It applies to state and local governments as well as third parties, including religious entities and private nonprofit organizations.

The ADA has implications for sheltering requirements and public notifications. During an emergency alert, officials must use a combination of warning methods to ensure that all residents have all necessary information. Those with hearing impairments may not hear radio, television, sirens, or other audible alerts, while those with visual impairments may not see flashing lights or other visual alerts. Two technical documents for shelter operators address physical accessibility needs of people with disabilities, as well as medical needs and service animals.

The ADA intersects with disaster preparedness programs in regards to transportation, social services, temporary housing, and rebuilding. Persons with disabilities may require additional assistance in evacuation and transit (e.g., vehicles with wheelchair lifts or paratransit buses). Evacuation and other response plans should address the unique needs of residents. Local governments may be interested in implementing a special-needs registry to identify the home addresses, contact information, and needs for residents who may require more assistance.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Bureau of Land Management

The U.S. Bureau of Land Management (BLM) funds and coordinates wildfire management programs and structural fire management and prevention on BLM lands. BLM works closely with the Forest Service and state and local governments to coordinate fire safety activities. The Interagency Fire Coordination Center in Boise, Idaho serves as the center for this effort.

Civil Rights Act of 1964

The Civil Rights Act of 1964 prohibits discrimination based on race, color, religion, sex or nation origin and requires equal access to public places and employment. The Act is relevant to emergency management and hazard mitigation in that it prohibits local governments from favoring the needs of one population group over another. Local government and emergency response must ensure the continued safety and well-being of all residents equally, to the extent possible. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, and pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. Numerous issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The CWA is important to hazard mitigation in several ways. There are often permitting requirements for any construction within 200 feet of water of the United States, which may have implications for mitigation projects identified by a local jurisdiction. Additionally, CWA requirements apply to wetlands, which serve important functions related to preserving and protecting the natural and beneficial functions of floodplains and are linked with a community's floodplain management program. Finally, the National Pollutant Discharge Elimination System is part of the CWA and addresses local stormwater management programs. Stormwater management plays a critical role in hazard mitigation by addressing urban drainage or localized flooding issues within jurisdictions.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Community Development Block Grant Disaster Resilience Program

In response to disasters, Congress may appropriate additional funding for the U.S. Department of Housing and Urban Development Community Development Block Grant programs to be distributed as Disaster Recovery grants (CDBG-DR). These grants can be used to rebuild affected areas and provide seed money to start the recovery process. CDBG-DR assistance may fund a broad range of recovery activities, helping communities and neighborhoods that otherwise might not recover due to limited resources. CDBG-DR grants often supplement disaster programs of FEMA, the Small Business Administration, and the U.S. Army Corps of Engineers. Housing and Urban Development generally awards noncompetitive, nonrecurring CDBG-DR grants by a formula that considers disaster recovery needs unmet by other federal disaster assistance programs. To be eligible for CDBG-DR funds, projects must meet the following criteria:

- Address a disaster-related impact (direct or indirect) in a presidentially declared county for the covered disaster
- Be a CDBG-eligible activity (according to regulations and waivers)
- Meet a national objective.

Incorporating preparedness and mitigation into these actions is encouraged, as the goal is to rebuild in ways that are safer and stronger. CDBG-DR funding is a potential alternative source of funding for actions identified in this plan.

Community Rating System

The CRS is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.

- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community would receive a 45 percent premium discount, and a Class 9 community would receive a 5 percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The discount partially depends on location of the property. Properties outside the special flood hazard area receive smaller discounts: a 10-percent discount if the community is at Class 1 to 6 and a 5-percent discount if the community is at Class 7 to 9. The CRS classes for local communities are based on 18 creditable activities in the following categories:

- Public information
- Mapping and regulations
- Flood damage reduction
- Flood preparedness.

CRS activities can help to save lives and reduce property damage. Communities participating in the CRS represent a significant portion of the nation's flood risk; over 66 percent of the NFIP's policy base is located in these communities. Communities receiving premium discounts through the CRS range from small to large and represent a broad mixture of flood risks, including both coastal and riverine flood risks.

As of May 2019, Kaua'i County was not participating in the CRS program.

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Emergency Relief for Federally Owned Roads Program

The U.S. Forest Service's Emergency Relief for Federally Owned Roads Program was established to assist federal agencies with repair or reconstruction of tribal transportation facilities, federal lands transportation facilities, and other federally owned roads that are open to public travel and have suffered serious damage by a natural disaster over a wide area or by a catastrophic failure. The program funds both emergency and permanent repairs (Office of Federal Lands Highway, 2016). Eligible activities under this program meet some of the goals and objectives for this plan and the program is a possible funding source for actions identified in this plan.

Emergency Watershed Program

The USDA Natural Resources Conservation Service (NRCS) administers the Emergency Watershed Protection (EWP) Program, which responds to emergencies created by natural disasters. Eligibility for assistance is not dependent on a national emergency declaration. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. EWP is an emergency recovery program. Financial and technical assistance are available for the following activities (Natural Resources Conservation Service, 2016):

- Remove debris from stream channels, road culverts, and bridges
- Reshape and protect eroded banks
- Correct damaged drainage facilities
- Establish cover on critically eroding lands

- Repair levees and structures
- Repair conservation practices.

This federal program could be a possible funding source for actions identified in this plan.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. It is the enabling legislation for the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Criminal and civil penalties are provided for violations of the ESA and the Convention.

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- Endangered means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- Threatened means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- Critical habitat means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- Section 4: Listing of a Species—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- Section 7: Consultation—Federal agencies must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigations or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- Section 9: Prohibition of Take—It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- Section 10: Permitted Take—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be

prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."

- Section 11: Citizen Lawsuits—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent engineer approved by the FERC must inspect and evaluate projects with dams higher than 32.8 feet (10 meters), or with a total storage capacity of more than 2,000 acre-feet.

FERC monitors seismic research and applies it in performing structural analyses of hydroelectric projects. FERC also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication Engineering Guidelines for the Evaluation of Hydropower Projects guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

Federal Wildfire Management Policy and Healthy Forests Restoration Act

Federal Wildfire Management Policy and Healthy Forests Restoration Act (2003). These documents call for a single comprehensive federal fire policy for the Interior and Agriculture Departments (the agencies using federal fire management resources). They mandate community-based collaboration to reduce risks from wildfire.

Hazard Mitigation Assistance Grant Programs

Hazard mitigation assistance grant programs to state and county agencies and qualifying nonprofits include the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation (PDM) grant program, and the Flood Mitigation Assistance (FMA) grant program, which funds mitigation of high loss insured properties through the National Flood Insurance Program. State and local mitigation strategies that qualify for funding are:

- Hazard mitigation planning

- Retrofit of critical facilities
- Acquisition, elevation, relocation or drainage improvements of repetitive flood loss structures
- Construction or upgrade of general population shelters
- Enhancement of development codes and standards
- Safe rooms and storm shelters
- Generators for critical facilities
- Warning systems

In Hawaiʻi, the Hawaiʻi Emergency Management Agency (HI-EMA) administers the hazard mitigation assistance grant programs. State and county agencies are eligible to apply for all three programs (HMGP, PDM and FMA). Certain private, non-profit organizations are eligible to apply for HMGP only. Individuals and businesses are not eligible to apply directly; however, an eligible applicant may apply on behalf of individuals or businesses

National Dam Safety Act

Potential for catastrophic flooding due to dam failures led to passage of the National Dam Inspection Act in 1972, creation of the National Dam Safety Program in 1996, and reauthorization of the program through the Dam Safety Act in 2006. National Dam Safety Program, administered by FEMA requires a periodic engineering analysis of the majority of dams in the country; exceptions include the following:

- Dams under jurisdiction of the Bureau of Reclamation, Tennessee Valley Authority, or International Boundary and Water Commission
- Dams constructed pursuant to licenses issued under the Federal Power Act
- Dams that the Secretary of the Army determines do not pose any threat to human life or property.

The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect lives and property of the public. The National Dam Safety Program is a partnership among the states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under FEMA's leadership, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and purchases of needed equipment. FEMA has also expanded existing and initiated new training programs. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most of the dams in the United States.

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to consider the environmental impacts of proposed actions and reasonable alternatives to those actions, alongside technical and economic considerations. The National Environmental Policy Act established the Council on Environmental Quality, whose regulations (40 CFR Parts 1500-1508) set standards for compliance. Consideration and decision-making regarding environmental impacts must be documented in an environmental impact statement or environmental assessment. Environmental impact assessment requires the evaluation of reasonable alternatives to a proposed action, solicitation of input from organizations and individuals that could be affected, and an unbiased presentation of direct, indirect, and cumulative environmental impacts. FEMA hazard mitigation project grant applications require full compliance with applicable federal acts. Any action identified in this plan that falls within the scope of this act will need to meet its requirements.

National Fire Plan (2001)

The 2001 National Fire Plan was developed based on the National Fire Policy. A major aspect of the National Fire Plan is joint risk reduction planning and implementation carried out by federal, state and local agencies and communities. The National Fire Plan presented a comprehensive strategy in five key initiatives:

- Firefighting—Be adequately prepared to fight fires each fire season.
- Rehabilitation and Restoration—Restore landscapes and rebuild communities damaged by wildfires.
- Hazardous Fuel Reduction—Invest in projects to reduce fire risk.
- Community Assistance—Work directly with communities to ensure adequate protection.
- Accountability—Be accountable and establish adequate oversight, coordination, program development, and monitoring for performance.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities that enact floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act.

For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent-annual-chance flood and the 0.2-percent-annual-chance flood. Base flood elevations and the boundaries of the flood hazard areas are shown on Flood Insurance Rate Maps, which are the principle tool for identifying the extent and location of the flood hazard. Flood Insurance Rate Maps are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under the local floodplain management program. In recent years, Flood Insurance Rate Maps have been digitized as Digital Flood Insurance Rate Maps, which are more accessible to residents, local governments and stakeholders.

Minimum Requirements

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 1-percent-annual-chance flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

NFIP Participation in Hawai'i

In the State of Hawai'i, the Department of Land and Natural Resources (DLNR) is the coordinating agency for floodplain management. DLNR works with FEMA and local governments by providing grants and technical assistance, evaluating community floodplain management programs, reviewing local floodplain ordinances, and participating in statewide flood hazard mitigation planning. Compliance is monitored by FEMA regional staff and by DLNR. Maintaining compliance under the NFIP is an important component of flood risk reduction.

Repetitive Loss

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced any of the following since 1978, regardless of any changes in ownership:

- Four or more paid losses in excess of $1,000
- Two paid losses in excess of $1,000 within any rolling 10-year period
- Three or more paid losses that equal or exceed the current value of the insured property.

The government has instituted programs encouraging communities to identify and mitigate the causes of repetitive losses. Studies have found that many of these properties are outside any mapped 1 percent annual chance (100-year) floodplain. The key identifiers for repetitive loss properties are the existence of flood insurance policies and claims paid by the policies.

FEMA-sponsored programs, such as the Community Rating System (CRS), require participating communities to identify repetitive loss areas. A repetitive loss area is the portion of a floodplain holding structures that FEMA has identified as meeting the definition of repetitive loss. Identifying repetitive loss areas helps to identify structures that are at risk but are not on FEMA's list of repetitive loss structures because no flood insurance policy was in force at the time of loss.

National Incident Management System

The National Incident Management System (NIMS) is a systematic approach for government, nongovernmental organizations, and the private sector to work together to manage incidents involving hazards. The NIMS provides a flexible but standardized set of incident management practices. Incidents typically begin and end locally, and they are managed at the lowest possible geographical, organizational, and jurisdictional level. In some cases, success depends on the involvement of multiple jurisdictions, levels of government, functional agencies, and emergency responder disciplines. These cases necessitate coordination across a spectrum of organizations. Communities using NIMS follow a comprehensive national approach that improves the effectiveness of emergency management and response personnel across the full spectrum of potential hazards (including natural hazards, technological hazards, and human-caused hazards) regardless of size or complexity.

Although participation is voluntary, federal departments and agencies are required to make adoption of NIMS by local and state jurisdictions a condition to receive federal preparedness grants and awards. The content of this plan is considered to be a viable support tool for any phase of emergency management. The NIMS program is considered as a response function, and information in this hazard mitigation plan can support the implementation and update of all NIMS-compliant plans within the planning area.

Presidential Executive Order 11988, Floodplain Management

Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. It requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values of floodplains. The requirements apply to the following activities:

Acquiring, managing, and disposing of federal lands and facilities
Providing federally undertaken, financed, or assisted construction and improvements
Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

Presidential Executive Order 11990, Protection of Wetlands

Executive Order 11990 requires federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The requirements apply to the following activities (National Archives, 2016):

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements

- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing.

All actions identified in this plan will seek full compliance with all applicable presidential executive orders.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers operates and maintains approximately 700 dams nationwide. It is also responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety. The Corps maintains the National Inventory of Dams, which contains information about a dam's location, size, purpose, type, last inspection and regulatory status (U.S. Army Corps of Engineers, 2017).

U.S. Army Corps of Engineers Flood Hazard Management

The U.S. Army Corps of Engineers has several civil works authorities and programs related to flood risk and flood hazard management:

- The Floodplain Management Services program offers 100-percent federally funded technical services such as development and interpretation of site-specific data related to the extent, duration and frequency of flooding. Special studies may be conducted to help a community understand and respond to flood risk. These may include flood hazard evaluation, flood warning and preparedness, or flood modeling.
- For more extensive studies, the Corps of Engineers offers a cost-shared program called Planning Assistance to States and Tribes. Studies under this program generally range from $25,000 to $100,000 with the local jurisdiction providing 50 percent of the cost.
- The Corps of Engineers has several cost-shared programs (typically 65 percent federal and 35 percent non-federal) aimed at developing, evaluating and implementing structural and non-structural capital projects to address flood risks at specific locations or within a specific watershed:
    - The Continuing Authorities Program for smaller-scale projects includes Section 205 for Flood Control, with a $7 million federal limit and Section 14 for Emergency Streambank Protection with a $1.5 million federal limit. These can be implemented without specific authorization from Congress.
    - Larger scale studies, referred to as General Investigations, and projects for flood risk management, for ecosystem restoration or to address other water resource issues, can be pursued through a specific authorization from Congress and are cost-shared, typically at 65 percent federal and 35 percent non-federal.
    - Watershed management planning studies can be specifically authorized and are cost-shared at 50 percent federal and 50 percent non-federal.
- The Corps of Engineers provides emergency response assistance during and following natural disasters. Public Law 84-99 enables the Corps to assist state and local authorities in flood fight activities and cost share in the repair of flood protective structures. Assistance is provided in the flowing categories:
    - Preparedness—The Flood Control and Coastal Emergency Act establishes an emergency fund for preparedness for emergency response to natural disasters; for flood fighting and rescue operations; for rehabilitation of flood control and hurricane protection structures. Funding for Corps of Engineers emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act. Disaster preparedness activities include coordination, planning, training and conduct of response exercises with local, state and federal agencies.

- Response Activities—Public Law 84-99 allows the Corps of Engineers to supplement state and local entities in flood fighting urban and other non-agricultural areas under certain conditions (Engineering Regulation 500-1-1 provides specific details). All flood fight efforts require a project cooperation agreement signed by the public sponsor and the sponsor must remove all flood fight material after the flood has receded. Public Law 84-99 also authorizes emergency water support and drought assistance in certain situations and allows for "advance measures" assistance to prevent or reduce flood damage conditions of imminent threat of unusual flooding.
- Rehabilitation—Under Public Law 84-99, an eligible flood protection system can be rehabilitated if damaged by a flood event. The flood system would be restored to its pre-disaster status at no cost to the federal system owner, and at 20-percent cost to the eligible non-federal system owner. All systems considered eligible for Public Law 84-99 rehabilitation assistance have to be in the Rehabilitation and Inspection Program prior to the flood event. Acceptable operation and maintenance by the public levee sponsor are verified by levee inspections conducted by the Corps on a regular basis. The Corps has the responsibility to coordinate levee repair issues with interested federal, state, and local agencies following natural disaster events where flood control works are damaged.

All of these authorities and programs are available to the County to support any intersecting mitigation actions.

U.S. Fire Administration

There are federal agencies that provide technical support to fire agencies/organizations. For example, the U.S. Fire Administration, which is a part of FEMA, provides leadership, advocacy, coordination, and support for fire agencies and organizations.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service fire management strategy employs prescribed fire to maintain early successional fire-adapted grasslands and other ecological communities throughout the National Wildlife Refuge System.

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix K. Detailed Capabilities Assessment

K. DETAILED CAPABILITIES ASSESSMENT

The Core Planning Team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of a jurisdiction's mission, programs and policies, and evaluates its capacity to carry them out. This process identifies potential gaps in the jurisdiction's capabilities. Any gap in capability was considered as possible mitigation action in this plan, as required under 44 CFR, Section 201.6(c)(3)). The sections below describe the specific capabilities evaluated under the assessment.

LEGAL AND REGULATORY CAPABILITIES

Jurisdictions have the ability to develop policies and programs and to implement rules and regulations to protect and serve residents. Local policies are typically identified in a variety of community plans, implemented via a local ordinance, and enforced through a governmental body.

Jurisdictions regulate land use through the adoption and enforcement of zoning, subdivision and land development ordinances, building codes, building permit ordinances, floodplain, and stormwater management ordinances. When effectively prepared and administered, these regulations can lead to hazard mitigation. A summary assessment of existing state and local legal and regulatory capabilities relevant to hazard mitigation is presented in Table K-1. An assessment of development and permitting capabilities is presented in Table K-2.

FISCAL CAPABILITIES

Assessing a jurisdiction's fiscal capability provides an understanding of the ability to fulfill the financial needs associated with hazard mitigation projects. This assessment identifies both outside resources, such as grant-funding eligibility, and local jurisdictional authority to generate internal financial capability, such as through impact fees. An assessment of fiscal capabilities is presented in Table K-3.

ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Legal, regulatory, and fiscal capabilities provide the backbone for successfully developing a mitigation strategy; however, without appropriate personnel, the strategy may not be implemented. Administrative and technical capabilities focus on the availability of personnel resources responsible for implementing all the facets of hazard mitigation. These resources include technical experts, such as engineers and scientists, as well as personnel with capabilities that may be found in multiple departments, such as grant writers. An assessment of administrative and technical capabilities is presented in Table K-4.

NATIONAL FLOOD INSURANCE PROGRAM COMPLIANCE

Community participation in the National Flood Insurance Program (NFIP) creates opportunity for additional grant funding associated specifically with flooding issues. Assessment of current NFIP status and compliance provides planners with a greater understanding of the local flood management program, opportunities for improvement, and available grant funding opportunities. Information on National Flood Insurance Program (NFIP) compliance is presented in Table K-5.

Table K-1. Legal and Regulatory Capability

	Local Authority	Capability Ranking (High, Medium, Low)	State Mandated	Integration Opportunity?
Codes, Ordinances, & Requirements				
Building Code	Yes	Medium	Yes	
Comment: 2012 IBC & IRC will take effect November 13, 2020. 2018 Codes to be adopted Spring 2021				
Zoning Code	Yes	High		
Comment: Planning Department				
Subdivisions	Yes	Medium		
Comment: Planning Department				
Stormwater Management	Yes	Low	No	
Comment:				
Post-Disaster Recovery	No	Low		
Comment:				
Real Estate Disclosure	Unknown	Unsure		
Comment:				
Growth Management	Yes	High		
Comment: Planning Department				
Site Plan Review	Yes	High		
Comment: Planning Department				
Environmental Protection	Yes	Medium	Yes	
Comment: Kaua‘i General Plan, State Department of Health & Office of Environmental Quality Control				
Flood Damage Prevention	Yes	Unsure	Yes	No
Comment: HRS 46-11				
Emergency Management	Yes	Medium	Yes	
Comment: Kaua‘i Emergency Management Agency; HRS 127A				
Climate Change	Yes	Medium	Yes	
Comment: Planning Department, Office of Economic Development				
Coastal Zone/Shoreline Management	Yes	High	Yes	
Comment: Planning Department, State & Federal Mandate				
Planning Documents				
General/Comprehensive Plan	Yes	High	Yes	
Does the General/Comprehensive Plan include components applicable to risk from natural hazard? If so, please describe. Yes.				
Comment:				
Capital Improvement Plan	Yes	Medium		
How often is the plan updated? Every six years				
Comment: Planning Department				
Disaster Debris Management Plan	Yes	Low		
Comment: DPW – Solid Waste Division, Kaua‘i Emergency Management Agency (KEMA)				
Floodplain or Watershed Plan	No	Unsure		
Comment:				
Stormwater Plan Master Plan that address either water quality, water quantity or both	No	Unsure		
Comment:				
Urban Water Management Plan	No	Unsure		
Comment:				
Habitat Conservation Plan	Unknown	Unsure		
Comment:				

	Local Authority	Capability Ranking (High, Medium, Low)	State Mandated	Integration Opportunity?
Economic Development Plan *Comment: Office of Economic Development*	Yes	Medium		
Shoreline Management Plan *Comment: Special Management Area – Planning Department*	No	Unsure		
Community Wildfire Protection Plan *Comment: Kauaʻi Fire Department*	Yes	Unsure		
Climate Action/Adaptation Plan *Comment: Planning Department*	Yes	Medium		
Comprehensive Emergency Management Plan or Emergency Operations Plan *Comment: KEMA*	Yes	Medium		
Threat & Hazard Identification & Risk Assessment (THIRA) *Comment: KEMA*	Yes	Medium		
Post-Disaster Recovery Plan *Comment: KEMA*	Yes	Medium		
Continuity of Operations Plan or Continuity of Government Plan *Comment: KEMA*	Yes	Medium		
Public Health Plan *Comment: State Department of Health, Kauaʻi District Health Office All-Hazards Plan*	Yes	High		

Table K-2. Development and Permitting Capability

Criterion	Response
Does the County issue development permits? • **If no, who does? If yes, which department?**	Yes Planning Department
Does the County have the ability to track permits by hazard area?	Yes
Does the County have a buildable lands inventory?	Yes. Kauaʻi County Use Analysis & Buildout Report (2015)

Table K-3. Fiscal Capability

Financial Resources	Accessible or Eligible to Use?
Community Development Block Grants	Yes
Capital Improvements Project Funding	Yes
Authority to Levy Taxes for Specific Purposes	Yes
User Fees for Water, Sewer, Gas or Electric Service	Yes
Incur Debt through General Obligation Bonds	Yes
Incur Debt through Special Tax Bonds	Yes
Incur Debt through Private Activity Bonds	No
Withhold Public Expenditures in Hazard-Prone Areas	No
State-Sponsored Grant Programs	Yes
Development Impact Fees for Homebuyers or Developers	No
Land Bank or Other Support for Transfer of Development Rights	No

Table K-4. Administrative and Technical Capability

Staff/Personnel Resources	Available?	Department/Agency
Planners or engineers with knowledge of land development and land management practices	Yes	Department of Public Works - Engineering
Engineers or professionals trained in building or infrastructure construction practices	Yes	Department of Public Works - Engineering
Planners or engineers with an understanding of natural hazards and climate change	Yes	Department of Public Works - Engineering
Staff with training in benefit/cost analysis	Yes	KEMA
Surveyors	No	
Personnel skilled or trained in GIS applications	Yes	Planning Department, KEMA
Scientist familiar with natural hazards in local area	Yes	Range of private and government expertise
Emergency manager	Yes	KEMA
Grant writers	TBD	Various

Table K-5. National Flood Insurance Program Compliance

Criterion	Response
What local department is responsible for floodplain management?	Department of Public Works
Who is the floodplain administrator? (department/position)	Department of Public Works – Engineering CE VI
Are any certified floodplain managers on County staff?	Yes
What is the date that your flood damage prevention ordinance was last amended?	September 2005
Does the floodplain management program meet or exceed minimum requirements? • **If exceeds, in what ways?**	Exceeds Substantial Improvement 1-Year Cumulative
When was the most recent Community Assistance Visit or Community Assistance Contact?	2003 CAV/2009 North Shore Audit
Does the County have any outstanding NFIP compliance violations to be addressed? • **If so, state what they are.**	No N/A
Are any RiskMAP projects currently underway in the County? • **If so, state what they are.**	No N/A
Do local flood hazard maps adequately address the flood risk within the County? • **If no, state why.**	Yes N/A
Does the floodplain management staff need any assistance or training to support its floodplain management program? • **If so, what type of assistance/training is needed?**	Yes Floodplain management training for new personnel
Does the County participate in the Community Rating System (CRS)? • **If yes, is the County interested in improving its CRS Classification?** • **If no, is the County interested in joining the CRS program?**	No N/A Yes
How many flood insurance policies are in force in the County?[a] • **What is the insurance coverage in force?** • **What is the premium in force?** • **What is the average cost of a flood insurance policy?**	4,792 $1,019,373,800 $4,387,457 $916
How many total loss claims have been filed in the County?[a] • **What were the total payments for losses?** • **What is the average claim paid?**	1,312 $38,416,601 $29,281

a. According to FEMA statistics as of February 29, 2020

PUBLIC OUTREACH CAPABILITY

Regular engagement with the public on issues regarding hazard mitigation provides an opportunity to directly interface with community members. Assessing this outreach and education capability illustrates the connection between the government and community members, which opens a two-way dialogue that can result in a more resilient community based on education and public engagement. An assessment of education and outreach capabilities is presented in Table K-6.

Table K-6. Education and Outreach Capability

Criterion	Response	Department/Agency
Do you have a public information officer or communications office?	Yes	Mayor's Office
Do you have personnel skilled or trained in website development?	Yes	Various
Do you have hazard mitigation information available on your website?	Yes	
If yes, briefly describe.	See Kauai.gov/Mitigation	
Do you use social media for hazard mitigation education and outreach?	Yes	
If yes, briefly describe.	See Kauai.gov/Mitigation	
Do you have any citizen boards or commissions that address issues related to hazard mitigation?	Yes	
If yes, briefly describe.	Multi-Hazard Mitigation and Resilience Plan Core Planning Team & Steering Committee, North Shore Community Group, Hanapēpē-'Ele'ele HHARP (Hawai'i Hazards Awareness and Resilience Program)	
Do you have any other programs in place that could be used to communicate hazard-related information?	Yes	
If yes, briefly describe.	County Facebook page, Sea Grant Extension Agent	
Do you have any established warning systems for hazard events?	Yes	
If yes, briefly describe.	County Sirens part of Statewide Siren Network	

PARTICIPATION IN OTHER PROGRAMS

Other programs, such as the Community Rating System, Storm/Tsunami Ready, and Firewise USA, can enhance a jurisdiction's ability to mitigate, prepare for, and respond to natural hazards. These programs indicate a jurisdiction's desire to go beyond minimum requirements set forth by local, state and federal regulations in order to create a more resilient community. These programs complement each other by focusing on communication, mitigation, and community preparedness to save lives and minimize the impact of natural hazards on a community. Classifications under various community mitigation programs are presented in Table K-7.

Table K-7. Community Classifications

	Participating?	Classification	Date Classified
Community Rating System	No		
Building Code Effectiveness Grading Schedule	No		
Public Protection	No		
StormReady/TsunamiReady	Yes	Hanapēpē- 'Ele'ele HHARP	2019
Firewise	Yes	Kaua'i Fire Department	Unknown

INTEGRATION OF HAZARD MITIGATION WITH OTHER PROGRAMS

For hazard mitigation planning, "integration" means that hazard mitigation information is used in other relevant planning mechanisms, such as general planning and capital facilities planning, and that relevant information from those sources is used in hazard mitigation. This section identifies where such integration is already in place, and where there are opportunities for further integration in the future.

Existing Integration

Some level of integration has already been established between local hazard mitigation planning and the following other local plans and programs:

- General Plan
- North Shore Plan
- West-Side Vulnerability Assessment

Opportunities for Future Integration

The capability assessment presented in this appendix identified the following plans and programs that do not currently integrate hazard mitigation information but provide opportunities to do so in the future:

- Other community vulnerability assessments
- Climate Adaptation and Resiliency Plan (CARP)

ADAPTIVE CAPACITY

The County views all core jurisdictional capabilities as fully adaptable to meet its needs. Every code can be amended, and every plan can be updated. Such adaptability is considered to be an overarching capability. An adaptive capacity assessment evaluates the ability to anticipate impacts from future conditions. By looking at public support, technical adaptive capacity, and other factors, jurisdictions identify their core capability for resilience against issues such as sea level rise. The adaptive capacity assessment provides an opportunity to identify areas for improvement by ranking such capacity as high, medium or low. The County's adaptive capacity for the impacts of climate change is presented in Table K-8.

Table K-8. Adaptive Capacity for Climate Change

Criterion	Department/ Division with Capacity	Rating[a]
TECHNICAL CAPACITY		
County-level understanding of potential climate change impacts on critical infrastructures, housing, natural and cultural resources critical ecosystems, etc.	Planning Department, Office of Economic Development	Medium
Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)		
County-level monitoring of climate change impacts on critical infrastructures, housing, natural and cultural resources critical ecosystems, etc.	Planning Department, Office of Economic Development	Low
Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)		
Technical resources to assess proposed strategies for feasibility and externalities	Planning Department, Office of Economic Development	Medium
Comment: Some resources exist, need to be addressed in pending Climate Adaptation and Resiliency Plan (CARP)		
County-level capacity for development of greenhouse gas emissions inventory	Planning Department, Office of Economic Development	High
Comment:		

Criterion	Department/ Division with Capacity	Rating[a]
Capital planning and land use decisions informed by potential climate impacts *Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)*	Planning Department, Office of Economic Development	Medium
Participation in regional groups addressing climate risks *Comment: With other counties (particularly Honolulu) and statewide; participation with national and international groups*	Planning Department, Office of Economic Development	Medium
IMPLEMENTATION CAPACITY		
Clear authority/mandate to consider climate change impacts during public decision-making processes *Comment: Various mayor's executive orders and directives, statewide framework*	Planning Department, Office of Economic Development	Medium
Identified strategies for greenhouse gas mitigation efforts *Comment:*	Planning Department, Office of Economic Development	High
Identified strategies for adaptation to impacts *Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)*	Planning Department, Office of Economic Development	Low
Champions for climate action in local government departments *Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)*	Planning Department, Office of Economic Development	Low
Political support for implementing climate change adaptation strategies *Comment:*	Planning Department, Office of Economic Development	Low
Financial resources devoted to climate change adaptation *Comment: Funding is in place for pending Climate Adaptation and Resiliency Plan (CARP)*	Planning Department, Office of Economic Development	Low
County authority over sectors likely to be negatively impacted *Comment:*	Planning Department, Office of Economic Development	Medium
PUBLIC CAPACITY		
Local residents' knowledge of and understanding of climate risk *Comment:*		Low
Local residents' support of adaptation efforts *Comment:*		Unsure
Local residents' capacity to adapt to climate impacts *Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)*		Unsure
Local economy current capacity to adapt to climate impacts *Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)*		Low
Local ecosystems capacity to adapt to climate impacts *Comment: To be addressed in pending Climate Adaptation and Resiliency Plan (CARP)*		Unsure

a. High = Capacity exists and is in use; Medium = Capacity may exist, but is not used or could use some improvement; Low = Capacity does not exist or could use substantial improvement; Unsure = Not enough information is known to assign a rating.

County of Kauaʻi Multi-Hazard Mitigation and Resilience Plan

Appendix L. Detailed Hazard Profiles

L. DETAILED HAZARD PROFILES

TROPICAL CYCLONE AND OTHER HIGH WINDS

Hazard Description

Three types of high winds affect the County of Kaua‘i:

- **Tropical cyclones—**Tropical cyclones are among the most dramatic, damaging, and potentially deadly events that occur in the Hawaiian Islands. In the United States, forecast centers classify tropical cyclones according to their maximum sustained winds (measured over one minute or more). However, wind is only one of three risks that tropical cyclones pose to the County; they also generate storm surge along coastlines and inland flooding due to heavy rainfall.
- **Trade winds**—Trade winds are the most common winds over Hawaiian waters, blowing 70 percent of the time from the northeast or east-northeast and generally ranging from 10 to 25 miles per hour. Occasional extreme events reach 40 to 50 miles per hour when a sub-tropical high-pressure cell north of the islands intensifies. Trade winds occur up to 90 percent of the time in summer (June through August) and 50 percent of the time in winter (December through January).
- **Kona winds**—Kona winds are rain-bearing winds that blow over the islands from the southwest or south-southwest, as the trade wind pattern is reversed. Kona winds are light and variable during winter when trade wind circulation diminishes, but strong, generally southerly, winds when storm systems move across Hawaiian waters.

Wind Pressure

Wind is one of the costliest hazards to insured property, causing more damage than earthquakes or other natural hazards. Wind pressure, not wind speed, is the primary cause of damage. There are three types of wind pressure:

- **Positive wind pressure** is the direct pressure from the force of the wind pushing inward against walls, doors and windows.
- **Negative wind pressure** occurs on the sides and roof of buildings as wind blows past. Air moving parallel to a surface reduces the air pressure on the surface, resulting in a force pulling the surface outward toward the moving air. Negative pressure causes buildings to lose all or a portion of their roofs and side walls and pulls storm shutters off the leeward side of a building (the side sheltered from wind).
- **Interior pressure** increases dramatically when a building loses a door or window on its windward side. The roof is placed under tremendous internal pressures pushing up from inside of the building together with the negative wind pressure lifting the roof from the outside.

Besides the high wind pressures exerted on structures during windstorms, and especially during tropical cyclones, windborne debris can be a major factor in causing damage. Debris includes flying objects, such as tree limbs, outdoor furniture, signs, roofs, gravel, and loose building components.

Wind Speed

Wind speeds vary with height above ground—the higher the elevation, the stronger the wind. Figure L-1 shows the average wind speed for the County of Kaua'i at 50 meters (165 feet) above the ground. Wind forces increase proportionally to the wind speed squared, so any increase in wind speed may significantly increase its effects.

Source: Hawaiian Electric Company, 2020

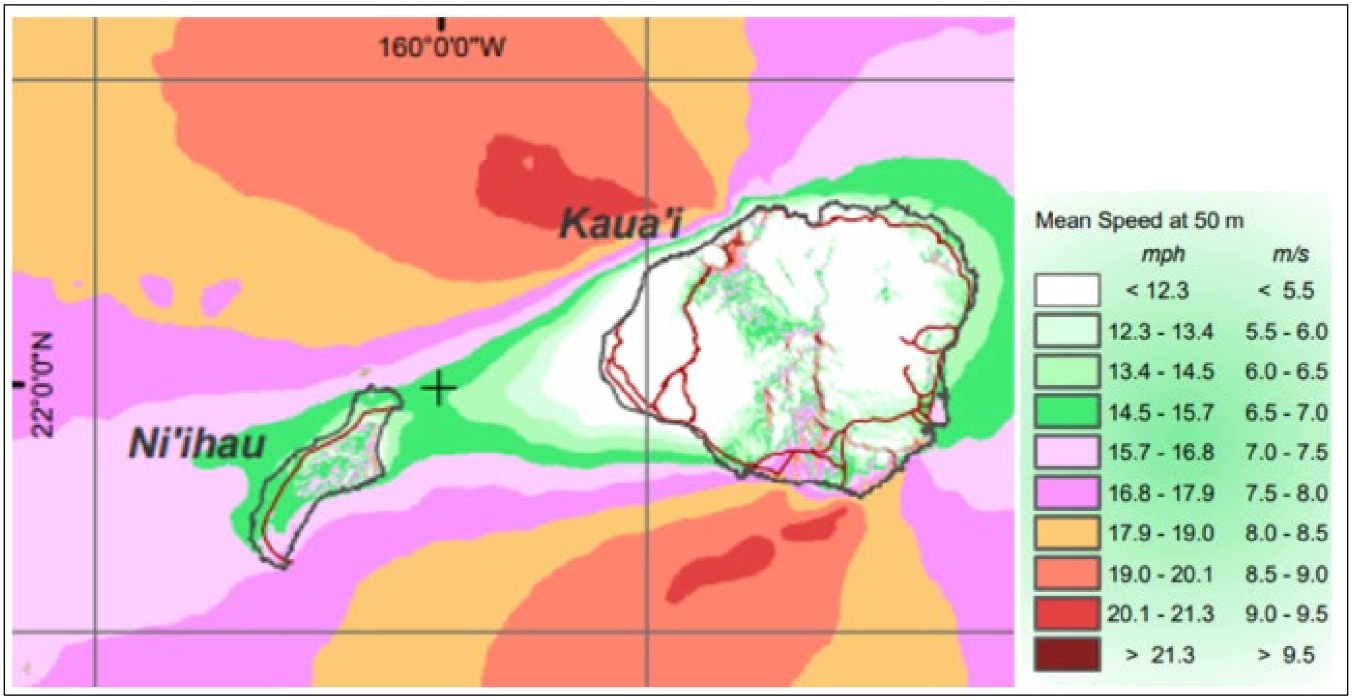


Figure L-1. Average Wind Speed at 50 Meters Above the Ground

There are many ways to measure wind speed:

- **The fastest-mile wind speed** is the highest recorded speed during a time interval in which one mile of wind passes a fixed measuring point. The measurement is taken at a height of 33 feet above ground in open terrain. The fastest-mile wind speed measurement has been historically used in many building codes and design standards such as the Uniform Building Code.
- **Sustained Wind** is the wind speed averaged over 1 minute.
- **Peak Gusts** are the maximum wind gust speeds averaged over a period of 2 to 5 seconds.

Specific Wind Event Types

Tropical Cyclones

Hawai'i lies in the Central Pacific, which, on average, experiences four to five tropical cyclones every year. Almost all tropical cyclones in the Pacific basin form between June 1 and November 30. This timeframe is known as hurricane season. August and September are peak months for hurricane development (County of Maui, 2015).

In the United States, forecast centers classify tropical cyclones in the following categories according to their maximum sustained winds:

- **Tropical Depression**—A weak tropical cyclone with a surface circulation including one or more closed isobars (lines or curves of constant pressure) and highest sustained winds (measured over one minute or more) of less than 38 miles per hour. Tropical depressions are assigned a number denoting their chronological order of formation in a given year.

- **Tropical Storm**—A tropical cyclone with highest sustained winds between 39 and 73 miles per hour.
- **Hurricane**—A tropical cyclone with highest sustained winds greater than 74 miles per hour. Intensity is quantified by the Saffir-Simpson Hurricane Scale, based on a hurricane's sustained wind speed. Table L-1 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous and require preventive measures.

Table L-1. The Saffir-Simpson Hurricane Scale

Category	Wind Speed	Expected Damage
1	74-95 mph	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last several days.
2	96-110 mph	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected, with outages that could last from several days to weeks.
3 (major)	111-129 mph	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	>157 mph	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: NWS, 2013

The threats caused by an approaching hurricane can be divided into three main categories:

- **Wind Damage**—The force of wind can quickly decimate the tree population, down power lines and utility poles, knock over signs, and damage/destroy homes and buildings. Flying debris can also harm both structures and people. When hurricanes first make landfall, tornadoes can form, causing severe localized wind damage.
- **Storm Surge**—A storm surge is a rise in the water level caused by wind forces driving water against the coast (wind set-up) or by wave forces (wave set-up). This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. The water rise enables the storm waves to reach further inland with the associated scouring and erosion caused by the wave forces. Storm surge is responsible for nearly 90 percent of all hurricane-related deaths and injuries.
- **Rainfall/Flooding**—The torrential rains that normally accompany a hurricane can cause serious flooding. Whereas the storm surge and high winds are concentrated around the "eye," the rain may extend for hundreds of miles and may last for several days, affecting areas well after the hurricane has diminished.

Storm surge levels are determined by modeling water depth, wind speed, vegetative cover and other factors to determine the "wave run-up" (how far inland waves will reach) and "wave setup" (the height, speed, and slope of waves and how they differ from the still-water elevation) (see Figure L-2). Estuaries or bays can cause a funneling or amplification effect on storm surge. Coincidence with high tide will also increase surge height.

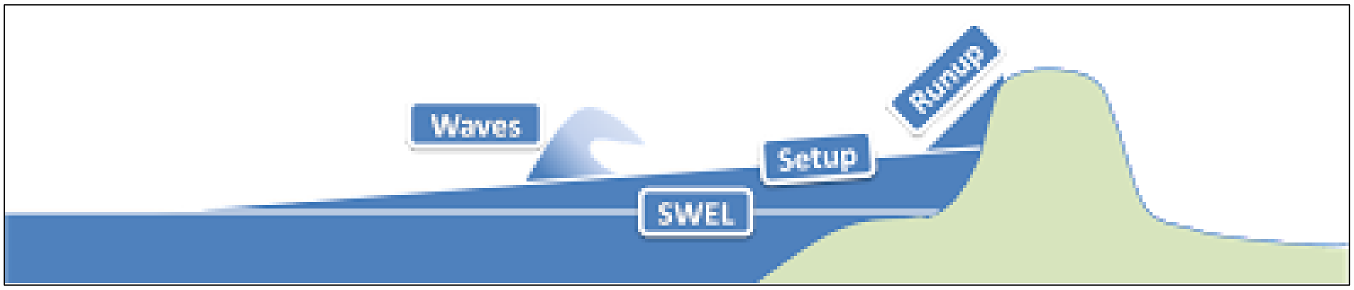


Figure L-2. Storm Surge Stillwater Elevation and Added Effects of Wave Setup and Run-up

Storm surges normally hit coasts ahead of high winds, as waves move faster than a hurricane advances. Locally intense rainfall may occur as the hurricane makes landfall. History has shown that the Hawaiian Islands do not have to take a direct landfall from a cyclone to sustain a high level of damage. Wind strength, storm radius of maximum winds, timing, and proximity are important factors that control storm impact. The winds can affect all parts of an island and can be intensified by mountain ranges (orographic or topographic amplification). Hurricane winds, blowing from variable directions, will experience topographic amplification, so a minimal hurricane or tropical storm can have significant wind effects on land.

Trade Winds

Trade winds are the most common winds over Hawaiian waters. These persistent winds blow 70 percent of the time from the northeast or east-northeast and generally range from 10 to 25 miles per hour. Occasional extreme events reach 40 to 50 miles per hour when a sub-tropical high-pressure cell north of the islands intensifies. Trade winds occur up to 90 percent of the time in summer (June through August) and 50 percent of the time in winter (December through January). North Pacific high-pressure systems can cause gusty trade wind episodes over Hawaiian waters, which commonly persist for several days.

Kona Winds

Kona winds are rain-bearing winds that blow over the islands from the southwest or south-southwest. The western sides of the islands become windward during Kona winds, as the trade wind pattern is reversed. Kona winds occur as light and variable winds during winter when trade wind circulation diminishes, and as strong generally southerly winds when storm systems move across Hawaiian waters. Strong Kona winds are most likely when a system with an unusually low central pressure is located within 500 miles northwest of the islands. Kona storms move erratically with a slow tendency toward the west.

Damaging Kona winds have reached velocities of 50 miles per hour for several days. Though most strong Kona wind episodes last no more than a day, some last up to two weeks. During this time, considerable damage can be inflicted to boats caught in the open ocean or anchored in southwest-exposed anchorages.

The effects of Kona winds on land can also be severe. Winds can accelerate down the slopes of mountains, hills, and escarpments to over 100 miles per hour. Winds with these speeds can be very destructive when they reach heavily populated low-lying areas. It is common for trees to be uprooted, for signs and utility poles to be overturned, and for residential roofs to be blown off.

Local Hazard Profile

Past Events

Tropical Cyclones

Little was recorded of hurricanes striking Hawaiʻi before the last half of the 20th century. Until 1950, tropical storms hitting the Hawaiian Islands were not classified as hurricanes. It was not until the advent of weather satellites that the storms in this part of the world were understood to be hurricanes. The only documented hurricane before 1950 was the "Kohala Cyclone" of 1871, which was believed to be a minimal hurricane that affected Maui and Hawaiʻi.

Since 1950, when adequate records began, eight hurricanes have affected the Hawaiian Islands and 17 others have posed a threat by their passage. Figure L-3 depicts storm tracks in the vicinity of Hawaiʻi from 1950 to 2020.

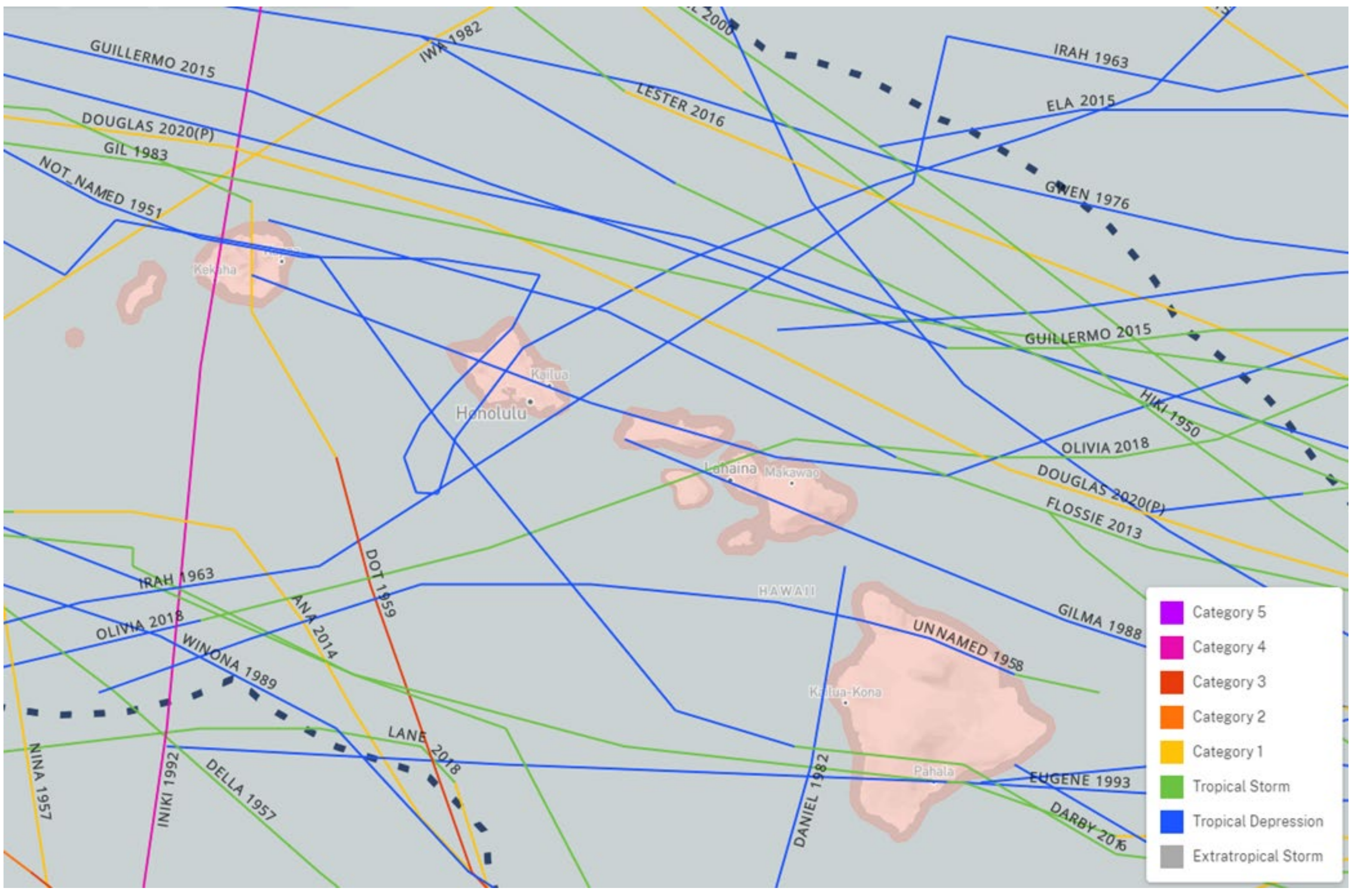


Figure L-3. Historical Tropical Cyclones Within 150 Miles of Hawaiʻi, 1950 to 2020

In 1959, the storm center of Hurricane Dot passed directly over Līhuʻe and although that station reported gusts to 75 miles per hour as the highest winds, unofficial reports of 104 mile per hour winds were received from other parts of the island. The hurricane blew off roofs, uprooted trees and knocked down utility lines around the island. Many roadways were blocked, huge waves pounded the shoreline, and torrential rains swelled rivers and streams to raise flood threats (Tilden, 1959). Hurricane Iwa impacted Kauaʻi and Niʻihau in 1982 with reported gusts exceeding 100 miles per hour and a storm surge of 30 feet. Statewide 2,345 buildings, including 1,927 houses, were damaged or destroyed, leaving 500 people homeless (NWS, 2020c). Hurricane Iniki in 1992 was the most destructive hurricane to strike Hawai‘i in the 20th century with estimated peak sustained winds of between 130 and 160 miles per hour over Kaua‘i. More than 14,000 homes were affected with 1,421 destroyed and 5,152 suffering major damage. More than half of the utility poles on the island were destroyed. Almost all the green vegetation on the island was stripped and trees were uprooted or broken (U.S. Department of Commerce, 1993). Hurricane Lane produced intense rainfall and severe flooding in 2018 to parts of the island already severely affected by record-breaking flooding earlier in the year (NWS, 2018).

All of the main Hawaiian Islands are at approximately the same risk of a direct hit by a hurricane. The following other hurricanes or tropical storms have caused serious damage in the state of Hawai‘i:

- Hurricane Nina in 1957 produced record winds in Honolulu on the Island of O‘ahu.
- Hurricane Iwa also resulted in widespread damage on O‘ahu in 1982.
- Hurricane Estelle caused high surf on the islands of Hawai‘i and Maui and floods on O‘ahu in 1986.
- Hurricane Iniki also produced severe damage on the leeward coast of the Island of O‘ahu in 1992.

In addition to all these destructive hurricanes, seven tropical storms or hurricanes since 1950 could have caused serious damage to the islands had they come much closer to the islands than they did. Among these hurricanes that missed the islands are Hurricane Fernanda in 1993, Hurricane Emilia in 1994, and Hurricane Ana in 2014.

Other High Wind Events

Table L-2 summarizes high wind events in the planning area since January 2005, as recorded by the National Oceanic and Atmospheric Administration (NOAA). According to this data, there have been no recorded fatalities and only one injury attributable to high wind events in Kaua‘i County in that timeframe. Many of the events caused power outages, downed trees, and some property damage, but the most costs of property damage are not available.

Table L-2. Past High Wind Events Impacting Planning Area

Start Date	End Date	Property Damage[a]	Injuries[b]	Fatalities[b]
01/08/2005	01/08/2005	$100,000	0	0
12/04/2007	12/05/2007	N/A	0	0
12/13/2008	12/13/2008	N/A	0	0
12/09/2010	12/09/2010	N/A	0	0
03/09/2012	03/09/2012	N/A	0	0
11/30/2013	11/30/2013	N/A	0	0
12/01/2013	12/01/2013	N/A	0	0
12/15/2013	12/15/2013	N/A	0	0
12/30/2014	12/30/2014	N/A	1	0
12/30/2014	12/30/2014	$10,000	0	0
02/14/2015	02/14/2015	N/A	0	0
02/09/2019	02/10/2019	N/A	0	0
12/24/2019	12/24/2019	$2,000	0	0
12/25/2019	12/25/2019	$8,000	0	0
Total		**N/A**	**1**	**0**

a. N/A in property damage represents damage costs not available.
b. Injuries or fatalities may have occurred that were not recorded in available datasets.
Source: NCEI, 2020; State of Hawai'i, 2018

The most notable documented winter storm high wind event in Kauaʻi County was that of January 2005, which caused damage estimated at $100,000. Powerful thunderstorms produced strong wind gusts and a small tornado in Waimea and caused significant wind damage at the National Tropical Botanical Garden in Kalāheo (NWS, 2020d). Other winter storms have caused less damage, but more localized effects, with flooding and power disruption constituting the main problems.

Location

Historically, most tropical cyclones have passed the Hawaiian Islands to the south. Because they spin counter-clockwise in the northern hemisphere, east-facing coastlines in Hawaiʻi receive the brunt of strong onshore winds as storms approach the islands, while the south and west coastlines feel onshore winds as the storms pass to the west. Coastlines facing the passing storms usually are adversely impacted by both wind and storm surge damage. The highest wind speeds, however, may occur on the side opposite the storm approach, as downdrafts accelerate downslope as they descend over the mountainous terrain.

High windstorms have the potential to happen anywhere in the planning area, but topography plays a significant role in where the impacts of such events are most severe. For example, strong Kona storms bring wind and rain and can cause extensive damage to south- and west-facing shores. In general, wind speeds vary with height above ground—the higher the elevation, the stronger the wind. As a result, the mountainous areas of Kauaʻi County generally experience the highest wind speeds (State of Hawaiʻi, 2018).

Wind speed increases over hills, ridges and cliffs. This is known as wind speed-up. Because wind speed is related to wind pressure, structures in wind speed-up areas experience more severe damage than those on flat, open terrain if building codes do not take the local topographic factor into consideration. In the past, the magnitude of wind speed-up caused by topography in Kauaʻi County has not been well understood and it was not historically considered in any building code used in the state (State of Hawaiʻi, 2018).

Frequency

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that may occur within any given year based on past recorded events. MRP is the average period of time, in years, between occurrences of a particular hazard event (equal to the inverse of the annual frequency of exceedance). The following maximum 3-second gust wind speeds have been identified for the Hazus model:

- For the 50-year MRP, 39 to 95 mph, characteristic of a Category 1 hurricane.
- For the 100-year MRP, 74 to 110 mph, characteristic of a Category 2 hurricane.
- For the 500-year MRP, 111 to more than 157 mph, characteristic of a Category 5 hurricane.

Records of other high-wind events show 14 events between 2005 and 2019, averaging about one event per year.

Severity

It is estimated that Hurricane Iniki delivered winds between 130 and 160 miles per hour over Kauaʻi. These windspeeds would be equivalent of a minimal Category Four hurricane. By comparison, Hurricane Iwa, the last hurricane to strike the island, was equivalent to a minimal Category Two. The eye of the storm crossed the coast in the Waimea area and departed over Hāʻena about 40 minutes later (U.S. Department of Commerce, 1993).

Although only two hurricanes have made direct landfall on Kauaʻi in recent decades, hurricane-induced storm surge and waves pose a flooding threat to the island. Review of hurricane storm-tracks from 1950 to 2020 indicate that 17 storms of Category 1 or higher have come within a 150 nautical mile radius of the Hawaiian Islands.

For this risk assessment, Kauaʻi County determined that a Category 4 event with a storm track south-southwest by northeast, following the path of Iniki, was the scenario likely to have the greatest impact on the planning area. Using Hazus, two types of impacts were modeled for the Category 4 storm scenario event: wind and storm surge. Figure L-4 and Figure L-5 show the extent and location for these two parameters for the scenario event in the planning area. The maximum gusts for the Category 4 scenario modeled for this assessment range from 130 to 147 mph. This would correlate to an MRP of approximately 180 years, using interpolation from the above referenced Hazus MRP values.

High windstorms can be a problem in the planning area and have been known to cause damage to utilities, trees, boats, homes, and other structures and buildings. Kauaʻi County is located in FEMA's Wind Zone II, with speeds up to 160 miles per hour (FEMA, 2014). Economic impact is largely associated with disrupted services as a result of downed debris blocking transportation infrastructure and potential disruption of energy resources. Outside of a catastrophic high wind event, the economic disruption caused by this hazard is expected to remain short-term.

Warning Time

Tropical cyclones can be closely monitored and tracked. As a result, accurate warnings up to days in advance of the event are possible, with the modeling offering possible storm movement up to a week prior. Track forecasts have improved due in part to the increased numbers of satellites, outfitted with more sophisticated weather-monitoring devices. At the same time, supercomputing power has increased exponentially, and computer models used to forecast a cyclone's direction keep improving (Main, 2014). The National Oceanic and Atmospheric Administration (NOAA) offers multiple watch, warning, and resource tools through the National Hurricane Center including, but not limited to those described in the sections below.

Tropical Cyclone Public Advisory

The tropical cyclone public advisory contains a list of all current watches and warnings on a tropical or subtropical cyclone. It gives the cyclone position in terms of latitude and longitude and distance from a selected land point, as well as the current motion. The advisory includes the maximum sustained wind speed and the estimated or measured minimum central pressure. The advisory may also include information on potential storm tides, rainfall or tornadoes associated with the cyclone, as well as any pertinent weather observations.

Public advisories are issued for all Atlantic, eastern Pacific and central Pacific tropical or subtropical cyclones. Public advisories for eastern Pacific and central Pacific tropical cyclones are normally issued every 6 hours. Intermediate public advisories may be issued every 3 hours when coastal watches or warnings are in effect, and every 2 hours when coastal watches or warnings are in effect and land-based radars have identified a reliable storm center. Special public advisories may be issued at any time due to significant changes conditions.

High Wind Watch, Warnings, and Advisories

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may be 25 to 30 percent higher.

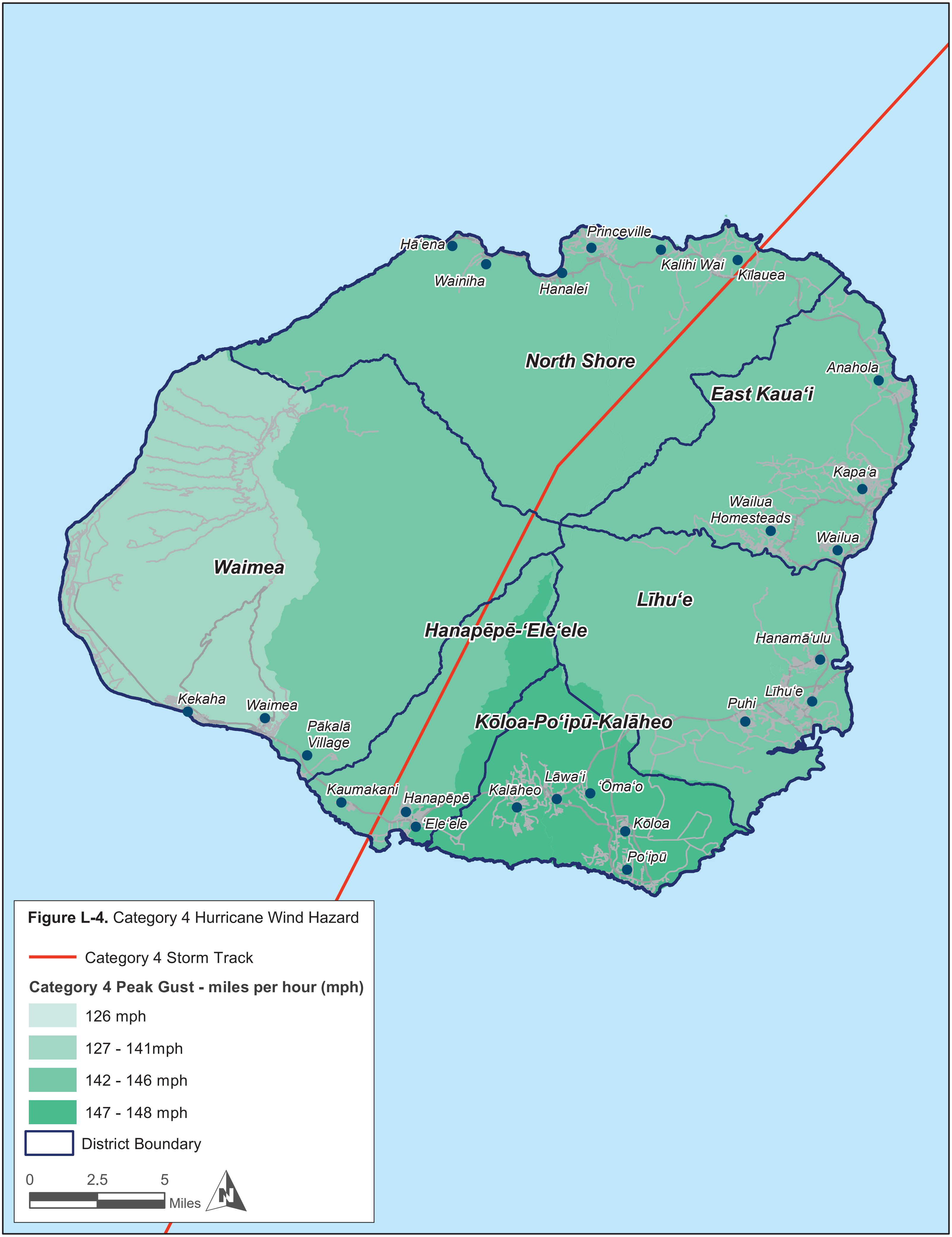


Figure L-4. Category 4 Hurricane Wind Hazard

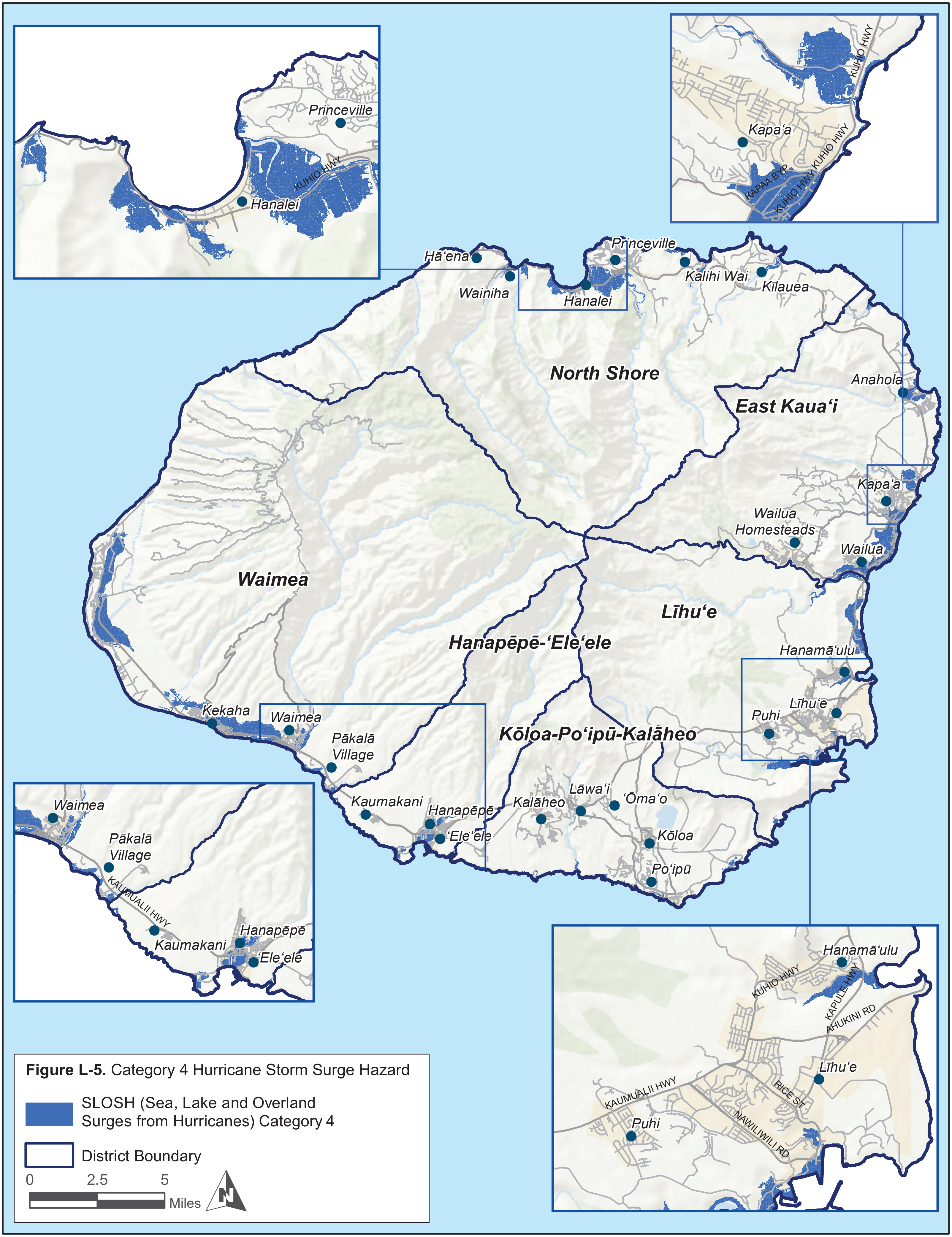


Figure L-5. Category 4 Hurricane Storm Surge Hazard

The National Weather Service Forecast Office in Honolulu issues the following watches, warnings, and advisories when high wind threatens the state:

- **High Wind Watch**—A high wind watch is issued when sustained winds exceeding 40 miles per hour (mph) and/or frequent gusts over 60 mph are likely to develop in the next 24 to 48 hours. For summit areas, high wind watches are issued for predicted sustained winds exceeding 56 mph and/or frequent gusts over 66 mph.
- **High Wind Warning**—A high wind warning is issued when sustained winds exceeding 40 mph and/or frequent gusts over 60 mph are occurring or imminent. For summit areas, warnings are issued for winds exceeding 56 mph and/or frequent gusts over 66 mph. Wind warnings may be issued up to 24 hours ahead of the onset of high winds.
- **Wind Advisory**—A wind advisory is issued when sustained winds of 30 to 39 mph and/or frequent gusts to 50 mph or greater are occurring or imminent. For summit areas the range is 45 to 55 mph for sustained wind and/or 55 to 65 mph for frequent gusts. Wind advisories may be in effect for 6 to 12 hours.
- **Small Craft Advisory**—A small craft advisory is issued for coastal waters when winds of 25 to 33 knots and seas 10 feet or higher are occurring or forecast.
- **Gale Warning**—A gale warning is issued for coastal, offshore, and high seas areas when winds of 34 to 47 knots not associated with a tropical cyclone are occurring or forecast.

Tropical Cyclone Forecast/Advisory

The tropical cyclone forecast/advisory contains a list of all current watches and warnings on a tropical or subtropical cyclone, as well as the current latitude and longitude, intensity, and system motion. The advisory contains forecasts of the cyclone positions, intensities, and wind fields. It may also include information on any pertinent storm tides associated with the cyclone. Forecast/advisories are issued on all eastern Pacific tropical and subtropical cyclones every 6 hours.

Tropical Cyclone Discussion

The tropical cyclone discussion explains the reasoning for the analysis and forecast of a tropical or subtropical cyclone. It includes a table of the forecast track and intensity. Tropical cyclone discussions for eastern and central Pacific tropical cyclones are normally issued every 6 hours. Special tropical cyclone discussions may be issued at any time due to significant changes in warnings or in the cyclone.

Secondary Hazards

Secondary effects of tropical cyclones and high winds include landslides, flooding, coastal erosion, and high surf.

WILDFIRE

Hazard Description

A wildfire is any uncontrolled fire occurring on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson.

The potential for significant damage to life and property exists in areas designated as "wildland urban interface (WUI) areas," where development is adjacent to densely vegetated areas. Fires in WUI areas tend to be more damaging than urban structural fires, are often more difficult to control, and behave differently from structural fires. When these fires erupt, people and structures must take priority, often at a devastating expense to natural resources. People who live in these areas often come directly from urban areas and may have little understanding of wildfire cycles and dangers. Homes and other structures are built and maintained in a manner that leaves them and their occupants vulnerable. Thus, fire becomes a significant threat to both humans and natural resources.

NOAA identifies four types of wildfires based on position relative to the ground (see Figure L-6):

- **Ground Wildfires**—These wildfires burn in natural litter, duff, roots, or sometimes high-organic soils. Once they start, they are very difficult to detect and control. In addition, ground fires may rekindle.
- **Surface Wildfires**—These wildfires burn in grasses and low shrubs (up to 4 feet tall) or in the lower branches of trees. Surface wildfires may move rapidly, and the ease of control depends upon the fuel involved.
- **Crown Wildfires**—These wildfires burn on the tops of trees. Once started, they are very difficult to control since wind plays an important role in their spread.
- **Spotting Wildfires**—These wildfires occur when large burning embers are thrown ahead of a crown fire by wind and atmospheric conditions. Once spotting begins, the wildfire is very difficult to control.

Source: County of Maui, 2015

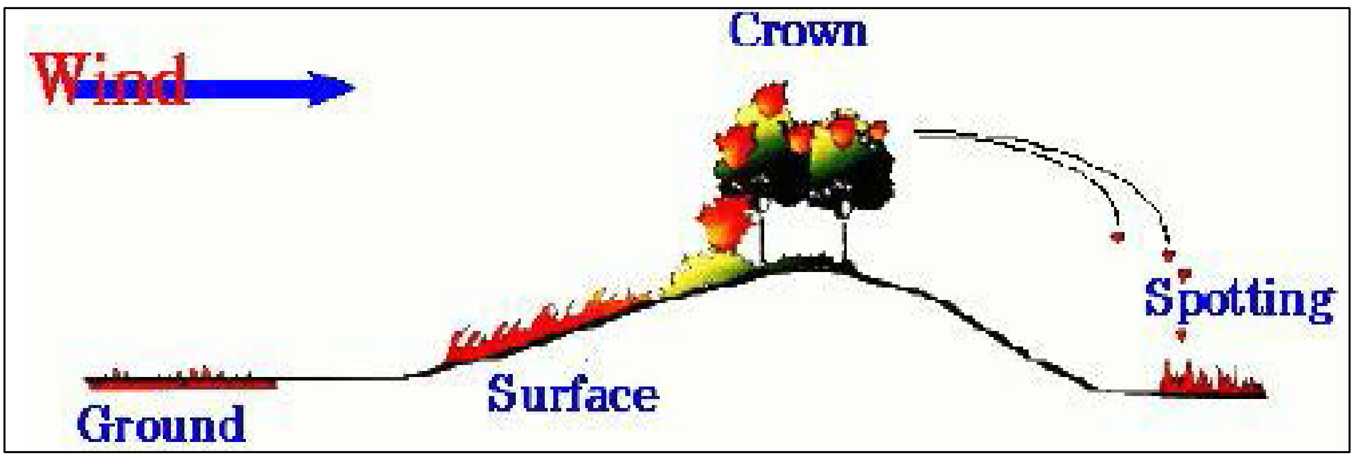


Figure L-6. Types of Wildfires

FEMA defines four categories of wildfires based on location, severity or purpose (FEMA, 1997):

- **Wildland Fires**—Wildland fires are fueled mostly by natural vegetation. They typically occur in national forests and parks, where federal agencies are responsible for fire management and suppression.
- **Interface Fires**—Interface fires are urban/wildland fires in which vegetation and the built-environment provide fuel.
- **Firestorms**—Firestorms are events of such extreme intensity that effective suppression is virtually impossible. Firestorms occur during extreme weather and generally burn until conditions change or the available fuel is exhausted.
- **Prescribed Fires and Natural Burns**—Prescribed fires are intentionally set and natural burns are selected natural fires that are allowed to burn for beneficial purposes.

Hazard Profile

Past Events

Table L-3 lists recorded wildfire events in Kaua'i County between 2011 and 2019.

Table L-3. Wildfires from 2011 to 2019

Date Started	Area	Acres Burned	Impacts
08/17/2011	Kōloa	50	Dry brush burned; 2 homes burned, 3 damaged, 8 people left homeless
05/28/2012	Na Pali-Kona Forest Reserve	40	Dry grass and slash pine burned
06/25/2012	West of Waimea Canyon State Park	650	Dry brush and eucalyptus burned
08/17/2012	Near Kekaha	3,000	Dry brush burned; power poles destroyed
09/21/2013	Near Wailua	42	Brush burned
12/22/2014	Near Anahola	25	Dry brush burned; residents evacuated
03/23/2015	Waimea Canyon Drive	200	Dry brush burned
03/31/2015	Kōloa	100	Dry brush burned
05/19/2015	Hanamāʻulu	70	Dry brush burned
06/05/2015	Pōki'i Ridge	400	Dry brush burned
07/18/2015	Behind Līhuʻe Airport	40	Brush burned; diverted 3 flights to Honolulu
05/15/2017	Above Waimea town	750	Dry grass and shrubs burned
09/24/2017	Near Poʻipū	215	Dry brush burned; base-yard machinery, trucks, and equipment damaged
09/25/2017	Makana Mountain	100	Dry brush and vegetation burned
06/11/2019	Near Poʻipū	500	Dry brush burned; residents evacuated; roads closed

Location

Wildfire potential varies with location base on the following factors:

- **Fuel**—Fuel may include living and dead vegetation on the ground, along the surface as brush and small trees, and above the ground in tree canopies. Lighter fuels such as grasses, leaves and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite. Trees killed or defoliated by forest insects and diseases are more susceptible to wildfire.
- **Weather**—Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, lightning, and the stability of the atmosphere. Strong, dry winds produce extreme fire conditions. Such winds generally reach peak velocities during the night and early morning hours.
- **Terrain**—Topography includes slope and elevation. The topography of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of landforms (fire spreads more easily uphill than downhill).

Steep slopes, rough terrain, difficult access, and an increase of non-native high fire-intensity plants, coupled with warm weather, recurring droughts, changes in land use, and a history of human-caused fires puts the County at risk of wildfire (HWMO, 2016).

The Hawaiʻi Wildfire Management Organization has developed mapping of Communities at Risk from Wildfire (CARW), which was used for the wildfire risk assessment. CARW maps delineate communities that share similar environmental conditions, land use characteristics, fuel types, hazards, and general wildfire issues. They provide ratings to characterize generalized hazards in each area. The state DLNR has developed streamlined community boundaries for its CARW maps. Figure L-7 shows the CARW map for Kauaʻi County.

Source: HWMO, 2016

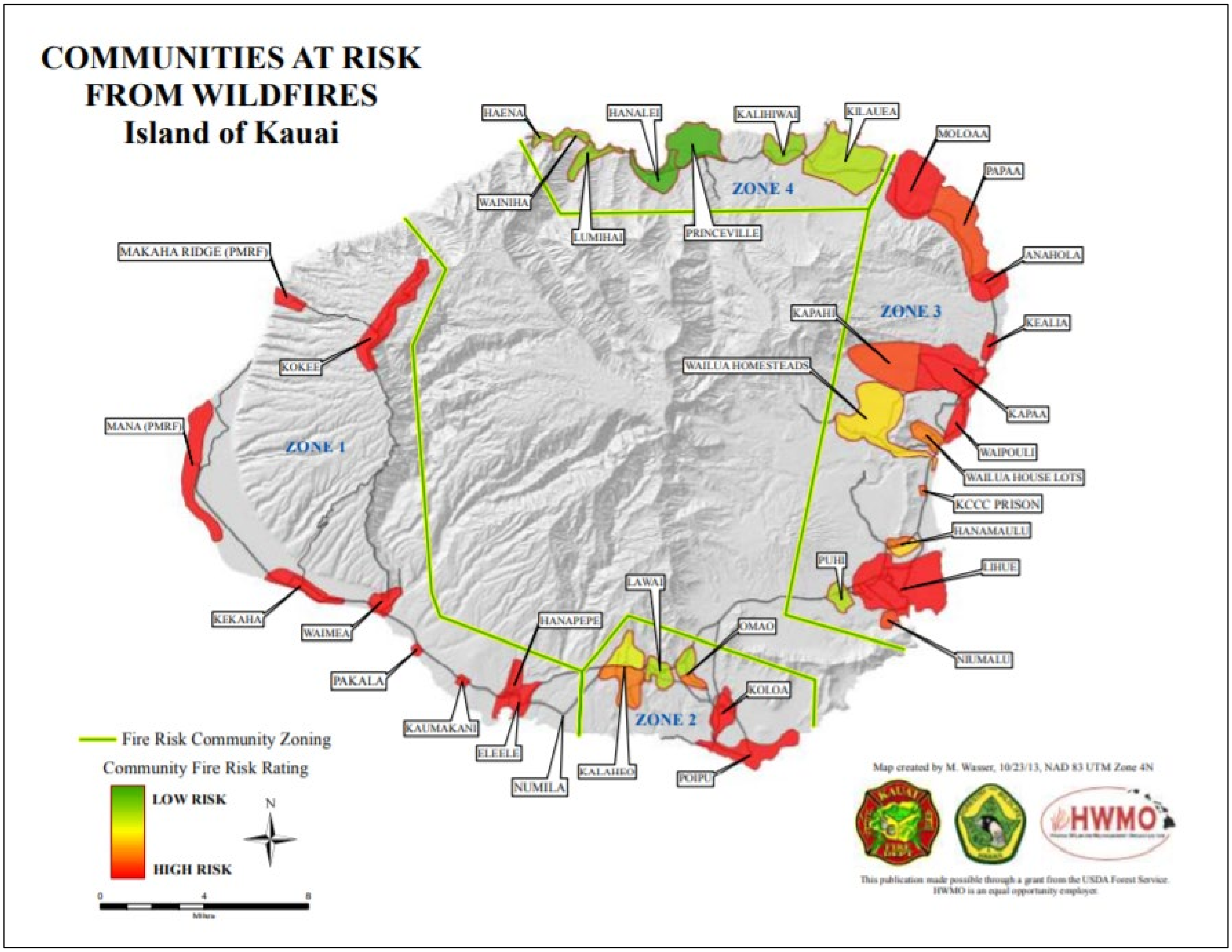


Figure L-7. Communities at Risk from Wildfire

Frequency

Naturally occurring wildfires are most likely in dry periods. In Hawai‘i, the fire season typically consists of the dry months of April through October. However, periods of drought can extend the season. According to government authorities, humans caused the highest percentage of wildfires in the County of Kaua‘i either accidentally or intentionally, especially near developments, power line right of ways, and along roadsides. Sprawling dray nonnative grasslands surround many communities. Wildfires are usually extinguished while smaller than 1 acre but can spread to thousands of acres.

Severity

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Fire warning and response are generally sufficient so that the likelihood of injuries and casualties caused directly by a wildfire is minimal. However, smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly and those with respiratory and cardiovascular diseases. First responders are exposed to risks from the initial incident and after-effects from smoke inhalation and heat stroke.

Fire hazards present a considerable risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure.

Economic impacts due to wildfires include costs and losses due to burned agricultural crops, damaged public infrastructure and private property, interrupted transportation corridors, and disrupted communication lines. They also include diminished real property values and thus tax revenues, loss of retail sales, and relocation expenses of temporarily or permanently displaced residents. Currently there is no measure in place to quantify the potential economic impacts due to wildfires besides historical data.

Warning Time

Humans often cause wildfires, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

If a fire does break out and spread rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has contributed to a significant improvement in warning time.

In coordination with the Emergency Management Agency, drought and other fire-hazard conditions are constantly monitored, and actions such as burning bans and closures are instituted when needed. The public is informed of these restrictions by radio announcements and newspaper notices. New tools, such as satellite observation of burns, are being examined.

Firefighting Resources

Initial response to the majority of wildfires is the responsibility of Kaua'i Fire Department from eight fire stations located around the island. DLNR-DOFAW (Department of Land and Natural Resources-Division of Forestry and Wildlife) responds to wildfire events on state lands and provides additional wildland fire fighting assistance when state lands are threatened.

Given Kaua'i County's widely distributed population, response times can be long and the weight of response (number of firefighters and engines) can be limited. Kaua'i County has many areas where the roads accessing communities and residential clusters do not meet emergency access standards for road width (to allow residential population evacuation and incoming emergency apparatus) and where alternative access routes are not available.

For wildfire and rural use, Kaua'i Fire Department and DLNR-DOFAW are equipped with 2 engine trucks 2 water tenders, and 4 special brush trucks. Two helicopters are on contract and 2 additional are available as needed. A D7 dozer, backhoe, excavator, skid steer, and grader are available as well as portable pumps, dip tanks, and utility terrain vehicles (HWMO, 2016).

Secondary Hazards

Wildfires can lead to secondary hazards such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire.

Vulnerability to flooding increases due to the destruction of watersheds. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

Wildfires can cause direct economic losses in the reduction of harvestable crops and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs and destroy transmission lines.

CLIMATE CHANGE

Climate, consisting of patterns of temperature, precipitation, humidity, wind and seasons, plays a fundamental role in shaping natural ecosystems and the human economies and cultures that depend on them. "Climate change" refers to changes over a long period of time.

The well-established worldwide warming trend of recent decades and its related impacts are caused by increasing concentrations of carbon dioxide and other greenhouse gases in the earth's atmosphere. Greenhouse gases are gases that trap heat in the atmosphere, resulting in a warming effect. Carbon dioxide is the most commonly known greenhouse gas; however, methane, nitrous oxide and fluorinated gases also contribute to warming. Emissions of these gases come from a variety of sources, such as the combustion of fossil fuels, agricultural production and changes in land use. According to the National Aeronautics and Space Administration (NASA), carbon dioxide concentrations measured about 280 parts per million (ppm) before the industrial era began in the late 1700s and have risen dramatically since then, surpassing 400 ppm in 2013 for the first time in recorded history (see Figure L-8).

Source: NASA, 2020

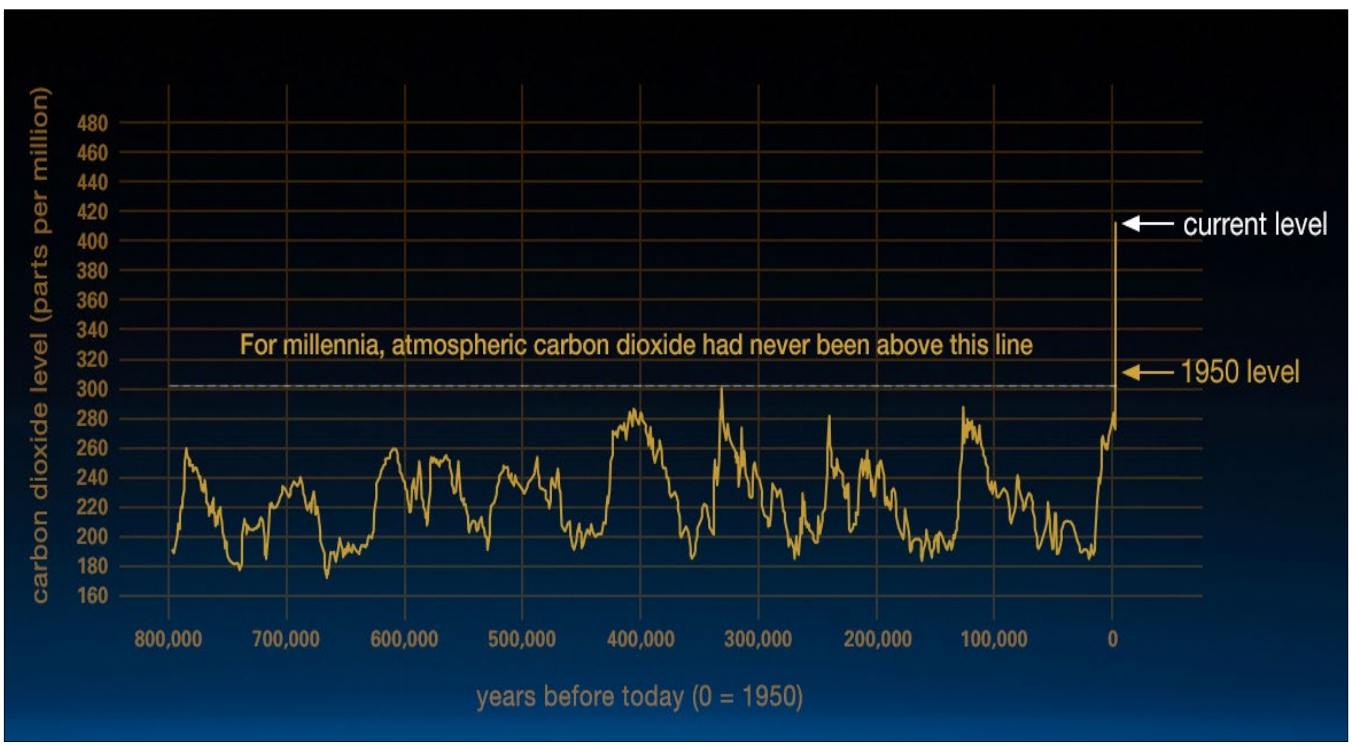


Figure L-8. Global Carbon Dioxide Concentrations Over Time

How Climate Change Affects Hazard Mitigation

Climate change will affect the people, property, economy and ecosystems of Kaua'i County in a variety of ways. Consequences of climate change include increased flood vulnerability, and increased heat-related illnesses. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every 5 years for the past 100 years, then it can be expected to continue to flood an average of once every 5 years.

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. Specifically, as hydrology changes, storms currently considered to be the 100-year flood might strike more often, leaving many communities at greater risk. The risks of landslide, severe storms, and wildfire are all affected by climate patterns as well. For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis.

Current Indications of Climate Change

Global Impacts

The major scientific agencies of the United States—including NASA and the National Oceanic and Atmospheric Administration (NOAA)—have presented evidence that climate change is occurring. NASA summarizes key evidence as follows (NASA, 2020a):

- Global Temperature Rise—The planet's average surface temperature has risen about 1.62 ºF since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the warming occurred in the past 35 years, with the five warmest years on record taking place since 2010.
- Warming Oceans—The oceans have absorbed much of this increased heat, with the top 2,300 feet of ocean showing warming of more than 0.4 ºF since 1969.
- Shrinking Ice Sheets—The Greenland and Antarctic ice sheets have decreased in mass. Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, and Antarctica lost about 127 billion tons of ice per year during the same time period. The rate of Antarctica ice mass loss has tripled in the last decade.
- Glacial Retreat—Glaciers are retreating almost everywhere around the world—including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.
- Decreased Snow Cover—Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier
- Sea Level Rise—Global sea level rose about 8 inches in the last century. The rate in the last two decades is nearly double that of the last century and is accelerating slightly every year.
- Declining Arctic Sea Ice—Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades

- Extreme Events—The number of record high temperature events in the United States has been increasing since 1950, while the number of record low temperature events has been decreasing. The U.S. has also witnessed increasing numbers of intense rainfall events.
- Ocean Acidification—Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.

Impacts in Hawaiʻi

According to a briefing sheet produced by the University of Hawaiʻi Sea Grant College Program, Hawaiʻi is getting warmer. Data shows a rapid rise in air temperature in the past 30 years (averaging 0.3 °F per decade). The rate of temperature rise at elevations below 2,600 feet—0.16 °F per decade—is less than the global rate of 0.36 °F per decade. However, the rate of warming at elevations in Hawaiʻi above 2,600 feet—0.48 °F per decade—is faster than the global rate. Most of the warming is related to a larger increase in minimum temperatures compared to the maximum—a net warming about 3 times as large—causing a reduction of the daily temperature range.

Despite recent years where the rate of global warming was low, surface temperatures in Hawaiʻi have remained high. As temperatures rise, modeling results indicate to some extent that the State of Hawaiʻi should expect to see decreased rainfall in response to climate change. Studies over the past 20 years have confirmed this phenomenon, as rainfall in throughout the state has steadily declined about 15 percent over the past 20 years (Fletcher, 2010).

A University of Hawaiʻi study noted the following trends (University of Hawaiʻi, 2014):

- 70 percent of the beaches have eroded and over 13 miles of beach have been completely lost to erosion in the last century. Additionally, many of the state's coastlines are experiencing shoreline retreat, with an average of 1 foot lost per year, wetland migration, and cliff collapse.
- Low coastal areas have experienced more frequent flooding due to elevated groundwater tables, which have increased partially due to sea-level rise.
- Tropical cyclones are occurring more frequently, with more having developed from Pacific storms between 1991 and 2010 than in the last century
- Hawaiʻi has recorded a decrease of prevailing northeasterly trade winds in the last 40 years; these winds drive precipitation on windward coasts.
- There has been an overall decline in rainfall in the last 30 years, leading scientists to expect droughts and heavy rains more frequently leading to flash flooding, infrastructure damage, runoff and sedimentation. In addition, the decrease in rainfall levels has also led to a decline in stream base flow over the last 70 years, influencing aquatic and riparian ecosystems, local agriculture, and aquifer recharge and freshwater supplies.
- Global ocean acidification has also been noted, with a 30 percent increase of marine uptake of carbon dioxide or pH change of 0.1. Scientists expect this trend to continue, with pH levels increasing up to 0.4 by 2100. Higher levels of ocean acidity can negatively impact marine animals, such as by inhibiting shell and skeleton growth in corals, shellfish, and plankton.

Projected Future Impacts

Global Projections

Scientists project that Earth's average temperatures will raise between 5 ºF and 9 ºF by 2100 (Reuters, 2018). Some research has concluded that every increase of 2ºF in average global average temperature can have the following impacts (NRC, 2011):

- 3 to 10 percent increases in the amount of rain falling during the heaviest precipitation events, which can increase flooding risks
- 200 to 400 percent increases in the area burned by wildfire in parts of the western United States
- 5 to 10 percent decreases in stream flow in some river basins
- 5 to 15 percent reductions in the yields of crops as currently grown.

Sea level is rising at increasing rates due to global warming of the atmosphere and oceans and melting of the glaciers and ice sheets. Rising sea level and projections of stronger and more frequent El Niño events and tropical cyclones in waters surrounding Hawai'i all indicate a growing vulnerability to coastal flooding and erosion. While the IPCC's "business as usual" scenario, in which greenhouse gas emissions continue at the current rate of increase, predicts up to 3.2 feet of global sea level rise by 2100 (IPCC, 2014), recent observations and projections suggest that this magnitude of sea level rise could occur as early as 2060 under more recently published highest-end scenarios (Sweet et al., 2017). Figure L-9 shows the projected rate of global sea level rise under different greenhouse gas scenarios (IPCC, 2014).

Source: IPCC 2014

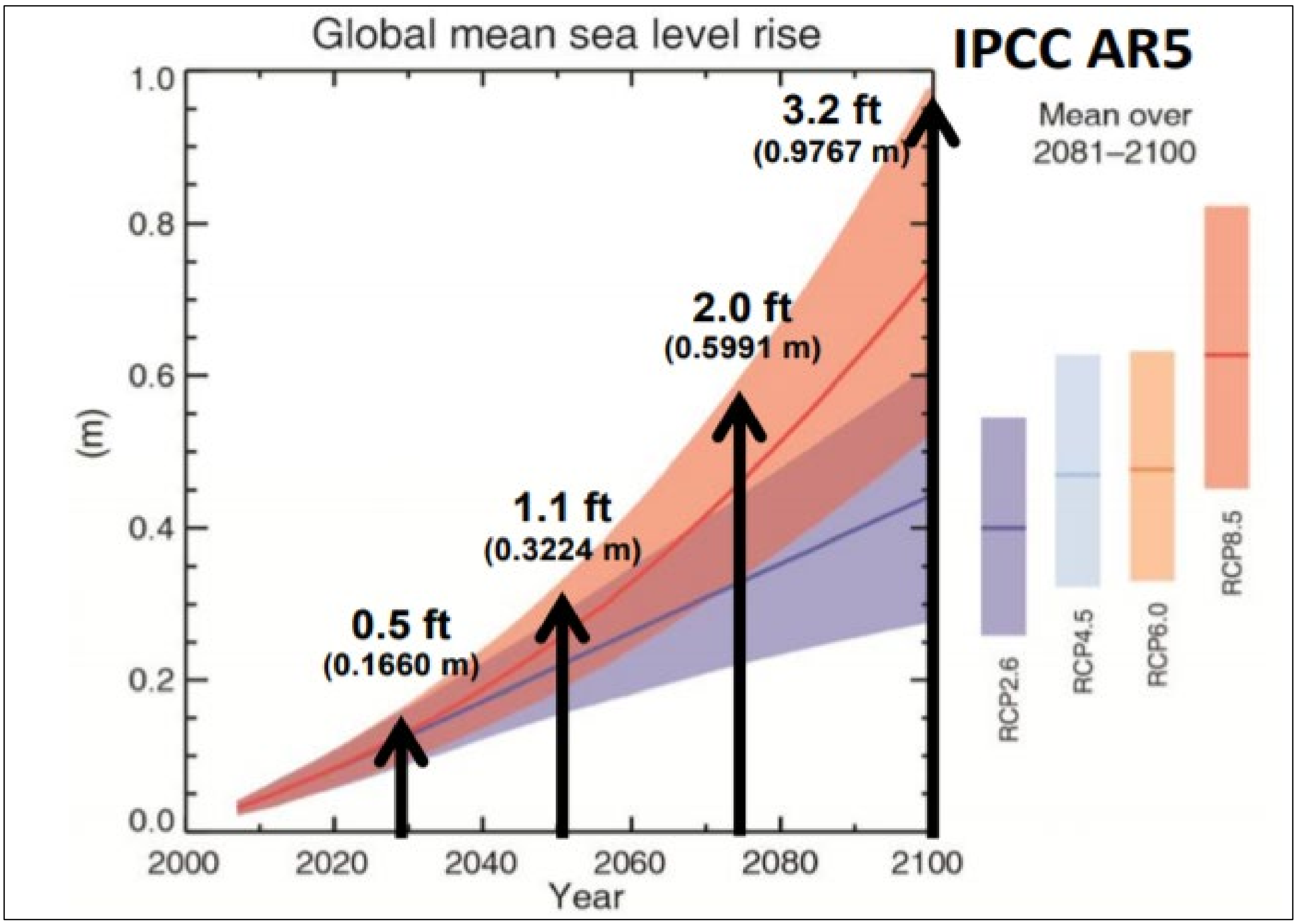


Figure L-9. Projected Rate of Global Sea Level Rise under Different Emissions Scenarios

Projections for Hawai'i

The University of Hawai'i's 2014 climate report summarizes the major expected impacts of climate change in Hawai'i. These impacts concern five primary areas: the marine ecosystems (open ocean and coral reefs/near-shore habitats), coasts and the built environment, terrestrial eco-systems, freshwater resources, and public health. The study noted that the most likely changes to Hawai'i include accelerated sea level rise, ocean and atmospheric warming, increased flooding, ocean acidification, changing distributions of terrestrial and marine biota, and changing intensity and frequency of storms.

Specific projected changes with relevance to this hazard mitigation plan include the following:

- Sea surface temperatures will continue warming, increasing between 2.3 ºF and 4.9 ºF in the Pacific by 2100.
- Mean sea-level rise estimates of 3.2 -feet by the end of the century, or as early as 2060.
- Portions of low-lying coastal areas may become submerged, including Hanalei in Kaua'i County.
- The island of Kaua'i is expected to become slightly drier closer to 2100. This can lead to increased public health concerns.

Climate change impacts are not limited to just physical impacts, however; they can also create social, cultural, and economic impacts. The residents of Kaua'i County need to implement climate change mitigation actions not just to prevent increased risk of hazards but also to prevent any negative impacts on the tourism economy or a coastal culture (University of Hawai'i, 2014).

Threats to food and water security, infrastructure, health, and safety could lead to increased human migration away from the islands or towards higher land, decreasing tourism and making it more difficult for unique regional customs, beliefs and languages to endure. Additionally, native plants and animals, particularly those in high-elevation ecosystems or experiencing increased exposure to invasive species, face higher stresses and a greater risk of extinction (Leong et al., 2014).

Responses to Climate Change

Mitigation and Adaptation

Communities and governments worldwide are working to address, evaluate and prepare for climate changes that are likely to impact communities in coming decades. Generally, climate change discussions encompass two separate but inter-related considerations: mitigation and adaptation. The term "mitigation" can be confusing, because its meaning changes across disciplines:

- Mitigation in emergency management—as generally addressed in this hazard mitigation plan—is typically defined as the effort to reduce loss of life and property by lessening the impact of disasters.
- Mitigation in climate change discussions is defined as a human intervention to reduce impacts on the climate system. It includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks.

In this appendix section, mitigation is used as defined by the climate change community. Elsewhere in this plan, mitigation is primarily used in an emergency management context.

Adaptation refers to adjustments in natural or human systems in response to the actual or anticipated effects of climate change and associated impacts. These adjustments may moderate harm or exploit beneficial opportunities. Mitigation and adaptation are related, as the world's ability to reduce greenhouse gas emissions will affect the degree of adaptation that will be necessary. Some initiatives and actions can both reduce greenhouse gas emissions and support adaptation to likely future conditions.

Societies across the world are facing the need to adapt to changing conditions associated with natural disasters and climate change. Farmers are altering crops and agricultural methods to deal with changing rainfall and rising temperature; architects and engineers are redesigning buildings; planners are looking at managing water supplies to deal with droughts or flooding.

Most ecosystems show a remarkable ability to adapt to change and to buffer surrounding areas from the impacts of change. Forests can bind soils and hold large volumes of water during times of plenty, releasing it through the year; floodplains can absorb vast volumes of water during peak flows; coastal ecosystems can hold out against storms, attenuating waves and reducing erosion. Other ecosystem services—such as food provision, timber, materials, medicines and recreation—can provide a buffer to societies in the face of changing conditions.

Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change. This includes the sustainable management, conservation and restoration of specific ecosystems that provide key services. This plan is one way in which the County of Kauaʻi intends to identify and achieve more mitigation projects.

Future Modeling Efforts

Current modeling efforts are unable to assess climate change at a resolution small enough to determine specific impacts for individual communities. However, generalized assessments of larger climatic regions can be used to determine impacts that are most likely to affect these communities. As these models are developed in the future, the risk assessment presented in this plan may be enhanced to better measure these impacts. The Pacific Islands Regional Climate Assessment (PIRCA), released in 2012, does contain some regional models and estimates. Since these data are not focused on the specific impacts to the County of Kauaʻi, it has been included as a reference and was not utilized in overall vulnerability assessment ratings (Keener et al., 2012).

Hawaiʻi State Response

In 2014, the Hawaiʻi State Legislature passed Act 83, which formally established The Hawaiʻi Climate Adaptation Initiative to enable a coordinated approach among all agencies at all levels of government to plan for and address the effects of climate change to protect the state's economy, health, environment, and way of life. Act 83 established a coordinating body to carry out this mission, known as the Hawaiʻi Climate Change Mitigation and Adaptation Commission, which is composed of state and county government representatives. The committee's first tasks were to develop a report addressing the statewide impacts of sea level rise and to develop recommendations for action.

In 2017, the *Hawaiʻi Sea Level Rise Vulnerability and Adaptation Report* prepared by the Hawaiʻi Climate Change Mitigation and Adaptation Commission provided a statewide assessment of Hawaiʻi's vulnerability to sea level rise. The assessment was based on an aggregate of hazard data defining the "chronic sea level rise exposure area" (SLR-XA). The SLR-XA includes passive flooding, coastal erosion, and annual high wave runup with sea level rise. The report outlines recommendations to reduce exposure and sensitivity to sea level rise and increase capacity to adapt. The report's recommendations are based on emerging good practices and framed through extensive stakeholder consultations.

National Response

The Sea Level Rise Viewer is a web-based map developed by the NOAA Office for Coastal Management that offers access to data and information about the risks of sea level rise, storm surge, and flooding along the coastal United States. The map lets community planners, city officials, and coastal residents identify flood-prone locations in their area. It offers hard-to-find data and information regarding the flood risks due to various possible scenarios of sea level rise. Community planners can assess what infrastructure is vulnerable under these conditions, and the tool enables businesses and homeowners along the coasts to make decisions regarding their livelihoods and see how rising sea levels may affect them in the future. Features of the interactive tool include the following:

- Displays potential future sea levels
- Provides simulations of sea level rise at local landmarks
- Communicates the spatial uncertainty of mapped sea levels
- Models potential marsh migration due to sea level rise
- Overlays social and economic data onto potential sea level rise
- Examines how tidal flooding will become more frequent with sea level rise.

INLAND FLOOD

Hazard Description

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states). A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood.

Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability for river systems. The discharge probability is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for different discharge levels and storm surge levels. These measurements reflect statistical averages only; it is possible for multiple floods with a low probability of occurrence (such as a 1-percent-annual-chance flood) to occur in a short time period. For riverine flooding, the same flood event can have flows at different points on a river that correspond to different probabilities of occurrence.

The extent of flooding associated with a 1-percent annual probability of occurrence (also called the base flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

FEMA Regulatory Flood Zones

According to FEMA, flood hazard areas are defined as areas that are shown on a map to be inundated by a flood of a given magnitude. These areas are determined using statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on FEMA’s FIRM, which are official maps of a community on which the Federal Insurance and Mitigation Administration has delineated both the Special Flood Hazard Areas (SFHA) and the risk premium zones applicable to the community. These maps identify the SFHAs; the location of a specific property in relation to the SFHA; the base flood elevation (1-percent annual chance) at a specific site; the magnitude of flood a flood hazard in a specific area; the undeveloped coastal barriers where flood insurance is not available and locates regulatory floodways and floodplain boundaries (1-percent and 0.2-percent annual chance floodplain boundaries).

The land area covered by the floodwaters of the base flood is the SFHA on a FIRM. It is the area where the NFIP floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities since many communities have maps showing the extent of the base flood and likely depths that will be experienced.

The 1-percent annual chance flood is referred to as the base flood. As defined by NFIP, the base flood elevation on a FIRM is the elevation of a base flood event, or a flood which has a 1-percent chance of occurring in any given year. The base flood elevation describes the exact elevation of the water that will result from a given discharge level, which is one of the most important factors used in estimating the potential damage to occur in a given area. A structure located within a 1-percent annual chance floodplain has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. The 1-percent annual chance flood is a regulatory standard used by federal agencies and most states, to administer floodplain management programs. The 1-percent annual chance flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict 0.2-percent annual chance flood designations.

Digitized Flood Insurance Rate Maps (DFIRM), FIRMs, and other flood hazard information can be used to identify the expected spatial extent of flooding from a 1-percent and 0.2-percent annual chance event. DFIRMS and FIRMS depict SFHAs - those areas subject to inundation from the 1-percent annual chance. Those areas are defined as follows:

- **Zones A1-30 and AE:** SFHAs that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base Flood Elevations are shown within these zones.
- **Zone A (Also known as Unnumbered A-zones)**: SFHAs where no Base Flood Elevations or depths are shown because detailed hydraulic analyses have not been performed.
- **Zone AO:** SFHAs subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
- **Zone VE, V1-30:** SFHAs along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base Flood Elevations derived from detailed hydraulic analysis are shown within these zones.
- **Zone B and X (shaded):** Zones where the land elevation as been determined to be above the Base Flood Elevation, but below the 500-year flood elevation. These zones are not SFHAs.
- **Zones C and X (unshaded):** Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500-year flood elevation. These zones are not SFHAs.

Floodplain Ecosystems

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a water source and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick growing compared to non-riparian trees.

Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. As a result, FIRMs delineate regulatory floodways where development is restricted or prohibited. Development projects within floodways are highly regulated and proceed on a case by case basis.

Hazard Profile

Federal Flood Program Participation

National Flood Insurance Program (NFIP)

Kaua‘i County participates in the NFIP and has adopted and enforced floodplain management regulations that meet or exceed the requirements of the NFIP. At the time of the preparation of this plan, the County is in good standing with NFIP requirements (FEMA Community Status Book Report, accessed 07/21/2020). Full compliance and good standing under the NFIP are application prerequisites for all FEMA grant programs for which participating jurisdictions are eligible under this plan.

In participating communities, structures permitted or built in the planning area before NFIP and related building code regulations went into effect are called "pre-FIRM" structures, and structures built afterwards are called "post-FIRM." The insurance rate is different for the two types of structures. Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent. The Kaua‘i County Code requires new construction to be elevated to or above the base flood elevation.

The first FIRMs in the planning area were available in November 1981.The most recent FIRMs in the County are dated November 26, 2010. These effective FIRMs form the basis of the risk assessment for inland flooding. Table L-4 lists flood insurance statistics for Kaua‘i County.

Table L-4. Flood Insurance Statistics

Date of Entry Initial FIRM Effective Date	11/04/1981
# of Flood Insurance Policies as of 07/21/2020	4,792
Insurance In Force	$1,019,373,800
Total Annual Premium	$4,387,457
Claims, as of February 29, 2020	1,312
Value of Claims Paid, as of February 29, 2020	$38,416,601
Average Payment per Claim, as of February 29, 2020	$29,281

Levees

For the NFIP, FEMA only recognizes levee systems that meet minimum design, operation, and maintenance standards. CFR 44 (Section 65.10) describes the information needed for FEMA to determine if a levee system provides protection from the 1 percent annual chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate FIRM flood zone.

FEMA coordinates its programs with the U.S. Army Corps of Engineers, who may inspect, maintain, and repair levee systems. The Corps has authority under Public Law 84-99 to supplement local efforts to repair flood control projects that are damaged by floods. Like FEMA, the Corps provides a program to allow public sponsors or operators to address levee system maintenance deficiencies. Failure to do so within the required timeframe results in the levee system being placed in an inactive status in the Corps' Rehabilitation and Inspection Program. Levee systems in an inactive status are ineligible for rehabilitation assistance under Public Law 84-99.

FEMA coordinated with the Corps, the local communities, and other organizations to compile a list of levees that exist within Kauaʻi County. Table L-5 lists all levees shown on the FEMA FIRM. Corps of Engineers Levee ID numbers listed are from the Corps' National Levee Database; they may not match numbers based on other identification systems listed in previous FIS reports.

Table L-5. Levees in Kauaʻi County

Flood Source	Levee Location	Levee Owner	Corps of Engineers Levee ID	FIRM Panels	Levee Status
Hanapēpē Stream	Left Bank	County of Kauaʻi Public Works Department	3205052301	1500020287F 1500020289F	Decertified
Hanapēpē Stream	Right Bank	County of Kauaʻi Public Works Department	3205052302	1500020287F	Decertified
Waimea River	Right Bank	County of Kauaʻi Public Works Department	3205052401	1500020257E 1500020259F 1500020258F 1500020256F	Decertified

The Community Rating System

As of the May 2019 FEMA report, Kauaʻi County was not participating in the CRS program.

Typical Flood-Causing Events

Prolonged rainfall may result in an accumulation of water creating flooding conditions that last several days, or even weeks. Microbursts or "rain bombs" caused by a sudden concentrated downburst of wind and rain can result in flash flooding. Factors influencing flooding conditions include rainfall intensity and duration, topography, soil type, antecedent soil moisture, and ground cover. In Hawaiʻi, major floods typically occur during the rainy winter, accounting for approximately 84 percent of the floods in the islands. Four types of storms produce heavy precipitation, and therefore floods:

- **Kona Storms**—These storms occur during the wettest period of the year, from November to April. Trade winds from the northeast slack during this time, allowing storms from the south to more easily approach the islands. Kona winds are generally warmer and carry moisture that is dropped evenly as rain over the entire islands. The low-elevation and southern, drier sides of the islands get most of their rainfall (approximately 25 to 30 inches each season) during Kona storms. Because of the potential combination of high winds and heavy rains, these events can cause coastal and inland flooding over larger geographic areas.

- **Frontal Storms**—Frontal storms usually occur from December through March. They originate over the Pacific Ocean as a result of the intersection of polar and tropical air masses and move eastward over the islands. Heavy continuous rainfall over a period of several hours can create disaster conditions in high sloping areas of the islands. Low-lying areas with poor drainage are prone to landslides and flash floods during these storms.
- **Upper Level Lows**—Upper level lows and troughs can occur any time of the year. In many instances, upper level lows have little or no effect on the lower levels of the atmosphere. However, these lows are sometimes able to tap into the marine layer and induce heavy showers that sometimes produce flash flooding.
- **Tropical Cyclones**—The various categories of tropical cyclones—tropical depressions, tropical storms, and hurricanes—hitting or passing near the Hawaiian Islands cause heavy rains, storm surge, high winds and surf. Impacts from these events include severe coastal and inland flooding. Tropical cyclones also cause severe damage due to high surf.

General Flooding Types

Riverine Floods

Small rivers and streams, such as those found in Kaua‘i County, are susceptible to flooding from large-scale and more localized weather systems that cause intense rainfall over small areas. Riverine floods occur along a channel and include overbank and flash flooding. Channels are defined ground features that carry water through and out of a watershed. They may be rivers, creeks, streams, or ditches. Channel overflow occurs when the carrying capacity of the channel is exceeded, which can be exacerbated by development changes within the drainage basin or clogging by debris or overgrown streambed vegetation. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas.

Flash Floods

Intense rainfall may trigger “flash-floods” which provide little warning (less than six hours) before the affected area experiences flood conditions. Flash floods are “a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within 6 hours of the causative event (e.g., intense rainfall, dam failure). However, the actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters” (NOAA, 2012).

Flash floods are capable of tearing out trees, undermining buildings and bridges, and scouring new channels. In urban areas, flash flooding is an increasingly serious problem due to the removal of vegetation and replacement of ground cover with impermeable surfaces such as roads, driveways, and parking lots. The greatest risk from flash floods is that they occur with little to no warning. The major factors in predicting potential damage are the intensity and duration of rainfall and watershed and stream steepness.

Overland Sheet Flow

Poorly drained low-lying areas are a problem when flooding occurs even when rainfall is not heavy. Overland sheet flow occurs primarily in areas with undefined drainage ways.

Dam Failure Floods

Dam failures can occur anywhere there is a dam.

Principal Flooding Sources

Principal flooding sources on the island of Kauaʻi, as identified on FEMA flood maps, include the following streams; for descriptions of each of these areas, please refer to Volume I of the Kauaʻi County Flood Insurance Study (FEMA, 2010):

- Waipā Stream
- Waiʻoli Stream
- Hanalei River
- Kapaʻa Stream
- Moʻikeha Canal
- Waikaʻea Canal
- Kekaha Drainageway
- Waimea River
- Wailua River
- ʻŌpaekaʻa Stream
- ʻŌpaekaʻa Tributary
- Kalama Stream
- Nāwiliwili Stream
- Puali Stream
- Hulāʻia Stream
- Papakōlea Stream
- Hanapēpē River
- Hanamāʻulu Stream
- Anahola Stream
- Waikomo Stream
- ʻŌmaʻo Stream
- Lāwaʻi Stream
- Wainiha River
- Limahuli Stream
- Lumahaʻi River
- Manoa Stream
- Wainiha River
- Keālia Stream
- Keailia Stream
- Hanalei River
- Stream No. 1
- Waihohonu Stream
- Lower Reach of ʻŌpaekaʻa Stream
- Kalihi Wai River
- Kīlauea Stream
- Moloaʻa Stream
- Pāpaʻa Stream
- Waimea River
- Makaweli River

The sections below summarize historical flooding issues in specific local areas across the island.

Hanalei Watershed

Hanalei is a small rural community located on the higher ground along the coastline of Hanalei Bay. The major portion of the Hanalei area is in agricultural use; taro fields and pasturelands predominate. Residential and commercial properties are also located in the floodplain, but most are on slightly higher ground. The upper half of the detailed-study section of Hanalei River lies in the Hanalei National Wildlife Refuge.

The plateaus and lowlands extending from Hanalei in the north and clockwise to the Mana-Barking Sands area on the southwest are the island's most fertile lands. The central area, on Kōkeʻe Plateau, consists of steep gulches and valleys, bordered on the west by the cliffs of Na Pali and on the east by Alakaʻi Swamp. The inaccessible sheer cliffs ad mountainous terrain of Na Pali, as well as parts of Kōkeʻe, are reserved for conversation and a State Park.

The Hanalei River has a history of flooding Kūhiō Highway and adjacent croplands.

Anahola Watershed

Anahola Stream flows easterly from the mountains, bisecting the Town of Anahola before emptying into the Pacific Ocean. The upper slopes of the mountains in the Anahola Watershed are predominantly overgrown with thick vegetation.

Anahola Stream drains an area of approximately 10.3 square miles that is approximately 1.5 miles wide and 7 miles long. The Anahola area is not heavily urbanized. A large portion of the residential area is owned by the Hawaiian Homes Commission. The southeastern bank of the river supports most of the residential homesites, as well as agricultural activities.

The largest flood in the Anahola area occurred on January 25, 1956, when more than 13 inches of rain fell within a 24-hour period. The flood exceeded 100-year and approached the 200-year flood discharge record. On December 14, 1991, over 20 inches of rain fell during a 12-hour period, resulting in flash floods which recorded five deaths, severe flooding, erosions, slides, and numerous property damages.

Kapaʻa Watershed

Kapaʻa Stream is the primary flooding source of Keālia, a small rural community located near the coastline north of Kapaʻa. Upstream of Keālia along Kapaʻa Stream are large tracts of sugarcane fields. Moʻikeha Canal drains an area of approximately 2.0 square miles and flows through the northern section of Kapaʻa. Approximately 45 percent of the drainage area is forested, 50 percent is in sugarcane and grazing fields, and 5 percent is occupied by residential and commercial facilities. Moʻikeha and Waikaʻea Canals were built to alleviate the flood problems of Kapaʻa. However, neither canal has the capacity to contain a 100-year flood, and each is potentially a primary source of flooding for the Kapaʻa area.

Wailua Watershed

The pear-shaped Wailua River basin extends approximately 11 miles from the ocean on the east to the summit of Mount Waiʻaleʻale in the central part of the island. Its topography is generally hilly and rugged in the upper sections, with a valley plain in the central portion, which terminates in small, flat area at the coast.

The Wailua River is the primary source of flooding in the coastal area of Wailua. The land is in agricultural use in the vicinity of the Wailua River and ʻŌpaekaʻa Stream confluence. Commercial and hotel establishments, along with some residences occupy the coastal area on relatively low lands; the average ground elevation is approximately 6 feet in the residential and business area and approximately 4 feet in the agricultural district. Farmland and pastures predominate in the vicinity of ʻŌpaekaʻa Stream; there is a residential subdivision downstream of ʻŌpaekaʻa Road.

The largest recorded flood in the watershed, located in the left branch of ʻŌpaekaʻa Stream, occurred on January 31, 1975. The largest recorded flood on the Wailua River inundated half of the Wailua residential area on April 15, 1963. At least 20 major floods have been recorded on the river since 1912. In 1955, the Coco Palms Hotel dining room was inundated to a depth of approximately 5 feet. The latest flood, which occurred on January 31, 1975, rose to a stage that nearly inundated the road leading into the Wailua Homestead area. Flood problems on the Wailua River are aggravated by accumulation of debris at the highway bridge piers.

Līhuʻe Watershed

The Līhuʻe Watershed supports agricultural and commercial activities. Commercial and business centers, a major inter-island airport, a deep-draft commercial harbor, and the island's major hospital are the notable developments. Located in the watershed is Līhuʻe, the county seat and commercial center of Kauaʻi. The watershed extends from the coast to the lower ridges of Mount Waiʻaleʻale. A significant portion of the developable land is used for agriculture. Several reservoirs built in the watershed serve the agricultural irrigation system.

The Nāwiliwili Stream is the primary source of flooding for the Līhuʻe and Nāwiliwili areas. The upper reach flows through the commercial and industrial are of Līhuʻe. The residential and commercial areas of Nāwiliwili are located near the stream mouth. Puali Stream flows though the residential area of Niumalu, a small community on the outskirts of Nāwiliwili.

The worst flood on Nāwiliwili Stream occurred in April 1963, when the stream overflowed and inundated the low-lying coastal area and damaged sugarcane fields. The lowlands of the Puali and Nāwiliwili Streams are particularly vulnerable to inundation. Sand buildup at the mouth of Nāwiliwili Stream causes backwater in the lower portions. To add to the problem, debris accumulation at the bridge openings has aggravated floods in the upstream areas, especially upstream of the Rice Street bridge. In the past, the lawns, parking lots, and roads near Puali Stream have been inundated by sheet runoff and stream overflow. Low spots in residential areas have been covered with standing water to depths of 1 to 2 feet.

Kōloa Watershed

The Kōloa-Poʻipū community is located on the southern coast of Kauaʻi, approximately 8 miles southwest of Līhuʻe. The flood plain contains mostly residential, commercial, and resort development.

The upper reach of Waikomo Stream flows through Kōloa and is that town's primary flooding source. The central and lower reaches flow mostly through agricultural lands. The ʻŌmaʻo Stream watershed, an area of approximately 4.1 square miles, contains six irrigation reservoirs. The Lāwaʻi Stream floodplain is predominantly covered by vegetation with a few houses, several small cultivated areas, and a warehouse complex.

Properties in Kōloa in the vicinity of Waikomo Stream and Waikomo Road are particularly flood prone. Debris and vegetation growth in the stream channel aggravate the flood problem in this area. Although Waikomo Stream has caused flooding in Kōloa, the major flood problem area is the coastal region of Kōloa-Poʻipū, where shallow flooding caused by low-lying topography and inadequate drainage facilities frequently occurs. On January 31, 1975, Waikomo Stream flooded the Town of Kōloa. About 30 people had to be evacuated from their homes.

Hanapēpē Watershed

The Hanapēpē River is located in the south-central portion of the island. Its steep slopes induce rapid runoff during heavy rainfall, causing an abrupt rise in streamflow and a low rate of infiltration. The flood plain is roughly triangular and is confined by steep bluffs. Except for several small stores, there are no commercial or industrial establishments within the flood plain. It is the primary flooding source of the Hanapēpē area.

The largest recorded flood in the Hanapēpē area occurred on April 15, 1963. During the storm, the Hanapēpē River gaging station recorded its highest discharge (39,000 cfs) in 47 years of record. The flood destroyed several homes and severely damaged many more in the Hanapēpē Valley area.

West Kauaʻi Watershed

The West Kauaʻi Watershed extends from the coast to the Waimea Canyon ridgeline. Lying on the leeward side of the island and outside the rain-causing influence of Mount Waiʻaleʻale, the watershed is fairly dry most of the year.

The community of Kekaha lies along the coast in the Kekaha Drainageway and is made up primarily of residences and the Kekaha Sugar Mill and its plantation facilities. Kekaha is located on a broad, flat shelf that forms the greater part of the southwestern coastline of the Island of Kauaʻi. The area is devoid of deep, well-defined streams.

The largest recorded storm in the Kekaha area occurred on December 1973. Intense rain fell (7 inches of rain within 2 hours) throughout Kekaha, inundating the Hawaiian Homes area and damaging Cox's Ditch. County and State roads about 50 homes sustained damage. Also flooded were sugarcane fields, which sustained damage from rock and debris deposition and topsoil erosion. According to several local residents, the flood was aggravated by non-natural sand plugs in the drainageways near Kekaha.

Wainiha Watershed

The sparsely populated Wainiha Watershed is a rural environment. Small clusters of residential and commercial (primarily tourist-oriented) areas are located along the coast. Most of the watershed lies in steep, mountainous terrain. Having a northern exposure, the watershed receives a large amount of rainfall from the prevailing trade winds.

Few houses are located within the Wainiha Valley. Most of the valley area is either under cultivation or covered by natural vegetation.

Three severe floods have occurred on the Wainiha River. On February 17, 1956, more than 20 inches of rain fell in the valley during a 24-hour period. During a 4-day period of November-December 1968, approximately 15.47 inches of rain recorded at the Wainiha Powerhouse rain gage and 29 inches estimated at the Wainiha Power Canal Intake rain gage. Taro patches near the stream were either washed away or covered with mud and debris. The flood plain in the downstream reach (up to the 20-foot contour area) was inundated to depths of 2 to 3 feet. The two wooden bridges at Kūhiō Highway that span the in stream and the side branch on the in stream were damaged. Further up the valley, hillside runoff caused road washouts and landslides. The generator units and part of the building of the Wainiha Powerhouse were damaged by a landslide and sustained damages. On April 19, 1974, approximately 11.5 inches of rain fell at the Wainiha Power Canal Intake rain gage and approximately 9.2 inches at the Wainiha Powerhouse rain gage during a 24-hour period. One child drowned, and another child survived after being swept 600 feet downstream. Several homes and cars were destroyed. Eleven residents were evacuated by helicopter from the flooded valley area. The floodwater inundated 100 acres of land up to 7 feet deep and heavily damaged the taro crop.

Waimea Watershed

The Waimea Watershed drains the northwestern summit slopes of Mount Wai'ale'ale. The uplands contain a large swamp area that drops steeply into several valleys. A forest reserve that encompasses the Waimea Canyon State Park occupies most of the watershed area.

Near the mouth of the Waimea River is the town of Waimea, where the houses near the river are protected by a flood-control levee. Cultivated fields and natural vegetation occupy the flood plain not protected by the levee.

On several occasions, Waimea River flooded the Waimea Town area. Severe floods dating back to 1916, 1921, 1927, and 1942 were recorded. On February 7, 1949, the most destructive flood occurred; two lives were lost, and five houses were destroyed.

Past Events

Table L-6 summarizes flood events in the County of Kaua'i since 2005, as recorded in the National Climatic Data Center's Storm Events Database and the Spatial Hazard Events and Losses Database for the United States. The sections below describe some of the more severe occurrences of flooding in the County.

December 1991

Flash floods resulting from a storm on December 14, 1991 that dropped over 20 inches of rain in 12 hours over Anahola, caused five deaths, intense flooding, bank failures, erosion, and slides, totaling more than $5 million in property damages.

October/November 2006

Heavy rainfall in October 31 to November 2, 2006 across much of Hawai'i during the period was the result of two systems. The first being left over moisture from an old front that pooled along the windward sides of the islands. The light easterly wind flow helped push the moisture over windward sections of the islands, resulting in some showers on October 30. By October 31, the destabilized further as an upper level trough of low pressure moved toward Hawai'i. The more unstable conditions resulted in locally heavy rainfall that persisted into the afternoon hours of November 1. Rainfall amounts during the period were quite large, especially along windward sections of Kaua'i and O'ahu, with some locations receiving well over 15 inches of rainfall. Some locations received over 3 inches in just a matter of 1 or 2 hours. The excessive rains produced flooding over portions of windward Kaua'i.

Table L-6. History of Flood Events

Date	Event	Date	Event	Date	Event
03/28/2020	Flash Flood	12/23/2014	Flash Flood [a]	07/23/2009	Flash Flood [a]
03/16/2020	Flash Flood	02/21/2014	Flash Flood	03/09/2009	Flash Flood [a]
02/06/2020	Flash Flood [a]	02/16/2014	Flash Flood	12/31/2008	Flash Flood [a]
12/25/2019	Flash Flood	12/15/2013	Flash Flood	12/13/2008	Flash Flood
11/16/2019	Flash Flood [c]	12/01/2013	Flash Flood	10/28/2008	Flash Flood [a]
10/11/2019	Flash Flood [a]	11/09/2013	Flash Flood	02/04/2008	Flash Flood
09/16/2019	Flash Flood [a]	03/27/2013	Flash Flood	02/03/2008	Flash Flood
08/04/2019	Flash Flood	03/26/2013	Flash Flood	12/05/2007	Flash Flood
12/29/2018	Flash Flood [a]	02/21/2013	Flood [b]	11/28/2007	Flash Flood
11/10/2018	Flash Flood [a]	01/27/2013	Flash Flood	02/23/2007	Flash Flood [a]
08/28/2018	Flash Flood [b]	03/09/2012	Flash Flood	11/01/2006	Flash Flood [a]
08/27/2018	Flash Flood	03/05/2012	Flash Flood	08/07/2006	Flash Flood [a]
04/14/2018	Flash Flood	03/04/2012	Flash Flood	04/02/2006	Flash Flood [a]
03/15/2018	Flash Flood	03/03/2012	Flash Flood	03/27/2006	Flash Flood [a]
03/14/2018	Flash Flood	02/26/2012	Flash Flood [a]	03/26/2006	Flash Flood [a]
02/22/2018	Flash Flood	01/17/2012	Flash Flood [a]	03/17/2006	Flash Flood [a]
02/04/2018	Flash Flood [a]	11/05/2011	Flash Flood [a]	03/16/2006	Flash Flood [a]
11/30/2017	Flash Flood [a]	05/12/2011	Flash Flood	03/15/2006	Flash Flood [a]
11/01/2017	Flash Flood	05/08/2011	Flash Flood	03/13/2006	Flash Flood [b]
10/31/2017	Flash Flood [a]	01/16/2011	Flash Flood	03/10/2006	Flash Flood [a]
08/21/2017	Flash Flood [a]	12/27/2010	Flash Flood	03/09/2006	Flash Flood [a]
03/01/2017	Flash Flood	12/09/2010	Flash Flood	02/21/2006	Flash Flood
12/03/2016	Flash Flood [b]	12/03/2010	Flash Flood	10/01/2005	Flash Flood [a]
12/02/2016	Flash Flood	04/07/2010	Flash Flood [a]	09/14/2005	Flash Flood [a]
03/25/2016	Flash Flood	11/26/2009	Flash Flood [a]	02/02/2005	Flash Flood
09/04/2015	Flash Flood [a]	11/14/2009	Flash Flood	01/31/2005	Flash Flood
07/22/2015	Flash Flood [a]	11/13/2009	Flash Flood	01/01/2005	Flash Flood

a. No property damage recorded for this event.
b. Fatalities resulted from this event.
c. Injuries were reported.
Source: NCEI, 2020

April 2018

A developing upper low northwest of the state, in combination with tropical moisture, induced periods of heavy showers and thunderstorms, and generated historic flash flooding conditions over Kaua'i. An apparent 24-hour rainfall total of 49.69 inches, ending at 1245 HST April 15th, was recorded at an automated rain gauge in Waipā, Kaua'i, about a mile west of Hanalei. If this total is certified, it will be a new 24-hour rainfall record for the United States, beating the old record of about 43 inches in Alvin, TX, on July 25-26, 1979.

The deluge, mainly over northern Kaua'i but also affecting East O'ahu, damaged or destroyed farms and various structures, including 532 homes; downed trees and power lines; flooded homes, businesses and vehicles; and closed and damaged numerous roadways with water and debris flows, with highway and road repairs estimated at $35 million. There were apparently no significant injuries, but material losses will be extremely exorbitant, with public property damages alone estimated at $19.7 million. Hawai'i's state legislature approved $125 million in relief aid for flood-ravaged communities on Kauaʻi and Oʻahu. A Major Disaster Declaration (DR-4365) was declared on May 8, 2018 with over $11 million in Public Assistance Grants and almost $1.6 million for Individual Assistance.

March 2020

Heavy rainfall led to severe flooding. Almost uninterrupted heavy rain for more than 36 hours on the north shore cut off Hanalei and the rest of the west end of the island. Kūhiō Highway was closed near the Hanalei Bridge as the Hanalei River overflowed along the roadway. Kūhiō Highway was also closed in Wailua as debris piled up against the Wailua River Bridge, creating a makeshift dam. The National Weather Service issued two severe thunderstorm warnings, a flash flood warning, and a tornado warning (no tornado occurred). A major disaster declaration (DR-4549) was issued to assist with recovery.

Location

Annual rainfall on the island of Kauaʻi ranges from more than 400 inches on Mt. Waiʻaleʻale, to between 20 and 80 inches along the coast. Flooding is common on the wet, windward side of the island where annual rainfall is high. Most of the flooding that has caused damage has been flash flooding during extreme rainfall events that bring about sheet flow between stream channels.

Area Within the Mapped Floodplain

Flooding that has occurred in portions of the County has been documented by gage records, high water marks, damage surveys, and personal accounts. This documentation was the basis for the floodplains mapped by FEMA on FIRMs for Kauaʻi County (see Figure L-10). All of the principal flooding sources are incorporated in the currently effective FIRMs. The FIRMs are the most detailed and consistent data source available for determining flood extent. The 2010 Flood Insurance Study is the sole source of data used in this risk assessment to map the extent and location of the flood hazard.

Only 3 percent of the entire County (355,024 acres) is located within the mapped 1 percent annual chance floodplain. Table L-7 shows the area of mapped floodplain in each of the County's six districts.

Table L-7. Area in the 1-Percent-Annual-Chance (100-Year) Floodplain

	Area in the 1 Percent Annual Chance (100-Year) Floodplain	
	Area (acres)	% of Total Floodplain Area
North Shore	2,063	19.2%
East Kauaʻi	1,538	14.3%
Līhuʻe	1,095	10.2%
Kōloa-Poʻipū-Kalāheo	1,170	10.9%
Hanapēpē- ʻEleʻele	506	4.7%
Waimea	4,375	40.7%
Total	**10,746**	**100.0%**

Repetitive Loss Properties and Areas in the Planning Area

FEMA has identified 45 repetitive loss properties in the planning area as of November 4, 2020. Eighty-four percent of these structures are residential, and the rest are commercial. None of these properties have been identified as being mitigated. The probable causes of flooding for all properties in identified repetitive loss areas has been determined to be commensurate with the risk reflected in the SFHA mapping.

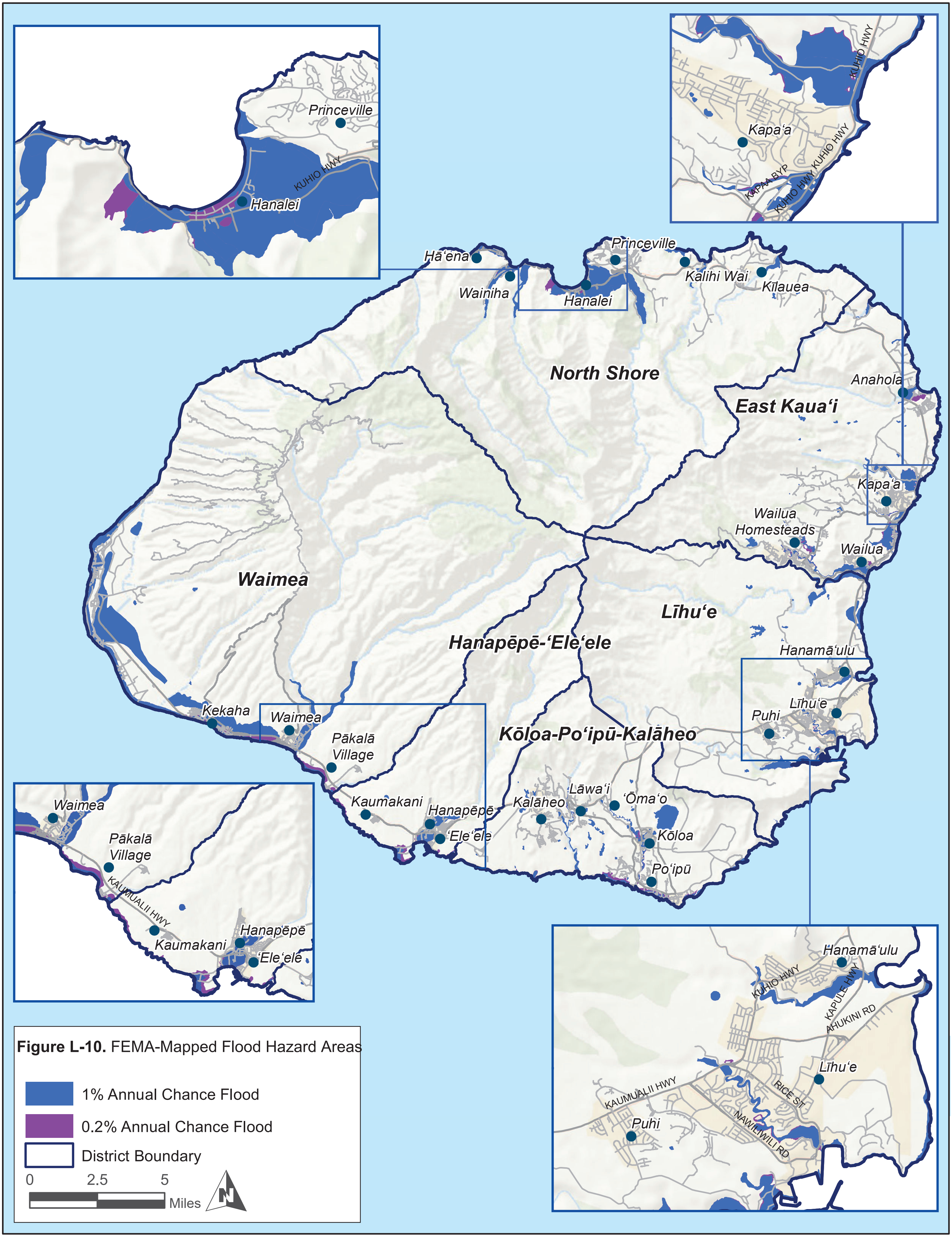


Figure L-10. FEMA-Mapped Flood Hazard Areas

All identified repetitive loss properties were geocoded for analysis, which provided the following conclusions:

- Fourteen of the 45 repetitive loss properties have average loss claims of less than $10,000 dollars. Such losses are generally associated with localized flood events resulting from urban drainage issues or other smaller scale occurrences such as a water main break.
- Two of the properties incurred flood damage twice prior to the 1990s but have not filed a claim since.
- The remainder of the properties appear to have losses that correlate to the flood depths reflected in the FEMA mapping, so the losses are likely associated with the flood risk reflected in the mapping.

Repetitive loss area in the County are shown in Figure L-11.

Frequency

There have been 10 federal disaster declarations for non-tsunami flooding in the Hawaiian Islands since 1963. This equates to a major, non-tsunami, non-tropical-cyclone-related flood event every six years on average. More localized flood events can be expected to happen annually. Data compiled over the last 50 years indicate that, on average, a damaging flood event occurs on Kaua'i with an annual probability of 0.5 percent.

The planning area can expect an average of one episode of minor river flooding each winter. Large, damaging floods typically occur every 10 years. The frequency of flooding in smaller streams and basins can be expected to increase somewhat as a result of increased development, increasing the amount of impervious surface.

Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges. Peak flows used by FEMA to map the floodplains of the planning area are listed in Table L-8.

Warning Time

Due to the sequential pattern of weather conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger.

The duration of a flood event means the time between the start and end of the flood or the event that caused it. This can be difficult to define for floods, particularly inland floods, as they recede slowly and do not vanish completely; flood water moves from one area to another. Flash flooding occurs within six hours of a rain event, while other types of flooding are longer-term events and may last a week or more.

Flood warnings and watches are issued by the local NWS office. The NWS updates watches and warnings and notifies the public when they are no longer in effect. Flood watches and warnings in Hawai'i are as follows:

- Coastal Flooding:
    - **Coastal Flood Advisory**—Issued when minor or nuisance coastal flooding is occurring or imminent.
    - **Coastal Flood Watch**—Issued when moderate to major coastal flooding is possible. Such flooding could pose a serious risk to life and property.
    - **Coastal Flood Warning**—Issued when moderate to major coastal flooding is occurring or imminent. This flooding will pose a serious risk to life and property.

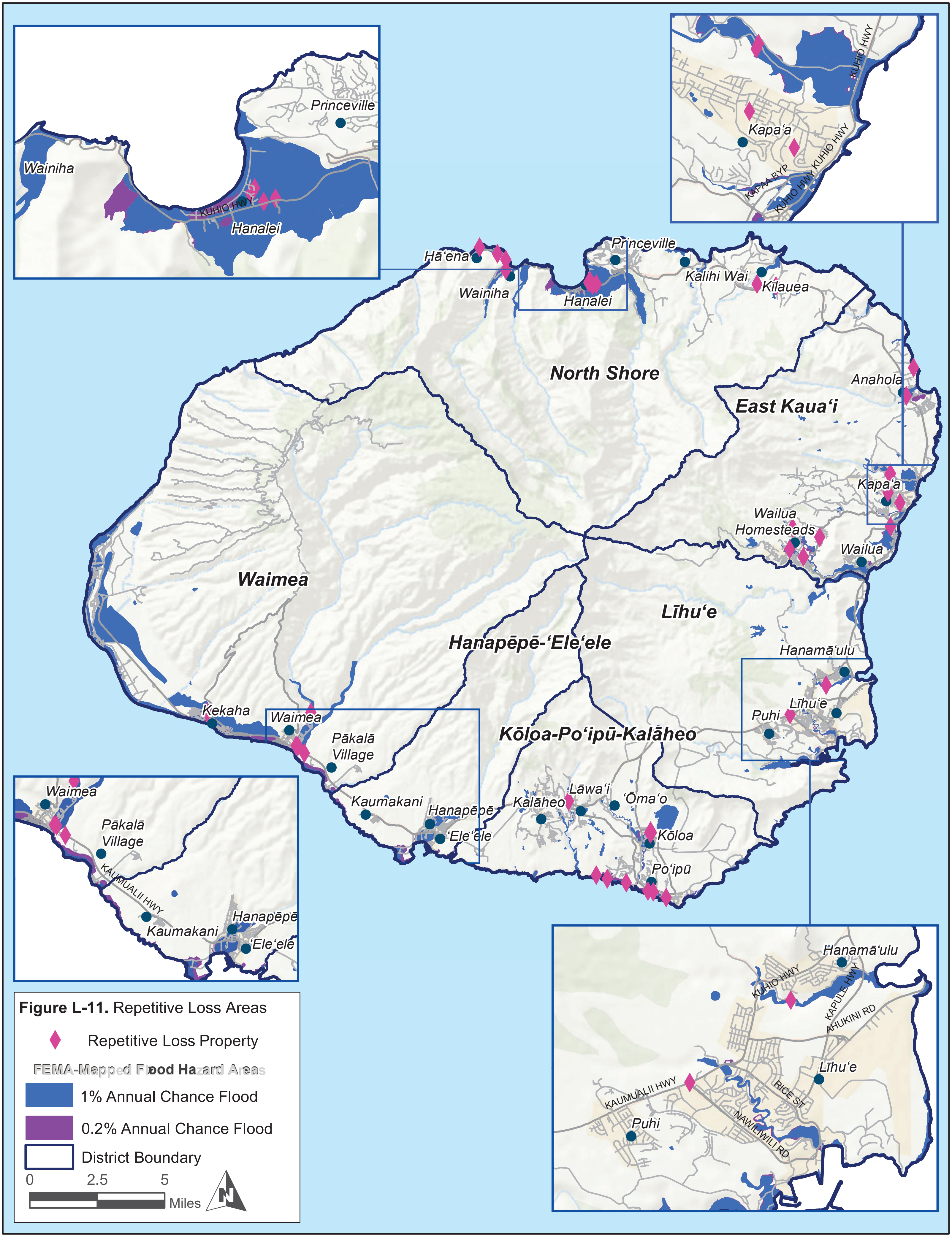


Figure L-11. Repetitive Loss Areas

Table L-8. Summary of Peak Discharges Island of Kauaʻi

Source/Location	Discharge (cubic feet/second)			
	10-Year	50-Year	100-Year	500-Year
ANAHOLA STREAM - At mouth	15,000	24,000	29,000	42,000
HANALEI RIVER - At mouth	37,000	51,000	58,000	73,000
HANAMĀʻULU STREAM - At mouth	N/A	N/A	27,300	N/A
HANAMĀʻULU STREAM TRIBUTARY - At mouth	N/A	N/A	11,193	N/A
HANAPĒPĒ RIVER - At mouth	21,000	32,000	38,000	52,000
HANAPĒPĒ RIVER - At Gage No. 16049000	17,000	26,000	31,000	42,000
HULĀʻIA STREAM - At mouth	21,270	34,020	40,160	56,190
HULĀʻIA STREAM - At a point approximately 13,800 feet inland	16,800	26,860	31,700	44,330
KALAMA STREAM - At confluence with ʻŌpaekaʻa Stream	3,800	6,600	8,200	12,200
KAPAʻA STREAM - At mouth	21,000	32,000	37,000	51,000
KEKAHA DRAINAGEWAY Waipao-Waika Basin	N/A	N/A	8,605	N/A
KEKAHA DRAINAGEWAY Kapilimao-Waimea Basin	N/A	N/A	10,650	N/A
KEKAHA DRAINAGEWAY Drainageway between basins	N/A	N/A	5,550	N/A
LĀWAʻI STREAM - At Lauoho Road	3,090	5,470	6,650	10,170
LĀWAʻI STREAM - At upstream Access Road crossing	2,870	2,070	6,170	9,440
MOʻIKEHA CANAL - At mouth	900	1,300	1,500	1,900
NĀWILIWILI STREAM - At mouth	2,400	6,350	10,400	19,000
NĀWILIWILI STREAM - At Līhuʻe Mill Access Road	2,250	5,800	9,450	17,400
ʻŌMAʻO STREAM - At confluence with Waikomo Stream	2,700	3,900	4,400	5,700
ʻŌPAEKAʻA TRIBUTARY At confluence with Wailua River	9,000	15,200	18,500	27,500
ʻŌPAEKAʻA TRIBUTARY - Downstream of confluence of Kalama Stream	7,300	12,200	15,500	22,200
ʻŌPAEKAʻA TRIBUTARY - Upstream of confluence of Kalama Stream	4,300	7,600	9,400	14,000
ʻŌPAEKAʻA TRIBUTARY - Downstream of confluence of ʻŌpaekaʻa Tributary	1,810	3,440	4,390	7,230
ʻŌPAEKAʻA TRIBUTARY - Upstream of confluence of ʻŌpaekaʻa Tributary	1,560	2,960	3,775	6,200
ʻŌPAEKAʻA TRIBUTARY - At Access Road crossing	1,395	2,650	3,375	5,550
ʻŌPAEKAʻA TRIBUTARY - At confluence of ʻŌpaekaʻa Stream	370	710	900	1,480
ʻŌPAEKAʻA TRIBUTARY - At Poʻo Road	350	660	840	1,380
PAPAKŌLEA STREAM - At confluence with Hulāʻia Stream	3,760	6,000	7,060	9,830
PUALI STREAM - At mouth	3,000	5,400	6,600	9,700
WAIKAʻEA CANAL - At mouth	3,300	4,700	5,400	6,900
WAIKOMO STREAM - At mouth	5,600	7,900	9,000	11,600
WAIKOMO STREAM - Downstream of confluence of ʻŌmaʻo Stream	4,200	6,000	6,900	8,900
WAIKOMO STREAM - Upstream of confluence of ʻŌmaʻo Stream	N/A	N/A	2,500	N/A
WAIKOMO STREAM TRIBUTARY - At confluence with Waikomo Stream	N/A	N/A	670	N/A
WAILUA RIVER - At mouth	40,000	64,000	76,000	105,000
WAIMEA RIVER - At mouth	35,500	54,500	64,000	89,000
WAIMEA RIVER - Upstream of confluence with Makaweli River	28,900	45,300	53,300	74,600
WAINIHA RIVER - At mouth	29,700	46,600	55,590	76,560
WAINIHA RIVER - At a point approximately 8,800 feet inland	27,550	43,220	51,540	70,980
WAIPĀ STREAM - At mouth	5,000	8,800	10,500	16,000
WAIʻOLI STREAM - At mouth	7,400	12,500	16,000	23,000

Source: FEMA, 2010

- Inland Flooding:
  - **Flood Advisory**—Issued when nuisance flooding is occurring or imminent. A flood advisory may be upgraded to a flash flood warning if flooding worsens and poses a threat to life and property.
  - **Flash Flood Watch**—Issued when heavy rain leading to flash flooding is possible. People in the area of a flash flood watch should be prepared for heavy rains and potential flooding. Flash flood watches may be issued up to 12 hours before flash flooding is expected.
  - **Flash Flood Warning**—Issued when flooding is occurring or will develop quickly. The population needs to take shelter and/or move to high ground as necessary.

The USGS also provides real time information on stream flows in Kauaʻi County through its Water Watcher program. This program provides real-time stream flow information as well as flood and high flow information for fourteen gages throughout Kauaʻi County. An example image from this online tool is shown in Figure L-12.

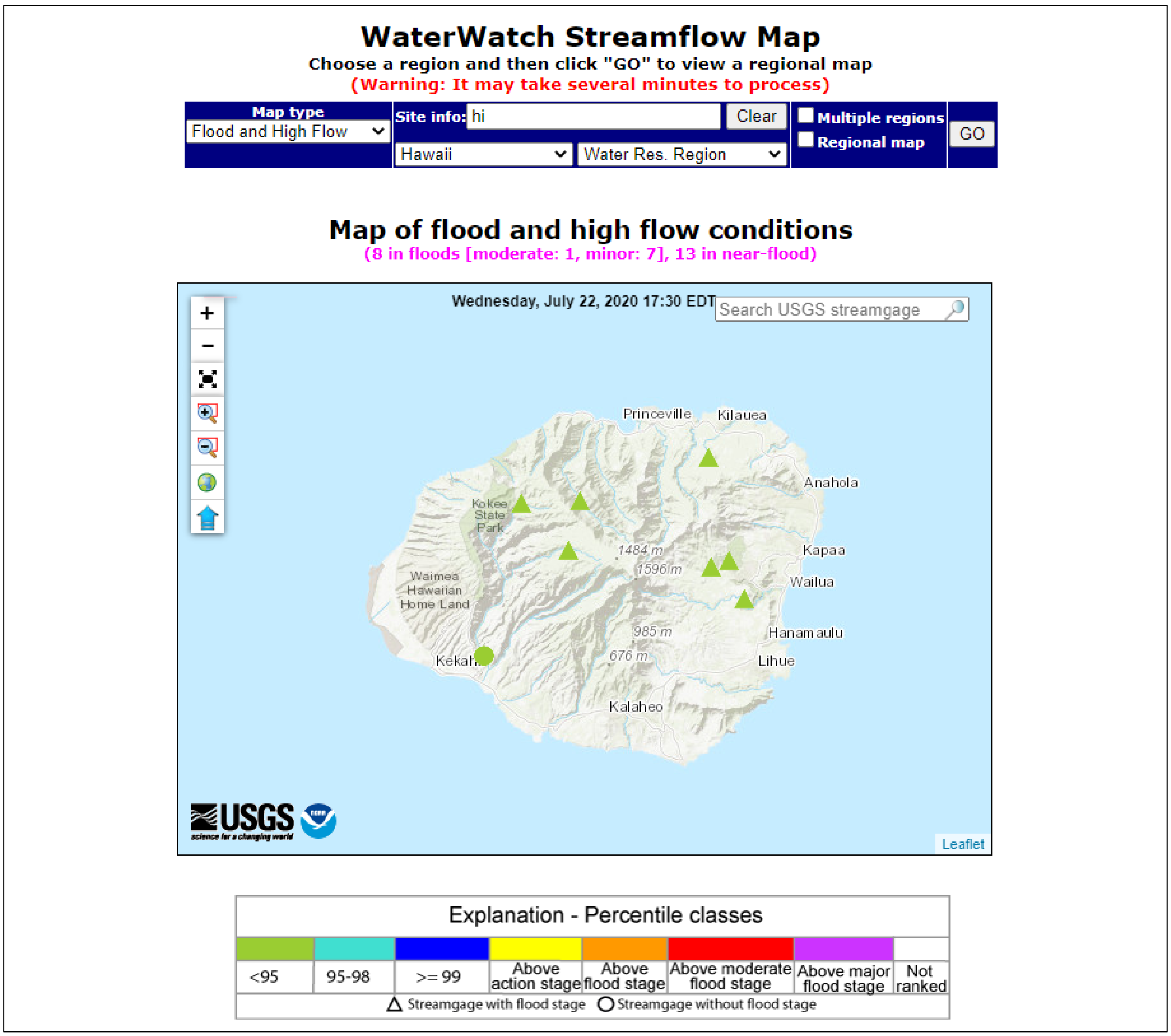


Figure L-12. USGS WaterWatch Stream Flow Map

Secondary Hazards

The most problematic secondary hazard for riverine flooding is bank erosion, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers, or storm sewers.

HIGH SURF, COASTAL FLOOD AND EROSION

Hazard Description

Waves

The greatest number of deaths, injuries and rescues in the Hawaiian Islands are from high waves breaking at the shoreline. High surf, resulting from dangerous and damaging waves, is typically described as waves ranging in height from 10 feet to 20 feet or more. These waves result from storms passing across the higher latitudes of the Northern and Southern Hemispheres in addition to storms passing across the Central Pacific in proximity to the Islands. These high wave events threaten lives and coastal property and infrastructure.

When deep-water ocean swells encounter the shallow island margins, they rise to great heights because their tops stack up on their slower moving bottoms due to friction along the shallower seafloor. Because the contact between deep water and the shallow margins around the Hawaiian Islands is abrupt, surface waves can grow very tall, very rapidly. Large waves tend to travel in sets, and after breaking they rush up onto the beach temporarily elevating the sea surface near the shoreline. Rip currents form as the water that is pushed up on the shore by successive large waves tries to flow back to the sea.

The hazards associated with high surf include debris overwash, flooding, erosion, high wave energy and turbulence in the near shore zone, and strong currents. Waves that reach the shoreline are determined by the energy inherent in the approaching swell (a function of wave height and wave length—the distance between successive wave crests), shoreline aspect, slope, morphology, and geology, and offshore characteristics including seafloor depth, morphology, and barriers (islands, rocks, reefs, sandbars). Large wind-generated waves can also cause storm surge.

High waves from tropical cyclones present a more complex hazard, as they may coincide with high tide or storm surge to produce a combined threat. High waves from tropical cyclones generally occur during hurricane season between June and December. High waves from tropical cyclones most often hit the eastern shores of the Hawaiian Islands as storms approach the islands from the east and the south and west-facing shorelines as the storm passes to the south and west. When combined with storm surge, wave action may have damaging effects over the entire coastline facing a major storm center. In Hawai‘i the wave run-up typically floods areas not reached by the surge itself. The high velocities of hurricane winds often produce wave heights higher than the maximum level of the prevailing high tide or of the surge itself.

FEMA Regulatory Coastal Flood Zones

Coastal SFHAs are of particular concern within the planning area along coastline areas that are at or slightly above sea level. In 2013, FEMA announced additional information regarding the flood hazard area associated with coastal zones. The NFIP depicts two coastal flood hazard zones on its DFIRMS:

- Zone VE, where the flood elevation includes wave heights equal to or greater than 3 feet.

- Zone AE, where flood elevation includes wave heights less than 3 feet.

Although the coastal flood zones were not developed exclusively to address the impacts of high surf, they do provide an approximate delineation of areas that may be at risk. The coastal zones in Hawai'i also include tsunami inundation risk in some areas, so these zones are likely to greatly overestimate the risk from high surf impacts alone.

Post-storm field visits and laboratory tests throughout coastal areas of the United States have consistently confirmed that wave heights as low as 1.5 feet can cause significant damage to structures that are constructed without considering coastal hazards. FIRMs recently published also include a line showing the Limit of Moderate Wave Action (LiMWA), which is the inland limit of the area expected to receive 1.5-foot or greater breaking waves during the 1-percent annual-chance flood event beyond the coastal VE zones and into the AE zone (Figure L-13).

Source: FEMA, 2014a

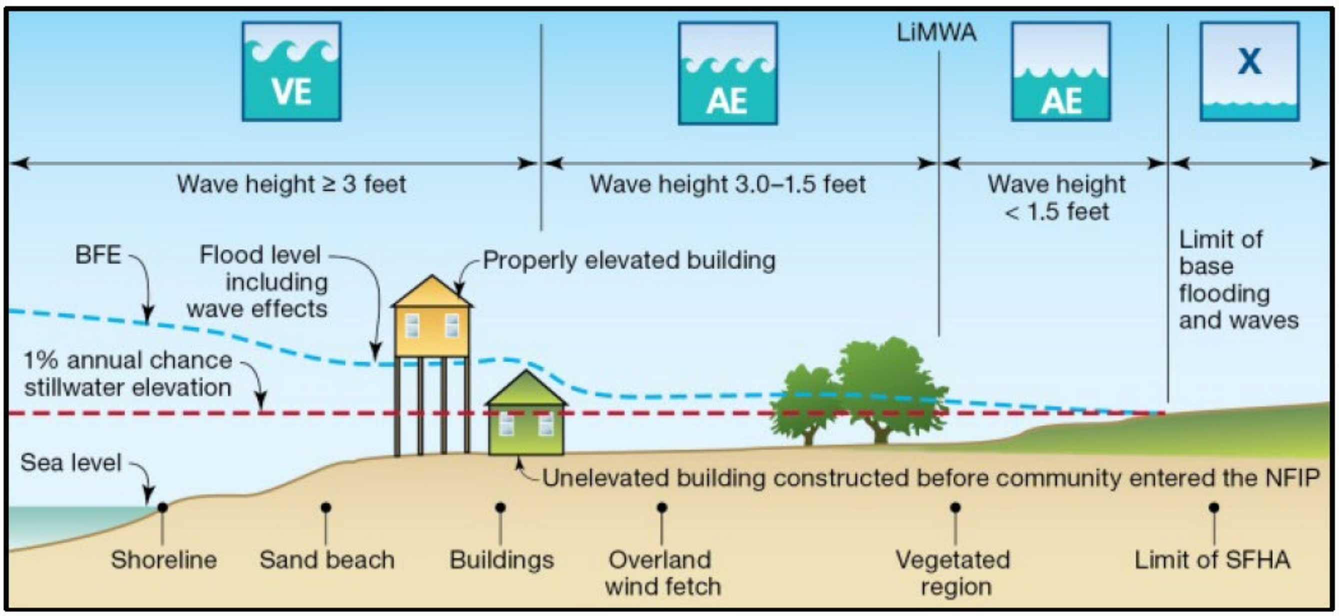


Figure L-13. Limit of Moderate Wave Action

The addition of the LiMWA area to FIRMs allows communities and individuals to better understand the flood risks to their property. The LiMWA area alerts property owners on the coastal side of the line that although their property is in Zone AE, their property may be affected by 1.5-foot or higher breaking waves and may therefore be at significant risk during a 1-percent-annual-chance flood event. While not formally defined in the NFIP regulations or mapped as a flood zone, the area between Zone VE and the LiMWA is called the Coastal A Zone. This area is subject to flood hazards associated with floating debris and high-velocity flow that can erode and scour building foundations and, in extreme cases, cause foundation failure (FEMA, 2014a).

The current effective FIRM for the County of Kaua'i does not delineate LiMWA areas. Future map updates will include such information and should be used to develop additional coastal flooding mitigation items.

Coastal Erosion

Coastal erosion occurs when strong wave action, coastal floods, and local sea level rise wear away rocks, soil, and sand along a coastline. In the United States, coastal erosion causes roughly $500 million in coastal property loss each year. In Hawai'i, 70 percent of beaches are eroding and 13 miles of beaches have been lost, with 3.7 miles lost on Kaua'i. Beaches serve as a buffer between wave action and the land and are the lifeline of Hawai'i's economy. Shoreline resources and the ocean-based economy in Hawai'i are worth over $9 billion annually (U.S. Army Corps of Engineers, 2018). Coastal erosion affects all shorelines, but erosion rates and potential impacts are highly localized (U.S. Climate Resilience Toolkit, 2020). Coastal erosion has the potential to augment high surf or tsunami/run-up incidents along coast flood zones subject to wave action. Coastal erosion includes:

- Beach erosion, when sand is carried away from a beach and deposited farther from shore.
- Dune erosion, when sand or sediment not normally affected by wave action is carried away from land and deposited farther from shore.

The following human activities in the past or present may increase coastal erosion:

- Shoreline hardening such as building seawalls, which may protect land directly behind the structure but can accelerate coastal erosion on the makai (waterward) side of the structure due to scouring.
- Dune leveling for development, which removes the natural protection from high waves and sea level rise.
- Canalization to control flash flooding, which may trap sand in the coastal channel mouths. Accumulated sand may be removed offsite, leaving a deficiency in the immediate beach area.
- Coral reef degradation from pollution, turbidity and warmer ocean temperatures, which removes a natural barrier protecting shorelines from high surf events.
- Sand mining

Hazard Profile

Coastal floods are characterized by inundation of normally dry lands by ocean waters. This flooding is often caused by storm surge that occurs during severe storms, tsunamis, or extreme high tide events (sometimes called king tides) that result in shallow flooding of low-lying coastal areas. Coastal floods typically result in coastal erosion, salinization of freshwater sources, and contamination of water supplies. These floods are also responsible for significant agricultural losses, loss of life and damage to public and private structures and infrastructure.

Coastal flooding is becoming increasingly exacerbated by sea level rise as a result of climate change or relative sea level rise caused by a local increase in the level of the ocean relative to land as a result of tectonic activity (NOAA, n.d.).

Past Events

Several high surf events since 2016 have been catastrophic and resulted in deaths. February 2016 saw wave sets as high as 55 feet causing beach erosion and damage to roadways. One man was swept out to sea as a large wave broke where he was taking a picture at Queen's Bath. Later the same year, in November, surf of 25 to 40 feet pounded the north- and west-facing shores and one man drowned east of Kīlauea. In January 2017, swells of 15 to 30 feet resulted in the drowning of a young woman in the high surf.

Table L-9 summarizes high surf events in the planning area since 2018. No injuries or fatalities were reported with any of these events.

Table L-9. Past High Surf Events Impacting Planning Area

Start Date	End Date	Location	Start Date	End Date	Location
01/10/2018	01/17/2018	Leeward and Windward	02/12/2019	02/22/2019	Leeward and Windward
01/18/2018	01/23/2018	Windward	02/27/2019	02/28/2019	Leeward and Windward
02/02/2018	02/05/2018	Leeward and Windward	03/09/2019	03/10/2019	Leeward and Windward
02/12/2018	02/13/2018	Leeward and Windward	03/10/2019	03/11/2019	Leeward and Windward
02/19/2018	02/23/2018	Windward	03/17/2019	03/20/2019	Leeward and Windward
02/23/2018	02/28/2018	Windward	03/22/2019	03/23/2019	Leeward and Windward
03/01/2018	03/03/2018	Windward	03/30/2019	03/31/2019	Leeward and Windward
03/06/2018	03/10/2018	Windward	04/11/2019	04/15/2019	Windward
03/12/2018	03/13/2018	Leeward and Windward	05/11/2019	05/13/2019	Leeward and Windward
03/21/2018	03/22/2018	Windward	05/26/2019	05/28/2019	Leeward and Windward
03/25/2018	03/27/2018	Windward	06/14/2019	06/15/2019	Leeward and Windward
04/09/2018	04/10/2018	Leeward and Windward	06/30/2019	06/30/2019	Leeward and Windward
04/13/2018	04/14/2018	Leeward and Windward	07/01/2019	07/04/2019	Leeward and Windward
04/14/2018	04/17/2018	Windward	07/06/2019	07/09/2019	Leeward and Windward
04/28/2018	04/30/2018	Leeward and Windward	07/13/2019	07/16/2019	Leeward and Windward
05/08/2018	05/09/2018	Leeward and Windward	08/04/2019	08/06/2019	Leeward and Windward
06/04/2018	06/06/2018	Leeward and Windward	08/20/2019	08/21/2019	Leeward and Windward
06/08/2018	06/10/2018	Leeward and Windward	09/26/2019	09/28/2019	Leeward and Windward
07/05/2018	07/08/2018	Leeward and Windward	10/27/2019	10/31/2019	Leeward and Windward
07/18/2018	07/19/2018	Windward	11/04/2019	11/05/2019	Leeward and Windward
08/01/2018	08/03/2018	Windward	11/09/2019	11/10/2019	Leeward and Windward
08/07/2018	08/09/2018	Leeward and Windward	11/14/2019	11/17/2019	Leeward and Windward
08/21/2018	08/27/2018	Leeward and Windward	11/20/2019	11/25/2019	Leeward and Windward
09/06/2018	09/08/2018	Windward	11/27/2019	11/27/2019	Leeward and Windward
09/11/2018	09/12/2018	Windward	12/01/2019	12/02/2019	Leeward and Windward
10/04/2018	10/05/2018	Leeward and Windward	12/07/2019	12/08/2019	Leeward and Windward
10/10/2018	10/12/2018	Leeward and Windward	12/10/2019	12/13/2019	Leeward and Windward
10/16/2018	10/17/2018	Leeward and Windward	12/20/2019	12/26/2019	Windward
10/20/2018	10/27/2018	Leeward and Windward	12/29/2019	12/31/2019	Leeward and Windward
10/28/2018	10/29/2018	Leeward and Windward	01/01/2020	01/02/2020	Leeward and Windward
10/30/2018	10/31/2018	Leeward and Windward	01/06/2020	01/16/2020	Windward
11/09/2018	11/11/2018	Leeward and Windward	01/17/2020	01/20/2020	Leeward and Windward
11/15/2018	11/17/2018	Leeward and Windward	01/20/2020	01/24/2020	Leeward and Windward
11/25/2018	11/28/2018	Leeward and Windward	01/25/2020	01/31/2020	Leeward and Windward
12/05/2018	12/08/2018	Leeward and Windward	02/06/2020	02/09/2020	Leeward and Windward
12/09/2018	12/10/2018	Leeward and Windward	02/10/2020	02/12/2020	Leeward and Windward
12/10/2018	12/14/2018	Windward	02/13/2020	02/14/2020	Windward
12/16/2018	12/19/2018	Leeward and Windward	02/19/2020	02/21/2020	Windward
12/27/2018	12/29/2018	Leeward and Windward	02/25/2020	02/26/2020	Leeward and Windward
01/01/2019	01/05/2019	Leeward and Windward	02/28/2020	02/29/2020	Leeward and Windward
01/09/2019	01/10/2019	Windward	03/01/2020	03/04/2020	Windward
01/11/2019	01/16/2019	Leeward and Windward	03/07/2020	03/08/2020	Windward
01/23/2019	01/25/2019	Leeward and Windward	03/12/2020	03/14/2020	Leeward and Windward
01/27/2019	01/31/2019	Windward	03/20/2020	03/22/2020	Leeward and Windward
02/01/2019	02/02/2019	Windward	03/24/2020	03/25/2020	Leeward and Windward
02/06/2019	02/08/2019	Windward	04/15/2020	04/16/2020	Leeward and Windward
02/07/2019	02/12/2019	Leeward and Windward	04/18/2020	04/20/2020	Leeward and Windward
			04/22/2020	04/24/2020	Leeward and Windward

Source: NCEI, 2020

Location

Damaging wind-generated waves occur from distant storms in the northern and southern hemisphere, tropical cyclones, and localized Kona storms (see Figure L-14):

- North-facing shores receive annual North Pacific swells in winter ranging from 10 to 20 feet. Usually damage-causing events from north swells are over 20 feet. Waves from the north Pacific swells tend to be the highest on an annual basis and generally occur several days at a time, most frequently between October and March (Fletcher et al., 2002).
- Larger northeast trade waves are typically 2 to 4 feet; however, well-developed trade swells produce high waves of 6 to 8 feet that have caused damage. Trade wind swell-induced high waves, typically between 3 and 4 feet high, affect the eastern facing shores of the island.
- South-facing shores are exposed to Kona storms and southern swells, which have caused damage at heights of 4 to 6 feet. Kona storms generate high waves that affect the south-facing coast of the island.

Source: State of Hawai'i, 2018

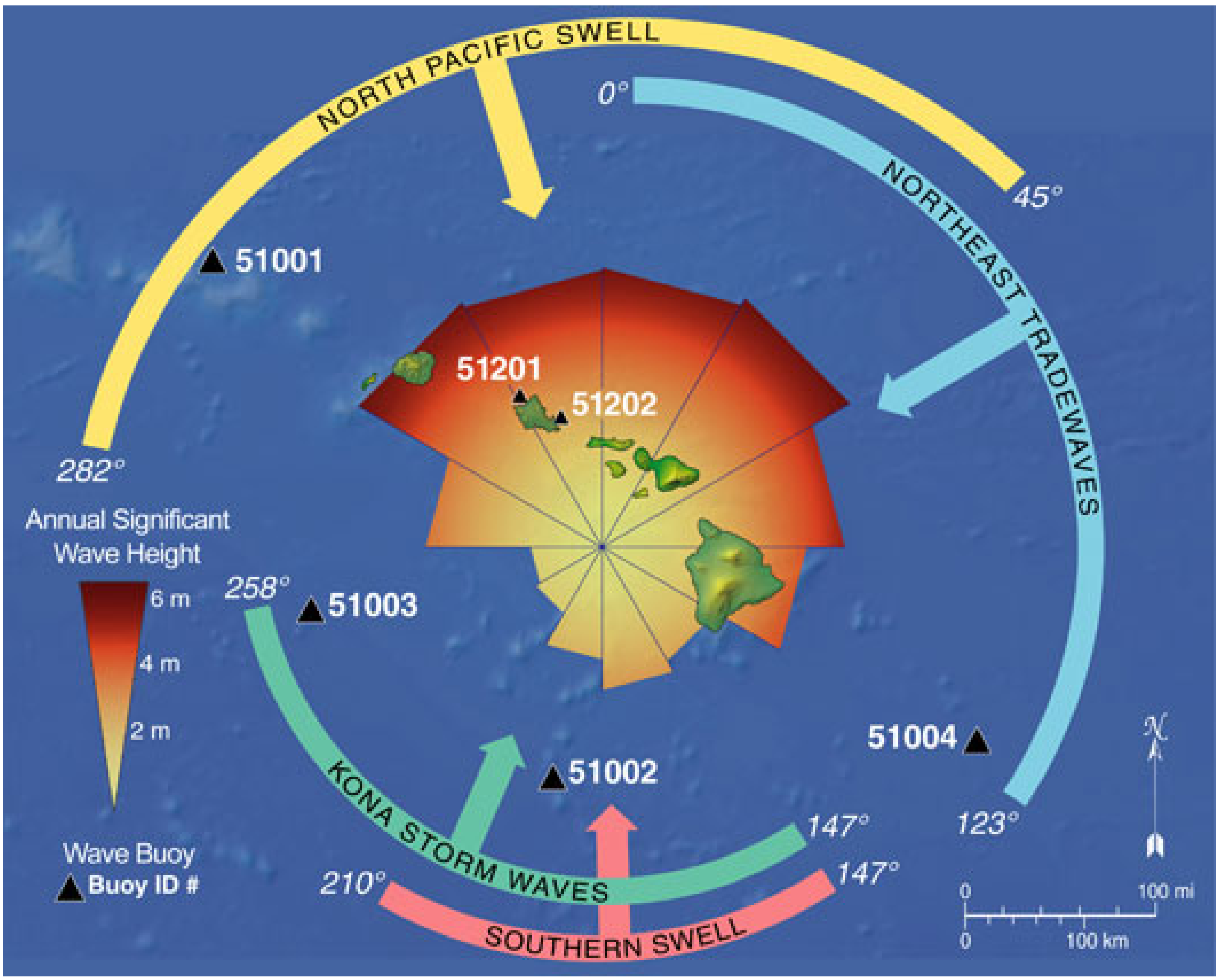


Figure L-14. Dominant Swell Regimes in the State of Hawai'i

Even though deep ocean swells typically produce the highest waves affecting the Island, much of the high waves and surf on the island are attributable to passing tropical cyclones. Tropical cyclones can affect all shorelines, especially during summer and fall, with damaging high waves of 10 to 30 feet. Flooding from storm surge is a potential threat in heavily developed coastal areas near Hanalei, Kapaʻa, Līhuʻe and Poʻipū.

Coastal erosion affects all shorelines, but potential impacts and erosion rates vary greatly by location. Figure L-15 shows project coastal erosion locations around the island at the 1.1-foot sea level rise scenario.

Source: State of Hawaiʻi Sea Level Rise Viewer

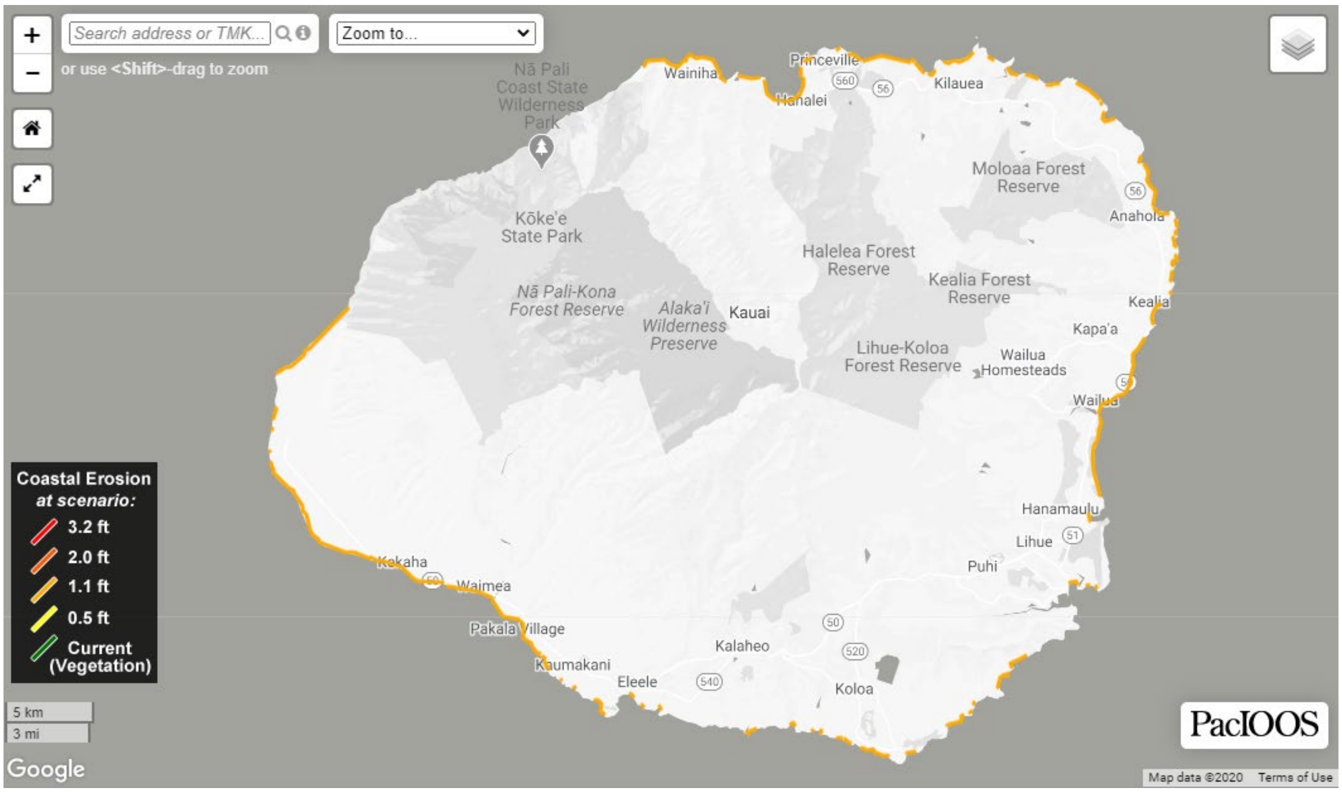


Figure L-15. Coastal Erosion Locations at 1.1-Foot Sea Level Rise Scenario

According to the *National Assessment of Shoreline Change 2012*, Kauaʻi lost 8 percent of its beaches to erosion over the analysis period of 1926 to 2008. The East Shore had the greatest percent of sandy beaches experiencing long-term coastal erosion at 78 percent, followed by the North Shore at 76 percent. The South and West Shores also had significant amounts of beach erosion—63 and 64 percent, respectively.

Frequency

High surf events occur quite frequently on all coasts of the County of Kauaʻi. Table L-9 lists 95 events since 2018.

Severity

The highest hazard occurs in most cases for north-facing shorelines where north Pacific swells arrive in the winter with regularity in heights exceeding 12 feet. Sets of these large waves are characterized by rapid onset so that within a few seconds they can double in size, often catching unaware swimmers, fishermen, and hikers walking along the shoreline. The water level on the coast increases with these large waves and rip currents are generated as this excess water surges seaward.

The wave zone of impact coincides to some extent with FEMA's V and VE FIRM zones. These zones are subject to flooding and high velocity wave action (although some action identified is from tsunami events). The inland extent of the wave impact zone is expected to be much greater than the erosion zone. For residences displaced by the threat of high surf, shelters may be opened in or nearby the affected areas.

Table L-10 summarizes the still-water elevations along the island of Kauaʻi coastline, representing the steady state water depth not accounting for breaking waves. These are the projected elevations of floodwaters in the absence of waves resulting from wind or seismic effects. In coastal areas, still-water elevations are determined when modeling coastal storm surge; the results of overland wave modeling are used in conjunction with the still-water elevations to develop the coastal base flood elevations.

Table L-10. Summary of Still-Water Elevations

Flooding Source/Location	Still-Water Elevation (feet Local Mean Sea Level)			
	10-Year	50-Year	100-Year	500-Year
Station 253 Anahola Bay	0.66	0.88	1.19	2.33
Station 226 Nāwiliwili Bay	0.66	0.83	1.10	2.18
Station 198 Kukuiʻula Bay	0.66	0.84	1.10	2.25
Station 172 Waimea Bay	0.66	0.82	1.07	2.31

Source: FEMA Flood Insurance Study Number 150002V001C, Kaua'i County, November 26, 2010

Flood severity from coastal flooding is determined by wave run-up and setup. Table L-11 shows the water levels used for mapping coastal floodplains in the planning area. Base flood elevations that include wave height range from 18 to 55 feet for a 1-percent-annual-chance event in the planning area.

Table L-11. Coastal Flooding Water Elevations

	Coastal Flood Water Elevations (feet, North American Vertical Datum)	
	Nāwiliwili Bay (Transect 15)	Hanapēpē Bay (Transect 33)
10-percent	0.7	0.7
2-percent	0.8	0.8
1-percent	1.1	5.0[a]
0.2 percent	2.2	2.4

Source: Source: FEMA Flood Insurance Study Number 150002V001C, Kaua'i County, November 26, 2010
a. Includes wave setup

The County of Kauaʻi may experience temporary economic impacts associated with disrupted transportation infrastructure along coastal areas. Long-term economic impacts are not expected as a result of this hazard.

Warning Time

The timing of individual waves cannot be predicted, however general forecasting can be made about surf conditions. Wave forecasting involves the prediction and evolution of wind-generated waves using numerical models. These mathematical simulations, often known as ocean surface wave models, consider atmospheric and oceanic conditions, wave interaction, and frictional dissipation. The models output typically consists of statistics regarding wave heights and periods that can be used by officials and managers in the shipping industry, emergency response personnel, news media, and the public.

The National Weather Service issues high surf warnings and advisories when general forecasting indicates high surf conditions. The definitions of the warning and advisory are as follows (NWS, 2020a):

- **High Surf Warning**—A high surf warning is issued when breaking wave action results in an especially heightened threat to life and property within the surf zone. High surf warnings may be issued up to 24 hours ahead of the arrival of the swell and may remain in effect for several days.
- **High Surf Advisory**—A high surf advisory is issued when breaking wave action poses a threat to life and property within the surf zone. High surf advisories may be issued up to 24 hours ahead of the arrival of the swell and may remain in effect for several days.

Secondary Hazards

Hazards associated with high waves include debris overwash, flooding, high wave energy and turbulence in the nearshore zone, and strong currents. Loss of beaches due to erosion can have negative impacts on ecosystems, native species, cultural and historical sites, recreation, subsistence practices, and tourism.

TSUNAMI

Hazard Description

A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs. The waves arrive at shorelines over an extended period. According to the National Tsunami Hazard Mitigation Program's *National Tsunami Hazard Assessment*, Hawaiʻi as a whole is classified as a "high hazard" area for tsunamis. The state has experienced the highest number of tsunami-associated deaths in the country (Dunbar and Weaver, 2008).

Tsunami Characteristics

Tsunamis are typically classified as local or distant. Locally generated tsunamis have minimal warning times, leaving little time for response. They may be accompanied by damage resulting from the triggering earthquake through ground shaking, surface faulting, liquefaction or landslides. Distant tsunamis may travel for hours before striking a coastline, giving a community a chance to implement more detailed evacuation plans.

In the open ocean, a tsunami may be only a few inches or feet high, but it can travel with speeds approaching 500 miles per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. The first wave usually is not the largest. Several larger and more destructive waves often follow the first one. As tsunamis reach the shoreline, they may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (up to 60 miles per hour).

The tsunami's size and speed, as well as the coastal area's form and depth, affect the impact of a tsunami; wave heights of 50 feet are not uncommon. Offshore canyons can focus tsunami wave energy and islands can filter the energy. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on a coast and much larger at other points. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. It has been estimated, for example, that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide.

Damage from Tsunami

The first visible indication of a tsunami may be a rise in water level. The advancing tsunami can resemble a strong surge increasing the sea level like the rising tide, but the tsunami surge rises faster and often does not break as a normal wave. Additionally, this surge of water does not stop at the shoreline and pushes above normal sea level tidal reach. This phenomenon is called "run-up" (Figure L-16). Even if the run-up appears to be small—3 to 6 feet for example—the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, and other debris. Boats and debris are often carried inland by the surge and left stranded when the water recedes. Floating debris carried by a tsunami can endanger human lives and batter inland structures. Breakwaters and piers can collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because of the sheer impact of the waves.

Source: UNESCO, n.d.

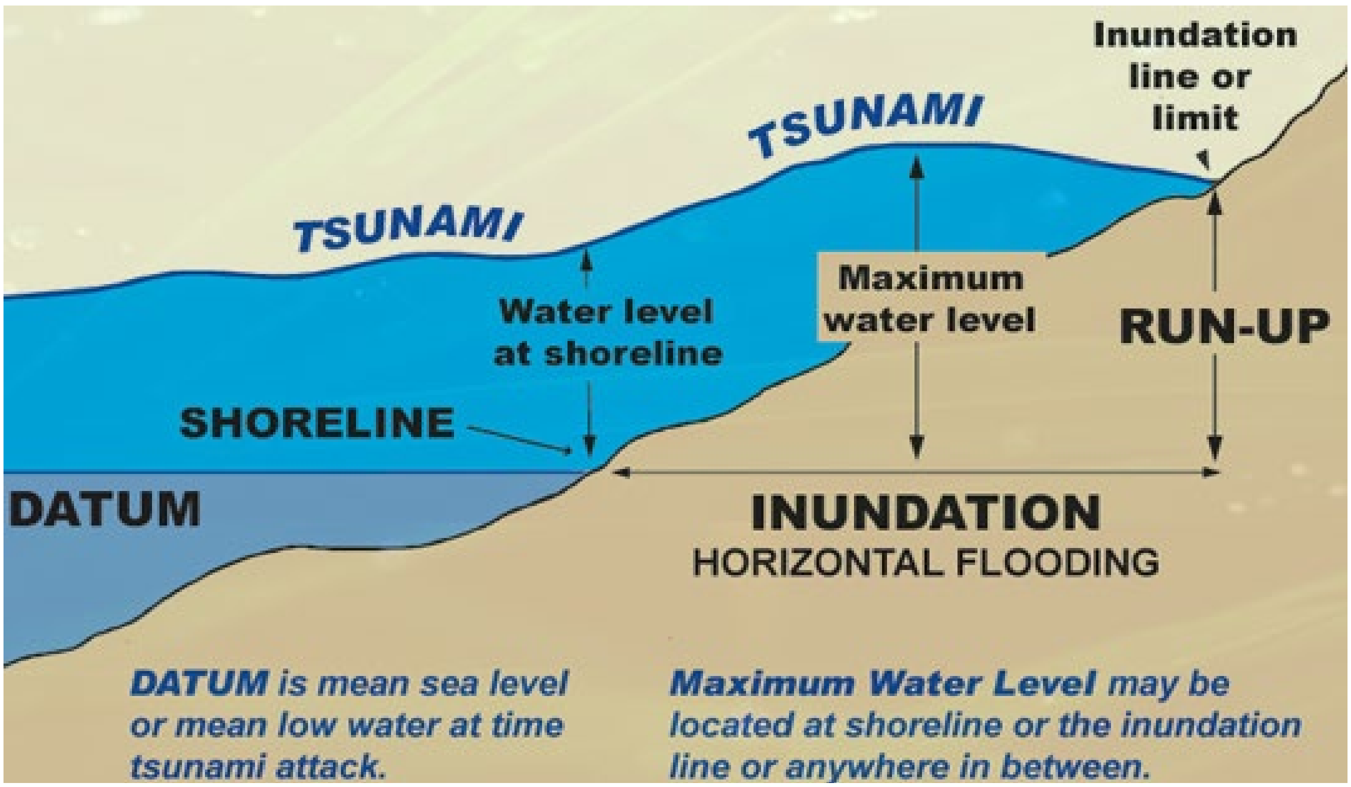


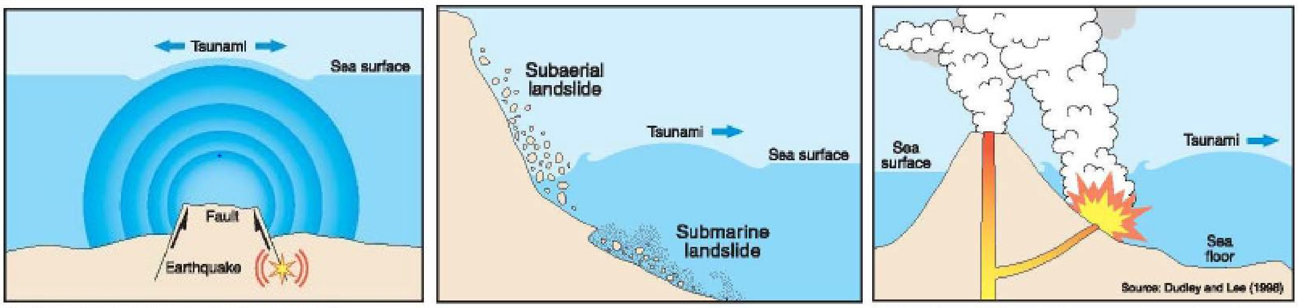
Figure L-16. Run-up Distance and Height in Relation to the Datum and Shoreline

Conversely, the first indication of an approaching tsunami may be recession of water (draw down) caused by the trough preceding the advancing, large inbound wave crest. Rapid draw down can create strong currents in harbor inlets and channels, undermining roads, buildings, bulkheads, and other structures and severely damaging coastal structures due to erosive scour around piers and pilings. As the water's surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. Ships and boats, unless moved away from shore, may be dashed against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom. The outflow action also can carry enormous amounts of highly damaging debris with it, resulting in further destruction.

At some locations, the advancing turbulent front will be the most destructive part of the tsunami. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests.

Sources of Tsunamis

A tsunami can be generated by any disturbance that displaces a large water mass from its equilibrium position. The most common causes of tsunamis are earthquakes, landslides, and submarine volcanic explosions (see Figure L-17). The three tsunami sources are described in the following sections.



Faulting of the ocean floor may produce a tsunami. Subaerial or submarine landslides may produce a tsunami. A submarine volcanic explosion may produce a tsunami.

Figure L-17. Common Sources of Tsunamis

Tsunamis Induced by Earthquakes

Earthquakes that cause tsunamis are referred to as "tsunamigenic earthquakes." Earthquakes generate tsunamis when the sea floor abruptly deforms and displaces the overlying water from its equilibrium position. Waves are formed as the displaced water mass, which acts under the influence of gravity, attempts to regain its equilibrium. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami.

The main factor that determines the initial size of a tsunami is the amount of vertical sea floor deformation. The earthquake's magnitude, depth, fault characteristics, and coincident slumping of sediments or secondary faulting control the size of the tsunami. Other features that influence the size of a tsunami along the coast are the shoreline and bathymetric configuration, the velocity of the sea floor deformation, the water depth near the earthquake source, and the efficiency at which energy is transferred from the earth's crust to the water column.

Most tsunamis induced by earthquakes originate in the Pacific Ocean, where resulting tsunami waves can travel at up to 500 miles per hour, striking distant coastal areas in a matter of hours (see Figure L-18). Tsunamis affecting Kaua'i County may be induced by earthquakes at a considerable distance, such as in Alaska or South America.

Tsunamis Induced by Landslides

The second most common cause of tsunamis is landslides. A tsunami may be generated by a landslide originating above sea level but plunging into the sea, by a landslide occurring mainly beneath the sea level, or by a landslide occurring entirely beneath sea level.

Submarine landslides often occur during a large earthquake. During a submarine landslide, the equilibrium sea level is altered by sediment moving along the sea floor. Hydraulic forces then propagate the tsunami, given the initial perturbation of the sea level. The Hawaiian island chain is flanked by at least 20 large submarine landslides. Sedimentary evidence of landslide-induced tsunamis in Hawai'i is believed to have been found 200 feet above sea level on the flanks of the Kohala volcano in the northern tip of the island of Hawai'i.

Above-water landslides disturb the water from above the surface. Like submarine landslides, they typically occur during large earthquakes. A tsunami also can be generated by the collapse of the flanks of volcanic islands.

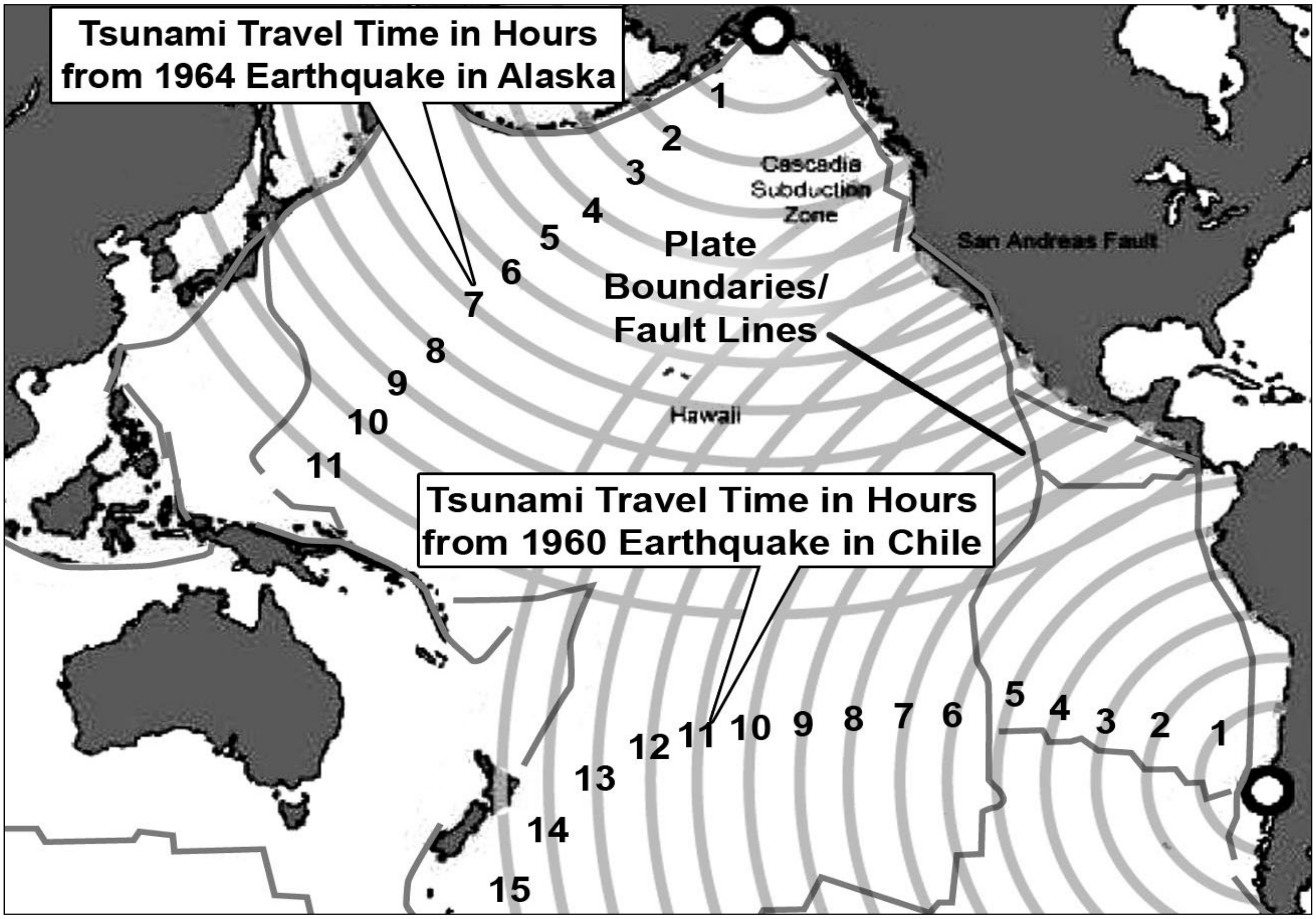


Figure L-18. Potential Tsunami Travel Times in the Pacific Ocean

Tsunamis Induced by Submarine Volcanic Explosions

Three island volcanoes are the subject of studies pertaining to their potential to generate destructive tsunamis: Cumbre Vieja volcano on the Island of La Palma in the Canary Islands, and Mauna Loa and Kīlauea volcanoes on the island of Hawai'i. Review of submarine geology around Mauna Loa shows evidence of past landslides along the volcano's southwestern flank.

Hazard Profile

Past Events

The recorded history of tsunamis in Hawai'i encompasses several phases according to the availability of recorded data. During the 19th century, numerous tsunamis were reported in newspapers, weeklies, and books written by residents at the time. The cause of tsunamis was not generally known, nor was the origin in terms of whether the tsunami was the result of a distant seismic event or a local submarine landslide. Toward the end of the 19th century, seismological stations became available to record and locate earthquakes. Through the instruments in these stations, it became easier to associate distant earthquakes with tsunamis in Hawai'i. The establishment of the Hawaiian Volcano Observatory in 1912 brought the expertise needed to accurately determine the origin and causes of local earthquakes and tsunamis in the islands. After a 1946 tsunami, the Tsunami Warning System was established and a group of experts was constituted to track and document origin, wave heights, and other data pertinent to tsunamis.

The recorded history of Hawaiian tsunamis shows that 26 large tsunamis have made landfall within the islands and 8 have had significant damaging effects on Kauaʻi (USGS, 2002). Table L-12 summarizes tsunamis experienced in Kauaʻi County since 1819 (see Figure L-19 for historical events and run-up heights).

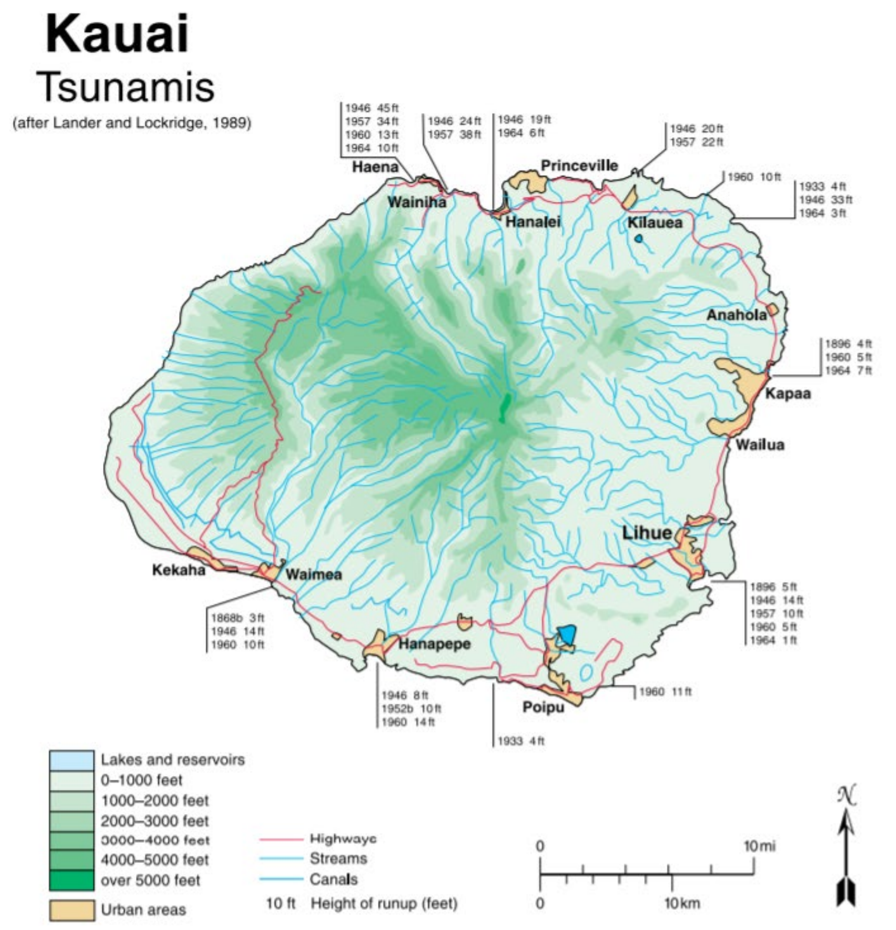
The most devastating tsunamis to hit the island of Kauaʻi in this century occurred in 1946 and 1957. The tsunami of 1946 originated in the Aleutian Islands, struck Kauaʻi without warning and killed 17 people, destroyed homes, natural resources and built infrastructure, and damaged boats. Moloaʻa, Kīlauea, and Waimea recorded wave heights of 13.7 meters. The tsunami of 1957 also originated in the Aleutian Islands and destroyed or damaged infrastructure, homes, and boats. The highest measured wave was 16.2 meters at Wainiha Bay on the north shore.

Table L-12. Tsunamis Affecting Kauaʻi County, 1819 to Present[a]

Date	Place of Observation	Source	Meters	Fatalities	Damage
08/14/1868	Waimea	Chile	1.8	0	Sank ships, carried ships inland
06/15/1896	Kapaʻa, Kīlauea, Nāwiliwili	Japan	1.5	0	Boats stranded/landed, road and bridge flooded
03/02/1933	Lāwaʻi, Moloaʻa	Japan	N/A	0	None recorded
04/01/1946	Hāʻena, Hanalei, Kīlauea, Moloaʻa, Hanapēpē, Waimea	Eastern Aleutian Islands	13.7	17	Destroyed homes, trees, boat launch, shifted buoys, washed tug against breakwater
11/04/1952	Hanapēpē	Kamchatka	N/A	0	None recorded
03/09/1957	Nāwiliwili, Kīlauea, Wainiha, Hāʻena	Central Aleutian Islands	16.2	0	Destroyed bridges, flooded highways, homes destroyed or badly damaged, sampans disabled
05/22/1960	Waimea, Hanapēpē, Poʻipū, Nāwiliwili, Kapaʻa, Kīlauea, Hāʻena	Chile	N/A	0	Minor damage
03/28/1964	Nāwiliwili, Kapaʻa, Moloaʻa, Hanalei, Hāʻena	Gulf of Alaska	N/A	0	None recorded
06/22/1977	Nāwiliwili	Tonga Trench	<0.1	0	None recorded
12/12/1979	Nāwiliwili	Ecuador	0.04	0	None recorded
05/07/1986	Kapaʻa, Hanalei, Nāwiliwili	Aleutian Islands	0.6	0	None recorded
11/30/1987	Nāwiliwili	Alaska	0.06	0	None recorded
10/04/1994	Nāwiliwili, Port Allen	Kuril Islands	0.18	0	None recorded
11/15/2006	Hanalei, Nāwiliwili	Kuril Islands	0.44	0	None recorded
03/11/2011	Anahola, Hanamāʻulu, Keālia, Kīlauea, Moloaʻa, Nāwiliwili	Japan	5.18	0	Minor damage
10/28/2012	Hanalei, Nāwiliwili	British Columbia	0.19	0	None recorded
04/01/2014	Hanalei, Nāwiliwili	Northern Chile	0.15	0	None recorded
09/16/2015	Hanalei, Nāwiliwili	Central Chile	0.14	0	None recorded
01/23/2018	Hanalei, Nāwiliwili	Gulf of Alaska	0.13	0	None recorded

a. This table represents a selection of data and is not inclusive of all tsunami events.
Source: NOAA, 1989; NOAA, 2020a

Source: USGS



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.

Figure L-19. Tsunamis on the Island of Kauaʻi, 1819 – 1975

Location

Detailed FEMA flood studies were conducted on the entire coastline of Hawaiʻi to determine tsunami inundation limits. Figure L-20 shows the tsunami inundation mapping for the planning area.

Frequency

Distant tsunamis have an annual probability of affecting Hawaiʻi of roughly 10 percent. Local tsunami events occur with a roughly 2 percent probability in a year.

Severity

According to the National Tsunami Hazard Mitigation Program, tsunami events with run-ups of more than 1 meter (about 3 feet) are the most likely to be dangerous to people and property.

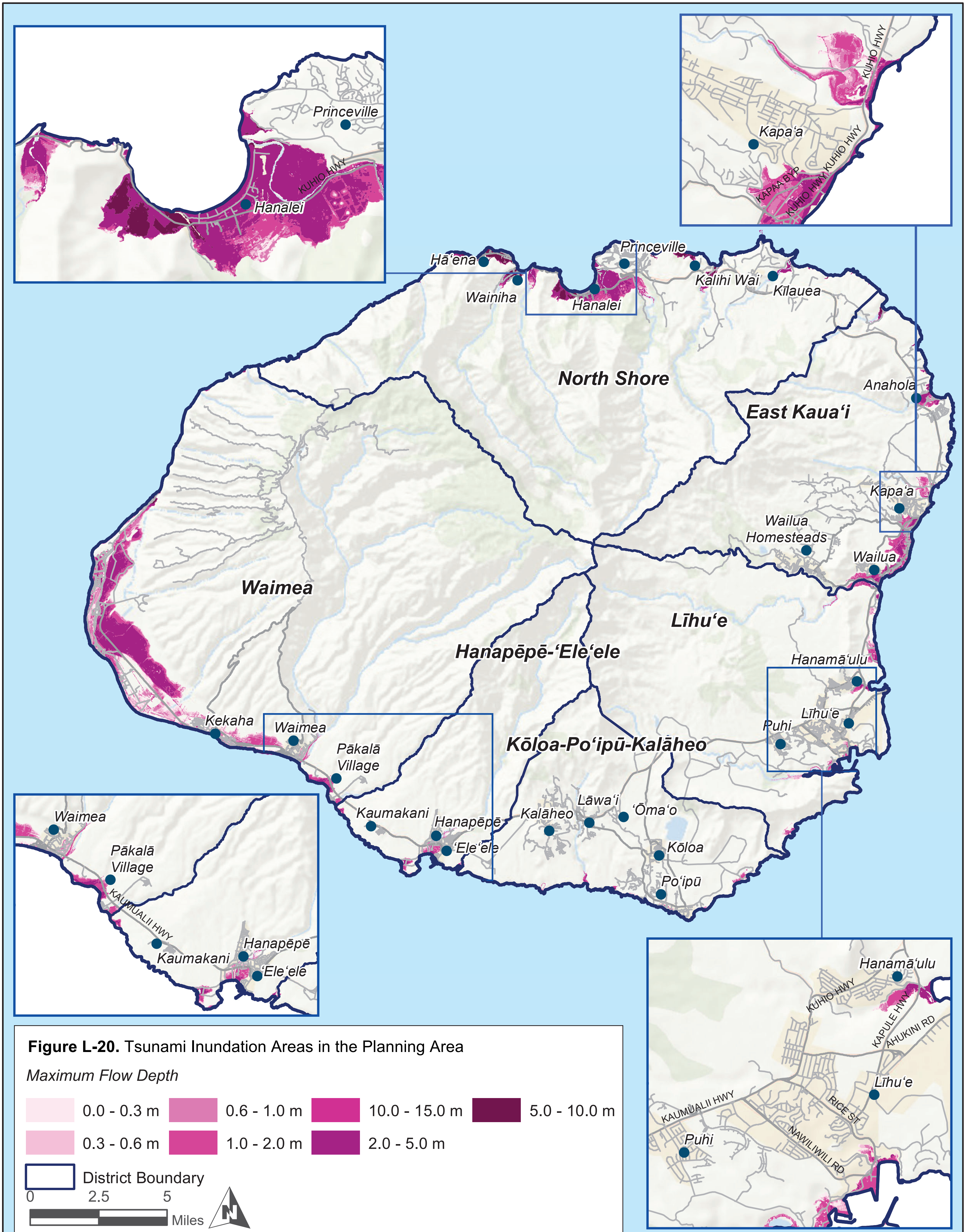


Figure L-20. Tsunami Inundation Areas in the Planning Area

Maximum Flow Depth

0.0 - 0.3 m
0.3 - 0.6 m
0.6 - 1.0 m
1.0 - 2.0 m
10.0 - 15.0 m
2.0 - 5.0 m
5.0 - 10.0 m

District Boundary

0 2.5 5 Miles

N

Warning Time

Typical signs of a tsunami hazard are earthquakes and/or sudden and unexpected rise or fall in coastal water. The large waves are often preceded by coastal flooding and followed by a quick recession of the water. Tsunamis are difficult to detect in the open ocean because waves are often less than 3 feet high.

The Pacific Tsunami Warning System evolved from a program initiated in 1946. It is a cooperative effort involving 26 countries along with numerous seismic stations, water level stations and information distribution centers. The National Weather Service operates two regional information distribution centers: one located in ʻEwa Beach, Hawaiʻi; and the other in Palmer, Alaska. The ʻEwa Beach center also serves as an administrative hub for the Pacific warning system.

The warning system only begins to function when a Pacific basin earthquake of magnitude 6.5 or greater triggers an earthquake alarm. When this occurs, the following sequence of actions occurs:

- Data is interpolated to determine epicenter and magnitude of the event.
- If the event is magnitude 7.5 or greater and located at sea, a TSUNAMI WATCH is issued.
- Participating tide stations in the earthquake area are requested to monitor their gages. If unusual tide levels are noted, the tsunami watch is upgraded to a TSUNAMI WARNING.
- Tsunami travel times are calculated, and the warning is transmitted to agencies that relay it to the public.
- The ʻEwa Beach center will cancel the watch or warning if reports from the stations indicate that no tsunami was generated or that the tsunami was inconsequential.

This system is not considered to be effective for communities located close to the tsunami-generating source because the first wave would arrive before the data were processed and analyzed. In this case, strong ground shaking would provide the first warning of a potential tsunami.

In addition, NOAA as part of the U.S. National Tsunami Hazard Mitigation Program, implemented the Deep-Ocean Assessment and Reporting of Tsunami (DART) project to ensure detection of tsunamis and to acquire data critical to real-time forecasts. DART systems consist of an anchored seafloor bottom pressure recorder and a moored surface buoy for real-time communications. An acoustic link transmits data from the recorder on the seafloor to the surface buoy. The surface buoy transmits data to the National Weather Service Telecommunications Gateway, which then distributes it in real-time to the Tsunami Warning Centers. Figure L-21 depicts the operation of the DART System (County of Maui, 2015).

Secondary Hazards

Port facilities, naval facilities, fishing fleets and public utilities are often the backbone of the economy of the affected areas, and these are the resources that generally receive the most severe damage. Until debris can be cleared, wharves and piers rebuilt, utilities restored, and fishing fleets reconstituted, communities may find themselves without fuel, food and employment. Wherever water transport is a vital means of supply, disruption of coastal systems caused by tsunamis can have far-reaching economic effects.

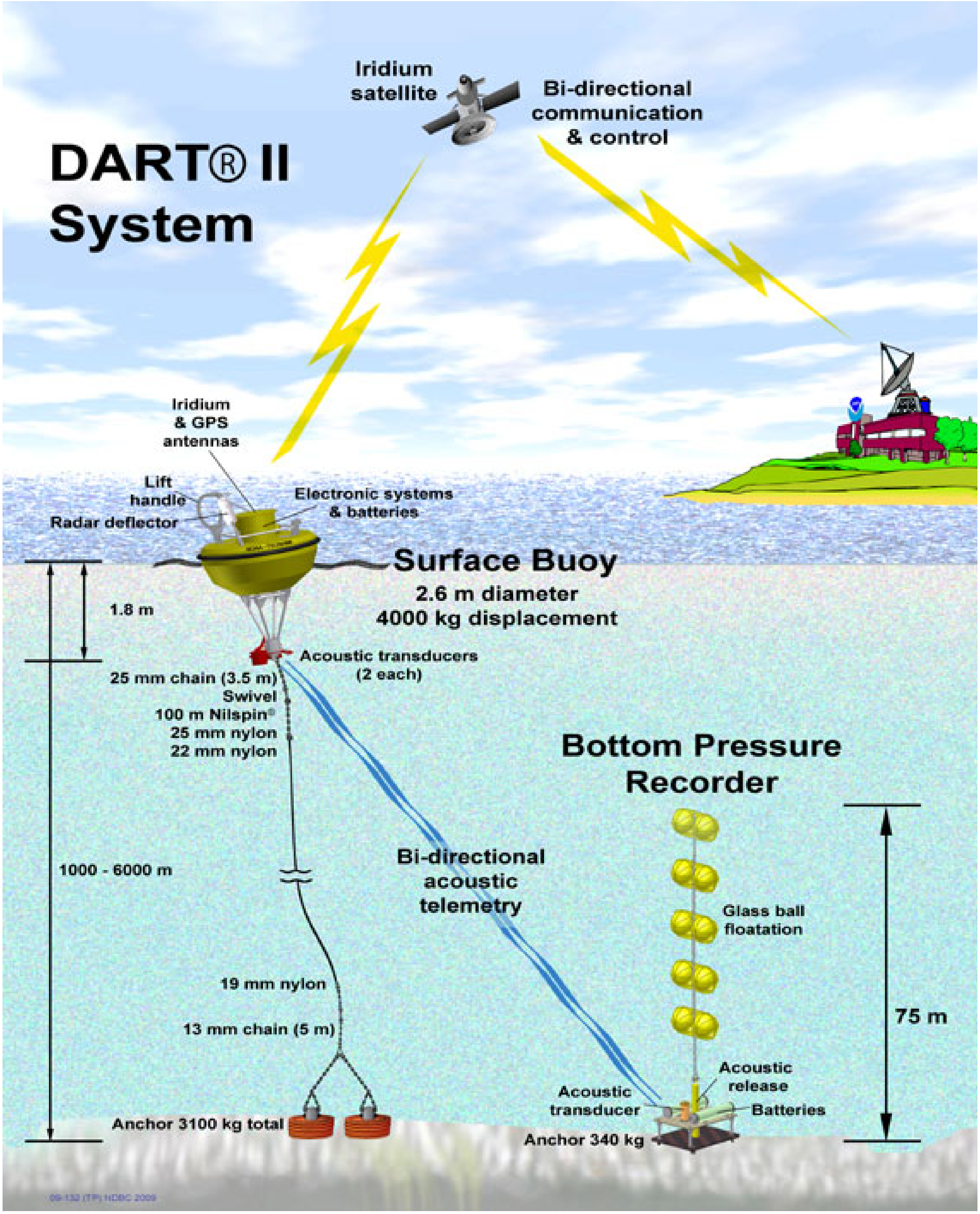


Figure L-21. DART II System

LANDSLIDE

Hazard Description

A landslide is a mass of rock, earth or debris moving down a slope, caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. They can be initiated by storms, earthquakes, fires, or volcanic eruptions. These natural conditions may be affected by human residential, agricultural, commercial and industrial development and the infrastructure that supports it.

Rivers of rock, earth, organic matter and other soil materials saturated with water can develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud. The material can travel miles from its source, growing as it descends, picking up trees, boulders, cars and anything else in its path. These slides may pack many times the hydraulic force of water due to the mass of material included in them. They can be some of the most destructive events in nature.

Landslides are caused by one or more of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, weathering of rocks, and removing or changing the type of vegetation on slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 33 percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, mixed with granular soils such as sand and gravel.

Landslides may be minor or very large and can move at slow to very high speeds. They are commonly categorized by the form of initial ground failure. Figure L-22 shows common types of slides. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

Slides can pose serious hazard to property in hillside terrain. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

Landslides destroy property and infrastructure and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. Economic impact is largely associated with the disruption of transportation infrastructure. Communities that are isolated as a result of the landslide hazard may suffer from economic issues resulting from a lack of resource movement in and out of the area. This issue could last for a significant amount of time based on the extent of the event.

Source: Washington State Department of Ecology, 2014

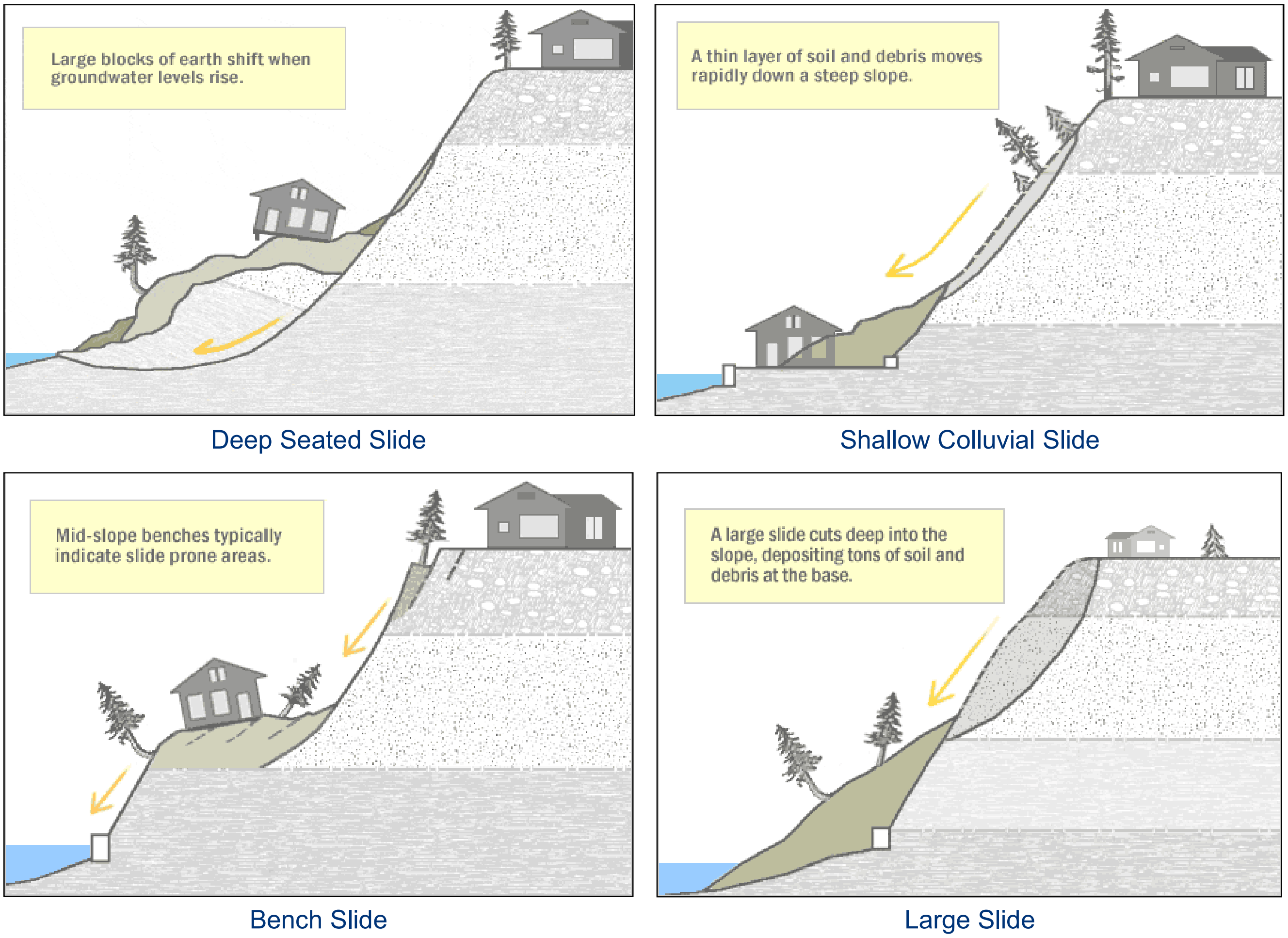


Figure L-22. Common Landslide Types

Hazard Profile

Past Events

Since 2007, NASA's Global Landslide Catalog has recorded landslide events in Kaua'i on nine dates, as listed in Table L-13. The most recent significant landslide event began with torrential rainfall and severe flooding in April 2018, resulting in numerous landslides over north Kaua'i west of Hanalei that cut off access to Wainiha and Hā'ena for more than two weeks (NWS, 2020e).

Location

Soil avalanches or landslides generally take place on the western side or northern side of Kaua'i. Soil avalanches may leave bright scars on the hillside for months. A good example is a slide that occurred in Olokele Canyon on Kaua'i in October 1981. The slide face was about a thousand feet wide and 2,400 feet high. This slide was caused by a combination of high rainfall and underground water seepage.

Table L-13. Landslides in Kaua‘i County, 2007 – 2020

Event Date	Event Title/Description	Landslide Setting	Landslide Trigger	Landslide Size[a]	Fatalities	Injuries
4/14/2018	Kūhiō Highway Landslides cut off Limahuli Garden and Preserve	above road	downpour	medium	0	0
Description: Intense rainfall on April 14 and 15—nearly 50 inches of rain in 24 hours—caused widespread flooding and landslides in Kaua‘i. More than 20 landslides occurred along the Kūhiō Highway between Hā‘ena and Hanalei, blocking the path to Limahuli Garden and Preserve in Hā‘ena.						
8/6/2016	Kūhiō Highway just south of Hanalei Bridge	above road	rain	small	0	0
Description: The road was closed in both directions after a landslide just south of Hanalei Bridge.						
8/11/2014	Mount Wai‘ale‘ale	natural slope	unknown	medium	0	0
Description: Local resident Dale Rosenfeld took a photo of the slide and submitted it to The Garden Island. She said it was not visible from her home in Wailua Homesteads before Monday morning.						
3/11/2012	Hā‘ena Beach Park	unknown	downpour	small	0	
Description: Hā‘ena State Park closed due to a landslide closing the road to the Park.						
3/9/2012	Near Kaua‘i Marriott	unknown	downpour	small	0	
Description: A landslide was reported near the Kaua‘i Marriott, blocking a lane of traffic.						
3/4/2012	Kūhiō Highway in Lumaha‘i	unknown	downpour	medium	0	
Description: The landslide was reported on Kūhiō Highway in Lumaha‘i, near mile marker 5. Both lanes of the highway were closed. A crew from the State Department of Transportation Highways Division removed boulders from the roadway.						
2/26/2012	Multiple Roads in Lāwa'i, Kaua'i, Līhu‘e, and Kalāheo	unknown	downpour	small	0	
Description: Landslides and boulders were reported on Kalihi Wai Road, Akemama Road in Lāwa‘i, Kahumoku Road in Līhu‘e and Waha Road in Kalāheo.						
11/14/2009	Kalihi Wai Bridge on Kūhiō Highway	unknown	downpour	medium	0	
Description: The Kalihi Wai Bridge on Kūhiō Highway was closed, and landslide was reported near a home off Kalihi Wai Road.						
6/8/2008	Kūhiō Highway, Kaua‘i	unknown	rain	small		
Description: Several boulders, rocks and other debris broke loose from a North Shore hillside along Kūhiō Highway.						

a. Small landslide affects one hillslope or small area, with minimal impact on infrastructure and few or no fatalities. Medium landslide is a single or multiple landslides with a large volume of material, moderate impact on infrastructure, and few or no fatalities.

Source: NASA, 2020b

Valley development often involves work that can trigger landslides:

- Hillside cut: Here where houses are built on the side of the hill, even very slow movements may cause the house to break. It may cause telephone poles to bend very slowly. It may cause fences to move.
- Road cuts: Landslides have been seen frequently near road cuts. The Department of Transportation mitigates landslides near roadways by erecting chicken wire strapped around the edge of the cliff. The purpose of this is to prevent rockfalls and other things from sliding out onto the highway.

Areas generally more prone to landslides are those located at:

- Previous landslides areas
- Base of slopes
- Base of minor drainage hollows
- Base or top of an old, filled slope
- Base or top of a steep, cut slope
- Developed hillsides with leach-field septic systems.

These areas include sections on the highway past Anahola, Lumahaʻi, Kalāheo, Lāwaʻi, and Kuamoʻo Road. The significant historical landslides have occurred along the highway and coastal roads. During recent year flooding and storm events, several mudslides occurred impacting transportation. There were also landslide events on the Leeward and North Shore areas of Kauaʻi during the March 2012 and April 2018 flood disaster events, wherein at least 3-5 major landslides occurred between Kīlauea and Hāʻena, causing multiple points of isolation and visitors and residents being unable to evacuate or move between these points. Debris flow occurred in Kapaʻa on March 27, 2013 and Waimea on December 2, 2013, both events which were caused by heavy rainfall. Based on historic events, there have been occurrences of land movement on conservation lands two or three times per year with heavy rainfall events that coincide with 1 in 50 year flood events (County of Kauaʻi, 2015).

The best available predictor of where landslides might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small portion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges. The landslide risk mapping for this assessment was provided by the Pacific Disaster Center. Landslide susceptibility is measured on a scale of I to X, with I being the least susceptible. The hazard areas based on these criteria are shown in Figure L-23.

Frequency

The nine landslide events recorded by NASA in the 14 years from 2007 to 2020 suggests that landslides can occur in Kauaʻi County once every year or two. Landslides are often triggered by other natural hazards such as heavy rain, floods, wildfires, or earthquakes so landslide frequency is often related to the frequency of these other hazards. The County of Kauaʻi is susceptible to all of these factors that trigger landslides. Tropical cyclone events are more likely during the Pacific Cyclone season. Heavy rain may result from cyclonic storms or seasonally rainy weather. During storm-related landslide events, the ground must be saturated prior to the onset of a major storm for significant landslides to occur. Earthquakes may occur at any time of the year.

Severity

Giant catastrophic slides occurred around the major Hawaiian Islands thousands of years ago. At least 15 giant landslides have been identified by the U.S. Geological Survey (USGS), with the most recent occurring approximately 100,000 years ago off the Kona coast of the Big Island. Each of these slides resulted in huge land losses to the islands and resulted in large waves that have carried rocks and sediments as high as 1,000 feet above sea level.

Although these giant landslides have the potential for enormous loss of life, property and resources, they are infrequent in human terms, occurring perhaps once every few tens of thousands of years, and were associated with an earlier geologic setting of island building. The USGS suggests that hazard mitigation should not focus on giant landslides because they are so infrequent. Among the more recent landslides listed in Table L-13, none involved injuries or fatalities, and all were rated as small or medium, defined as follows:

Small landslides affect one hillslope or small area, with minimal impact on infrastructure and few or no fatalities. Medium landslides are single or multiple landslides with a large volume of material, moderate impact on infrastructure, and few or no fatalities.

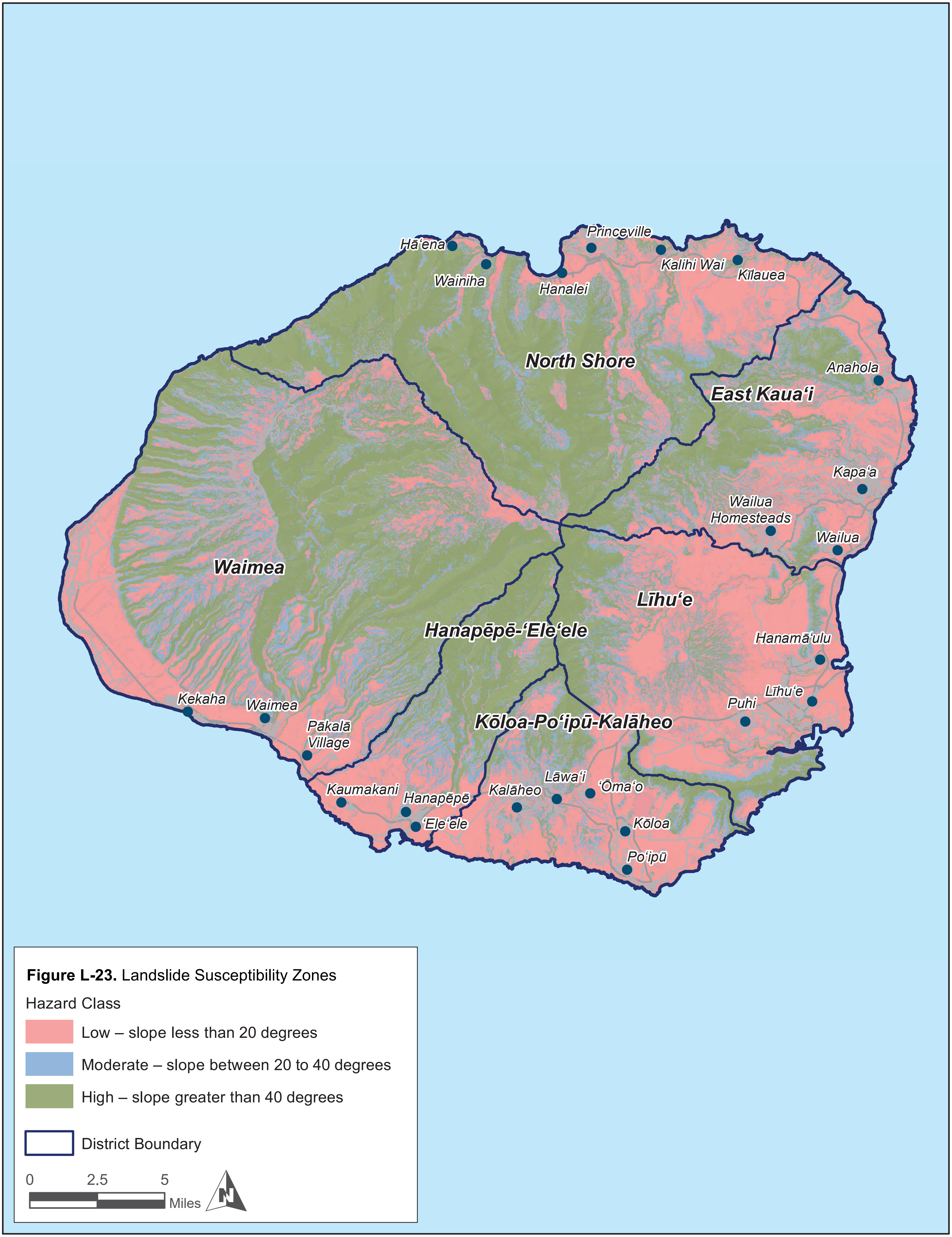


Figure L-23. Landslide Susceptibility Zones

Warning Time

The velocity of a landslide may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods.

Assessing the geology, vegetation and amount of predicted precipitation for an area can help in predicting landslides. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis and respond after the event has occurred. Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

Secondary Hazards

Landslides can cause secondary effects such as flooding if the landslide material blocks the natural flow of a stream.

DAM FAILURE

Hazard Description

Definition and Classification of Dams

Hawaiʻi Administrative Rules (Chapter 190.1) define a state-regulated dam as any artificial barrier, including appurtenant works that impounds or diverts water and has one of the following characteristics:

- Is 25 feet or more in height from the natural bed of the stream or watercourse or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse
- Has an impounding capacity at maximum water storage elevation of 50 acre-feet or more.
- Has two or more reservoirs that operate or function as a single facility or are connected together with an uncontrolled conduit, which shall be construed to be one dam or reservoir.
- Is a natural structure that retains water and has been altered by the addition of an outlet works and has a maximum storage volume greater than 50 acre-feet.

There are generally three types of dams:

- Detention dams minimize the effects of flood runoff by storing all or part of an anticipated flood runoff. The stored floodwater is released at a rate that does not exceed the carrying capacity of the channel downstream.
- Storage dams impound water during periods of surplus supply to be used during dry periods for crop irrigation, livestock watering, municipal or industrial water supply, or electricity generation.
- Diversion dams (not regulated) provide hydraulic head for diverting water from streams and rivers into ditches or canals.

Causes of Dam Failure

Partial or full failure of dams has the potential to cause massive destruction to the ecosystems and communities located downstream. Partial or full failure can occur as a result of one or a combination of the following reasons (FEMA, 2015):

- Overtopping caused by floods that exceed the dam capacity (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate or negligent operation, maintenance, and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction/landslides).

Many dam failures in the United States have been secondary results of other disasters. The most common causes are earthquakes, landslides, extreme storms, equipment malfunction, structural damage, foundation failures, and sabotage. Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public.

Regulatory Oversight

The U.S. Army Corps of Engineers is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety.

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety. More than 3,000 dams are part of regulated hydroelectric projects in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important.

FERC inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

State and federal initiatives have been established to reduce the potential of full or partial failures. The State of Hawaiʻi's 2010 Dam Safety Act (HAR, Title 13, Subtitle 7, Chapter 190.1) is administered by the Department of Land and Natural Resources (DLNR), which reviews and approves plans and specifications for the construction of new or modified dams. Any individual or entity seeking to construct, alter, repair or remove an existing dam must fill out the DLNR's *Application for Approval of Plans and Specifications for Construction, Enlargement, Repair, Alteration, or Removal of Dam*.

Hazard Profile

Past Events

On March 14, 2006, the Ka Loko Dam broke on the North Shore of Kauaʻi, sending millions of gallons of water downstream. Seven people were killed, and dozens of homes and properties were damaged. The owner faced charges for the disaster because he allegedly filled an emergency spillway, although no direct observations of him doing so exist. The State of Hawaiʻi came under scrutiny for the break because the state failed to follow its own regulations regarding dam inspections. The state was also vulnerable because water originating on state lands was being diverted to the Ka Loko Reservoir at the time of the break. The County of Kauaʻi was accountable because it did not properly manage illegal construction activities by the owner that probably led to the filling of the spillway (ASCE, 2010).

Location

List of High-Hazard Dams

Most dams in Hawaiʻi are old earthen berm reservoirs built during the plantation era originally for irrigation purposes. Kauaʻi County has 48 high-hazard dams, all of which are earth dams (see Table L-14). Their locations are shown on Figure L-24.

Inundation and Evacuation Mapping

Following the catastrophic breach of the Ka Loko Dam in March 2006, dam owners in Hawaiʻi were mandated to prepare, maintain, and implement emergency preparedness plans for each dam or reservoir. A key element for each plan is a map defining the potential downstream inundation should the dam fail, and an assessment of the critical infrastructure and population at risk under these circumstances. For each dam inundation scenario modeled, it was assumed that:

- The dam failure occurred under sunny day, dry stream conditions
- The dam failure occurred while the dam was at maximum capacity
- Failure occurred by piping halfway up the dam face (or in a location designated by DLNR)
- The spillways or outlet works were inoperable at the time of the breach.

Working groups headed by representatives from county civil defense and emergency management agencies determined evacuation boundaries using the dam inundation maps.

Table L-14. Kaua'i County High Hazard Dams

Name	Drainage Area (square miles)	Owner[a]	Year Built	Spillway Type	Crest Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Use[b]
Pu'u Lua Reservoir	0.08	HI DLNR	1925	Channel	640	105	888	MULTI
Kitano Reservoir	0.02	SHDA	1928	Pipe	720	38	120	IRR
Mānā Reservoir	0.08	SHDA	1905	Channel	1600	17	135	IRR
Waikaia Reservoir	0.08	Gay & Robinson Inc.	1951	Channel	720	26	58	IRR
Kepani Reservoir	0.05	Gay & Robinson Inc.	1954	Channel	860	32	85	IRR
Waikoloi Reservoir	0.089	Gay & Robinson Inc.	1958	Culvert	505	64	147	IRR
Ka'awanui Reservoir	0.014	Gay & Robinson Inc.	1950	Culvert	2560	26	110	IRR
Wai'akalua Reservoir	0.43	Multiple (a)	1920	Channel	1800	26	220	IRR
Aii Reservoir	0.21	Grove Farm Company	1920	Channel	350	21	68	IRR
Kapaia Reservoir	2.51	Grove Farm Company	1910	Channel	1050	50	1114	IRR
Upper Kapahi Reservoir	0.17	CKDPW, HI DLNR	1910	Channel	1080	40	296	IRR
Okinawa Reservoir	0.78	Grove Farm Company	1920	2 Bay Box Culvert	470	25	142	IRR
Kaneha Reservoir	0.7	Multiple (b)	1910	Channel	410	46	420	IRR, REC
Mimino Reservoir	0.35	Cornerstone Hawai'i Holdings LLC	1920	Pipe	600	44	70	IRR
Kalihi Wai Reservoir	0.32	Kalihi Wai Ridge Community Assoc.	1920	Channel	950	20	428	IRR, REC
Kaloko Reservoir	0.12	Multiple (c)	1890	None Found	915	27	1400	IRR
Wailua Reservoir	0.88	HI DLNR	1920	Channel	1080	40	1223	IRR
Lower Kapahi Reservoir	0.38	CKDPW	1920		650	20	194	O
Twin Reservoirs	0.49	Multiple (d)	1920	Tunnel	1810	18	520	O
'A'ahoaka Reservoir	0.74	SHDA	1910	Channel	550	36	210	IRR
Field 2 Keālia Reservoir	0.07	State of Hawai'i, DHHL	1920	Channel	304	25	146	IRR, O
Field 1 Keālia Reservoir	0.12	State of Hawai'i, DHHL	1920	Channel	530	29	105	IRR, O
Alexander Reservoir	2.86	Alexander & Baldwin, Inc	1931	Channel	600	112	2540	POW, IRR
Waita Reservoir	3.36	Grove Farm Company	1906	Channel	3250	23	9900	IRR
Kapa Reservoir	0.0064	Multiple (e)	1901	None Found	1780	21	50	IRR
Hukiwai Reservoir	0.0094	Multiple (e)	1910	Channel	1200	33	56	IRR
Aepo Reservoir	0.17	Multiple (f)	1901	Pipe	440	70	457	IRR
Huinawai Reservoir	0.28	Multiple (f)	1902	Channel	335	48	196	IRR
'Elima Reservoir	0.24	Alexander & Baldwin, Inc	1901	Channel	700	38	126	IRR
Kumano Reservoir	0.11	Multiple (f)	1902	None Found	400	48	175	IRR
Pu'u O Hewa Reservoir	0.24	Eric A. Knudsen Trust	1915	Channel	540	23	115	IRR
Kaupale Reservoir	0.25	Multiple (f)	1910	Channel	500	49	240	IRR, O
Ipuolono Reservoir	1.96	Multiple (e)	1910	Channel	680	45	450	IRR
Aepoalua Reservoir	0.08	Multiple (f)	1915	Channel	435	33	131	IRR
Aepoekolu Reservoir	0.04	Multiple (f)	1910	Channel	420	37	152	IRR
Aepoeha Reservoir	0.81	Multiple (f)	1913	Channel	600	42	670	IRR
'Ōma'o Reservoir	1.17	Multiple (g)	1915	Channel	454	40	194	IRR
Piwai Reservoir	0.3903	Multiple (f)	1916	Channel	535	56	261	IRR
Pia Mill Reservoir	0.35	Eric A. Knudsen Trust	1910	Channel	450	16.5	38.6	IRR
Mau Reservoir	1.04	Alexander & Baldwin, Inc	1901	Channel	460	38	78.5	IRR
'Elua Reservoir	1.15	Alexander & Baldwin, Inc	1902	Channel	600	30	340	IRR

Name	Drainage Area (square miles)	Owner[a]	Year Built	Spillway Type	Crest Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Use[b]
Manuhonuhonu Reservoir	0.156	Kukui‘ula Development Company (Hawai‘i) LLC	1954	None Found	400	45	49	IRR
Mauka Reservoir	0.56	Eric A. Knudsen Trust	1910	Channel	550	19	345	IRR
Papua‘a Reservoir	1.75	Grove Farm Company	1914	Channel	2000	43	921	IRR
Halenānahu Reservoir	1.16	Grove Farm Company	1920	Channel	650	35	460	MULTI
Kaua‘i Lagoons	0.64	Hokuala Kaua‘i	1987	Pipe	0.0	15	470	REC
Hala‘ula Reservoir	0.34	Kealia Properties LLC		Pipe	410	25.9		IRR, REC
Pond No. 1 at Kaua‘i Ranch	0.02344	Cornerstone Hawai‘i Holdings LLC	2004	Channel	570	31.5		IRR

a. CKDPW = County of Kaua‘i – Department of Public Works; SHDA = State of Hawai‘i Department of Agriculture; HI DLNR = Hawai‘i Department of Land and Natural Resources; DHHL = Department of Hawaiian Home Lands; Multiple (a) = Frederic North, He Makana Ka Wai, Malie Wai Properties/Farms, Matthew Miller, Theresa Drake, Thomas Atkin, V. Stephen Hunt, Victor Mission Trust LLC, William L. Flaherty Trust; Multiple (b) = Cornerstone Hawai‘i Holdings LLC, Frank Vandersloot; Multiple (c) = Mary N. Lucas Trust, Pacific 808 Properties, LP; Multiple (d) = CKDPW, Green Aloha Real Estate LLC, Kapa‘a 382, Kulana Home Owners Association, Leonard Kaua‘i, Matthew Goodale, Troy and Renee Johnston, Twin Lakes, Waipouli Manoa LLC; Multiple (e) = Alexander & Baldwin Inc, Kaua‘i Coffee Company, McBryde Resources Inc.; Multiple (f) = A & B Properties Inc, Alexander & Baldwin Inc; Multiple (g) = A & B Properties Inc, Alexander & Baldwin Inc, Eric A. Knudsen Trust

b. Use codes: DIV = Diversion; DOM = Domestic; IND = Industrial; IRR = Irrigation; MULTI = Multi-purpose; MUN = Municipal; POW = Power Generation; REC = Recreation; REG = Regulation; STO = Storage, FC = Flood Control, O = Other

Source: HI DNLR, Dam Inventory System (http://132.160.239.52/daminventory/Default.aspx?qt=damkauai&p=0)

Source: DLNR, 2020

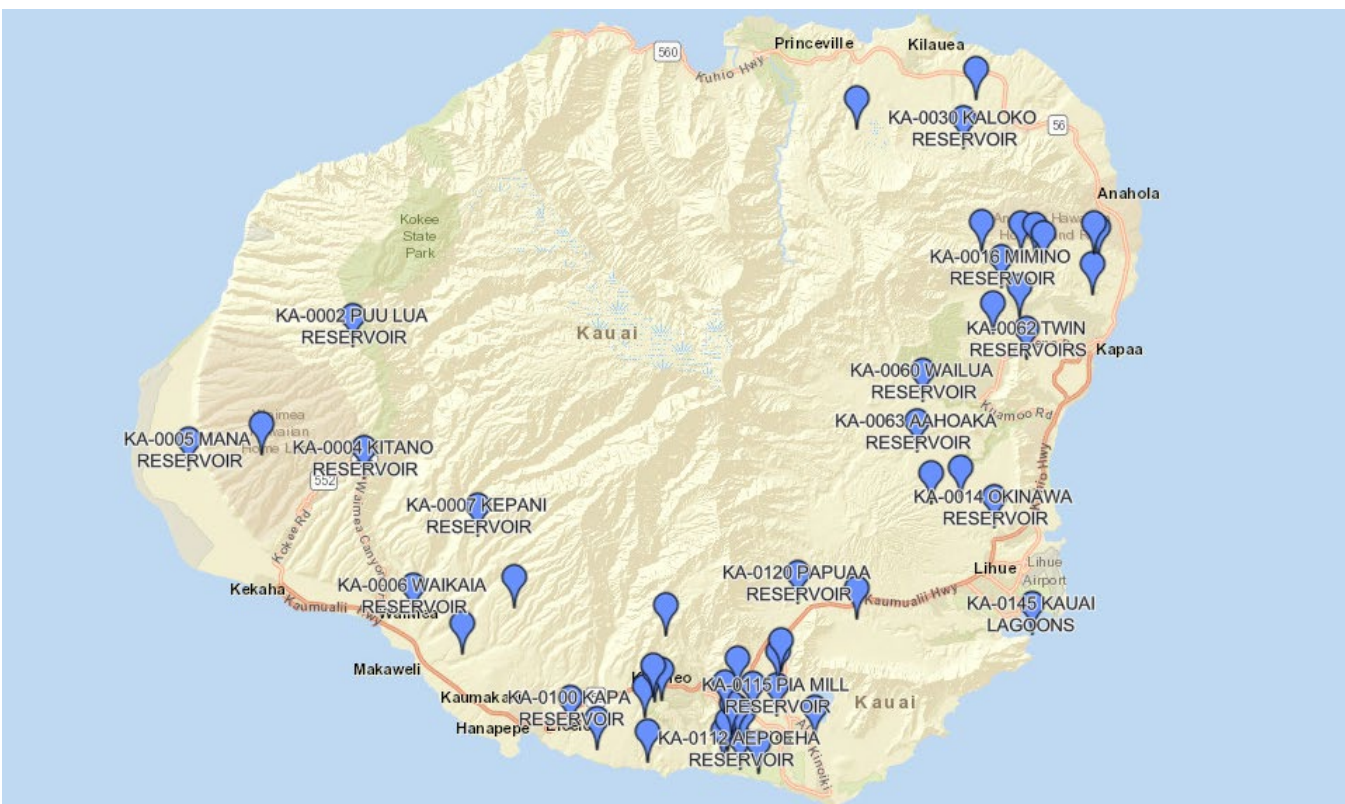


Figure L-24. Locations of Dams in Kaua‘i County

For this risk assessment, digital data suitable for a quantitative assessment of dam failure risk was available for all high hazard dams listed in Table L-14.

Frequency

Given the increased monitoring procedures enacted following the 2006 Ka Loko Dam breach, the probability of a dam failure anywhere in the state of Hawai'i has been significantly reduced. A major dam failure is a rare event for which there is no defined recurrence interval. However, failure potential does exist during an extreme rainfall event or major earthquake at any unmaintained or under-maintained location.

Severity

Dam failure can be catastrophic to all life and property downstream. The State of Hawai'i classifies dams and reservoirs in a three-tier hazard rating system based on potential consequences to downstream life and property that could result from a failure of the dam (HAR Section 13-190.2-2):

- **High Hazard**—High hazard dams are those where failure would probably cause loss of human life.
- **Significant Hazard**—Significant hazard dams are those where failure would result in no probable loss of human life but could cause major economic loss, environmental damage, disruption of lifeline facilities, or other concerns. Significant hazard potential classification dams or reservoirs are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- **Low Hazard**—Low hazard dams are those where failure would result in no probable loss of human life and low economic loss or environmental loss, or both. Economic losses are principally limited to the owner's property.

DLNR has rated forty-nine dams in Kaua'i County as high-hazard, as listed in Table L-14.

Warning Time

Warning time for dam failure depends on the cause of the failure. In events of extreme precipitation, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be little warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers, 1997).

Secondary Hazards

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on streams, and destruction of downstream habitat. Dam failure may worsen the severity of a drought by releasing water that might have been used as a potable water source.

EARTHQUAKE

Hazard Description

An earthquake is the vibration of the earth's surface following a release of energy in the Earth's crust. This energy can be generated by a sudden dislocation of the crust, a volcanic eruption, or a volcano mass settling on the ocean floor. Dislocations of the crust cause more destructive quakes than does volcanic activity. Proximity of the built environment to the epicenter results in the most damage. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth's surface directly above the hypocenter.

According to the U.S. Geological Survey (USGS) Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect resident's normal activities. This includes the following:

- **Surface Faulting**—Displacement that reaches the earth's surface during slip along a fault. Commonly occurs with shallow earthquakes, those with an epicenter less than 20 kilometers.
- **Ground Motion (shaking)**—The movement of the earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves that are generated by sudden slip on a fault or sudden pressure at the explosive source and travel through the earth and along its surface.
- **Landslid**e—A movement of surface material down a slope.
- **Liquefaction**—A process by which water-saturated sediment temporarily loses strength and acts as a fluid. Earthquake shaking can cause this effect.
- **Tectonic Deformation**—A change in the original shape of a material due to stress and strain.
- **Tsunami**—A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or violent underwater volcanic eruptions.

Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity.

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. Magnitude is commonly expressed by ratings on the moment magnitude scale (M_W), the most common scale used today (USGS, 2017). This scale is based on the total moment release of the earthquake (the product of the distance a fault moved and the force required to move it). The scale is as follows:

- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Intensity

The most commonly used intensity scale is the modified Mercalli intensity scale. Ratings of the scale as well as the perceived shaking and damage potential for structures are shown in Table L-15. The modified Mercalli intensity scale is generally represented visually using shake maps, which show the expected ground shaking at any given location produced by an earthquake with a specified magnitude and epicenter.

Table L-15. Mercalli Scale and Peak Ground Acceleration Comparison

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17% - 1.4%
IV	Light	None	None	1.4% - 3.9%
V	Moderate	Very Light	Light	3.9% - 9.2%
VI	Strong	Light	Moderate	9.2% - 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% - 34%
VIII	Severe	Moderate/Heavy	Heavy	34% - 65%
IX	Violent	Heavy	Very Heavy	65% - 124%
X – XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA = peak ground acceleration. Measured in percent of g, where g is the acceleration of gravity
Sources: USGS, 2008; USGS, 2010

An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the variation of ground shaking in a region immediately following significant earthquakes (for technical information about shake maps see USGS, 2018).

Ground Motion

Earthquake hazard assessment is also based on expected ground motion. During an earthquake when the ground is shaking, it also experiences acceleration. The peak acceleration is the largest increase in velocity recorded by a particular station during an earthquake. Estimates are developed of the annual probability that certain ground motion accelerations will be exceeded; the annual probabilities can then be summed over a time period of interest.

The most commonly mapped ground motion parameters are horizontal and vertical peak ground accelerations (PGA) for a given soil type. PGA is a measure of how hard the earth shakes, or accelerates, in a given geographic area. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. PGA is measured in g (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage "short period structures" (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges).

USGS Earthquake Mapping Programs

ShakeMaps

The USGS Earthquake Hazards Program produces maps called ShakeMaps that map ground motion and shaking intensity following significant earthquakes. ShakeMaps focus on the ground shaking caused by the earthquake, rather than on characteristics of the earthquake source, such as magnitude and epicenter. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust.

A ShakeMap shows the extent and variation of ground shaking immediately across the surrounding region following significant earthquakes. Such mapping is derived from peak ground motion amplitudes recorded on seismic sensors, with interpolation where data are lacking based on estimated amplitudes. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. In addition to the maps of recorded events, the USGS creates the following:

- Scenario ShakeMaps of hypothetical earthquakes of an assumed magnitude on known faults
- Probabilistic ShakeMaps, based on predicted shaking from all possible earthquakes over a 10,000-year period. In a probabilistic map, information from millions of scenario maps are combined to make a forecast for the future. The maps indicate the ground motion at any given point that has a given probability of being exceeded in a given timeframe, such as a 100-year (1-percent-annual chance) event.

National Seismic Hazard Map

National probabilistic maps of earthquake shaking hazards have been produced since 1948. They provide information essential to creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning used in the U.S. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damage and disruption. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al., 2001). The USGS has not updated its National Seismic Hazard Map for Hawai'i since 1998. Figure L-25 shows the peak ground acceleration with 10 percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas.

Liquefaction and Soil Types

Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table L-16 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. In general, areas with NEHRP Soils D, E and F are also susceptible to liquefaction. If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it, creating sand boils. This is a vital need for assessing seismic risk within the planning area, however, NEHRP mapping has not been done for the County of Kaua'i.

Source: USGS, 2020

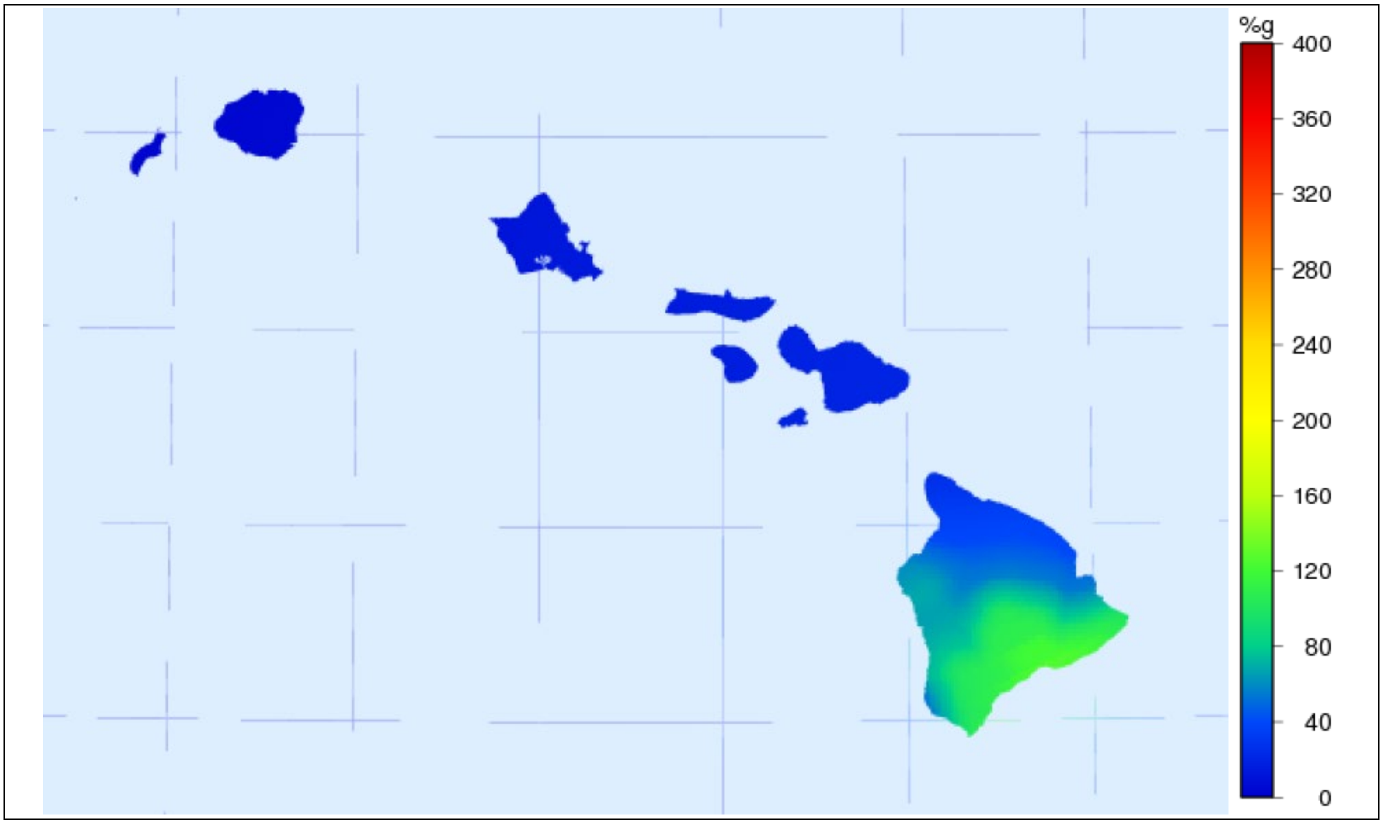


Figure L-25. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years

Table L-16. NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 meters (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 meters thick)	

Hazard Profile

In addition to posing a life safety hazard, earthquakes are destructive to the County's infrastructure, including buildings, roads, bridges, and utilities. The seismic hazard is often characterized in terms of probability of peak ground acceleration (PGA) measured as a percent of Earth's gravitational acceleration (%g) within a fixed time period. The County has the lowest expected ground acceleration in the State (see Figure L-26). A PGA of 100%g can cause significant impacts as described in Table L-17. Engineers use this information to develop building codes and design earthquake resistant structures.

Source: USGS, https://volcanoes.usgs.gov/observatories/hvo/hazards_earthquakes.html

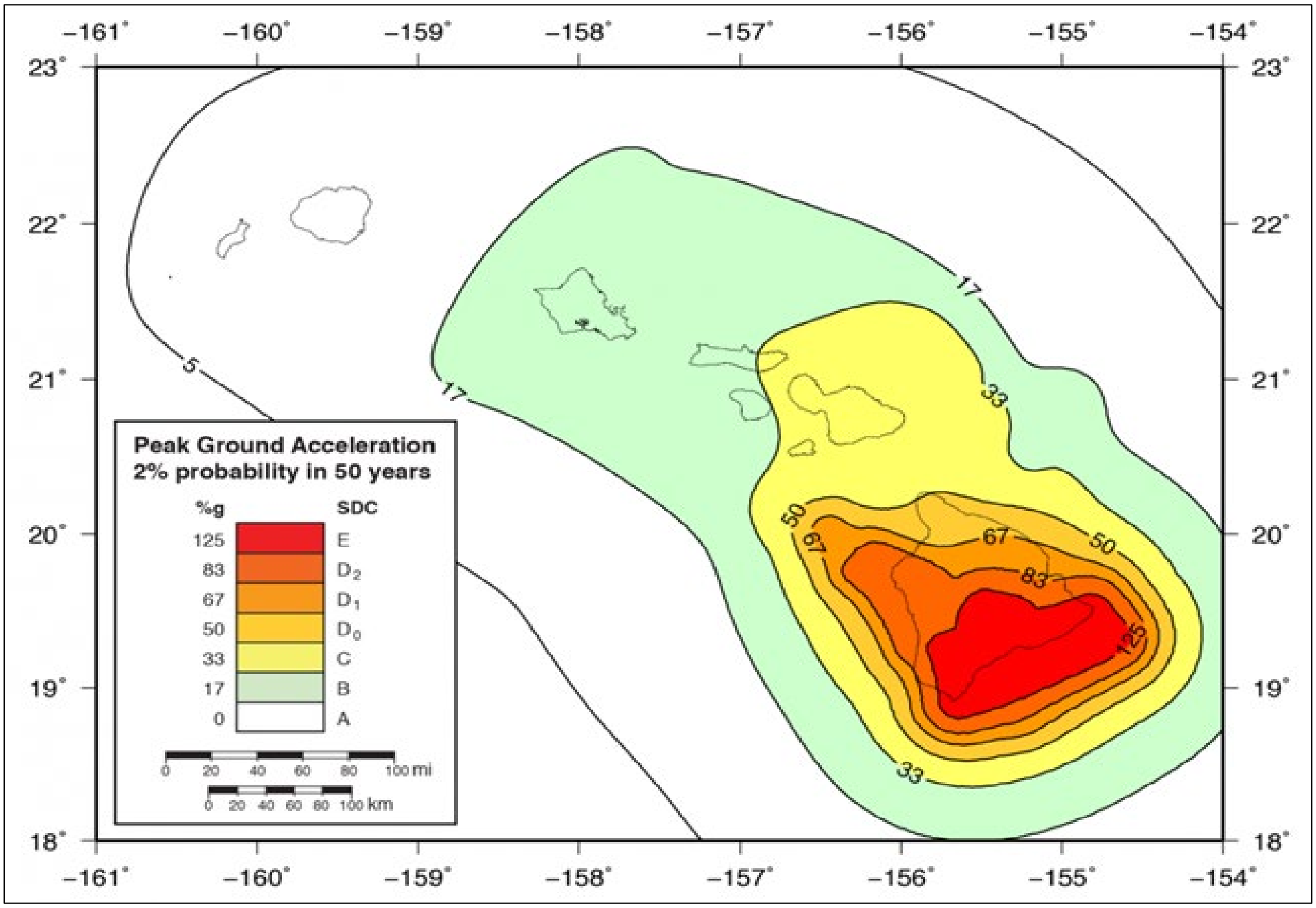


Figure L-26. Seismic Hazards Across the State

Table L-17. Seismic Hazard Zones Reflecting Intensity and Probability of Shaking

SDC[a]	Map Color	Earthquake Hazard	Potential Effects of Shaking[b]
A	White	Very small probability of experiencing damaging earthquake effects.	
B	Green	Could experience shaking of moderate intensity.	Moderate shaking—Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
C	Yellow	Could experience strong shaking.	Strong shaking—Damage negligible in buildings with good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built structures.
D0	Dark Yellow	Could experience very strong shaking (the darker the color, the stronger the shaking).	Very strong shaking—Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures.
D1	Light Orange		
D2	Orange		
E	Red	Near major active faults capable of producing the most intense shaking.	Strongest shaking—Damage considerable in specially designed structures; frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Shaking intense enough to completely destroy buildings.

a. SDC = Seismic design categories
b. Abbreviated descriptions from the Modified Mercalli Intensity Scale

According to the U.S. Geological Survey, one problem in assigning seismic hazard zones to the island is that the ground shaking during a strong earthquake may vary within a small area. This variation is due to the nature of the underlying ground; for example, whether it is mainly lava bedrock or soil. Two homes in the same neighborhood may suffer different degrees of damage depending on the properties of the ground upon which they are built. In addition, local topography strongly affects earthquake hazards. Steep slopes composed of loose material may produce large landslides during an earthquake. (County of Kaua‘i, 2015).

Past Events

Each year thousands of earthquakes occur in Hawai'i, with the majority of them too small to be felt except by highly sensitive instruments. However, there have been earthquakes that jolted the islands. The island of Hawai‘i has experienced numerous earthquakes of magnitude 5 or greater, however, no large earthquakes have occurred in Kaua‘i. Even though there has not been a significant earthquake in Kaua‘i, it is important to remember that these tremors anywhere in the state could result in a tsunami. (County of Kaua‘i, 2015).

The USGS lists 22 earthquakes in the state with magnitudes of 5.0 or greater since 1990, as listed in Table L-18 and shown on Figure L-27. The following sections describe significant earthquakes in the State’s history.

1868 Ka’ū District Earthquake

An earthquake occurred in 1868 in the Ka’ū district on the southeast flank of Mauna Loa with an estimated magnitude of 7.5 to 8.0. Although the 1868 earthquake caused damage island-wide, the devastation was greatest in Ka’ū where the earthquake triggered a mudflow killing 31 people and coastal subsidence generated a tsunami that destroyed several villages. Approximately 79 people were killed, mostly due to the mudslide and the tsunami (County of Hawai‘i, 2015).

1973 South Hilo Earthquake

A large earthquake, unrelated to volcanic activity, was located 25 miles beneath Honomū in the South Hilo district in 1973. This earthquake had a magnitude of 6.2. It caused $5.6 million worth of damage and injured 11 people (County of Hawai‘i, 2015).

1975 Kīlauea Earthquake

The largest earthquake on the island during the 20th century occurred on the south flank of Kīlauea in 1975. This earthquake had a magnitude of 7.2. It caused coastal subsidence at Kalapana, generated a tsunami that killed two people in the Hawai‘i Volcanoes National Park, destroyed houses in the Ka’ū district, sank fishing boats in Keauhou Bay within the North Kona district, and damaged boats and piers in Hilo, within the South Hilo district (County of Hawai‘i, 2015).

2006 Kīholo Bay Earthquake

The most recent major earthquakes in the State of Hawai‘i were the Magnitude 6.7 Kīholo Bay and Magnitude 6.0 Māhukona earthquakes that occurred on October 15, 2006 at 7:07 a.m. and 7:14 a.m., respectively. Both earthquakes were centered near the Kona coastline of Hawai‘i. The largest ground shaking for this earthquake was at the northern end of the island at the towns of Waimea and Hāwī. These areas had amplified ground motion due to their softer soil conditions. The most heavily damaged buildings were concentrated in the Waimea and Hāwī areas, with some damage also in the Honoka‘a and Kona areas. There was very little damage at the south end of the island (County of Hawai‘i, 2015).

Table L-18. Earthquakes of Magnitude 5.0 or Larger in the State of Hawai'i—Modern (1990 – 2020)

Date	Magnitude	Epicenter Location (see Figure L-27)		
		Latitude (degrees)	Longitude (degrees)	Depth (miles)
4/14/2019	5.34	19.74	-155.79	8.3
3/13/2019	5.54	19.33	-155.20	4.3
5/4/2018	6.9	19.32	-155.00	3.6
5/4/2018	5.73	19.33	-155.02	4.0
5/3/2018	5.06	19.34	-155.07	4.0
6/8/2017	5.28	19.33	-155.12	4.4
6/28/2015	5.2	19.34	-155.21	5.3
6/5/2013	5.3	18.91	-155.06	25.0
4/14/2009	5.2	19.33	-155.21	6.2
8/14/2007	5.4	19.35	-155.07	6.0
11/23/2006	5.2	19.89	-155.97	23.4
10/15/2006	6.1	20.13	-155.98	11.7
10/15/2006	6.7	19.88	-155.94	24.2
7/17/2005	5.1	18.78	-155.45	20.3
7/15/2005	5.3	20.44	-155.13	11.1
9/13/2001	5.2	18.86	-155.24	7.8
4/17/1999	5.8	19.25	-155.49	6.8
6/30/1997	5.7	19.36	-155.07	4.7
2/1/1994	5.6	19.24	-155.29	20.4
6/8/1993	5.2	19.33	-155.22	2.3
5/8/1991	5.5	19.37	-156.27	22.6
8/2/1990	5	19.84	-155.62	12.9

Source: USGS, 2020a

Source: USGS, 2020a

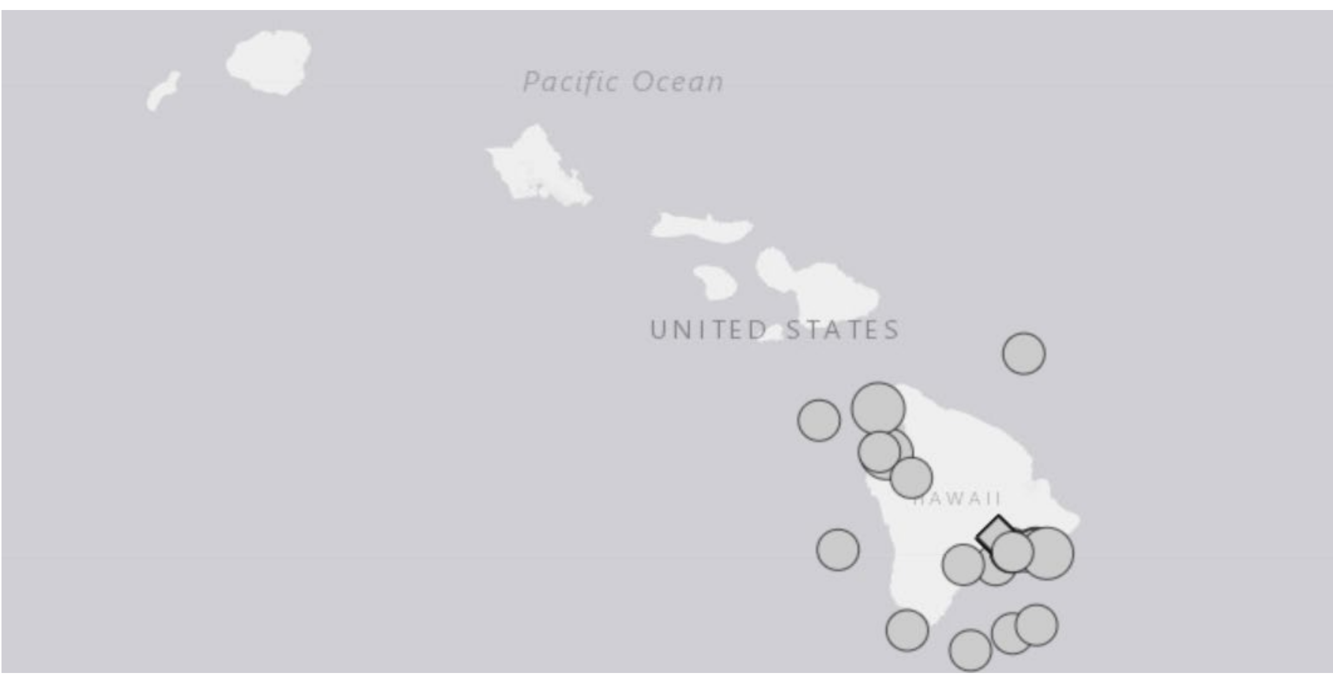


Figure L-27. Earthquakes of Magnitude 5.0 or Greater in the State of Hawai'i, 1990 – 2019

Location

NEHRP Soil Maps

NEHRP soil type maps define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. NEHRP soil classifications are only available for Maui and Hawai‘i Counties, but are not available for Kaua‘i County.

Fault Locations

The USGS maintains a map and database on faults that show evidence of seismic activity with the past 1.6 million years (the Quaternary period). Figure L-28 shows the known fault complexes on the island of Hawai‘i. USGS mapping shows no faults on any of the other Hawaiian islands.

Source: USGS, 2020a

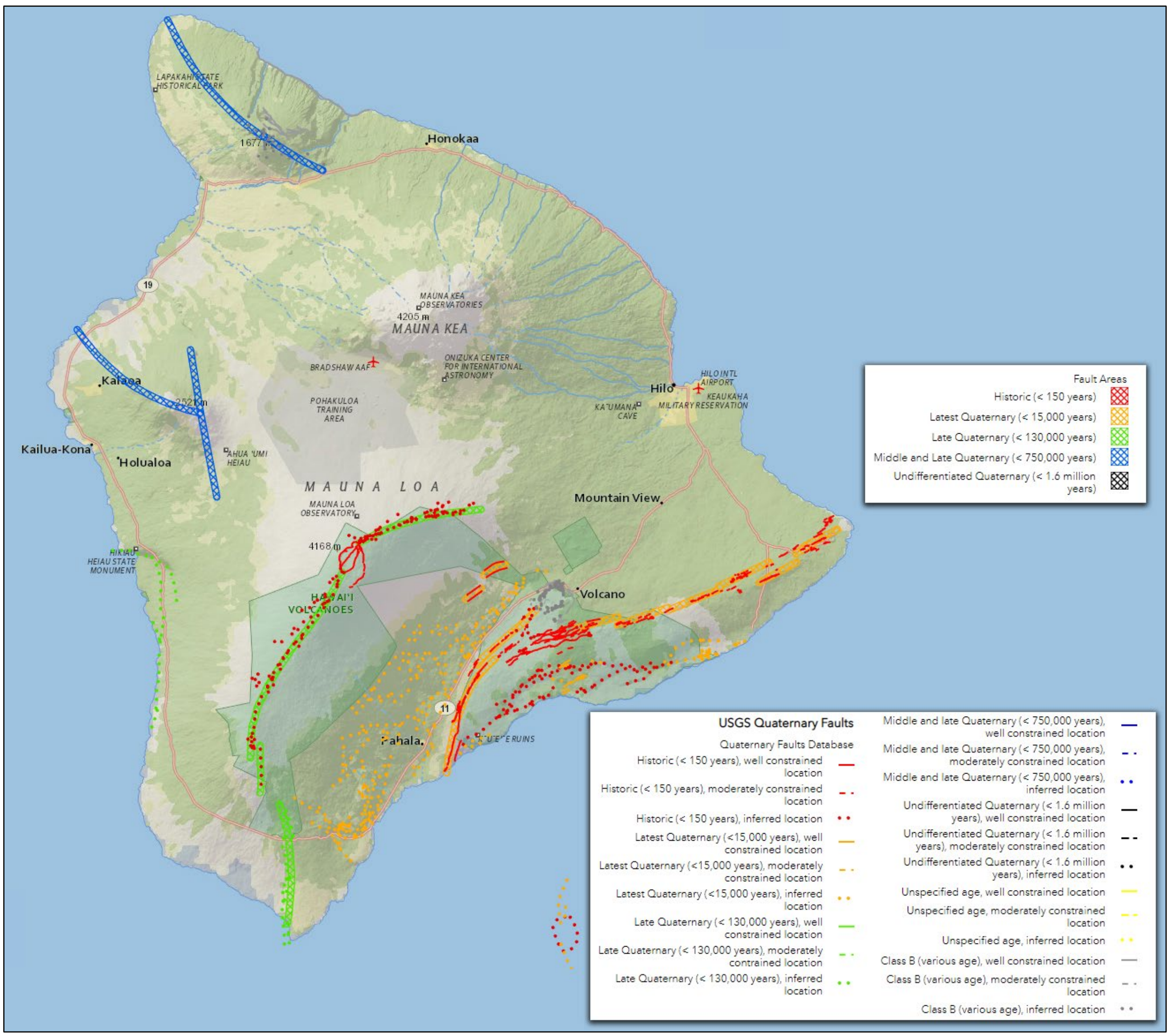


Figure L-28. Mapped Faults in Hawai‘i County (the only county in the state with USGS fault lines)

Frequency

Due to a lack of volcanic activity and historical occurrence of earthquakes, Kaua‘i County can expect earthquake activity to be minimal, however, the USGS estimates a 50-percent probability of a 6.5 magnitude or greater earthquake occurring in the Hawai‘i Islands in the next 10 years. (County of Maui, 2015).

Severity

Potential Earthquake Intensity in the Planning Area

USGS probabilistic mapping is an indication of potential earthquake intensity in an area. Figure L-25 shows the intensity with a 10-percent exceedance chance in 50 years in Hawai‘i. For Kaua‘i County, this PGA is 0g.

Potential Damage

While Kaua‘i has a low potential of earthquake damage, the risks to property from earthquakes in the State of Hawai‘i are among the highest in the nation, with only San Francisco and San Jose, California having a greater annual loss per million dollars of building value. Earthquake occurrence rates in the County of Hawai‘i are responsible for the losses and are as high as that near the most hazardous fault areas on the mainland United States (County of Hawai‘i, 2015).

Strong earthquakes, while infrequent, may endanger people and property by shaking structures, causing ground cracks, ground settling and landslides. Strong earthquakes in Hawai‘i’s past have destroyed buildings, water tanks and bridges and damaged roadways, water, sewer and utility lines. Soil and topographic conditions may exacerbate potential earthquake hazards where steep slopes and water saturated soils may be susceptible to mudflows or landslides. Large earthquakes may also generate tsunamis.

Warning Time

There is currently no reliable way to predict when an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

Secondary Hazards

Earthquakes can cause landslides. River and stream valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction can turn the ground into a pudding-like liquid. Building and road foundations can lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

Earthen dams and levees are highly susceptible to seismic events and their failures can be considered secondary risks for earthquakes. Fire may also occur from broken gas lines or downed electric wires. Additionally, tsunamis and run-ups may result from earthquakes, leading to potential coastal flooding and coastal erosion.

HEAT AND DROUGHT

Hazard Description

Periods of high temperature and low precipitations do not generally pose risks to structures, but they can have significant impacts on the people and economy of the affected area.

Extreme Heat

Extreme Heat Description

Extreme heat is defined as temperatures 10º F or more above the local average high temperature lasting for prolonged periods, often accompanied by high humidity. National Weather Service criteria for heat advisories measure the severity and intensity of extreme heat. As conditions warrant, the following are issued:

- **Excessive Heat Warning—Take Action:** An excessive heat warning is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this warning is when the maximum heat index temperature is expected to be 105 °F or higher for at least 2 days and night time air temperatures will not drop below 75 °F; however, these criteria vary across the country, especially for areas not used to extreme heat conditions. Those who do not take precautions immediately when conditions are extreme may become seriously ill or even die.
- **Heat Advisory—Take Action:** A heat advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this advisory is when the maximum heat index temperature is expected to be 100 °F or higher for at least 2 days, and night time air temperatures will not drop below 75 °F; however, these criteria vary across the country, especially for areas that are not used to dangerous heat conditions. Take precautions to avoid heat illness. Those who do not take precautions may become seriously ill or even die.
- **Excessive Heat Watches—Be Prepared:** Heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
- **Excessive Heat Outlooks—Be Aware:** The outlooks are issued when the potential exists for an excessive heat event in the next 3 to 7 days. An outlook provides information to those who need considerable lead-time to prepare for the event.

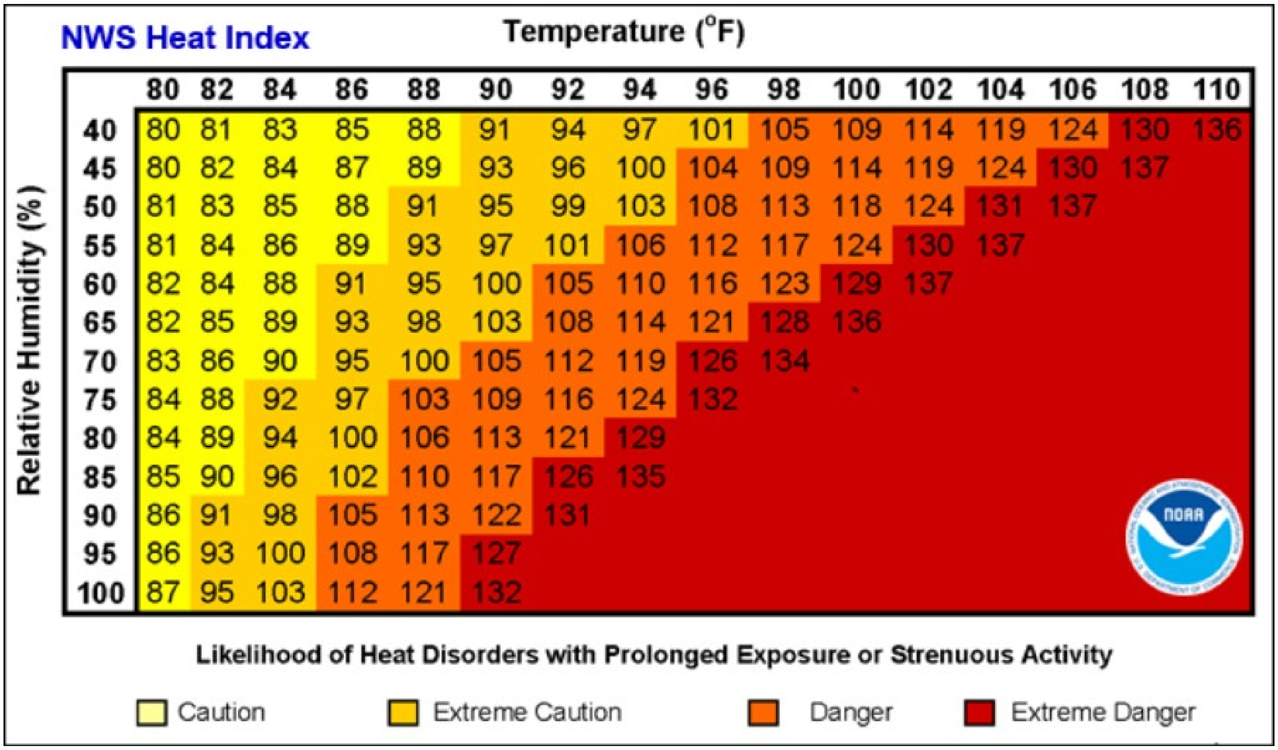
The heat index measures how hot it feels when relative humidity is factored in with actual air temperature (see Figure L-29). The National Weather Service will initiate alert procedures when the heat index is expected to exceed 105 to 110 ºF (depending on the local climate) for at least two consecutive days.

Extreme Heat Impacts

Extreme heat can pose a significant risk to human health, diminishing the body's ability to maintain a normal temperature. Coupled with too much fluid or salt loss through dehydration or sweating, extreme heat compounds health risks. Studies have shown that a significant rise in heat-related illness occurs when excessive heat persists for more than two days. The following are symptoms of heat exhaustion and heat stroke:

- Heat exhaustion:
  - ➢ Faint or dizzy
  - ➢ Excessive sweating
  - ➢ Cool, pale, clammy skin
  - ➢ Nausea or vomiting
  - ➢ Rapid, weak pulse
  - ➢ Muscle cramps
- Heat stroke:
  - ➢ Throbbing headache
  - ➢ No sweating
  - ➢ Body temperature above 103 degrees
  - ➢ Red, hot, dry skin
  - ➢ Nausea or vomiting
  - ➢ Rapid, strong pulse
  - ➢ May lose consciousness

Heat is one of the leading weather-related killers in the United States, resulting in hundreds of fatalities each year and even more heat-related illnesses. Toddlers are especially vulnerable if left or trapped in a parked car (see Figure L-30. Seniors in residences without air conditioning are also more at risk of heat illness and death during excessive heat waves.



RH (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Figure L-29. National Weather Service Heat Index Chart

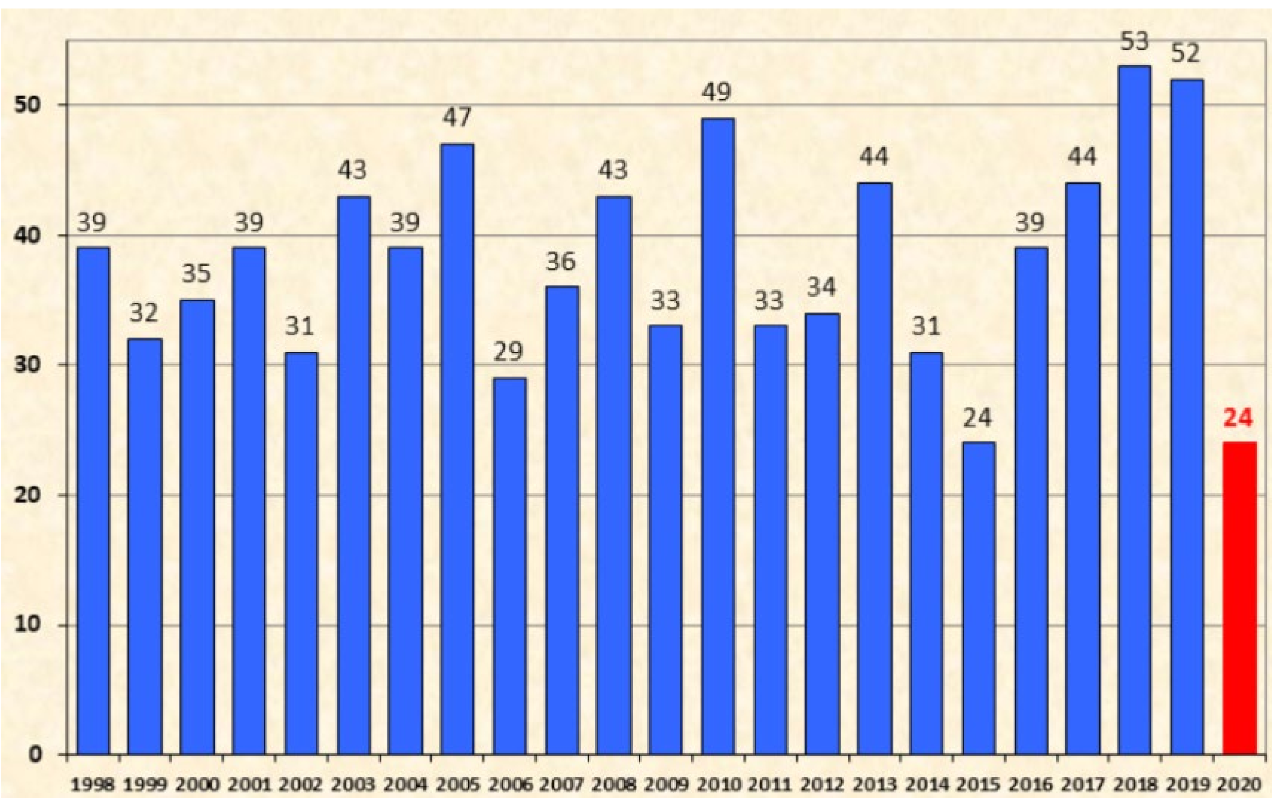


Figure L-30. Pediatric Vehicular Heatstroke Deaths in the U.S. 1998 - September 2020

Drought

Drought Description

A drought is a period of abnormally dry weather. Drought diminishes natural stream flow and depletes soil moisture, which can cause social, environmental and economic impacts. In general, the term "drought" is reserved for periods of moisture deficiency that are relatively extensive in both space and time.

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

In Hawai'i, droughts and wildland fires can threaten all the islands in any given year, though the eastern portion of the Hawaiian Islands seem to have been most severely impacted by drought events since 1999. This includes Kaua'i County. The severity and duration of drought has not been as bad as in other islands (CWRM, 2003).

Drought Impacts

Lack of rainfall is not the only factor defining drought. Drought can be characterized based on various impacts or measurements (State of Hawai'i, 2018):

- Meteorological measurements such as rainfall deficit compared to normal or expected rainfall
- Agricultural impacts due to reduced rainfall and water supply (e.g., crop loss, herd culling, etc.)
- Hydrological measurements of stream flows, groundwater, and reservoir levels relative to normal conditions
- Direct and indirect socio-economic impacts on society and the economy (e.g., increased unemployment due to failure of an industry because of drought).

Drought can affect a wide range of economic, environmental, and social activities. The demand that society places on water systems and supplies—such as expanding populations, irrigation, and environmental needs—also contributes to drought impacts. According to the most recent draft of Hawai'i's State Water Protection Plan, drought can lead to difficult decisions regarding the allocation of water, as well as stringent water use restrictions, water quality problems, and inadequate water supplies for fire suppression. There are also issues such as growing conflicts between agricultural uses of surface water and in-stream uses, surface water and groundwater interrelationships, and the effects of growing water demand on traditional and cultural uses of water.

The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand. The impacts of drought vary between sectors of the community in both timing and severity:

- **Water supply—**The water supply sector encompasses urban and rural drinking water systems that are affected when a drought depletes ground water supplies due to reduced recharge from rainfall.
- **Agriculture and commerce—**The agriculture and commerce sector includes the reduction of crop yield and livestock sizes due to insufficient water supply for crop irrigation and maintenance of ground cover for grazing.
- **Environment, public health, and safety—**The environmental, public health, and safety sector focuses on wildfires that are both detrimental to the forest ecosystem and hazardous to the public. It also includes the impact of desiccating streams, such as the reduction of in-stream habitats for native species.

Monitoring Drought

Scientists and academics commonly use drought indices to monitor droughts. Some indices used for the continental United States are not suitable for use in Hawai'i's highly variable climate. The sections below describe indices that are useful for drought monitoring in Hawai'i.

Standardized Precipitation Index

The Standardized Precipitation Index (SPI) considers only precipitation. An index value of zero represents the median precipitation amount, and the index is negative for drought and positive for wet conditions. SPI values can be generated for multiple time scales, which is useful for monitoring because the effects of droughts occur over wide ranges of time scales. SPI values are as follows:

- 2.00 and Greater Extremely Wet
- 1.50 to 1.99 Very Wet
- 1.00 to 1.49 Moderately Wet
- 0.99 to -0.99 Near Normal
- -1.00 to -1.49 Moderately Dry
- -1.50 to -1.99 Very Dry
- -2.00 and Less Extremely Dry

The following descriptions explain applicable SPI intervals and values for key sectors in Hawai'i (State of Hawai'i, 2017):

- **Water Supply Sector**—The water supply sector is typically affected by long sustained periods of drought that affect ground and surface water resources. For this reason, a 12-month SPI is typically the best interval to evaluate drought severity for this sector.
- **Agriculture and Commerce Sector**—The agriculture sector is usually the first sector to feel the effects of drought. Farmers and ranchers who depend on rainfall for irrigation may be severely affected by even short-term moderate drought events. Because the agriculture and commerce sector is affected by short-term drought events, a 3-month SPI drought interval is best suited to evaluate drought severity for this sector.
- **Environment, Public Health, and Safety Sector**—Drought can have a number of effects on the environment, public health and safety sector. However, focus is often given exclusively to the area of wildfire impacts. Prolonged periods of drought can create dry landscapes that are vulnerable to wildfire hazard. Since even short drought periods can increase the risk of wildfire hazards, the 3-month SPI is best suited to evaluate drought severity for this sector.

Table L-19 describes SPI intervals values that can be used to evaluate drought severity for the three key sectors.

Table L-19. Drought Stage and SPI Interval and Value per Sector

Drought Stage	SPI Time Interval and Value		
	Water Supply Sector	Agriculture & Commerce Sector	Environmental, Public Health, & Safety Sector
Normal	12-month SPI 0.99 to -0.99	3-month SPI 0.99 to -0.99	3- and 12-month SPI 0.99 to -0.99
Moderate	12-month SPI -1.00 to -1.49 for 2 consecutive months	3-month SPI -1.00 to -1.49 for 2 consecutive months	3- and 12-month SPI -1.00 to -1.49 for 2 consecutive months
Severe	12-month SPI -1.50 to -1.99 for 2 consecutive months	3-month SPI -1.50 to -1.99 for 2 consecutive months	3- and 12-month SPI -1.50 to -1.99 for 2 consecutive months
Extreme	12-month SPI less than -2.00 for 2 consecutive months	3-month SPI less than -2.00 for 2 consecutive months	3- and 12-month SPI less than -2.00 for 2 consecutive months

Source: State of Hawai'i, 2017.

Figure L-31 is an example SPI maps for the island of Kauaʻi as of May 2020. The County at that time fell within the Near Normal to Moderately Wet categories, depending on the selected timeframe.

Source: https://www.weather.gov/hfo/fullspi

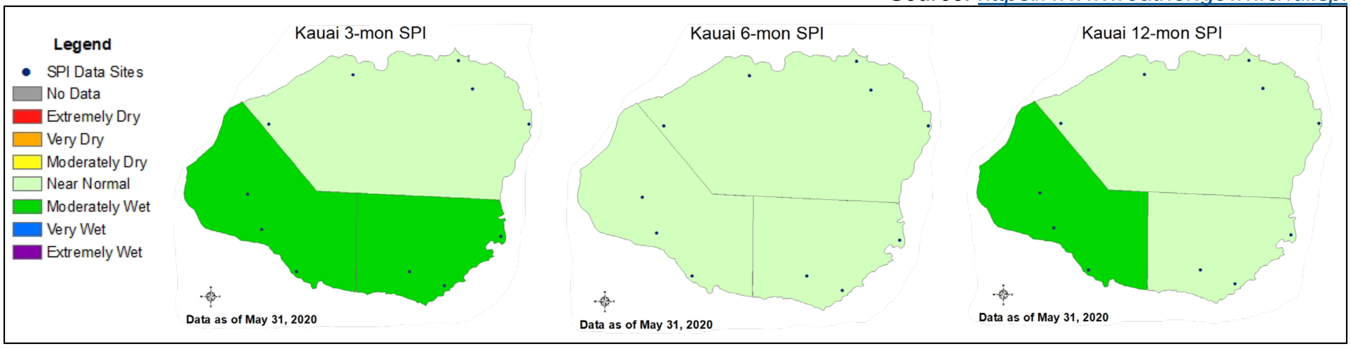


Figure L-31. Island of Kauaʻi SPI Maps, as of May 2020

The Honolulu Forecast Office (HFO) of the National Weather Service (NWS) has tailored SPI software for use in Hawaiʻi. Hawaiʻi's SPI monitoring network includes 58 rain gages, of which 11 are located in Kauaʻi County (NWS, 2020):

- 17 quick-look sites use data from real-time reporting stations in the HFO flash flood monitoring network. They provide data immediately after the end of a month so that SPI values can be quickly determined. Table L-20 provides SPI values at the four quick-look stations in Kauaʻi County through the end of March 2020.
- 41 standard sites are locations from the NWS Cooperative Observer Network. Rainfall readings at these sites are taken manually and submitted via mail after the end of the month.

Table L-20. SPI Values for Kauaʻi County Quick Look Stations as of June 2020

Station	SPI Value						
	1-Month	2-Month	3-Month	6-Month	12-Month	18 Month	24-Month
Līhuʻe AP	-0.53	-0.34	-0.44	0.63	0.75	0.30	0.49
PH Wainiha	-0.97	-0.55	-1.56	0.18	0.04	-0.51	0.30

Source: NWS, 2020b

U.S. Drought Monitor

The U.S. Drought Monitor (USDM) is a map that is updated weekly to show the location and intensity of drought across the country. The USDM uses a five-category system (NIDIS, 2020):

- D0—Abnormally Dry
  - ➢ Short-term dryness slowing planting, growth of crops
  - ➢ Some lingering water deficits
  - ➢ Pastures or crops not fully recovered
- D1—Moderate Drought
  - ➢ Some damage to crops, pastures
  - ➢ Some water shortages developing
  - ➢ Voluntary water-use restrictions requested

- D2—Severe Drought
  - ➢ Crop or pasture loss likely
  - ➢ Water shortages common
  - ➢ Water restrictions imposed
- D3—Extreme Drought
  - ➢ Major crop/pasture losses
  - ➢ Widespread water shortages or restrictions
- D4—Exceptional Drought
  - ➢ Exceptional and widespread crop/pasture losses
  - ➢ Shortages of water creating water emergencies

The USDM categories show experts’ assessments of conditions related to drought. These experts check variables including temperature, soil moisture, water levels in streams and lakes, snow cover, and meltwater runoff. They also check whether areas are showing drought impacts such as water shortages and business interruptions. Associated statistics show what proportion of various geographic areas are in each category of dryness or drought, and how many people are affected. U.S. Drought Monitor data go back to 2000.

Figure L-32 shows the categories in the County of Kaua‘i as of July 7, 2020. On that date, no drought was indicated over most of the northeastern half of the county, abnormally dry conditions affected most of the southwestern half, and moderate drought affected coastal areas around Port Allen.

Source: https://www.drought.gov/drought/states/Hawai‘i

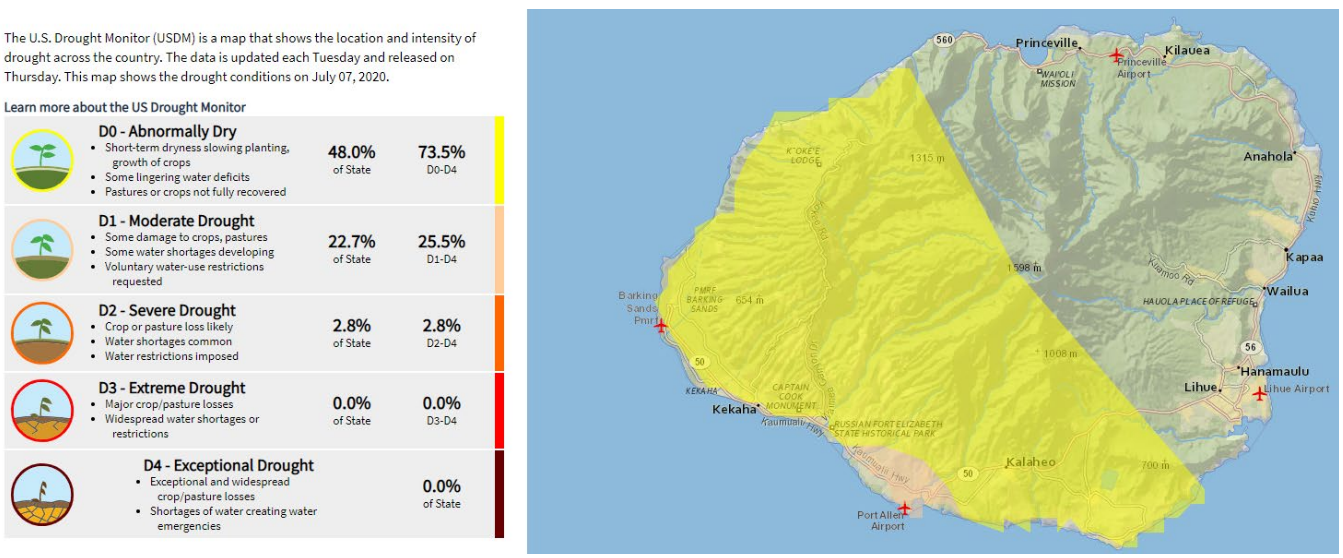


Figure L-32. Island of Kaua‘i U.S. Drought Monitor Map as of July 7,2020

The Drought Severity and Coverage Index (DSCI) is an experimental method for converting drought levels from the USDM map to a single value for an area. DSCI values are part of the U.S. Drought Monitor data tables. Possible values of the DSCI range from 0 to 500. The utility of the DSCI has not yet been widely tested but it provides a convenient way to convert USDM data from categorical to continuous, and to aggregate from spatially specific to geopolitical boundaries.

El Niño and Drought

El Niño and La Niña are opposite phases of the El Niño-Southern Oscillation (ENSO) cycle, which describes fluctuations in ocean and atmosphere temperature in the east-central Equatorial Pacific. La Niña is sometimes referred to as the cold phase of ENSO and El Niño as the warm phase of ENSO. These temperatures deviations can have large-scale impacts on global weather and climate. El Niño and La Niña episodes occur on average every two to seven years and typically last nine to 12 months, though some prolonged events may last for years.

El Niño is a large-scale ocean-atmosphere climate interaction linked to periodic warming in sea surface temperatures across the central and east-central Equatorial Pacific. The presence of El Niño can significantly influence weather patterns, ocean conditions, and marine fisheries across large portions of the globe for an extended period of time (NOAA, 2020).

El Niño events are closely linked to drought conditions in Hawai'i. Records show that there is an approximately 70 percent chance of drought in Hawai'i during the wet season following an El Niño event. Many severe Hawaiian drought events are associated with the El Niño phenomenon (Hawai'i Drought Monitor, 2020). The most severe droughts impacting the Hawaiian Islands have been associated with the El Niño Phenomenon and persistent zones of high-pressure systems throughout the islands (County of Kaua'i, 2015).

During El Niño years, droughts in the State of Hawai'i have occurred during what is normally the winter-spring wet season. For example, in January 1998, the National Weather Service's network of 73 rain gauges throughout the state did not record a single above-normal rainfall, with 36 gages recording less than 25 percent of normal (NWS Honolulu Forecast Office). All reporting stations on Kaua'i had below average precipitation for the month, with the south and southwest sides of the island reporting only 25 to 35 percent of average rainfall (WRCC, 1998).

Hazard Profile

Past Events

Table L-21 summarizes notable heat events in recent years.

Table L-21. Notable Heat Events Since 2014

Year	Area Recorded	Remarks
2014	Līhu'e	High temperatures recorded at the Līhu'e airport broke a record five out of the seven days starting October 10. The high of 88 ºF on October 16 broke the previous record set in 1981. The National Weather Service attributed the heat wave to warm ocean temperatures.
2019	Līhu'e	Every day between August 24 and September 12, high record temperatures were set or surpassed in Līhu'e. Forty-eight days had record highs or ties and 44 nights had record high lows. Sixteen nights stayed above 80 ºF.
2020	Līhu'e	83 days between July 1 and October 18 exceeded normal high temperatures.

Sources: The Washington Post, 2014. HNN, 2019. NWS, 2020

Table L-22 summarizes the history of severe droughts affecting Kaua'i County. Figure L-33 shows cumulative USDM ratings for Kaua'i County since the system began in 2000.

Table L-22. Historical Drought in the Hawaiian Islands

Year	Areas	Remarks
1952	Kaua'i	Long, severe dry spell
1953	Hawai'i, Kaua'i, Maui, O'ahu	Water rationing on Maui water tanks in Kona almost empty; 867 head of cattle died; pineapple production on Moloka'i reduced by 30%; rainfall 40% less than normal on Kaua'i.
1962	Hawai'i and Maui	State declared disaster for islands of Hawai'i and Maui crop damage, cattle deaths, and severe fire hazards; losses totaled $200,000.
1965	Hawai'i	State water emergency declared; losses totaled $400,000.
1971	Hawai'i and Maui	Irrigation and domestic water users sharply curtailed.
1975	Kaua'i and O'ahu	Worst drought for sugar plantations in 15 years.
1977	Hawai'i and Maui	State declared disaster for islands of Hawai'i and Maui
1980-1981	Hawai'i and Maui	State declared disaster; heavy agricultural and cattle losses; damages totaling at least$ 1.4 million
1983-1985	Hawai'i	El Nino effect; State declared disaster; crop production reduced by 80% in Waimea/Kamuela area; $96,000 spent for drought relief projects.
1996	Hawai'i, Maui, Moloka'i	Declared drought emergency; heavy damages to agriculture and cattle industries; losses totaling at least $49.4 million
1998	Hawai'i and Maui	State declared drought emergency for Maui County declared emergency for Hawai'i due to water shortages.
2000 – 2002	Hawai'i, Maui, Moloka'i O'ahu, Kaua'i	Counties declare drought emergencies; Governor proclaims statewide drought emergency; Secretary of Agriculture designates all Counties as primary disaster areas due to drought.
2003	Hawai'i, Maui, Moloka'i, O'ahu, Kaua'i	Secretary of Agriculture designates all Counties as primary disaster areas due to drought (2003); Governor proclaims statewide drought emergency.
2007-2008	State of Hawai'i	D0 (Abnormally dry) to D3 (Extreme drought) covered the entire state; all counties declare drought emergencies; Governor proclaims statewide drought emergency.
2010-2011	Hawai'i, Honolulu, Kaua'i, and Maui	El Niño drought conditions cause all four counties to be designated as Primary Natural Disaster Areas due to losses caused by drought; USDA Farm Service Agency provides assistance. Notable drought areas for Kaua'i County include the windward side from February to December 2010, and November 2011.
2012-2013	Hawai'i, Kaua'i, Maui	Primary Natural Disaster Area due to drought declared for Maui, Kaua'i, and Hawai'i Counties. Windward and leeward sides, from August to December 2012, and January 2013.
2015	Kaua'i	County listed from Abnormally Dry (D0) to Moderate Drought (D1).
2016	Kaua'i	March through June 35-44% of the County experienced Severe Drought (D2).
2017	Kaua'i	Entire County experienced periods listed as Abnormally Dry (D0) to Severe Drought (D2).
2019	Kaua'i	Only one month (November) with no drought listing. All other months experienced D0 to D2 conditions.
2020	Kaua'i	As of July, nearly 60% of the County experiencing Abnormally Dry (D0) conditions.

Sources: County of Kaua'i, 2015. USDM, 2020a. State of Hawai'i, 2017

Source: USDM, 2020b

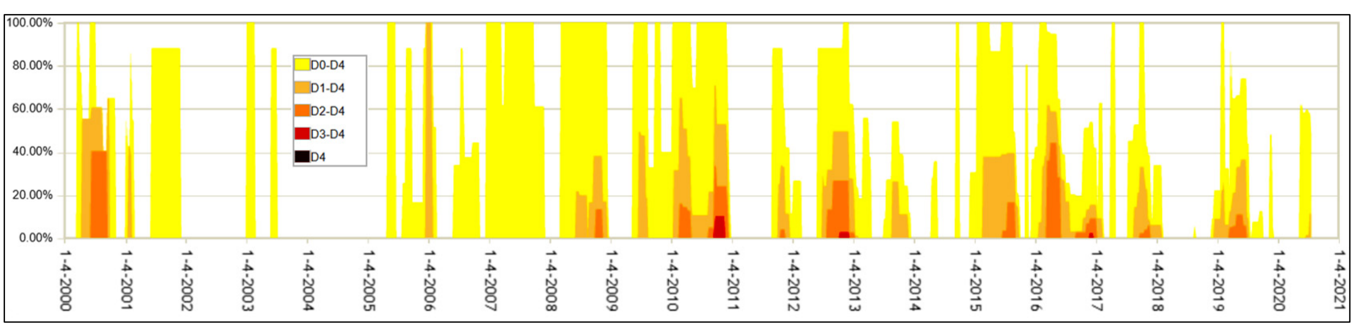


Figure L-33. Percent of Kaua'i County Affected by Each USDM Rating, 2000 – 2020

Location

All areas of Kaua‘i County are susceptible to extreme heat. Rural communities can be disrupted during periods of unusually hot weather. The effects of heat may be exacerbated in the more urban areas such as Līhu‘e due to the urban heat island effect caused by human activity factors such as:

- Modification of land surfaces (vegetation replaced by pavement or buildings)
- Heat generated by the energy required to operate air conditioning or other cooling systems

All areas of Kaua‘i County are susceptible to drought, although the extent and severity of the drought will depend on the variance of rainfall throughout the planning area based on location. The climate, and consequently the amount of rainfall, of the Hawaiian Islands is directly influenced by the northeasterly trade winds. Typically, leeward locations (south and west shores) are much drier and sunnier than windward locations (north and east shores). Within leeward and windward locations, rainfall varies considerably according to elevation (WRCC, 2020).

Rainfall variability is far greater during winter, when occasional storms contribute to rainfall totals, than during summer, when trade-wind showers provide most of the rain. The severe drought years are the ones where the winter rains fail. Although such a deficit of winter storms can affect any portion of the state, it hits hardest in the normally dry areas that depend chiefly on winter rains and receive little rain from the trade wind showers. In these locations, the small amount of rainfall that occurs during the usual dry summer season is insufficient to prevent severe drought (WRCC, 2020).

According to Hawai‘i’s *Drought Risk and Vulnerability Assessment and GIS Mapping Project* Kaua‘i has an extensive water supply system to cover nearly the entire population, but most of the developed lands in Kaua‘i County coincide with low rainfall zones and may be susceptible to drought risk. Specific sector risks are as follows (CWRM, 2003):

- For the water supply sector, the greatest risk area from a regional perspective is in the Kōloa region due to low rainfall and sizable population. Other areas where drought frequency is high include Anahola, Kapa‘a, Wailua, Līhu‘e, and Po‘ipū.
- For the agriculture and commerce sector, the lands in Waimea, between Po‘ipū and Līhu‘e, and in Anahola are at risk.
- For the environment, public health and safety sector, based on past wildland fires, Kaua‘i appears to have the least amount of problems with wildland fires. Most have occurred in the forest reserves of Waimea, away from population concentrations.

Frequency

Official temperature and humidity readings are taken hourly at the NOAA Weather Observation Stations located at the Līhu‘e Airport and at the Pacific Missile Test Facility Barking Sands. News outlets often report on these readings during extreme heat events. Between 2014 and 2020, three multi-day extreme heat events occurred that exceeded previous records. Figure L-34 shows the temperatures at Līhu‘e during the first half of October 2020. Each day, normal high temperatures were exceeded, with many days nearing or meeting record highs.

Hawai‘i’s 2003 *Drought Risk and Vulnerability Assessment and GIS Mapping Project* used GIS mapping to identify areas at risk of drought and assess the environmental and socioeconomic impacts of drought. The assessment included the creation of drought frequency maps for all the main Hawaiian Islands. The maps are a graphical representation of the spatial distribution of historical drought occurrences in the islands. They are available for both a 3-month and 12-month SPI interval for moderate, severe, and extreme drought stages (six maps total).

Source: NWS, 2020f

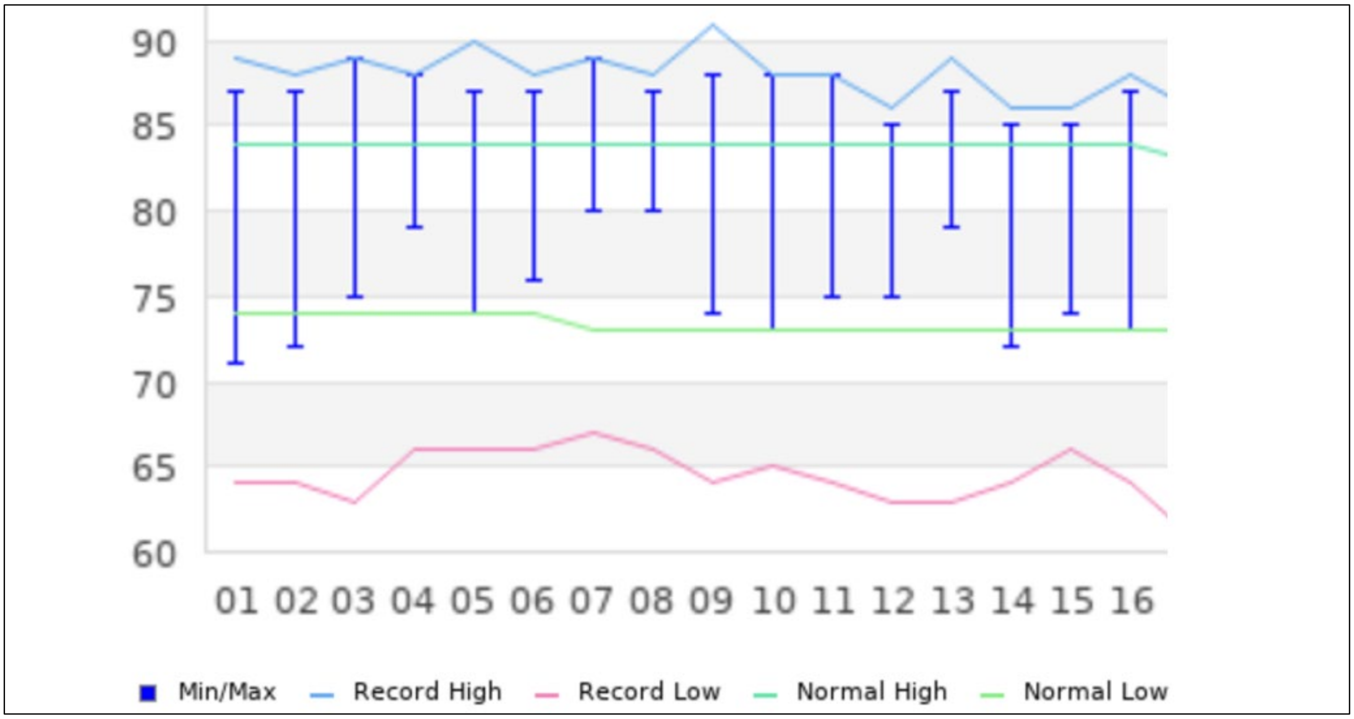


Figure L-34. Līhu'e Temperature Plot. October 1 – 16, 2020

Figure L-35 shows the 3-month and 12-month moderate and severe drought frequency maps for the County of Kaua'i. Contours on the maps indicate the percent of time from 1972 through 2001 that the indicated level of drought occurred (CWRM, 2003).

Severity

Kaua'i has experienced record highs surpassing 90 ºF. Coupled with humidity, the heat index has soared well into the "Extreme Caution" range (see Figure L-29).

The State Koke'e Water System has experienced decreased shallow well capacity due to reduced recharge of perched ground water and increased system water demand due to increased development and population. The system has been exposed to increased risk from wildfires. The Waimea Water System well has shown increased salinity due to heavier pumping and decreased groundwater recharge. The County Department of Water and several private water systems have recorded declining capacity of water sources due to decreased groundwater recharge and increased pumping to meet a higher water demand (County of Kaua'i, 2015).

Warning Time

The National Weather Service issues excessive heat warnings within 12 hours of the onset of extremely dangerous heat conditions. Heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A heat advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. Excessive HEAT OUTLOOKS are issued when the potential exists for an excessive heat event in the next 3 to 7 days.

Source: CWRM, 2003

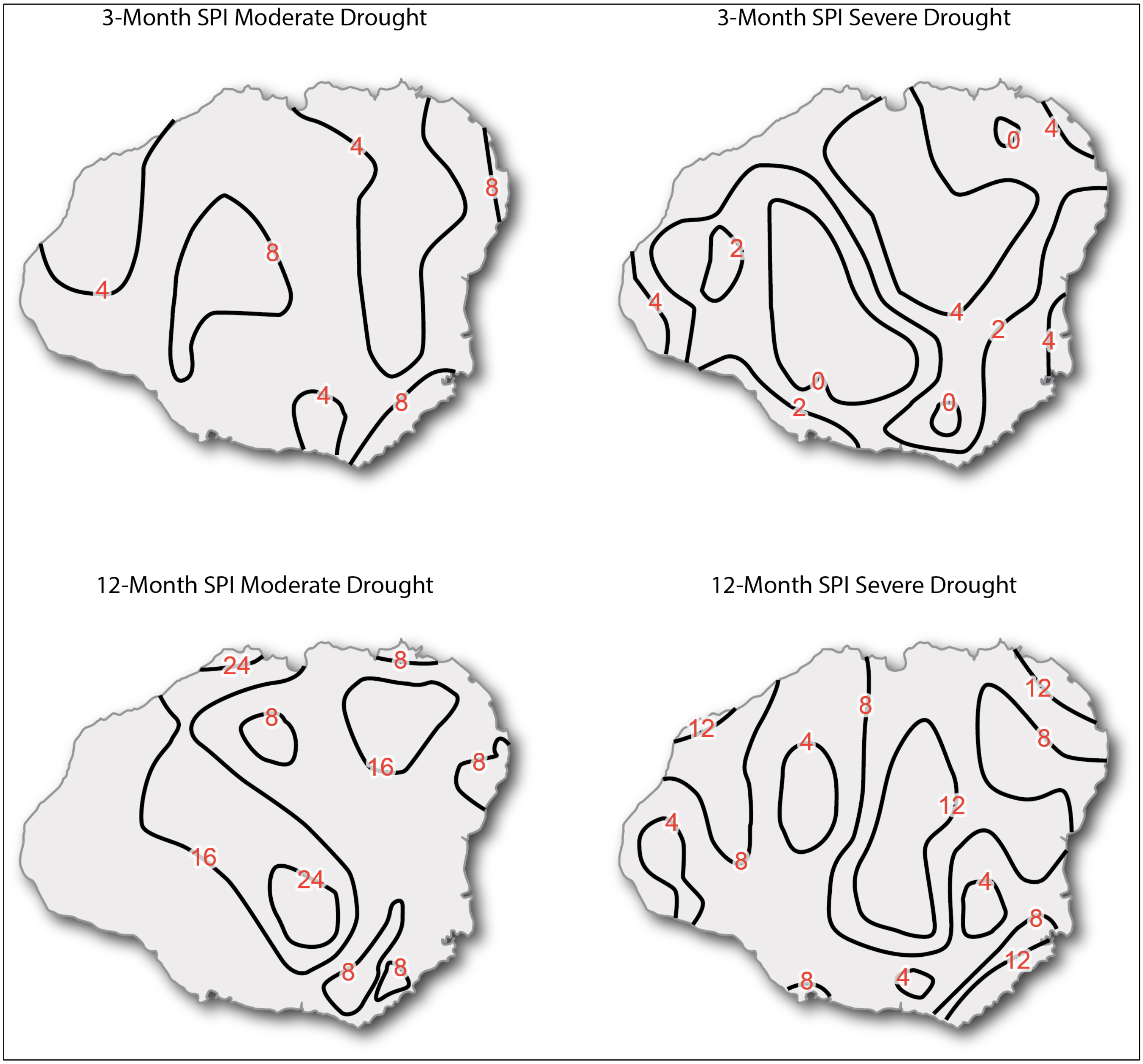


Figure L-35. Percent of Time That Drought Was Experienced, 1972 – 2001

Drought forecasting is necessary to help prepare the state for potentially devastating drought events and forecasting tools have improved over the past few years. The National Oceanographic and Atmospheric Administration's Climate Prediction Center and National Integrated Drought Information System have developed drought forecasting tools and long-lead rainfall outlooks.

The following are key resources for predicting drought (Hawaiʻi Drought Monitor, 2020):

- **U.S. Drought Information**—The National Weather Service Climate Prediction Center (CPC) develops operational predictions of climate variability, real-time monitoring of climate and required data bases, and assessments of the origins of major climate anomalies. The products cover time scales from a week to seasons, extending into the future as far as technically feasible, and cover the land, the ocean, and the atmosphere, extending into the stratosphere. The CPC's U.S. Monthly Drought Outlook and the U.S. Seasonal Drought Outlook include the Hawaiian Islands.

- **El Niño Diagnostic Discussion—**Many severe Hawaiian drought events are associated with the El Niño phenomenon. The CPC offers a monthly El Niño/Southern Oscillation (ENSO) Diagnostic Discussion and a weekly ENSO update.
- **Tropical Pacific Islands Rainfall Outlooks—**The CPC produces a suite of short and long-range precipitation forecasts for Hawai'i and the tropical Pacific islands, including maps showing estimates of rainfall anomalies.
- **The U.S. Drought Monitor**—The USDM provides current and recent history of areas and populations affected by drought.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Anomalies of precipitation and temperature may last from several months to several decades, depending on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale. However, meteorologists have made significant advances in understanding the climate system in the tropics. It is now known that a major portion of the atmospheric variability that occurs on time scales of months to several years is associated with variations in tropical sea surface temperatures.

The Tropical Ocean Global Atmosphere project has produced results that point to the possibility of predicting certain climatic conditions associated with ENSO events more than a year in advance. Since El Niño events are closely linked to drought conditions in Hawai'i, this project's results may help produce more reliable meteorological forecasts that can reduce risks in those economic sectors most sensitive to climate variability and, particularly, extreme events such as drought.

Secondary Hazards

Heatwaves can burden health and emergency services and increase strains on water, energy and transportation, resulting in power outages. Food and livelihood security may be strained if people lose their crops or livestock due to extreme heat.

The secondary hazard most commonly associated with heat and drought is wildfire. High temperatures and prolonged lack of precipitation can dry out vegetation, which becomes increasingly susceptible to ignition as the duration of the warm dry weather extends.

Appendix M. Detailed Risk Assessment Results

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Category 4 storm surge data provided by NOAA.
(4) Percent of residential buildings exposed multiplied by the Estimated Population.

`

Jurisdiction	Category 4 Hurricane Storm Surge (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	1,614	3,256	15.17%	540,448,929	406,454,144	946,903,073	25.70%
Hanapepe-Eleele	276	808	12.39%	59,757,805	43,124,478	102,882,283	11.56%
Koloa-Poipu-Kalaheo	14	18	0.15%	15,427,269	8,972,824	24,400,092	0.56%
Lihue	505	1,330	7.55%	59,355,761	35,621,170	94,976,932	1.46%
North Shore	241	306	4.22%	53,011,907	28,073,601	81,085,508	1.98%
Waimea	1,062	2,363	48.21%	225,946,205	148,617,436	374,563,641	43.91%
Total	**3,712**	**8,081**	**11.60%**	**953,947,875**	**670,863,654**	**1,624,811,529**	**7.96%**

-year estimates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

Jurisdiction	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	1,376	202	32	0	4	0	0	1,614
Hanapepe-Eleele	218	52	4	0	2	0	0	276
Koloa-Poipu-Kalaheo	12	2	0	0	0	0	0	14
Lihue	483	12	9	0	1	0	0	505
North Shore	236	4	1	0	0	0	0	241
Waimea	997	50	15	0	0	0	0	1,062
Total	**3,322**	**322**	**61**	**0**	**7**	**0**	**0**	**3,712**

Jurisdiction	Estimated Exposure				
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed
East Kauai	21,459	100%	9,371	$3,684,931,500	100%
Hanapepe-Eleele	6,526	100%	1,899	$890,307,898	100%
Koloa-Poipu-Kalaheo	11,949	100%	8,123	$4,383,192,487	100%
Lihue	17,608	100%	7,320	$6,484,552,718	100%
North Shore	7,248	100%	5,795	$4,103,681,163	100%
Waimea	4,901	100%	2,187	$853,099,377	100%
TOTAL	**69,691**	100%	**34,695**	**$20,399,765,142**	100%

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5-year estimates. Downloaded from
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.

Jurisdiction	Economic Impact						
	Structure Debris (Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)	Value Structure in $ Damaged (3)	Value Contents in $ Damaged (3)	Total Value (Structure and Contents in $) Damaged (3)	% of Total Value Damaged
East Kauai	154,300	4,285	2,673	$1,190,018,851	$559,142,312	$1,749,161,163	47.5%
Hanapepe-Eleele	32,770	1,169	792	$249,015,513	$141,111,603	$390,127,116	43.8%
Koloa-Poipu-Kalaheo	162,347	2,640	1,679	$1,321,531,369	$639,995,430	$1,961,526,799	44.8%
Lihue	188,263	3,267	2,216	$1,880,106,649	$1,203,058,042	$3,083,164,691	47.5%
North Shore	116,208	1,594	985	$1,112,355,693	$459,136,964	$1,571,492,658	38.3%
Waimea	31,794	1,147	784	$232,315,071	$122,149,577	$354,464,648	41.6%
TOTAL	**685,682**	**14,102**	**9,129**	**$5,985,343,147**	**$3,124,593,928**	**9,109,937,075**	44.7%

Hawaii Statewide GIS Program Geospatial Data Portal.

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
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Total	**69,691**	**34,695**	**32,681**	**$20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5-year esti
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, a
(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

Jurisdiction	Estimated Building Exposure						
	Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
East Kauai	476	932	4.3%	$213,942,681	$173,086,202	$387,028,883	10.5%
Hanapepe-Eleele	316	901	13.8%	$85,157,012	$67,750,871	$152,907,883	17.2%
Koloa-Poipu-Kalaheo	1,076	1,570	13.1%	$424,763,846	$239,827,749	$664,591,595	15.2%
Lihue	234	485	2.8%	$87,526,377	$73,046,205	$160,572,582	2.5%
North Shore	413	479	6.6%	$112,352,270	$77,406,839	$189,759,110	4.6%
Waimea	1,093	2,429	49.6%	$257,169,130	$164,529,913	$421,699,043	49.4%
Total	**3,608**	**6,796**	**9.8%**	**$1,180,911,317**	**$795,647,779**	**$1,976,559,096**	**9.7%**

mates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

nd adjusted to reflect the estimated population.

Jurisdiction	Economic Impact								
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged	Acres of Floodplain
East Kauai	11,647	129	8	408	$14,597,083	$16,984,227	$31,581,310	0.9%	1,538
Hanapepe-Eleele	5,142	422	22	284	$10,829,632	$18,683,114	$29,512,745	3.3%	506
Koloa-Poipu-Kalaheo	6,737	166	4	1,005	$30,485,703	$26,787,567	$57,273,270	1.3%	1,170
Lihue	4,990	79	3	164	$14,118,562	$31,296,050	$45,414,612	0.7%	1,095
North Shore	36,648	148	11	375	$11,995,998	$12,334,790	$24,330,787	0.6%	2,063
Waimea	9,108	1,519	85	855	$31,829,472	$28,048,905	$59,878,377	7.0%	4,375
Total	**74,273**	**2,463**	**133**	**3,091**	**$113,856,450**	**$134,134,652**	**$247,991,102**	**1.2%**	**10,746**

Jurisdiction	Number of Structures in Floodplain (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	394	60	18	0	1	0	3	476
Hanapepe-Eleele	243	66	5	0	2	0	0	316
Koloa-Poipu-Kalaheo	1,025	43	3	0	5	0	0	1076
Lihue	176	50	7	0	1	0	0	234
North Shore	369	30	13	0	1	0	0	413
Waimea	1,025	50	17	0	1	0	0	1093
Total	**3,232**	**299**	**63**	**0**	**11**	**0**	**3**	**3608**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**20,399,765,142**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Communities at Risk from Wildfire data provided by the Hawaii Wildfire Management C
(4) Percent of residential buildings exposed multiplied by the Estimated Population.

Jurisdiction	Communities At Risk Fire Risk Rating Level High (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	6,905	15,655	73.0%	$1,776,411,378	$1,070,047,296	$2,846,458,674	77.2%
Hanapepe-Eleele	1,794	6,263	96.0%	$403,956,073	$266,737,141	$670,693,215	75.3%
Koloa-Poipu-Kalaheo	5,501	8,139	68.1%	$1,840,766,390	$1,066,325,869	$2,907,092,259	66.3%
Lihue	4,089	9,624	54.7%	$2,643,627,218	$2,105,612,797	$4,749,240,015	73.2%
North Shore	75	95	1.3%	$20,717,810	$10,979,319	$31,697,129	0.8%
Waimea	1,982	4,467	91.2%	$445,915,963	$282,795,382	$728,711,345	85.4%
Total	**20,346**	**44,244**	**63.5%**	**$7,131,394,833**	**$4,802,497,804**	**$11,933,892,637**	**58.5%**

Jurisdiction	Communities At Risk Fire Risk Rating Level Medium (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	2,284	5,392	25.1%	$510,451,557	$256,145,276	$766,596,833	20.8%
Hanapepe-Eleele	0	0	0.0%	$0	$0	$0	0.0%
Koloa-Poipu-Kalaheo	707	1,048	8.8%	$151,504,568	$86,847,186	$238,351,754	5.4%
Lihue	987	2,646	15.0%	$261,825,310	$137,608,822	$399,434,132	6.2%
North Shore	0	0	0.0%	$0	$0	$0	0.0%
Waimea	0	0	0.0%	$0	$0	$0	0.0%
Total	**3,978**	**9,085**	**13.0%**	**$923,781,435**	**$480,601,283**	**$1,404,382,719**	**6.9%**

-year estimates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

rganization (HWMO).

Jurisdiction	Number of Structures in Risk Rating Level High (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	6,617	236	40	0	9	0	3	6,905
Hanapepe-Eleele	1,689	87	14	0	4	0	0	1,794
Koloa-Poipu-Kalaheo	5,313	161	15	2	10	0	0	5,501
Lihue	3,496	446	132	0	14	0	1	4,089
North Shore	73	0	0	0	0	0	2	75
Waimea	1,885	69	22	0	5	0	1	1,982
Total	**19,073**	**999**	**223**	**2**	**42**	**0**	**7**	**20,346**

Jurisdiction	Number of Structures in Risk Rating Level Medium (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	2,279	5	0	0	0	0	0	2,284
Hanapepe-Eleele	0	0	0	0	0	0	0	0
Koloa-Poipu-Kalaheo	684	12	11	0	0	0	0	707
Lihue	961	19	6	0	1	0	0	987
North Shore	0	0	0	0	0	0	0	0
Waimea	0	0	0	0	0	0	0	0
Total	**3,924**	**36**	**17**	**0**	**1**	**0**	**0**	**3,978**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Sea Level Rise Exposure Area (SLR-XA) 3.2ft from the 2017 Hawaii Sea Level Rise Vul

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Jurisdiction	SLR Future Chronic Coastal Flood (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	440	963	4.49%	97,419,982	61,997,250	159,417,232	4.33%
Hanapepe-Eleele	101	367	5.63%	16,742,632	8,951,119	25,693,751	2.89%
Koloa-Poipu-Kalaheo	22	34	0.28%	27,220,978	13,610,489	40,831,466	0.93%
Lihue	167	418	2.38%	28,110,291	19,503,350	47,613,641	0.73%
North Shore	257	330	4.55%	62,822,656	32,871,760	95,694,416	2.33%
Waimea	268	578	11.80%	76,090,982	49,381,353	125,472,335	14.71%
Total	**1,255**	**2,690**	**3.86%**	**308,407,522**	**186,315,321**	**494,722,842**	**2.43%**

-year estimates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

nerability and Adaptation Report.

Jurisdiction	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	407	26	7	0	0	0	0	440
Hanapepe-Eleele	99	2	0	0	0	0	0	101
Koloa-Poipu-Kalaheo	22	0	0	0	0	0	0	22
Lihue	152	14	0	0	1	0	0	167
North Shore	254	3	0	0	0	0	0	257
Waimea	244	23	1	0	0	0	0	268
Total	**1,178**	**68**	**8**	**0**	**1**	**0**	**0**	**1,255**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**$20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5-year esti
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, a
(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

Jurisdiction	Estimated Building Exposure						
	Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
East Kauai	73	170	0.8%	$15,916,560	$8,326,684	$24,243,243	0.7%
Hanapepe-Eleele	5	19	0.3%	$1,062,392	$531,196	$1,593,588	0.2%
Koloa-Poipu-Kalaheo	45	69	0.6%	$17,947,184	$8,973,592	$26,920,777	0.6%
Lihue	5	0	0.0%	$9,641,492	$9,641,492	$19,282,985	0.3%
North Shore	451	581	8.0%	$152,249,345	$77,585,104	$229,834,449	5.6%
Waimea	14	33	0.7%	$2,669,377	$1,334,689	$4,004,066	0.5%
Total	**593**	**872**	**1.3%**	**$199,486,350**	**$106,392,757**	**$305,879,108**	**1.5%**

mates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

nd adjusted to reflect the estimated population.

Jurisdiction	Economic Impact								
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged	Acres of Floodplain
East Kauai	2,326	11	0	54	$2,037,902	$937,008	$2,974,910	0.1%	249
Hanapepe-Eleele	183	1	0	5	$115,859	$51,424	$167,283	0.0%	117
Koloa-Poipu-Kalaheo	8,932	6	0	40	$1,836,440	$826,965	$2,663,405	0.1%	246
Lihue	1,895	0	0	0	$0	$0	$0	0.0%	283
North Shore	21,673	110	9	429	$21,438,343	$12,430,935	$33,869,279	0.8%	656
Waimea	461	5	0	7	$480,615	$231,129	$711,743	0.1%	1,075
Total	**35,469**	**134**	**9**	**535**	**$25,909,159**	**$14,477,461**	**$40,386,620**	**0.2%**	**2,627**

Jurisdiction	Number of Structures in Floodplain (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	72	1	0	0	0	0	0	73
Hanapepe-Eleele	5	0	0	0	0	0	0	5
Koloa-Poipu-Kalaheo	45	0	0	0	0	0	0	45
Lihue	0	4	0	0	1	0	0	5
North Shore	448	3	0	0	0	0	0	451
Waimea	14	0	0	0	0	0	0	14
Total	**584**	**8**	**0**	**0**	**1**	**0**	**0**	**593**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) 1%-Annual-Chance Coastal Flood Zone (1%CFZ) + 3.2ft SLR from the 2017 Hawaii Sea
(4) Percent of residential buildings exposed multiplied by the Estimated Population.

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Jurisdiction	Event-based Coastal Flood Plus SLR (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	2,336	4,893	22.80%	903,151,793	602,005,428	1,505,157,220	40.85%
Hanapepe-Eleele	345	971	14.89%	103,463,253	90,140,841	193,604,093	21.75%
Koloa-Poipu-Kalaheo	1,322	1,979	16.56%	505,270,336	279,678,491	784,948,826	17.91%
Lihue	1,654	4,187	23.78%	1,026,183,190	614,864,149	1,641,047,339	25.31%
North Shore	1,037	1,284	17.72%	303,205,956	174,294,114	477,500,071	11.64%
Waimea	1,754	3,906	79.69%	417,371,785	284,323,979	701,695,764	82.25%
Total	**8,448**	**17,221**	**24.71%**	**3,258,646,313**	**2,045,307,001**	**5,303,953,314**	**26.00%**

-year estimates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

Level Rise Vulnerability and Adaptation Report.

Jurisdiction	Number of Structures in Hazard Area (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	2,068	226	32	0	7	0	3	2,336
Hanapepe-Eleele	262	73	8	0	2	0	0	345
Koloa-Poipu-Kalaheo	1,292	26	1	0	3	0	0	1,322
Lihue	1,521	105	25	0	3	0	0	1,654
North Shore	990	33	13	0	1	0	0	1,037
Waimea	1,648	71	30	0	4	0	1	1,754
Total	**7,781**	**534**	**109**	**0**	**20**	**0**	**4**	**8,448**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**$20,399,765,142**

Sources:

(1) 2015 Census Block Groups with population figures from American Community Survey 5-year esti

(2) Values based off of 2020 parcel and real property data provided by Kauai County.

(3) Percent of residential buildings exposed multiplied by the Estimated Population.

(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.

(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, a

(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

Jurisdiction	Estimated Building Exposure						
	Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
East Kauai	2,093	4,353	20.3%	$854,538,926	$573,935,780	$1,428,474,706	38.8%
Hanapepe-Eleele	191	578	8.9%	$40,058,837	$27,876,756	$67,935,593	7.6%
Koloa-Poipu-Kalaheo	71	106	0.9%	$191,347,140	$102,292,175	$293,639,315	6.7%
Lihue	687	1,743	9.9%	$107,934,876	$78,288,571	$186,223,448	2.9%
North Shore	1,034	1,280	17.7%	$301,973,565	$173,677,919	$475,651,484	11.6%
Waimea	1,063	2,351	48.0%	$256,950,324	$175,399,127	$432,349,451	50.7%
Total	**5,139**	**10,411**	**14.9%**	**$1,752,803,669**	**$1,131,470,328**	**$2,884,273,996**	**14.1%**

mates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

nd adjusted to reflect the estimated population.

Jurisdiction	Economic Impact								
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged	Acres of Floodplain
East Kauai	129	1,142	92	1,909	$209,979,137	$240,445,793	$450,424,930	12.2%	1,636
Hanapepe-Eleele	1	188	9	74	$2,086,589	$2,374,005	$4,460,594	0.5%	368
Koloa-Poipu-Kalaheo	9	11	0	16	$2,922,175	$1,461,263	$4,383,439	0.1%	273
Lihue	8	162	4	621	$16,892,524	$19,127,447	$36,019,971	0.6%	881
North Shore	369	461	41	990	$197,706,145	$123,969,718	$321,675,863	7.8%	2,681
Waimea	8	1,460	83	373	$18,402,751	$10,285,870	$28,688,622	3.4%	7,406
Total	**525**	**3,424**	**228**	**3,983**	**$447,989,321**	**$397,664,097**	**$845,653,418**	**4.1%**	**13,245**

Jurisdiction	Number of Structures in Floodplain (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	1,840	213	32	0	5	0	3	2093
Hanapepe-Eleele	156	30	4	0	1	0	0	191
Koloa-Poipu-Kalaheo	69	2	0	0	0	0	0	71
Lihue	633	41	12	0	1	0	0	687
North Shore	987	33	13	0	1	0	0	1034
Waimea	992	47	23	0	1	0	0	1063
Total	**4,677**	**366**	**84**	**0**	**9**	**0**	**3**	**5139**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
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Total	**69,691**	**34,695**	**32,681**	**20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Slope data created from USGS 10m DEM and NOAA coastal 3m DEM.
(4) Percent of residential buildings exposed multiplied by the Estimated Population.

Jurisdiction	Landslide Hazard - High (greater than 40% slope) (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	45	106	0.5%	$11,112,028	$5,556,014	$16,668,042	0.5%
Hanapepe-Eleele	3	11	0.2%	$1,053,195	$526,598	$1,579,793	0.2%
Koloa-Poipu-Kalaheo	65	100	0.8%	$15,714,434	$7,857,217	$23,571,651	0.5%
Lihue	26	72	0.4%	$9,464,620	$4,732,310	$14,196,930	0.2%
North Shore	18	23	0.3%	$4,091,627	$2,045,813	$6,137,440	0.1%
Waimea	18	43	0.9%	$1,783,002	$891,501	$2,674,502	0.3%
Total	**175**	**355**	**0.5%**	**$43,218,906**	**$21,609,453**	**$64,828,359**	**0.3%**

Jurisdiction	Landslide Hazard - Moderate (20 - 40% slope) (3)						
	Estimated Exposure						
	Estimated Buildings Exposed (2)	Population Exposed (4)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value
East Kauai	375	887	4.1%	$77,794,944	$38,897,472	$116,692,417	3.2%
Hanapepe-Eleele	116	415	6.4%	$22,753,312	$12,498,413	$35,251,725	4.0%
Koloa-Poipu-Kalaheo	459	694	5.8%	$115,486,507	$61,740,212	$177,226,719	4.0%
Lihue	66	149	0.8%	$32,791,130	$26,747,892	$59,539,023	0.9%
North Shore	222	287	4.0%	$67,147,964	$34,089,857	$101,237,821	2.5%
Waimea	57	130	2.7%	$8,252,547	$4,851,690	$13,104,237	1.5%
Total	**1,295**	**2,562**	**3.7%**	**$324,226,405**	**$178,825,536**	**$503,051,941**	**2.5%**

-year estimates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

Jurisdiction	Number of Structures in High (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	45	0	0	0	0	0	0	45
Hanapepe-Eleele	3	0	0	0	0	0	0	3
Koloa-Poipu-Kalaheo	65	0	0	0	0	0	0	65
Lihue	26	0	0	0	0	0	0	26
North Shore	18	0	0	0	0	0	0	18
Waimea	18	0	0	0	0	0	0	18
Total	**175**	**0**	**0**	**0**	**0**	**0**	**0**	**175**

Jurisdiction	Number of Structures in Moderate (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	375	0	0	0	0	0	0	375
Hanapepe-Eleele	112	4	0	0	0	0	0	116
Koloa-Poipu-Kalaheo	453	0	6	0	0	0	0	459
Lihue	54	10	2	0	0	0	0	66
North Shore	221	0	1	0	0	0	0	222
Waimea	55	1	1	0	0	0	0	57
Total	**1,270**	**15**	**10**	**0**	**0**	**0**	**0**	**1,295**

Jurisdiction	Estimated Population (1)	Total Number of Buildings (2)	Total Number of Residential Buildings (2)	Total Building Value (Structure and contents in $) (2)
East Kauai	21,459	9,371	9,070	$3,684,931,500
Hanapepe-Eleele	6,526	1,899	1,760	$890,307,898
Koloa-Poipu-Kalaheo	11,949	8,123	7,800	$4,383,192,487
Lihue	17,608	7,320	6,396	$6,484,552,718
North Shore	7,248	5,795	5,587	$4,103,681,163
Waimea	4,901	2,187	2,068	$853,099,377
Total	**69,691**	**34,695**	**32,681**	**$20,399,765,142**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5-year esti
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Percent of residential buildings exposed multiplied by the Estimated Population.
(4) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03.
(5) Calculated using a Census block level, general building stock (GBS) analysis in Hazus 4.2 SP03, a
(6) Calculated using a user-defined (UDF) analysis in Hazus 4.2 SP03.

Jurisdiction	Estimated Building Exposure						
	Buildings Exposed (2)	Population Exposed (3)	% of Population Exposed	Value Structure in $ Exposed (2)	Value Contents in $ Exposed (2)	Value (Structure and contents in $) Exposed (2)	% of Total Value Exposed
East Kauai	0	0	0.0%	$0	$0	$0	0.0%
Hanapepe-Eleele	0	0	0.0%	$0	$0	$0	0.0%
Koloa-Poipu-Kalaheo	2,173	3,174	26.6%	$693,052,280	$394,543,510	$1,087,595,790	24.8%
Lihue	32	58	0.3%	$6,747,147	$6,580,971	$13,328,119	0.2%
North Shore	0	0	0.0%	$0	$0	$0	0.0%
Waimea	0	0	0.0%	$0	$0	$0	0.0%
Total	**2,205**	**3,232**	**4.6%**	**$699,799,427**	**$401,124,481**	**$1,100,923,908**	**5.4%**

mates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.

nd adjusted to reflect the estimated population.

Jurisdiction	Economic Impact								
	Structure Debris (Tons) (4)	Displaced Population (5)	People Requiring Short-Term Shelter (5)	Buildings Impacted (6)	Value Structure in $ Damaged (6)	Value Contents in $ Damaged (6)	Total Value (Structure and Contents in $) Damaged (6)	% of Total Value Damaged	Acres of Floodplain
East Kauai	0	0	0	0	$0	$0	$0	0.0%	0
Hanapepe-Eleele	0	0	0	0	$0	$0	$0	0.0%	0
Koloa-Poipu-Kalaheo	17,642	1,720	108	1,653	$65,397,324	$45,059,957	$110,457,280	2.5%	1,815
Lihue	757	3	0	25	$2,035,815	$3,928,281	$5,964,095	0.1%	458
North Shore	0	0	0	0	$0	$0	$0	0.0%	0
Waimea	0	0	0	0	$0	$0	$0	0.0%	0
Total	**18,399**	**1,723**	**109**	**1,678**	**$67,433,138**	**$48,988,237**	**$116,421,376**	**0.6%**	**2,273**

Jurisdiction	Number of Structures in Floodplain (2)							
	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
East Kauai	0	0	0	0	0	0	0	0
Hanapepe-Eleele	0	0	0	0	0	0	0	0
Koloa-Poipu-Kalaheo	2,072	92	4	0	5	0	0	2173
Lihue	21	5	6	0	0	0	0	32
North Shore	0	0	0	0	0	0	0	0
Waimea	0	0	0	0	0	0	0	0
Total	**2,093**	**97**	**10**	**0**	**5**	**0**	**0**	**2205**

Jurisdiction	Estimated Exposure							
	Estimated Population (1)	% Population Exposed	Total Number of Buildings (2)	Total Building Value (Structure and contents in $) (2)	% of Total Value Exposed	Structure Debris (x 1,000 Tons) (3)	Number of Displaced Households (3)	People Requiring Short-Term Shelter (3)
East Kauai	21,459	100%	9,371	$3,684,931,500	100%	0.25	0	0
Hanapepe-Eleele	6,526	100%	1,899	$890,307,898	100%	0.07	0	0
Koloa-Poipu-Kalaheo	11,949	100%	8,123	$4,383,192,487	100%	0.28	0	0
Lihue	17,608	100%	7,320	$6,484,552,718	100%	0.90	0	0
North Shore	7,248	100%	5,795	$4,103,681,163	100%	0.12	0	0
Waimea	4,901	100%	2,187	$853,099,377	100%	0.07	0	0
TOTAL	**69,691**	100%	**34,695**	**$20,399,765,142**	100%	**1.67**	**0**	**0**

Sources:
(1) 2015 Census Block Groups with population figures from American Community Survey 5-year estimates. Downloaded from Hawaii Statewide GIS Program Geospatial Data Portal.
(2) Values based off of 2020 parcel and real property data provided by Kauai County.
(3) Calculated using a Census tract level, general building stock (GBS) analysis in Hazus 4.2 SP03.
(4) Calculated using an Advanced Engineering Building Model (AEBM) analysis in Hazus 4.2 SP03.

Jurisdiction	Economic Impact			
	Value Structure in $ Damaged (4)	Value Contents in $ Damaged (4)	Total Value (Structure and Contents in $) Damaged (4)	% of Total Value Damaged
East Kauai	$193,680	$149,363	$343,044	0.0%
Hanapepe-Eleele	$29,625	$26,051	$55,676	0.0%
Koloa-Poipu-Kalaheo	$133,230	$110,014	$243,243	0.0%
Lihue	$387,536	$348,300	$735,836	0.0%
North Shore	$61,367	$48,236	$109,603	0.0%
Waimea	$20,597	$17,189	$37,786	0.0%
TOTAL	**$826,035**	**$699,152**	**1,525,188**	0.0%

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix N. Mitigation Best Practices Catalogs

N. MITIGATION BEST PRACTICES CATALOGS

BEST PRACTICES CATALOGS

Catalogs of hazard mitigation alternatives were developed that present a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR (Section 201.6(c)(3)(ii)). One catalog was developed for each hazard of concern evaluated in this plan. The catalogs for each hazard are listed in Table N-1 through Table N-10 (in alphabetical order). The catalogs present alternatives that are categorized in two ways:

- By what the alternative would do:
  - Manipulate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
  - Build local capacity to respond to or prepare for the hazard
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government.

Table N-1. Potential Mitigation Actions for Climate Change

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ Modify at-home practices to reduce carbon footprint • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Elevate home above potential sea level rise levels • **Build local capacity to respond to or prepare for the hazard:** ❖ Become educated about the climate change hazard and ways to reduce greenhouse gas emissions ❖ Create a retrofit savings account	• **Manipulate the hazard:** ❖ Modify business practices to reduce carbon footprint • **Reduce exposure to the hazard:** ❖ Preserve open space to benefit natural resources and reduce risk to structures from potential sea level rise • **Reduce vulnerability to the hazard:** ❖ Retrofit structures to elevate them above potential sea level rise levels • **Build local capacity to respond to or prepare for the hazard:** ❖ Educate employees about the climate change hazard and ways to reduce greenhouse gas emissions ❖ Solicit cost-sharing through partnerships with others on projects with multiple benefits.	• **Manipulate the hazard:** ❖ Adopt goals and policies for reduction of greenhouse gases • **Reduce exposure to the hazard:** ❖ Manage development in areas at risk of sea level rise ❖ Prevent infrastructure expansion in areas at risk of sea level rise ❖ Acquire and demolish or relocate structures in areas at risk of sea level rise ❖ Preserve open space to benefit natural resources and reduce risk to structures from potential sea level rise ❖ Examine the appropriate use of beach nourishment, sand scraping, dune-gap plugs, etc., for coastal hazards. ❖ Implement dune restoration, plantings, and use of natural materials. ❖ Examine the appropriate use of sediment-trapping vegetation, sediment mounds, etc., for coastal hazards. ❖ Plant sediment-trapping vegetation to buffer the coast against coastal storms by collecting sediment in protective features such as dunes. ❖ Use bulldozers to deposit the top foot of sand above the high-tide line—to reinforce the beach without adding new sand. • **Reduce vulnerability to the hazard:** ❖ Retrofit structures to elevate them above potential sea level rise levels • **Build local capacity to respond to or prepare for the hazard:** ❖ Map and assess vulnerability to sea level rise ❖ Improve public awareness of risks due to sea level rise through outreach activities

Table N-2. Potential Mitigation Actions for Dam Failure

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Relocate out of dam failure inundation areas • **Reduce vulnerability to the hazard:** ❖ Elevate home to appropriate levels • **Build local capacity to respond to or prepare for the hazard:** ❖ Learn about risk reduction for the dam failure hazard ❖ Learn the evacuation routes for a dam failure event ❖ Educate yourself on early warning systems and the dissemination of warnings	• **Manipulate the hazard:** ❖ Remove dams ❖ Harden dams • **Reduce exposure to the hazard:** ❖ Replace earthen dams with hardened structures • **Reduce vulnerability to the hazard:** ❖ Flood-proof facilities within dam failure inundation areas • **Build local capacity to respond to or prepare for the hazard:** ❖ Educate employees on the probable impacts of a dam failure ❖ Develop a continuity of operations plan	• **Manipulate the hazard:** ❖ Remove dams ❖ Harden dams • **Reduce exposure to the hazard:** ❖ Replace earthen dams with hardened structures ❖ Relocate critical facilities out of dam failure inundation areas ❖ Consider open space land use in designated dam failure inundation areas • **Reduce vulnerability to the hazard:** ❖ Adopt higher floodplain standards in mapped dam failure inundation areas ❖ Retrofit critical facilities within dam failure inundation areas • **Build local capacity to respond to or prepare for the hazard:** ❖ Map dam failure inundation areas ❖ Enhance emergency operations plan to include a dam failure component ❖ Institute monthly communications checks with dam operators ❖ Inform the public on risk reduction techniques ❖ Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas ❖ Consider the probable impacts of climate change in assessing the risk associated with the dam failure hazard ❖ Establish early warning capability downstream of listed high hazard dams ❖ Consider the residual risk associated with protection provided by dams in future land use decisions

Table N-3. Potential Mitigation Actions for Earthquake

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area (off soft soils) • **Reduce vulnerability to the hazard:** ❖ Retrofit structure (anchor house structure to foundation) ❖ Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) ❖ Build to higher design • **Build local capacity to respond to or prepare for the hazard:** ❖ Practice "drop, cover, and hold" ❖ Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event ❖ Keep cash reserves for reconstruction ❖ Become informed on the hazard and risk reduction alternatives available. ❖ Develop a post-disaster action plan for your household	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate or relocate mission-critical functions outside hazard area where possible • **Reduce vulnerability to the hazard:** ❖ Build redundancy for critical functions and facilities ❖ Retrofit critical buildings and areas housing mission-critical functions • **Build local capacity to respond to or prepare for the hazard:** ❖ Adopt higher standard for new construction; consider "performance-based design" when building new structures ❖ Keep cash reserves for reconstruction ❖ Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. ❖ Develop a continuity of operations plan	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate critical facilities or functions outside hazard area where possible • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure ❖ Provide redundancy for critical functions ❖ Adopt higher regulatory standards • **Build local capacity to respond to or prepare for the hazard:** ❖ Provide better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (e.g., tax incentives, information) ❖ Include retrofitting and replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components such as pipe, power line, and road repair materials ❖ Develop and adopt a continuity of operations plan ❖ Initiate triggers guiding improvements (such as <50% substantial damage or improvements) ❖ Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. ❖ Develop a post-disaster action plan that includes grant funding and debris removal components.

Table N-4. Potential Mitigation Actions for Heat and Drought

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Insulate house ❖ Provide redundant power ❖ Insulate structure ❖ Drought-resistant landscapes ❖ Reduce water system losses ❖ Modify plumbing systems (through water saving kits) ❖ For homes with on-site water systems: increase storage, utilize rainwater catchment • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice active water conservation ❖ Obtain a NOAA weather radio.	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ None • **Reduce vulnerability to the hazard:** ❖ Drought-resistant landscapes ❖ Reduce private water system losses ❖ Support alternative irrigation techniques to reduce water use and encourage use of climate-sensitive water supplies ❖ For businesses with on-site water systems: increase storage, utilize rainwater catchment • **Increase the ability to respond to or be prepared for the hazard:** ❖ Practice active water conservation	• **Manipulate the hazard:** ❖ Groundwater recharge through stormwater management ❖ Develop a water recycling program • **Reduce exposure to the hazard:** ❖ Identify and create groundwater backup sources • **Reduce vulnerability to the hazard:** ❖ Consider “cool roofs” and “green roofs” ❖ Water use conflict regulations ❖ Reduce water system losses ❖ Distribute water saving kits ❖ Increase conventional storage that is filled during high-flow periods • **Increase the ability to respond to or be prepared for the hazard:** ❖ Provide NOAA weather radios to the public ❖ Public education on drought resistance and heat safety ❖ Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers ❖ Develop drought contingency plan ❖ Develop criteria “triggers” for drought-related actions ❖ Improve accuracy of water supply forecasts ❖ Modify rate structure to influence active water conservation techniques ❖ Consider the probable impacts of climate change on the risk associated with the drought hazard ❖ Integrate cooling centers in vulnerable communities

Table N-5. Potential Mitigation Actions for High Surf, Coastal Flood and Erosion

Personal-Scale	Corporate-Scale	Government-Scale
• **Manipulate the hazard:** ❖ Protect, preserve and restore beaches and dunes • **Reduce exposure to the hazard:** ❖ Participate in voluntary property acquisition/ relocation programs sponsored by federal, state or local agencies • **Reduce vulnerability to the hazard:** ❖ Elevate home. ❖ Retrofit home to meet current building code standards for wind driven forces. • **Build local capacity to respond to or prepare for the hazard:** ❖ Buy flood Insurance ❖ Stockpile property protection measures to be used once you receive notice of pending coastal storms.	• **Manipulate the hazard:** ❖ Protect, preserve, restore wetlands. ❖ Protect, preserve and restore beaches and dunes • **Reduce exposure to the hazard:** ❖ Participate in voluntary property acquisition/relocation programs sponsored by federal, state or local agencies • **Reduce vulnerability to the hazard:** ❖ Retrofit facilities to meet current building code standards for wind driven forces. ❖ Maintain drainage facilities that service your property. • **Build local capacity to respond to or prepare for the hazard:** ❖ Develop a continuity of operations plan to address operations before, during and after coastal storm events. ❖ Buy flood Insurance ❖ Partner with personal scale and government scale partners to provide property protection components such as plywood and water resistant barriers in the preparedness phase pending coastal storms.	• **Manipulate the hazard:** ❖ Protect, preserve, restore wetlands. ❖ Protect, preserve and restore beaches and dunes ❖ Structural flood control, such as floodwalls, berms and levels • **Reduce exposure to the hazard:** ❖ Consider open space land uses in areas of high risk exposure to coastal storms. ❖ Acquire or relocate vulnerable properties in high risk areas impacted by coastal storms. ❖ Place utilities underground when and where appropriate. ❖ Consider low-density land use in high risk coastal zones. ❖ Require accounting of sea level rise in all applications for new development in shoreline areas • **Reduce vulnerability to the hazard:** ❖ Consider higher regulatory standards to the risk exposure to coastal storms such as: higher freeboard, enclosure prohibitions, coastal zone setbacks, lower substantial damage thresholds, non-conversion deed restrictions ❖ Elevate vulnerable properties in high risk areas impacted by coastal storms. ❖ Adopt/amend building codes such that they will address pre-existing properties. ❖ Implement tree management programs. ❖ Elevate roads that are vital/critical to evacuation and local community operations. ❖ Design or enhance existing drainage systems for higher design storms to provide increased capacity of the drainage system. ❖ Maintain the drainage infrastructure to levels that equal or exceed their design specifications. • **Build local capacity to respond to or prepare for the hazard:** ❖ Develop or enhance existing plans to include comprehensive evaluation of coastal storms and the reduction of their impacts at the local level. Seek to coordinate all levels of planning with this regard. ❖ Support/enhance code enforcement programs at the local level. ❖ Continue to develop, enhance and implement existing emergency response plans to utilize new and developing technology/ information as it becomes available. ❖ Develop a post-disaster action plan for coastal storm events that will address the local government operations post disaster. ❖ Promote the purchase of flood insurance ❖ Adopt regulations that require the disclosure of ocean-related hazards at the time of the purchase or sale of real property. ❖ Implement measures that will provide or help to provide property protection measures to property owners prior to the arrival of coastal storms. ❖ Utilize the best available technology to provide early warning of pending coastal storms to provide ample time to implement property protection measures. ❖ Educate the public on ways to protect their property before and during coastal storms, and where they can acquire the appropriate property protection measures.

Table N-6. Potential Mitigation Actions for Inland Flood

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area ❖ Elevate utilities above base flood elevation ❖ Use low-impact development techniques • **Reduce vulnerability to the hazard:** ❖ Raise structures above base flood elevation ❖ Elevate items within house above base flood elevation ❖ Build new homes above base flood elevation ❖ Flood-proof structures • **Build local capacity to respond to or prepare for the hazard:** ❖ Buy flood insurance ❖ Develop household plan, such as retrofit savings, communication with outside, 72-hour self-sufficiency during and after an event	• **Manipulate the hazard:** ❖ Clear storm drains and culverts ❖ Use low-impact development techniques • **Reduce exposure to the hazard:** ❖ Locate critical facilities or functions outside hazard area ❖ Use low-impact development techniques • **Reduce vulnerability to the hazard:** ❖ Build redundancy for critical functions or retrofit critical buildings ❖ Provide flood-proofing when new critical infrastructure must be located in floodplains • **Build local capacity to respond to or prepare for the hazard:** ❖ Keep cash reserves for reconstruction ❖ Support and implement hazard disclosure for sale of property in risk zones. ❖ Solicit cost-sharing through partnerships with others on projects with multiple benefits.	• **Manipulate the hazard:** ❖ Maintain drainage system ❖ Institute low-impact development techniques on property ❖ Dredging, levee construction, and providing regional retention areas ❖ Structural flood control, levees, channelization, or revetments. ❖ Stormwater management regulations and master planning ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff • **Reduce exposure to the hazard:** ❖ Locate or relocate critical facilities outside of hazard area ❖ Acquire or relocate identified repetitive loss properties ❖ Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. ❖ Adopt land development criteria such as planned unit developments, density transfers, clustering ❖ Institute low impact development techniques on property ❖ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff ❖ Preserve undeveloped and vulnerable shoreline ❖ Restore existing flood control and riparian corridors • **Reduce vulnerability to the hazard:** ❖ Harden infrastructure, bridge replacement program ❖ Provide redundancy for critical functions and infrastructure ❖ Adopt regulatory standards such as freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. ❖ Stormwater management regulations and master planning. ❖ Adopt "no-adverse impact" floodplain management policies that strive to not increase the flood risk on downstream communities ❖ Facilitate managed retreat from, or upgrade of, the most at-risk areas • **Build local capacity to respond to or prepare for the hazard:** ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) ❖ Incorporate retrofitting or replacement of critical system elements in capital improvement plan ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Consider participation in the Community Rating System ❖ Maintain and collect data to define risks and vulnerability ❖ Train emergency responders ❖ Create an elevation inventory of structures in the floodplain ❖ Develop and implement a public information strategy ❖ Charge a hazard mitigation fee ❖ Integrate floodplain management policies into other planning mechanisms within the planning area. ❖ Consider the probable impacts of climate change on the risk associated with the flood hazard ❖ Consider the residual risk associated with structural flood control in future land use decisions ❖ Enforce National Flood Insurance Program requirements ❖ Adopt a Stormwater Management Master Plan ❖ Develop an adaptive management plan to address the long-term impacts of sea level rise

Table N-7. Potential Mitigation Actions for Landslide

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope ❖ Minimize vegetation removal and the addition of impervious surfaces. • **Reduce exposure to the hazard:** ❖ Locate structures outside of hazard area (off unstable land and away from slide- run-out area) • **Reduce vulnerability to the hazard:** ❖ Retrofit home • **Build local capacity to respond to or prepare for the hazard:** ❖ Institute warning system, and develop evacuation plan ❖ Keep cash reserves for reconstruction ❖ Educate yourself on risk reduction techniques for landslide hazards	• **Manipulate the hazard:** ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope • **Reduce exposure to the hazard:** ❖ Locate structures outside of hazard area (off unstable land and away from slide run-out area) • **Reduce vulnerability to the hazard:** ❖ Retrofit at-risk facilities • **Build local capacity to respond to or prepare for the hazard:** ❖ Institute warning system, and develop evacuation plan ❖ Keep cash reserves for reconstruction ❖ Develop a continuity of operations plan ❖ Educate employees on the potential exposure to landslide hazards and emergency response protocol.	• **Manipulate the hazard:** ❖ Stabilize slope (dewater, armor toe) ❖ Reduce weight on top of slope • **Reduce exposure to the hazard:** ❖ Acquire properties in high-risk landslide areas. ❖ Adopt land use policies that prohibit the placement of habitable structures in high-risk landslide areas. • **Reduce vulnerability to the hazard:** ❖ Adopt higher regulatory standards for new development within unstable slope areas. ❖ Armor/retrofit critical infrastructure against the impact of landslides. • **Build local capacity to respond to or prepare for the hazard:** ❖ Produce better hazard maps ❖ Provide technical information and guidance ❖ Enact tools to help manage development in hazard areas: better land controls, tax incentives, information ❖ Develop strategy to take advantage of post-disaster opportunities ❖ Warehouse critical infrastructure components ❖ Develop and adopt a continuity of operations plan ❖ Educate the public on the landslide hazard and appropriate risk reduction alternatives. ❖ Consider the probable impacts of climate change on the risk associated with the landslide hazard

Table N-8. Potential Mitigation Actions for Tropical Cyclone/High Windstorm

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Trim trees away from structures • **Reduce vulnerability to the hazard:** ❖ Build home in compliance with building codes ❖ Incorporate building design standards to minimize wind damage ❖ Retrofit home to reduce future wind damage • **Build local capacity to respond to or prepare for the hazard:** ❖ Create a retrofit savings plan	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Relocate or underground electrical infrastructure • **Reduce vulnerability to the hazard:** ❖ Build facilities in compliance with building codes ❖ Incorporate building design standards to minimize wind damage ❖ Retrofit facilities to reduce future wind damage • **Build local capacity to respond to or prepare for the hazard:** ❖ Develop a continuity of operations plan to address operations before, during and after high wind events.	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Relocate or underground electrical infrastructure • **Reduce vulnerability to the hazard:** ❖ Adopt and enforce building codes to prevent wind damage ❖ Promote or require site and building design standards to minimize wind damage ❖ Regularly maintain utilities to prevent wind damage ❖ Retrofit public buildings and critical facilities to reduce future wind damage • **Build local capacity to respond to or prepare for the hazard:** ❖ Assess vulnerability to severe wind ❖ Improve public awareness of severe wind through outreach activities

Table N-9. Potential Mitigation Actions for Tsunami

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate outside of hazard area • **Reduce vulnerability to the hazard:** ❖ Apply personal property mitigation techniques to your home such as anchoring your foundation and foundation openings to allow flow though. • **Build local capacity to respond to or prepare for the hazard:** ❖ Develop and practice a household evacuation plan ❖ Educate yourself on the risk exposure from the tsunami hazard and ways to minimize that risk ❖ Understand tsunami warning signs and signals	• **Manipulate the hazard:** ❖ None • **Reduce exposure to the hazard:** ❖ Locate structure or mission critical functions outside of hazard area whenever possible • **Reduce vulnerability to the hazard:** ❖ Mitigate personal property for the impacts of tsunami • **Build local capacity to respond to or prepare for the hazard:** ❖ Develop and practice a corporate evacuation plan ❖ Educate employees on the risk exposure from the tsunami hazard and ways to minimize that risk	• **Manipulate the hazard:** ❖ Build wave abatement structures (e.g. the "Jacks" looking structure designed by the Japanese) • **Reduce exposure to the hazard:** ❖ Locate structure or functions outside of hazard area whenever possible ❖ Harden infrastructure for tsunami impacts ❖ Relocate identified critical facilities located in tsunami high hazard areas • **Reduce vulnerability to the hazard:** ❖ Adopt higher regulatory standards that will provide higher levels of protection to structures built in a tsunami inundation area ❖ Utilize tsunami mapping to guide development away from high risk areas through land use planning • **Build local capacity to respond to or prepare for the hazard:** ❖ Use probabilistic tsunami mapping and land use guidance from the state when published ❖ Provide incentives to guide development away from hazard areas ❖ Improve the tsunami warning and response system ❖ Provide residents with tsunami inundation maps ❖ Join NOAA's TsunamiReady program ❖ Develop and communicate evacuation routes ❖ Enhance the public information program to include risk reduction options for the tsunami hazard

Table N-10. Potential Mitigation Actions for Wildfire

Individuals	Businesses	Government
• **Manipulate the hazard:** ❖ Clear potential fuels on property such as dry overgrown underbrush and diseased trees • **Reduce exposure to the hazard:** ❖ Maintain defensible space around structures ❖ Locate outside of hazard area ❖ Mow regularly • **Reduce vulnerability to the hazard:** ❖ Create and maintain defensible space around structures and provide water on site ❖ Use fire-resistant building materials ❖ Maintain defensible spaces around home • **Build local capacity to respond to or prepare for the hazard:** ❖ Employ techniques from the National Fire Protection Association's Firewise USA program to safeguard home ❖ Identify alternative water supplies for fire fighting ❖ Install/replace roofing material with non-combustible roofing materials and implement other strategies to harden homes from embers and flame impingement	• **Manipulate the hazard:** ❖ Clear potential fuels on property such as dry underbrush and diseased trees • **Reduce exposure to the hazard:** ❖ Maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area • **Reduce vulnerability to the hazard:** ❖ Maintain defensible space around structures and infrastructure and provide water on site ❖ Use fire-resistant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. • **Build local capacity to respond to or prepare for the hazard:** ❖ Support Firewise USA community initiatives. ❖ Establish stored water supplies to be utilized for firefighting.	• **Manipulate the hazard:** ❖ Clear potential fuels on property such as dry underbrush and diseased trees ❖ Implement best management practices on public lands • **Reduce exposure to the hazard:** ❖ Maintain defensible space around structures and infrastructure ❖ Locate outside of hazard area ❖ Enhance building code to include use of fire resistant materials in high hazard area. • **Reduce vulnerability to the hazard:** ❖ Maintain defensible space around structures and infrastructure ❖ Use fire-resistant building materials ❖ Use fire-resistant plantings in buffer areas of high wildfire threat. ❖ Consider higher regulatory standards (such as Class A roofing) ❖ Establish biomass reclamation initiatives ❖ Reintroduce fire (controlled or prescribed burns) to fire-prone ecosystems ❖ Manage fuel load through thinning and brush removal ❖ Establish integrated performance standards for new development to harden homes. • **Build local capacity to respond to or prepare for the hazard:** ❖ More public outreach and education efforts, including an active Firewise USA program ❖ Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas ❖ Identify fire response and alternative evacuation routes and establish where needed ❖ Seek alternative water supplies ❖ Become a Firewise USA community ❖ Use academia to study impacts/solutions to wildfire risk ❖ Establish/maintain mutual aid agreements between fire service agencies ❖ Develop, adopt, and implement integrated plans for mitigating wildfire impacts in wildland areas bordering on development ❖ Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land use decisions ❖ Establish a management program to track forest and rangeland health ❖ Provide incentives for existing structures to be hardened against wildfire.

ADAPTIVE CAPACITY

Adaptive capacity is defined as “the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014). This term is typically used while discussing climate change adaptation; however, it is similar to the alternatives presented in the tables for building local capacity. In addition to hazard-specific capacity building, the following list provides general alternatives that the County considered to build capacity for adapting to both current and future risks:

- Incorporate climate change adaptation into relevant local and regional plans and projects.
- Establish a climate change adaptation and hazard mitigation public outreach and education program.
- Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation and mitigation strategy development and regional approaches.
- Establish an ongoing monitoring program to track local and regional climate impacts and adaptation strategy effectiveness.
- Increase participation of low-income, immigrant, non-English-speaking, racially and ethnically diverse, and special-needs residents in planning and implementation.
- Ask local employers and business associations to participate in local efforts to address climate change and natural hazard risk reduction.
- Conduct a community-wide assessment and develop a program to address health, socioeconomic, and equity vulnerabilities.
- Focus planning and intervention programs on neighborhoods that currently experience social or environmental injustice or bear a disproportionate burden of potential public health impacts.
- Use performance metrics and data to evaluate and monitor the impacts of climate change and natural hazard risk reduction strategies on public health and social equity.
- Develop coordinated plans for mitigating future flood, landslide, and related impacts through concurrent adoption of an updated general plan and local hazard mitigation plan.
- Update the General Plan to reflect existing hazards and projected climate change impacts on hazards.
- Implement General Plan hazard resiliency requirements through zoning and subdivision practices that restrict development in floodplains, landslide, and other natural hazard areas.
- Identify and protect locations where native species may shift or lose habitat due to climate change impacts (sea level rise, loss of wetlands, warmer temperatures, drought).
- Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.
- Promote economic diversity.
- Incorporate consideration of climate change impacts as part of infrastructure planning and operations.
- Conduct a climate impact assessment on community infrastructure.
- Identify gaps in legal and regulatory capabilities and develop ordinances or guidelines to address those gaps.
- Identify and pursue new sources of funding for mitigation and adaptation activities.
- Hire new staff or provide training to current staff to ensure an adequate level of administrative and technical capability to pursue mitigation and adaptation activities.

County of Kaua‘i Multi-Hazard Mitigation and Resilience Plan

Appendix O. Action Plan Detail

O. Action Plan Detail

The following table will be used as a staff implementation guide for detailed actions relating to each Master Action. This guide will be updated as the County implements and prioritizes integrated actions from this plan, the 2018 Kauaʻi County General Plan, and community plans.

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 1—Adopt the most current International Building Code and Standards					
n/a	IBC Code Adoption	Yes		County Funds	DPW
Master Action 2—Implement the most current International Building Code and Standards					
Conduct identification of specific infrastructure that will be impacted by the adoption of the IBC and identify relocation options.	IBC Code Adoption	No		FEMA BRIC (C&CB) with General Funds, NOAA Programs	DPW
Obtain BCEGS Classification for the County	IBC Code Adoption	No		FEMA BRIC (C&CB) with General Funds, NOAA Programs	DPW
Provide education and outreach for professionals and practitioners for enforcement and implementation of the IBC code	IBC Code Adoption	No		FEMA BRIC (C&CB) with General Funds, NOAA Programs	DPW
Master Action 3—Assess Kaua'i War Memorial Convention Hall Exhibition Hall for high wind retrofit. Implement actions to allow use of the exhibit hall as a disaster shelter during natural disasters					
n/a	Hardening Critical Infrastructure	Yes		FEMA HMA, County Funds	DOPR
Master Action 4—Harden State DLNR radio repeater sites and base station on Kaua'i					
n/a	Hardening Critical Infrastructure	Yes		State Funds	DLNR DOFAW
Master Action 5—Installation of a 500 kW dc photovoltaic ground mount and canopy renewable power generation systems ("PV") and renewable energy storage system ("RESS") at KCC					
n/a	Hardening Critical Infrastructure	Yes		State Funds	KCC
Master Action 6—Procure new 4,000-gallon capacity water truck to assist in providing the public with potable water as well as assist other state and county agencies efforts in disaster management activities					
n/a	Hardening Critical Infrastructure	Yes		State Funds	DLNR DOFAW

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 7—Provide alternate distribution feed to the Līhuʻe Airport with the installation of auto transfer switchgear and underground conduits and cables					
n/a	Hardening Critical Infrastructure	Yes		FEMA HMA, KIUC Funding	KIUC
Master Action 8—Assess hardening needs and develop implementation plans for critical infrastructure					
Assess County affordable housing communities (Paʻanau Village, Kālepa Village) for high wind retrofit to new building code standards. Implement retrofit actions. Priority projects will be identified in communities without existing hardened shelters.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Assess Kīlauea gymnasium for hurricane structural hardening measures to implement to better serve as an emergency shelter during natural disaster evacuations	Hardening Critical Infrastructure	Yes		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Partner with coordinating (federal, state, and county) agencies to convert cesspools to septic or integrated biotreatment individual household waste systems in coastal and low-lying communities with no sewer.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Develop county program to retrofit critical facilities with hurricane shutters, roof tie-downs, and other improvements, such as emergency power generation equipment.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Partner with coordinating agencies (e.g., State DOT) to harden existing bridges.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	Lead Agency, DOT for State bridges, DPW for County bridges
Upgrade bridges in key areas to ensure emergency vehicles can service all residents and visitors.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Provide for protection of clean, safe, and accessible fresh water supplies in disaster situations.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Identify portions of the grid that can be defined for mobile generators in anticipation of hazard events and power outages.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Identify critical facilities and residential properties eligible for new construction/retrofit for Safe Rooms. Develop options for pre-approved track for permitting.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Support measures that assist residents who have a need for continued electricity at homes for small appliances during events when the island's electrical service is damaged.	Hardening Critical Infrastructure	No		FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	
Master Action 9—Protect and restore the integrity of native habitats, especially Kaua'i's last remaining pristine native habitats in the upper watershed.					
n/a	Invasive Species	Yes		NOAA, EPA, FEMA BRIC, State Funding	DOF
Master Action 10— Develop and implement mitigation strategies to address impacts of invasive species that increase vulnerability to natural hazards					
Ensure adequate inspection and review of shipments that may contain invasive species.	Invasive Species	No		State Disaster Recovery Funding - Act 35, FEMA HMA (hazardous fuel reduction, landslide stabilization)	
Mitigate the impact of invasive species, such as Albizia and Hau, through management actions such as tree removal, treatment, or thinning in priority areas (priority watersheds, waterways, and road right-of-ways).	Invasive Species	No		State Disaster Recovery Funding - Act 35, FEMA HMA (hazardous fuel reduction, landslide stabilization)	
Master Action 11—Conduct an island-wide shelter needs assessment in coordination with community, faith-based, and government entities to identify shelter locations in new buildings and to ensure existing shelters are ready for use.					
New emergency shelter in Hanapēpē and multi-functional facility	Emergency Shelters	Partial		EMPG, DHS HSGP State High Wind Shelter Program	KEMA
Master Action 12—Conduct alternative analyses of identified vulnerable lifelines of Critical Facilities; 'Ele'ele, Waimea, Līhu'e & Wailua Wastewater Facilities (addresses all coastal hazards)					
n/a	Critical Infrastructure - Vulnerability Assessment	Yes		FEMA HMA Programs	DPW

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 13—Conduct alternative analyses of identified vulnerable lifelines					
Vulnerability Assessment of certain priority County roads phased project (addresses all coastal hazards): 1st - assess the vulnerability of various County assets and recommend possible actions 2nd – implement the recommendations	Critical Infrastructure - Vulnerability Assessment	No		FEMA HMA, General Funds, NOAA, U.S. Fish & Wildlife, EPA	DPW
Master Action 14—Continue assessing the vulnerability of critical assets using the best available science and support the development of vulnerability assessments specific to wastewater, roads, and other critical assets.					
Vulnerability Assessment of County Beach Parks phased project (addresses all coastal hazards): 1st - assess the vulnerability of various County assets and recommend possible actions 2nd – implement the recommendations	Critical Infrastructure - Vulnerability Assessment	No		FEMA HMA, General Funds, NOAA, U.S. Fish and Wildlife, EPA	DOPR, DPW
Vulnerability Assessment of impacts/capacity of drainage systems, including groundwater studies to inform the potential impacts from sea level rise	Critical Infrastructure - Vulnerability Assessment	No		FEMA HMA, General Funds, NOAA, U.S. Fish and Wildlife, EPA	DPW
Master Action 15—Public awareness and education campaign to promoted public health preparedness during hurricane season					
n/a	Public Health	Yes		State DOH, General County Funds, CDC, HHS	KEMA
Master Action 16—Develop a Public Health emergency action plan and implementation strategy to determine: which medications, equipment & staff will be needed post-event, and where they should be staged, how and by whom they will be administered, when and where to set up vaccine clinics, develop guidance for public awareness campaign					
Annual pre-hurricane season effort to mitigate impact of vaccine-preventable diseases post-event. Set up clinics to verify & administer common vaccines (tetanus, pertussis, measles, chickenpox, flu) to the at-risk population at the beginning of hurricane season	Public Health	No		State DOH, FEMA EMPG, CDC, HHS	DOH
Implement regulations so animals will not be allowed in, abandoned in, or fed at small harbors and county parks to prevent toxoplasmosis as a health hazard.	Public Health	No		State DOH, FEMA EMPG, CDC, HHS	DOH
Identify mitigation actions/monitoring associated with water-borne (vector) illnesses. Coordinate/collaborate with Parks and Rec.	Public Health	No		State DOH, FEMA EMPG, CDC, HHS	DOH
Pre-determine staging areas for meds, 1st aid kits, equipment & staff to support response & recovery	Public Health	No		State DOH, FEMA EMPG, CDC, HHS	DOH

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 17—Develop an Island-wide Climate Adaptation and Resiliency Plan to incorporate impacts of climate change in land use planning, relocation of critical infrastructure, and County operations.					
n/a	Adaptation and Resiliency Planning	Yes		County General Funds	Planning Deparment
Master Action 18—Reduce impacts from climate change risks through the implementation of mitigation actions, including already identified in regional community plans and assessments, such as the West Kaua'i Community Plan and West Kaua'i Community Vulnerability Assessment					
Acquire shoreline areas that could serve as refuge for species impacted by sea level rise or areas that could be appropriate sites for coastal habitat creation or restoration.	Climate Change Adaption	No	General Plan?	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County Public Access, Open Space, and Natural Resources Fund; State DLNR? Legacy Lands?
Address chronic and event-based coastal erosion impacts	Climate Change Adaption	No	General Plan	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County Planning, Public Works, Parks
Adequately fund and utilize the Public Access, Open Space, and Natural Resources Fund to actively acquire shoreline lands and accessways for public use and consider development of an "Offer To Dedicate" (OTD) Coastal Easement or Land Banking Program.	Climate Change Adaption	No	General Plan	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County Council, County Planning, ?
Analyze options and criteria for relocation of development outside of hazardous areas along the coast and incorporate findings into a long-term relocation plan.	Climate Change Adaption	No	General Plan	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County Planning with all agencies collaborating?
Continue the Kīkīaola sand bypass program from east to west of the harbor. When beach areas east of the harbor (Waimea Town) experience erosion, consider utilizing sand built up at the river mouth to nourish the beach.	Climate Change Adaption	No	West Kaua'i Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	State Department of Boating and Outdoor Recreation (DOBOR), DLNR Office of Conservation and Coastal Lands
Evaluate the long-term viability of Kīkīaola Harbor with SLR and its impact on alongshore transport of sediment on Waimea Beach.	Climate Change Adaption	No	West Kaua'i Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	DOBOR, County Planning? DLNR?
Develop a post-disaster recovery plan that identifies mitigation strategies, policies and a decision framework for scenario-based events.	Climate Change Adaption	No	General Plan	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Planning? KEMA?

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Develop detailed hazard, risk, and vulnerability assessments in low-lying coastal areas based on future data and forecasts regarding climate change. Use this assessment to identify where resources and planning efforts should be focused and to develop adaptation strategies and inform stakeholders, including tourists, of these dangers.	Climate Change Adaption	No	General Plan	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County Planning
Assess coastal erosion impacts on Kūhiō Highway and bike path to identify appropriate mitigation measures.	Climate Change Adaption	No		NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Hawai`i Department of Transportation, County of Kaua`i Parks Department and Public Works
Kaumuali'i Highway in Kekaha: (a.) Develop a strategic plan to respond to near term impacts from SLR to the highway, revetment, and drilled pier wall, which includes a monitoring and maintenance plan. Identify trigger points that identify changed conditions or need for different actions, including actions described below. (b.) Evaluate the costs and benefits, and feasibility of relocating the highway behind (mauka) town. (c.) Evaluate the costs, benefits, and feasibility of continuing to armor and maintain the road in place, taking into account SLR projections and how these will impact armoring over time and the need to upgrade the wall. In this evaluation consider the long-term impacts to the beach and coastal processes. (d.) Continue to monitor the best available science and modeling on hazard exposure and SLR projections. (e.) Identify cane haul roads as potential alternative access routes for evacuation purposes.	Climate Change Adaption	No	West Kaua‘i Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Hawai‘i Department of Transportation
Kaumuali'i Highway in Waimea including Waimea Bridge: (a.) Evaluate potential wave runup impacts on the highway and establish maintenance and response actions. (b.) Study potential realignment locations and emergency access/evacuation routes in the event of major damage of the road or the bridge. (d.) Conduct specific study on SLR exposure to the bridge, evaluate bridge height and design to withstand SLR plus heavy rainfall. (e.) Address river flow and siltation concerns, including the need for more frequent dredging and examine whether the mauka diversion needs to be adjusted.	Climate Change Adaption	No	West Kaua‘i Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Hawai`i Department of Transportation

Action Details	Code	Funding Available?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Hanapēpē Bridges: (a) Partner with coordinating agencies (e.g. State DOT) and scientists/engineers to conduct specific assessment of SLR exposure to bridges and evaluate appropriate bridge height and designs to withstand SLR combined with heavy rainfall. (b) Address river flow and siltation concerns, including whether there is a need for more frequent dredging, and examine whether mauka diversions need to be adjusted.	Hardening Critical Infrastructure	No	West Kauaʻi Comm Vuln Assessment	FEMA BRIC, FEMA HMGP, FEMA FMA (flood only), USGS, NOAA, HUD CDBG-DR, HUD CDBG-MIT: Local Match - CIP and General Fund	Lead Agency, DOT for State bridges, DPW for County bridges Reference the documents it is associated with it.
Waimea Makai County Roads: (a) Evaluate potential wave runup and erosion impacts on County roads and establish maintenance and response actions. (b) Study potential realignment locations and evaluate trigger points for relocation/removal (such as # of days flooded or a specified width of beach). (c) Conduct cost-benefit analysis of adaptation actions (relocation, armoring, elevation, and beach nourishment) for short term and long term.	Climate Change Adaption	No	West Kauaʻi Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County of Kauaʻi Public Works Division
West Kauaʻi Wastewater: Conduct focused study of all impacts to the municipal wastewater system and use results of the assessment to schedule future adaptation actions to line pipes, relocate pipes, raise maintenance holes, etc.'; Conduct a feasibility study of wastewater treatment alternatives in Kekaha that would consider replacing cesspools by (a) extending municipal wastewater system to the town of Kekaha; (b) replacing with alternative onsite disposal systems that are resilient to SLR and compatible with the environment. (c) Conduct pre-disaster planning for post-disaster reconstruction of the wastewater system, a full assessment of all OSDS, and whether reconstruction might include upgrades of current cesspools to alternative OSDS or a central sewer system. Update mapping of all private and public wastewater treatment facilities in GIS. (d) Assess power resilience at County of Kauaʻi Wastewater Management Department and increase power resilience measures in areas where needed, including communication, power assessments, emergency/standby generators, fuel, energy efficiency, on-site power, black sky planning, and funding.	Climate Change Adaption	No	West Kauaʻi Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	County of Kaua`i Wastewater Division

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
West Kaua'i water system: (a)Conduct focused study of all SLR impacts to the water system and use results of the assessment to schedule future adaptation actions to replace pipes with PVC, relocate pipes, etc. Coordinate with the Department of Transportation on relocation options. (b) Implement back-up generators to deep wells. (c.) Establish generator shelters at critical water sites in the event of a large hurricane. (d.) Assess power resilience at Department of Water and increase power resilience measures in areas where needed.	Climate Change Adaption	No	West Kaua'i Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Kaua'i Department of Water
Support the protection, restoration, and enhancement of surface and subsurface water resources, wetlands, stream habitats, and watershed areas	Nature-Based Solution	No		NOAA Programs, US Fish and Wildlife, FEMA HMA	County Planning Department, Department of Land and Natural Resources
Provide for ecological studies and assessments of impacts on or recovery of natural resources post-disaster.	Nature-Based Solution	No		NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Department of Land and Natural Resources
Re-engineer ports and harbors breakwaters, piers, and ramps to address sea level rise	Climate Change Adaption	No	West Kaua'i Community Vulnerability Assessment	NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	DLNR DOBOR
Relocate critical infrastructure located in high hazard areas.	Climate Change Adaption	No		NOAA Programs, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	
Master Action 19—Distribute University of Hawai'i, Sea Grant publications and Homeowner's Handbook to support education and outreach for hazard awareness. Target audience to include island youth (i.e., CSAV example), tourist operators, and other vulnerable populations.					
n/a		Yes		NOAA, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Sea Grant
Master Action 20—Develop and maintain public awareness of hazards, vulnerability, mitigation, and adaptation strategies					
Educate the public and visitors about native species protection, wildfire prevention, the spread of invasive species, and water quality protection.	Public Awareness	No	General Plan	NOAA, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	DLNR
In schools, develop programs that improve education and awareness of: (a) The role of native species and the importance of biodiversity in Hawai'i; (b) Projects that support the prevention and eradication of invasive species, and the protection and conservation of threatened and endangered species and habitats.	Public Awareness	No	General Plan	NOAA, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	DOE

Action Details	Code	Funding Available?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Provide interpretive signage within protected areas to educate people about native flora and fauna.	Public Awareness	No	General Plan	NOAA, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	DLNR, Department of Parks and Recreation
Promote public awareness of flood risks and ways to mitigate flood hazards, including effects of revised Flood Insurance Rate Maps as part of the National Flood Insurance Program	Public Awareness			NOAA, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Department of Public Works and Planning
Ensure Public awareness campaign incorporates targeting visitor accommodations to inform visitors of the flood risk	Public Awareness			NOAA, FEMA HMA, CDBG-MIT, EPA, State General Funds, Non-Profit Agencies	Kaua'i Visitor Bureau
Master Action 21—Develop tools to identify socially vulnerable populations (and vulnerable geographic areas) in Kaua'i County to determine and prioritize hazard risk reduction projects.					
n/a	Vulnerability Assessment	No		FEMA HMA, NOAA, EPA, HUD, State and County General Funds, Non-Profit Agencies	Planning Department
Master Action 22—Identify and implement enhanced cybersecurity measures across county government agencies.					
Encrypt County radio communications systems.	Cyber Security	No		HSGP, EMPG, County General Funds	KEMA
Master Action 23—Implement U.S. Army Corps of Engineers plan to raise the height of the Hanapēpē levee to re-establish the 100-year flood protection. Coordinate with CODEL & Corps of Engineers.					
n/a	Critical Infrastructure Maintenance	Yes		ACT-35 Funds	DPW
Master Action 24—Implement U.S. Army Corps of Engineers plan to raise the height of the Waimea levee and repair the broken sluice gate to re-establish the 100-year flood protection. Coordinate with CODEL & Corps of Engineers					
n/a	Critical Infrastructure Maintenance	Yes		ACT-35 Funds	DPW
Master Action 25—Inspect, repair, and maintain levees and county dams to reduce and/or prevent impacts from potential disasters.					
n/a	Critical Infrastructure Maintenance	No		ACT-35 Funds	DPW
Master Action 26—Integrate community-based disaster resilience plans into future community plan updates					
Identify elders in each community on the island and avenues to respond to their safety and needs in any disaster situation.	Capacity Building	No		FEMA HMA, NOAA, CDBG-MIT, EPA, ACT-35	Planning Department
Support the establishment of community-based councils to assist with watershed management issues.	Capacity Building	No			Department of Elderly Affairs, HWH
Master Action 27—Identify county and local resources to build capacity for preparedness, response, recovery, and mitigation.					
n/a	Capacity Building	Yes		EMPG, HSGP, County Funds	TBD

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 28—Conduct training and exercise for multi-hazard events					
n/a	Capacity Building	Yes		EMPG, HSGP, County Funds	KEMA
Master Action 29—Establish Resilience hubs and decentralized command and supply centers.					
n/a	Capacity Building	Yes		Act-35, FEMA HMA, NOAA, HUD, EPA	TBD
Master Action 30—Organize and coordinate local resources to prepare, respond to and recover from disaster events.					
Explore opportunities to support CERT and other community-based organizations. (Improve counties capability to manage and support CERT).	Capacity Building	No		FEMA PA & HMA, County Funds	KEMA
Work with local non-profits across the island to plan for their roles in both predisaster mitigation and post-disaster response.	Capacity Building	No			KEMA
Master Action 31—Pursue beach and dune restoration to mitigate impact from coastal hazards and sea level rise					
Beach Park Restoration: Kapa'a and Po'ipū Beach	Nature-Based Solution	No		NOAA Programs, U.S. Fish and Wildlife, FEMA HMA	DOPR
Conduct dune restoration at Salt Pond Beach park in consultation/collaboration with the Hui Hāna Pa'akai. Acquire or set aside lands for land bank and expansion of Salt Pond Beach Park mauka and westward.	Nature-Based Solution	No		NOAA Programs, U.S. Fish and Wildlife, FEMA HMA	DOPR
Master Action 32—Establish (5) repeater sites to enable better emergency response communications among DOFAW baseyard, DOFAW office, DSP office and DOCARE offices.					
n/a	Wildfire	Yes		State Funds	DLNR
Master Action 33—Integrate new equipment to increase wildfire-fighting capability					
n/a	Wildfire	Yes		State Funds	DLNR, KFD
Master Action 34—Reduce wildfire risk through the implementation of mitigation projects					
Develop firebreaks and fire safety zones in high-risk areas (e.g., Pu'u Ka Pele). a. Establish and maintain firebreaks between residential neighborhoods and the uncultivated agricultural lands.	Wildfire	No		U.S. Forest Service, U.S. Fish and Wildlife, FEMA HMA, FEMA AFG, FEMA FMAG	DLNR, KFD
Remove hazardous fuel loads within the previously burnt areas	Wildfire	No		U.S. Forest Service, U.S. Fish and Wildlife, FEMA HMA, FEMA AFG, FEMA FMAG	DLNR
Replace highly flammable invasive species with less flammable native species in high-risk wildfire areas	Wildfire	No		U.S. Forest Service, U.S. Fish and Wildlife, FEMA HMA, FEMA AFG, FEMA FMAG	DLNR
Master Action 35—Continue to maintain signage and sirens that were installed as part of the updated scenarios for tsunami evacuation zones					
n/a	Emergency Plan Updates	Yes		NOAA, FEMA HMA, EPA	KEMA

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 36—Develop and employ an Early Warning System for flood events on the north shore of Kauaʻi.					
n/a	Emergency Plan Updates	Yes		ACT-35	HWH
Master Action 37—Encourage development of local preparedness plans in cooperation with local communities to include the designation of evacuation routes, critical facility access routes, public shelters and storage of food and water.					
n/a	Emergency Plan Updates	Yes		ACT-35	HWH
Master Action 38—Install a KEMA outdoor warning siren on Ni'ihau					
n/a	Emergency Plan Updates	Yes		State Funds	KEMA
Master Action 39—Install public address system to ensure effective emergency communications to the KCC campus and surrounding areas					
n/a	Emergency Plan Updates	Yes		State Funds	KCC
Master Action 40—Update, maintain and enhance the use of the County's GIS and database to improve decision-making and ensure consistency in planning, permitting, and construction regulations to reduce disaster risk.					
n/a	Emergency Plan Updates	Yes		NOAA, State Funds	DOF
Master Action 41—Review and update County Emergency Management Plans					
Implement and update the Kauaʻi Community Wildfire Protection Plan.	Emergency Plan Updates	Yes			KEMA
Review and update debris management plan	Emergency Plan Updates	Yes			KEMA
Review and update the County Emergency Operation Plan (EOP)	Emergency Plan Updates	Yes			KEMA
Support the development of a Common Operational Picture, which incorporates real-time asset status tracking for Emergency Management.	Emergency Plan Updates	Yes			KEMA
Annually review and ensure agreements are in place among private utilities, the executive government agencies, Kauaʻi Emergency Management Agency (KEMA), and the Red Cross to ensure that high priority facilities and shelters are maintained	Emergency Plan Updates	Yes			KEMA
Annually review existing agreements with the hotels and resorts and confirm disaster response plans are in place including responsibility for residents during and after emergency, evacuation, etc.	Emergency Plan Updates	Yes			KEMA
Develop and distribute an evacuation plan for the North Shore of Kauaʻi.	Emergency Plan Updates	No		EMGP, HSGP, County General Funds	KEMA

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Develop an inventory of Critical Infrastructure and Key Resources, according to the standards of the National Incident Management System (NIMS), which can be used for mitigation and disaster recovery efforts.	Emergency Plan Updates	No		EMGP, HSGP, County General Funds	KEMA
Provide for recycling and waste management streams post-disaster which contain environmental contaminants and minimize waste.	Emergency Plan Updates	No		EMGP, HSGP, County General Funds	KEMA
Collection of household hazardous waste materials is done on an annual basis for all residents of Kaua'i. This includes but is not limited to batteries, paint, pesticides, chemicals, and other hazardous materials. The County has a comprehensive hazardous waste disposal program for County-generated waste.	Emergency Plan Updates	No		EMGP, HSGP, County General Funds	KEMA
Master Action 42—Continue to update and implement the shoreline setback ordinance taking into account the best available science with respect to erosion and sea level rise.					
n/a	Codes and Ordinance	Yes		County General Funds	Planning
Master Action 43—Review, update and implement codes and regulations to incorporate adaptation strategies, green infrastructure and low impact development strategies					
Review and update drainage regulations and the drainage constraint district to incorporate and encourage green infrastructure concepts.	Codes and Ordinance	No	General Plan	USDA, USDA-NRCS, EPA, FEMA BRIC	Planning Department, DPW
Master Action 44—Proposed Hydraulic/Hydrologic study of the North Shore, Waimea, and Wailua, which will produce a project list that can be turned into proposals for funding.					
n/a	Flood - Vulnerability Assessment	Yes		ACT-35	HWH

Action Details	Code	Funding Available ?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
Master Action 45—Utilize best available data and scientific studies to assess the vulnerability of agricultural properties and develop public outreach and mitigation strategies					
West Kauaʻi farming: Educate farmers on best management practices to prevent impacts from flooding and mitigate polluted runoff (e.g., with the use of vegetation buffers around farms). h. Map all small farms and make available to public in the event of a disaster for enhanced response and recovery to farmers. i. Develop disaster response and recovery plans to help farmers in the event of heavy rain. j. Pursue rainwater catchment or other water storage to ensure resiliency in the face of drought. Design incentive program to increase installation of private storage, efficient irrigation systems, and use of alternative irrigation sources (e.g., wastewater recycling).	Agriculture - Vulnerability Assessment	No	West Kauaʻi Community Vulnerability Assessment	USDA, USDA-NRCS, EPA	TBD
Master Action 46 — Utilize best available data and scientific studies to assess watershed and community flood drainage problems.					
n/a	Flood - Vulnerability Assessment	Yes		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Establish a drainage system database to better understand the drainage network on Kauaʻi and to assist with water quantity and quality impacts.	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Develop drainage master plans for flood-prone areas such as Hanalei, Nāwiliwili, Kapa'a, Wailua, Po'ipū, and Kekaha.	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Develop policies to address re-opening of river mouths and subsequent impact of ongoing sand transport	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Identify mitigation action associated with Urban stormwater issues, including maintenance and upkeep in drainage ways	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Identify nature-based solutions such as wetland restoration, green infrastructure that can be applied in different areas of the island	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Implement incentives and regulations to implement flood accommodation measures such as elevating homes and low impact development (LID) practices, and incentives for voluntary relocation of homes in flood-prone areas	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD
Strengthen hazard monitoring systems, such as streamflow and river gauges.	Flood - Vulnerability Assessment	No		FEMA HMA. NOAA Programs, EPA, USACE, USGS	TBD

Action Details	Code	Funding Available?	Plan Integration/ Reference	Grant Funding Options	Lead Agency
West Kauaʻi Drainage: a. Partner with scientists to conduct a focused hydrological assessment of West Kauaʻi drainage system, including pumps, ditches, canals, pipes, and outfalls to handle various projections of SLR in the short term and long term. b. Partner with scientists to conduct groundwater studies and mapping for various SLR scenarios in low-lying areas of Kekaha, Waimea, and Hanapēpē. c. Use the results of these assessments to inform future adaptation actions of the drainage system and/or adaptation actions within the communities affected (i.e., homes, cesspools, etc.) d. Consider wetland restoration on the Mānā Plain and elsewhere, as appropriate, as a technique to store floodwaters. e. Improve coordination across drainage system responsible parties and improve communication with the public. f. Update mapping of the West Kauaʻi drainage system in Geographic Information Systems (GIS).	Flood - Vulnerability Assessment	No	West Kauaʻi Community Vulnerability Assessment	FEMA HMA. NOAA Programs, EPA, USACE, USGS	Agriculture Development Corporation, Kauaʻi Agriculture Association, County of Kauaʻi Public Works, and PMRF
Master Action 47—Maintain NFIP Compliance. Continue to maintain good standing and compliance under the NFIP through implementation of floodplain management programs that, at a minimum, meet the NFIP requirements: • Enforce the flood damage prevention ordinance. • Participate in floodplain identification and mapping updates. • Provide public assistance/information on floodplain requirements and impacts.					
n/a		Yes		ACT-35, County Funds	DPW
Master Action 48—Work with the State NFIP coordinator to develop the program for participation in the Community Rating System					
n/a		Yes		ACT-35, County Funds	DPW
Master Action 49—Utilize best available data and scientific studies to identify landslide risk, geospatial data needs, and mitigation strategies					
Identify landslides areas to implement native planting and remove invasive species	Landslide - Vulnerability Assessment	No		USGS, FEMA HMA, DOT	DLNR
Utilize best available data and scientific studies to determine methods to stabilize the hillsides along the roadways in the North Shore	Landslide - Vulnerability Assessment	No		USGS, FEMA HMA, DOT	

Appendix P. Hazard Mitigation Plan Adoption Resolution

KAUAʻI EMERGENCY MANAGEMENT AGENCY
ELTON USHIO, ADMINISTRATOR

DEREK S.K. KAWAKAMI, MAYOR
MICHAEL A. DAHILIG, MANAGING DIRECTOR

April 21, 2021

RE: Adoption of the County of Kauai Multi-Hazard Mitigation and Resilience Plan 2021

WHEREAS, Kauai County is subject to various natural hazards, including hurricanes, tsunamis, inland flooding, landslides, high surf, coastal erosion, wildfires, and droughts; and

WHEREAS, these natural hazards have caused and will continue to cause physical and financial impacts to the County's population, environment, economy, and infrastructure; and

WHEREAS, an effective mitigation strategy including measures to prepare for and mitigation the risks posed by these natural hazards should be implemented to significantly reduce the vulnerabilities and risks; and

WHEREAS, partnerships with all levels of government, the private sector, community organizations and citizens and effectively plan, implement, and fund mitigation projects.

NOW, THEREFORE, I, Derek S.K. Kawakami, Mayor of the County of Kauai, approve and adopt this 2021 update of the County of Kauai Multi-Hazard Mitigation and Resilience Plan (Plan) in compliance with the Disaster Mitigation Act of 2000 (Public Law 106-390). This Plan updates the previous Plan adopted in 2015.

Kauai County is subject to various natural hazards, including hurricanes, tsunamis, inland flooding, landslides, high surf, coastal erosion, wildfires, and droughts. These hazards have caused and will continue to cause physical and financial impacts to the County's population, environment, economy, and infrastructure. The County continues to pursue a comprehensive, multi-hazard strategy to prepare for and mitigate the risks posed by these natural hazards. Therefore, I approve and adopt this 2021 update of the County of Kauai Multi-Hazard Mitigation and Resilience Plan (Plan) in compliance with the Disaster Mitigation Act of 2000 (Public Law 106-390). This Plan updates the previous Plan adopted in 2015.

With the adoption of this Plan update, the County is positioned to prioritize and leverage its resources when applying for various hazard mitigation funding, particularly the FEMA Hazard Mitigation Assistance programs, in coordination with the State of Hawaii Multi-Hazard Mitigation Plan, federal requirements and in partnership with the County's citizens, private sector, and community organizations.

Approved:

Derek S.K. Kawakami
Mayor

3900 Kaʻana Street, Suite 100 • Līhuʻe, Hawaiʻi 96766 • (808) 241-1800 (b) • (808) 241-1860 (f)

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA 94607-4052

FEMA

April 30, 2021

David Kennard
Disaster Assistance Project Manager
Kauai Emergency Management Agency
3990 Kāʻana Street, Suite 100
Līhuʻe, HI 96766

Dear Mr. Kennard:

The *Kauai County Multi-Hazard Mitigation and Resilience Plan* was officially adopted by the County of Kauai on April 21, 2021, and was submitted for review and approval to the Federal Emergency Management Agency (FEMA). The review is complete, and FEMA finds the plan to be in conformance with Code of Federal Regulations, Title 44, Part 201, Section 6 (44 C.F.R. 201.6).

This plan approval ensures the County of Kauai's continued eligibility for funding under FEMA's Hazard Mitigation Assistance programs, including the Hazard Mitigation Grant Program, Building Resilient Infrastructure and Communities program, and Flood Mitigation Assistance program. All requests for funding, however, will be evaluated individually according to the specific eligibility, and other requirements of the particular program under which applications are submitted. Approved hazard mitigation plans may also be eligible for points under the National Flood Insurance Program's Community Rating System (CRS).

FEMA's approval of the *Kauai County Multi-Hazard Mitigation and Resilience Plan* is for a period of five years, effective starting the date of this letter. Prior to **April 30, 2026**, the County of Kauai must review, revise, and submit their plan to FEMA for approval to maintain eligibility for grant funding. The enclosed plan review tool provides additional recommendations to into future plan updates.

If you have any questions regarding the planning or review processes, please contact the FEMA Region IX Hazard Mitigation Planning Team at fema-r9-mitigation-planning@fema.dhs.gov.

Sincerely,

KATHRYN J LIPIECKI Digitally signed by KATHRYN J LIPIECKI
Date: 2021.04.30 14:09:15 -07'00'

Kathryn Lipiecki
Director, Mitigation Division
FEMA Region IX

Enclosure (1)
Kauai County Plan Review Tool, dated April 30, 2021

cc: Theresa Woznick, State Hazard Mitigation Officer, Hawai'i Emergency Management Agency
Larry Kanda, Disaster Recovery Mitigation Planner, Hawai'i Emergency Management Agency

Appendix Q. Plan Maintenance Strategy

Q. PLAN MAINTENANCE STRATEGY

Plan maintenance is the formal process for achieving the following:

- Ensuring that the hazard mitigation plan remains active and relevant
- Ensuring that the County maintains its eligibility for applicable funding sources
- Monitoring, evaluating, and updating the plan as required
- Integrating public participation throughout the plan’s implementation
- Incorporating the mitigation actions into other County planning activities and programs, such as land-use planning, capital improvement planning, and building code enforcement.

The sections below describe each element of the proposed plan maintenance for this hazard mitigation and resilience plan.

INCORPORATION INTO OTHER PLANNING MECHANISMS

Integrating relevant information from this hazard mitigation plan into other plans and programs where opportunities arise will be the ongoing responsibility of the County. By adopting a general plan and zoning ordinances, the County has planned for the impact of natural hazards, and these documents are integral parts of this hazard mitigation plan. The hazard mitigation planning process provided an opportunity to review and expand on policies contained within these documents, based on the best science and technology available at the time this plan was prepared. The County should use its general plan and the hazard mitigation plan as complementary documents to achieve the goal of reducing risk exposure to citizens of the planning area. A comprehensive update to the general plan may trigger an update to the hazard mitigation plan. As information that can enhance this plan becomes available from other planning mechanisms, it will be incorporated via the update process.

The County has committed to creating a linkage between the hazard mitigation plan and its general plan and similar plans identified in the capability assessment. The action plan includes mitigation actions to create such a linkage. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Capital Improvement Plan
- Disaster Debris Management Plan
- Floodplain/Watershed Plan
- Stormwater Plan
- Urban Water Management Plan
- Habitat Conservation Plan
- Economic Development Plan
- Shoreline Management Plan
- Community Wildfire Protection Plan
- Climate Adaptation and Resiliency Plan
- Emergency Operations Plan
- Threat & Hazard Identification & Risk Assessment

- Post-Disaster Recovery Plan
- Continuity of Operations Plan
- Public Health Plan

GRANT MONITORING AND COORDINATION

Kaua‘i County Emergency Management Agency will identify grant funding opportunities for implementing the recommended plan actions. Once these opportunities are identified, staff will pursue a strategy to capture that grant funding.

PLAN MONITORING

Kaua‘i County Emergency Management Agency will be the lead agency responsible for monitoring the plan and will monitor plan implementation by tracking the status of all recommended mitigation actions in the action plan. Action items may be implemented through regulation, capital projects, or the creation of new educational programs, interagency coordination, or improved public participation.

PLAN EVALUATION

The plan will be evaluated by how successfully the implementation of identified actions has helped to achieve the plan goals and objectives of reducing risk and incorporating hazard mitigation concepts into other County plans, policies and programs. The Steering Committee recommends that equity analysis and screening be carried forward as actions are implemented. Kaua‘i County Emergency Management Agency will assume lead responsibility for planning and facilitating plan evaluation meetings. Review of the hazard mitigation plan at these meetings can include the following:

- Discussion of any hazard events that occurred during the prior year and their impact on the planning area
- Impact of potential grant opportunities on the implementation of mitigation actions
- Re-evaluation of the action plans to determine if the timeline for identified actions need to be amended (such as changing a long-term action to a short-term action because of funding availability)
- Recommendations for new actions
- Impact of any other planning programs or initiatives that involve hazard mitigation.

PLAN UPDATE

Federal regulations require that local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under the Disaster Mitigation Act (44 CFR Section 201.6.d(3)). This plan’s format allows the County to review and update sections when new data become available. New data can be easily incorporated, resulting in a plan that will remain current and relevant. The County intends to update the plan on a five-year cycle from the date of plan approval. This cycle may be accelerated to less than five years based on the following triggers:

- A presidential disaster declaration that impacts the planning area
- A hazard event that causes loss of life
- A full update of the General Plan

It will not be the intent of the update process to develop a completely new hazard mitigation plan. Based on needs identified by the Core Planning Team, the update process will, at a minimum, include the following elements:

- The process will be convened through a new steering committee.

- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- Action plans will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or County policies identified under other planning mechanisms (such as the General Plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- The County will adopt the updated plan.

Because plan updates can require a year or more to complete, Kaua‘i County Emergency Management Agency will initiate efforts to update the plan before it expires. Kaua‘i County Emergency Management Agency will consider applying for funding to update the plan in the Fiscal Year 2023/2024 grant cycle or will identify an alternate source of funding for the plan update in order to begin the update process in the spring of 2024.

CONTINUING PUBLIC PARTICIPATION

The public outreach strategy used during development of this plan can be adapted for ongoing public outreach through the plan maintenance process. A steering committee similar to the one involved in developing this hazard mitigation plan update will be put in place to provide stakeholder input on plan maintenance activities.

The public will continue to be apprised of hazard mitigation activities through the website and reports on successful hazard mitigation actions provided to the media. Kaua‘i County Emergency Management Agency will keep the website maintained, including monitoring the email address where members of the public can submit comments to the Core Planning Team. This site will house the final plan and will be a one-stop shop for information regarding the plan and its implementation. Copies of the plan also will be distributed to libraries in the planning area.

Upon initiation of the next plan update process, a new public involvement strategy will be initiated, with guidance from the new steering committee. This strategy will be based on the needs and capabilities of the County at the time of the update. At a minimum, it will include the use of local media outlets.

Appendix R. Roads in Mapped Hazard Areas

R. ROADS IN MAPPED HAZARD AREAS

RIVERINE FLOOD

100-Year

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua‘i	2.9	23.8	12.1%
Hanapēpē-‘Ele‘ele	0.5	7.2	7.6%
Kōloa-Po‘ipū-Kalāheo	0.5	20.7	2.3%
Līhu‘e	0.8	23.1	3.4%
North Shore	3.8	21.0	18.2%
Waimea	7.0	29.8	23.5%
Total	**15.5**	**125.5**	**12.3%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua‘i	6.1	113.7	5.4%
Hanapēpē-‘Ele‘ele	4.6	26.2	17.5%
Kōloa-Po‘ipū-Kalāheo	5.1	94.7	5.4%
Līhu‘e	1.7	91.5	1.8%
North Shore	3.0	67.4	4.5%
Waimea	17.3	145.6	11.9%
Total	**37.9**	**539.1**	**7.0%**

500-Year

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua‘i	3.4	23.8	14.2%
Hanapēpē-‘Ele‘ele	0.6	7.2	8.2%
Kōloa-Po‘ipū-Kalāheo	0.6	20.7	2.7%
Līhu‘e	0.8	23.1	3.7%
North Shore	3.8	21.0	18.2%
Waimea	10.1	29.8	33.9%
Total	**19.3**	**125.5**	**15.4%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	8.0	113.7	7.0%
Hanapēpē-'Ele'ele	5.5	26.2	21.0%
Kōloa-Po'ipū-Kalāheo	7.0	94.7	7.4%
Līhu'e	1.8	91.5	1.9%
North Shore	4.3	67.4	6.4%
Waimea	21.0	145.6	14.4%
Total	**47.6**	**539.1**	**8.8%**

COASTAL FLOOD AND SEA LEVEL RISE

100-Year

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	0.0	23.8	0.0%
Hanapēpē-'Ele'ele	0.0	7.2	0.0%
Kōloa-Po'ipū-Kalāheo	0.0	20.7	0.0%
Līhu'e	0.2	23.1	0.7%
North Shore	3.3	21.0	16.0%
Waimea	0.7	29.8	2.2%
Total	**4.2**	**125.5**	**3.3%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	1.0	113.7	0.9%
Hanapēpē-'Ele'ele	0.7	26.2	2.5%
Kōloa-Po'ipū-Kalāheo	1.2	94.7	1.3%
Līhu'e	0.2	91.5	0.2%
North Shore	4.8	67.4	7.2%
Waimea	11.0	145.6	7.5%
Total	**18.9**	**539.1**	**3.5%**

Chronic Coastal Flood

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	0.2	23.8	0.8%
Hanapēpē-'Ele'ele	0.0	7.2	0.7%
Kōloa-Po'ipū-Kalāheo	0.0	20.7	0.0%
Līhu'e	0.2	23.1	0.7%
North Shore	1.4	21.0	6.6%
Waimea	2.0	29.8	6.9%
Total	**3.8**	**125.5**	**3.0%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	0.7	113.7	0.6%
Hanapēpē-'Ele'ele	0.2	26.2	0.7%
Kōloa-Po'ipū-Kalāheo	0.5	94.7	0.5%
Līhu'e	0.0	91.5	0.0%
North Shore	1.0	67.4	1.5%
Waimea	2.5	145.6	1.7%
Total	**4.9**	**539.1**	**0.9%**

SLR Future Chronic Coastal FL

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	1.5	23.8	6.1%
Hanapēpē-'Ele'ele	0.1	7.2	0.7%
Kōloa-Po'ipū-Kalāheo	0.0	20.7	0.0%
Līhu'e	0.2	23.1	0.7%
North Shore	2.6	21.0	12.6%
Waimea	3.3	29.8	11.2%
Total	**7.6**	**125.5**	**6.1%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	3.1	113.7	2.7%
Hanapēpē-'Ele'ele	1.1	26.2	4.1%
Kōloa-Po'ipū-Kalāheo	0.7	94.7	0.8%
Līhu'e	0.5	91.5	0.6%
North Shore	2.2	67.4	3.2%
Waimea	10.4	145.6	7.1%
Total	**18.0**	**539.1**	**3.3%**

SLR Event-based Coastal Flood

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	7.6	23.8	32.1%
Hanapēpē-'Ele'ele	0.8	7.2	11.5%
Kōloa-Po'ipū-Kalāheo	0.4	20.7	1.7%
Līhu'e	2.8	23.1	12.0%
North Shore	7.9	21.0	37.9%
Waimea	15.2	29.8	51.0%
Total	**34.7**	**125.5**	**27.7%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	17.0	113.7	15.0%
Hanapēpē-ʻEleʻele	7.5	26.2	28.5%
Kōloa-Poʻipū-Kalāheo	7.2	94.7	7.6%
Līhuʻe	5.1	91.5	5.6%
North Shore	10.6	67.4	15.8%
Waimea	55.4	145.6	38.0%
Total	**102.8**	**539.1**	**19.1%**

TSUNAMI INUNDATION

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	5.3	23.8	22.1%
Hanapēpē-ʻEleʻele	0.4	7.2	5.6%
Kōloa-Poʻipū-Kalāheo	0.0	20.7	0.0%
Līhuʻe	0.7	23.1	2.9%
North Shore	7.6	21.0	36.5%
Waimea	10.7	29.8	36.0%
Total	**24.7**	**125.5**	**19.7%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	11.4	113.7	10.1%
Hanapēpē-ʻEleʻele	3.1	26.2	11.7%
Kōloa-Poʻipū-Kalāheo	2.8	94.7	3.0%
Līhuʻe	3.4	91.5	3.7%
North Shore	9.3	67.4	13.8%
Waimea	41.0	145.6	28.2%
Total	**71.0**	**539.1**	**13.2%**

COMBINED DAM FAILURE

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	0.0	23.8	0.0%
Hanapēpē-ʻEleʻele	0.0	7.2	0.0%
Kōloa-Poʻipū-Kalāheo	3.1	20.7	15.1%
Līhuʻe	0.2	23.1	0.9%
North Shore	0.0	21.0	0.0%
Waimea	0.0	29.8	0.0%
Total	**3.3**	**125.5**	**2.7%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	0.0	113.7	0.0%
Hanapēpē-'Ele'ele	0.0	26.2	0.0%
Kōloa-Po'ipū-Kalāheo	15.3	94.7	16.1%
Līhu'e	0.4	91.5	0.5%
North Shore	0.0	67.4	0.0%
Waimea	0.0	145.6	0.0%
Total	**15.7**	**539.1**	**2.9%**

HURRICANE STORM SURGE CAT 4

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	4.6	23.8	19.6%
Hanapēpē-'Ele'ele	0.5	7.2	6.6%
Kōloa-Po'ipū-Kalāheo	0.0	20.7	0.0%
Līhu'e	1.6	23.1	6.8%
North Shore	2.3	21.0	11.1%
Waimea	8.5	29.8	28.5%
Total	**17.5**	**125.5**	**14.0%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	10.7	113.7	9.4%
Hanapēpē-'Ele'ele	3.5	26.2	13.2%
Kōloa-Po'ipū-Kalāheo	1.3	94.7	1.4%
Līhu'e	3.0	91.5	3.2%
North Shore	3.2	67.4	4.8%
Waimea	14.9	145.6	10.2%
Total	**36.6**	**539.1**	**6.8%**

LANDSLIDE

High Susceptibility (slope greater than 40%)

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	0.1	23.8	0.4%
Hanapēpē-'Ele'ele	0.0	7.2	0.2%
Kōloa-Po'ipū-Kalāheo	0.0	20.7	0.2%
Līhu'e	0.1	23.1	0.5%
North Shore	0.9	21.0	4.5%
Waimea	0.3	29.8	1.0%
Total	**1.5**	**125.5**	**1.2%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	1.0	113.7	0.9%
Hanapēpē-'Ele'ele	0.3	26.2	1.1%
Kōloa-Po'ipū-Kalāheo	0.8	94.7	0.9%
Līhu'e	0.7	91.5	0.8%
North Shore	0.7	67.4	1.1%
Waimea	4.7	145.6	3.2%
Total	**8.3**	**539.1**	**1.5%**

Moderate Susceptibility (slope 20 to 40%)

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	1.3	23.8	5.4%
Hanapēpē-'Ele'ele	0.1	7.2	1.8%
Kōloa-Po'ipū-Kalāheo	1.7	20.7	8.1%
Līhu'e	0.8	23.1	3.3%
North Shore	1.1	21.0	5.3%
Waimea	3.6	29.8	12.1%
Total	**8.6**	**125.5**	**6.9%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kaua'i	6.5	113.7	5.7%
Hanapēpē-'Ele'ele	0.5	26.2	2.0%
Kōloa-Po'ipū-Kalāheo	7.9	94.7	8.3%
Līhu'e	4.1	91.5	4.5%
North Shore	3.1	67.4	4.6%
Waimea	25.4	145.6	17.4%
Total	**47.5**	**539.1**	**8.8%**

WILDFIRE COMMUNITIES AT RISK

High Risk

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi.02	13.4	23.8	56.2%
Hanapēpē-ʻEleʻele	2.8	7.2	38.7%
Kōloa-Poʻipū-Kalāheo	6.2	20.7	30.0%
Līhuʻe	11.3	23.1	49.0%
North Shore	0.8	21.0	3.9%
Waimea	8.6	29.8	28.8%
Total	**43.1**	**125.5**	**34.3%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	77.6	113.7	68.3%
Hanapēpē-ʻEleʻele	22.0	26.2	83.7%
Kōloa-Poʻipū-Kalāheo	38.4	94.7	40.5%
Līhuʻe	40.4	91.5	44.2%
North Shore	0.8	67.4	1.3%
Waimea	58.7	145.6	40.3%
Total	**238.0**	**539.1**	**44.1%**

Medium Risk

Major Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	3.6	23.8	15.3%
Hanapēpē-ʻEleʻele	0.0	7.2	0.0%
Kōloa-Poʻipū-Kalāheo	0.9	20.7	4.2%
Līhuʻe	1.3	23.1	5.6%
North Shore	0.0	21.0	0.0%
Waimea	0.0	29.8	0.0%
Total	**5.8**	**125.5**	**4.6%**

Other Roads

Jurisdiction	Miles in Hazard Area	Total Miles in Jurisdiction	% of Total
East Kauaʻi	23.4	113.7	20.6%
Hanapēpē-ʻEleʻele	0.0	26.2	0.0%
Kōloa-Poʻipū-Kalāheo	10.4	94.7	11.0%
Līhuʻe	9.8	91.5	10.7%
North Shore	0.0	67.4	0.0%
Waimea	0.0	145.6	0.0%
Total	**43.6**	**539.1**	**8.1%**