CHAPTER

4

MITIGATION STRATEGY

4.1 MITIGATION GOALS AND OBJECTIVES

To become a "disaster-resilient" community, the mitigation goals and objectives are as follows:

1.0 Goal: Continually strive to improve the state of the art for the identification of hazard areas, predication capabilities, and warning systems.

Objectives:

1.1 Prepare GIS maps for all hazards with the best available information and formulate a strategy to upgrade the data.

1.2 Improve flood prediction and field-monitoring systems.

1.3 Improve local tsunami warning systems.

1.4 Improve applicability of modeling systems to Hawaii Island conditions for hazard mapping, mitigation planning, scenario training purposes.

1.5 Establish a warning system that is cognizant of warning siren gaps that require supplemental field warning, that strives to fill those gaps based on population, that is routinely tested and maintained, and that educates the public on proper response.

1.6 Establish a rigorous reporting system after each major event to document the extent and cause of damage, lessons learned, and actions required to improve hazard mitigation, preparedness, response, or recovery.

2.0 Goal: Control future development and retrofit existing structures within hazard areas to minimize losses.

2.1 Periodically review the effectiveness of current land-use-related plans, codes, and standards to control future development within hazard areas.

2.2 Update the building code as necessary to cost-effectively resist earthquake, hurricane, and flood susceptibility.

2.3 Develop incentives, such as tax deductions and insurance discounts, to encourage retrofitting of existing structures to resist earthquake, hurricane, and flood susceptibility.

3.0 Goal: Ensure that all emergency response critical facilities and communication systems remain operational during hazard events.

3.1 Harden all essential emergency facilities and communication systems to withstand earthquake and hurricane forces (flood resistance not necessary since no emergency facilities should be located in the 100-year flood-prone areas).

3.2 Enhance emergency communication systems to improve the type and speed of data transmission, and diversity of systems for redundancy.

3.3 Establish communication contingencies for remote areas.

3.4 Ensure road access to hospitals remain clear and that all hospitals have helicopter access.

3.5 Develop a search and rescue system that can respond to individual emergencies and mass disasters.

4.0 Goal: Ensure that all lifeline infrastructure are able to withstand hazard events or have contingency plans to quickly recover after a disaster.

4.1 Harden ports and airports to enable post-disaster operations.

4.2 Harden major highway segments that have no alternate bypass to withstand earthquake and 100-year flood.

4.3 Harden fuel storage facilities and ensure distribution network to critical facilities.

4.4 Reduce vulnerability of electrical system to all hazards.

4.5 Develop water systems that resist damage to all hazards and contingency plans to truck water.

4.6 Develop post-disaster wastewater disposal contingency plans that do not depend on water.

4.7 Ensure post-disaster debris collection and disposal capacity.

4.8 Provide post-disaster transit and paratransit system.

5.0 Goal: Develop a training program of the highest standard to ensure that all involved personnel efficiently and effectively carry out their responsibilities as set forth in an updated emergency operations plan.

5.1 Achieve a level of readiness among existing and new employees who understand their role in a coordinated system.

5.2 Maintain an updated emergency operations plan to continually identify and add to contact list of resources that could provide assistance and improve procedures.

6.0 Goal: Provide adequate pre- and post-disaster emergency shelters to accommodate residents and visitors.

6.1 Ensure that all hotels, resorts, and cruise ships have an emergency response plan that has been reviewed and approved by Civil Defense, and implemented with an active personnel training program.

6.2 Identify and harden selected shelters to withstand hurricane.

6.3 Comprehensively inventory potential shelters to address mass temporary post-disaster housing requirements.

6.4 Provide services to address visitor needs for daily needs, communication with families back home, and alternate travel arrangements.

7.0 Goal: Develop a level of awareness among the general public and businesses, particularly the visitor industry, that results in calm and efficient evacuations, self-sufficient survival skills, and willingness to abide by preventive or property protection requirements.

7.1 Develop a broad-based public information program that utilizes a diversity of communication media.

7.2 Develop special public information programs targeted to vulnerable populations.

7.3 Develop a community-based network that double-functions as the Community Emergency Response Team and provides input into mitigation planning.

8.0 Goal: Minimize post-disaster recovery disruption by developing systems for efficient clean-up, documentation of damage and injury, and processing of appropriate aid to rebuild businesses and the economy.

8.1 Inventory potential debris movement resources and develop a plan to coordinate these resources.

8.2 Develop educational programs to instruct residents and businesses on clean-up and disposal options.

8.3 Educate businesses on business interruption planning.

8.4 Develop efficient field data collection systems to document damage and process aid.

8.5 Partner with financial institutions to facilitate customers' post-disaster access to cash.

9.0 Goal: Protect natural and cultural resources to the extent practicable that buffer hazards or have significant value.

9.1 Within the context of a multi-objective open space plan, identify significant natural and cultural resources and alternative means of protection.

4.2 MITIGATION ACTIONS BY HAZARD TYPE

This section summarizes applicable mitigation actions by the hazard type. Mitigation actions can be grouped into six broad categories:[1]

- Prevention. Government administrative and regulatory actions or processes that influence the way land and buildings are developed and built (e.g., planning and zoning, building codes, drainage standards).
- Property Protection. Actions that involve the modification of existing structures to protect them from a hazard, or removal from the hazard area (e.g., acquisition, elevation, relocation, structural retrofits, storm shutters, shatter-resistant glass).
- Public Education and Awareness. Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them (e.g., outreach projects, real estate disclosure, hazard information fairs, school-age and adult education programs).
- Natural Resource Protection. Actions that minimize hazard losses while also preserving or restoring the functions of natural systems (e.g., erosion control, stream restoration, watershed management, wetland restoration and preservation).
- Emergency Services. Actions that protect people and property during and immediately after a disaster or hazard event (e.g., warning systems, emergency response services, protection of critical facilities).
- Structural Projects. Actions that involve the construction of structures to reduce the impact of a hazard (e.g., dams, levees, flood walls, seawalls, diversion ditches).

4.2.1 Hurricanes and Wind Storms

Mitigation actions include improving emergency services and protecting property through enhanced structural integrity:

- Warning Systems. Warning has improved with the use of weather satellites, weather buoys, and tracking aircraft, but it is not possible to predict, more than a very few hours ahead, just where in the islands the main force of a hurricane will impact. Hurricane Iniki exemplified the sudden unpredictable track of a hurricane. However, the intensity of a storm approaching the islands is known before it makes landfall and thus the effects may be anticipated. Although the position of a storm refers to its center (the “eye”), hazardous wind, rain, and surf can extend 200 miles from the center. Therefore advance warning and preparation for a hurricane must consider the potential periphery effects. All cyclonic storms in this part of the ocean are carefully monitored by the Central Pacific Hurricane Center, which is established at the National Weather Service forecast office in Honolulu at the start of the “hurricane season” on June 1. “Warning” is actually provided in several stages: advisories of tropical depressions (incipient storms); warning of tropical storms (winds less that 74 mph); hurricane watch (hurricane within 36 hours) and hurricane warning (hurricane conditions - winds over 73 mph expected within 24 hours). [Note:74 mph = 64 knots, sometimes used in reports].
- Hurricane Shelters. Sheltering and preparation in Hawai`i is primarily the responsibility of residents themselves, since major evacuation as is done in the Gulf and Atlantic coasts is obviously impractical. Adequate public shelters capable of withstanding hurricane-force winds are limited; they can hold 80% of the population who will seek shelter, by State Civil Defense standards. These standards expect only 35% of the population to seek public shelters. Most of the shelters shown are schools and some are marginal for this purpose but are the best refuge available. Homeowner's preparations are vital and have been publicized in print by the UH Social Science Research Institute (SSRI)[2] and are repeated by Civil De-

1. FEMA, Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies, State and Local Mitigation Planning How-To Guide #3, April 2003.

fense via the media during a hurricane watch. However, evacuation of coastal areas threatened by storm surge is done in an ad hoc fashion by using the tsunami evacuation maps. These maps have some validity for this purpose in areas such as Kailua-Kona, (although they may be too small) but may encompass too large an area such as in Hilo, where some buildings in the zone are more important as shelters. There is a paradox in hurricane evacuation - it is important not to expose people to wind hazards while avoiding the flooding hazard.

- Structural Integrity. Structural integrity has only been tested on this island by winter storms (winds over 40 mph; Section 2.3.1). In areas with frequent hurricanes, such as Guam, the most vulnerable structures are damaged or removed by prior events. Since we have been lucky enough to not have such experience, a high percentage of homes and also commercial buildings will be lost when a hurricane moves through parts of the island. It has been estimated that 38% of homes will be heavily damaged and an equal number will suffer minor damage from an Iniki-strength hurricane striking any island.[3] State Civil Defense has published a guide on strengthening houses to minimize losses.[4] Adopting and enforcing a building code with adequate wind load requirements is the primary mitigation tool for structures. The code requirements for wind pressure have increased by a factor of 2:1 since 1958 as the Uniform Building Code changed. The current level is based on a 100 mph peak gust, is applicable to commercial structures only and was adopted by the County in 1993. Prior to 1993, the County had no specific code requirements related to wind forces for residences. The code implemented in 1993 (the 1991 UBC) requires roof-to-wall uplift ties. The advisory Committee expects the next code, the International Building Code 2000, will be applied in this county with a 120 mph gust level. Since wind force increases with the square of the speed, this means a 44% increase in structural capability. Realistically, it will be many years before the majority of structures in the county will meet these code requirements. The most important action the County can take other than code revision is to ensure that public buildings, shelters, and other vital facilities meet the code requirements. The FEMA 1993 report is an excellent manual on structural lessons from Iniki while the ARA 2001 report covers implementation of these factors in detail.[5]
- Infrastructure lifelines. Harden exposed communication and electrical systems. Consider underground installation for new development and in strategic existing areas.

4.2.2 Earthquakes

Hawaii County is believed to be exposed to the highest seismic hazard in the State. In approximately the past 50 years, the County has experienced at least eight earthquakes with a Richter Magnitude of 6.0 or greater, and the geological structure of the island is believed to be capable of generating even larger earthquakes. Moreover, because the vast majority of structures in the County were designed and constructed before adoption of the 1976 Uniform Building

2. Social Science Research Institute, UH, "Hurricanes in Hawai`i: What Are The Risks of Damage?", undated.

3. Schroeder, Tom, 1993, "Hawai`i Hurricanes: Their History, Causes, and Future," Office of State Planning, December 1993.

4. Hawai`i State Civil Defense, 1997, "Construction Guide: On Strengthening Houses Against Hurricanes and Earthquakes, May 1997.

5. Federal Emergency Management Agency (FEMA), 1993, "Building Performance: Hurricane Iniki in Hawai`i", January 1993, Federal Insurance Agency, Washington, D.C.; Applied Research Associates (ARA), 2001, "Hazard Mitigation Study for the Hawai`i Hurricane Relief Fund" (incorporates part of FEMA-sponsored Iniki Building Performance Report), December 2001.

Code (UBC), which is the earliest UBC edition whose seismic design requirements are similar to the 1991 UBC, many of these structures most likely do not conform to the minimum seismic design requirements adopted by other high seismic risk regions of the United States.

Mitigation actions include preventive measures and emergency services improvements:

- Identification of Vulnerable Structures and Areas. Refine the applicability of the HAZUS model to Hawaii Island to assess earthquake risks and identify appropriate mitigation actions. The findings of a recent study prepared for the Hawaii State Earthquake Advisory Committee that focused on Maui and Hawaii County needs to be examined and follow-up actions implemented such as incorporation of appropriate changes to the building code.[6]
- Hardening Critical Facilities. A 1993 study conducted a seismic evaluation of essential fire stations and hospitals. The findings of that study need to be fully implemented. Similar evaluations need to be made of the communication systems and fuel tanks.

4.2.3 Tsunamis

Mitigation actions include improve emergency services, protect property, and public education:

- Warning. Warning in time for evacuation is, of course, the key to the public safety aspect of tsunami mitigation. There are two distinct warning scenarios for this island: for a distant tsunami source such as Alaska where three hours notice for evacuation is possible, and for a local tsunami where a few minutes, if any, warning can be provided. The distant tsunami warning is provided by a well developed and capable Federal system (Pacific Tsunami Warning Center, PTWC), based on O`ahu and covering the Pacific ocean area. A local tsunami is an unusual event, but the source is most likely to be near the southern coastal areas of this island. The wave may travel faster than a feasible warning but fortunately the wave height diminishes fairly rapidly with distance. The primary warning is simply feeling the earthquake, coupled with education on the response. The new system which senses water rise at six locations on the Kona-Ka`u shoreline is now operational. It alerts the warning center which immediately confirms the event by an earthquake signal and advises County Civil Defense (or the police, after working hours). This system supplements the slower and less definite earthquake-only local system that was in service since 1978.
- Evacuation. Evacuation zones have been developed and used. These zones are based on a combination of historical data where available and numerical modeling, to produce maximum expectable inundation limits. County Civil Defense then uses these data to provide a map with zones related to physical features where possible and always mauka of or at the inundation limit. These zones apply to distant tsunamis only and are published in the front of the telephone directory. Because of the short warning time for a local tsunami, referring to published zones for this island is not considered feasible and so the public is advised to quickly move inland from the shore. Thirty five sirens around the island are operated by the County to alert the public to a tsunami warning, with specific information broadcast from Civil Defense via the emergency alert system (EAS) radio stations. Short-term sheltering is provided as well as bus evacuation of schools in risk areas. Civil Defense, in conjunction with other County, State, and Federal agencies has developed thorough plans for response to a warning.[7] These plans and procedures cover matters from roadblocks to school evacuation and are reviewed in periodic exercises with responsible agencies but which do not in-

6. Martin & Chock, Inc., Earthquake Loss Estimation/Mitigation Project, prepared with funding from the Hawaii Coastal Zone Management Program, December 2003.

7. County of Hawai`i, Emergency Procedures, Civil Defense Agency, 2000 (draft revision in process 2003).

volve the public. These warning and evacuation operations were most recently publicly tested in 1994 by evacuation for a tsunami which turned out to be non-hazardous.

- Public Education. The Disaster Preparedness pages of the telephone directory (provided by Civil Defense) are a basis for education of the public and are usually referred to in other safety material. The State provides a recent tsunami safety video which is shown on television and to various groups; it emphasizes checking the phone book pages to see if you are in an evacuation zone. The Pacific Tsunami Museum in Hilo has a primary mission of public education and awareness and safety and has exhibits on warning and response. The monthly siren test includes an EAS message about public response, on all radio stations.
- Structural Integrity. The Flood Insurance Rate Maps (FIRM), which used much of the same data as the inundation/evacuation work, are an aid to minimize risk to structures, along with County planning and building restrictions. The FIRM are considered more reliable for tsunamis than for stream flooding, but are known to also have some questionable areas in this regard. The County permitting process considers both public and structural safety in its regulations. The FEMA flood insurance program is a significant force in limiting home construction and design in probable inundation areas. The mortgage lenders are especially careful in this regard. Thus, in recent years, exposure has become more limited in scope. A detailed engineering publication which deals specifically with structural design to resist tsunamis is available to building code, permitting, and architecture users, is available.[8] The report was prepared for FEMA and coordinated with Tsunami Technical Advisory Committee and the University of Hawaii. Much of it applies to all exposed structures, not just residential. A recent, less technical report describes procedures to improve the tsunami resilience of communities.[9] It is primarily oriented toward the mainland coast although the California zonation example they describe was performed here.
- Recovery of Critical Facilities. Recovery may be the most difficult to plan because of the unpredictability of the nature and extent of the damage. For example, major damage to harbor facilities, interrupting the fuel supply, can result in loss of part of the electrical supply and thus of water and sewage. Other islands may (or may not) compete for recovery support, compounding the problem for this island. The Department of Transportation has recovery plans which are supplemented with current GIS layers in other portions of this report.

4.2.4 Rainfall Flooding and High Waves

Of the major natural hazards, flooding occurs most frequently. Mitigation measures include preventive land use measures, warning systems and public education, flood control structural projects, repetitive loss buyout programs, and natural resource protection programs.

- Land use measures. Preventive land use measures rely on accurate flood zone identification. The existing Flood Insurance Rate Maps (FIRM) do not cover all flood-prone areas and require updating for areas that are covered. Recognizing the cost to modernize the FIRM islandwide, mitigation actions will prioritize the modernization effort. When updating, tsunami and hurricane surge inundation limits and base flood elevations require verification with modeling and historical data. The zoning and flood control code use the FIRM as the basis to avoid exposure or apply special flood-proofing standards. Repetitive loss programs need to be incorporated into the flood control and land use systems to buyout and prevent future construction in such areas. Current drainage standards, which are based on

8. "Design and Construction Standards for Residential Construction in Tsunami-prone Areas in Hawai`i", Dames and Moore, Honolulu and Washington, D.C., January 1980.

9. "Designing for Tsunamis", National Tsunami Hazard Mitigation Steering Committee, NOAA, March 1991.

10-year storms, need to be reevaluated to better account for cumulative upslope development.

- Warning and public education systems. The National Weather Service has installed telemetered rain gages to aid in flood prediction and wave buoys for high waves. Two doppler radars on this island provide rainfall intensity in quantitative graphic form. NWS's system needs to be supplemented with an improved field reporting system and stream gaging system related to rainfall gages to better predict flash flooding and to extend flood warnings to areas that NWS's system cannot monitor. Warnings for specific areas are broadcast via normal and special radio/TV forecasts and by special County Civil Defense announcements, as well as over the NOAA Weather Radio (for airplanes and boats). Public education needs to be improved to address the problem of vehicles being driven across flooding streams-- road hazard signs need to be quickly erected along highways, and hunters and residences in remote areas should be educated. For high waves, the most effective action is the closure of beaches and coastal roads.
- Flood control structural and nonstructural projects. Flood control channels have long been established on this island; however, with increased urbanization some channels have been overloaded and need or have received enlargement or rerouting. The recent upgrade of Alenaio Stream in Hilo is a good example. As part of the cost-benefit for such projects, nonstructural alternatives need to be examined such as better watershed management. To reduce coastal damage to high waves, improvements to the seawall system in Hilo and Kailua-Kona have been discussed, but there are no firm plans. There is a tradeoff between the cost of expensive structural improvements and the cost of more frequent and extensive cleanup.

4.2.5 Lava Flows

Mitigation actions include preventive measures such as zoning, emergency services improvements such as warning systems based on improved predictive mapping, and limited structural protection measures.

- Identification of hazard areas. The Hawaiian Volcanoes Observatory (HVO), part of the U.S. Geological Survey, has developed very capable methodology and systems for predicting eruptions in a timely manner, and evaluating the probable lava flow hazard areas. All historical lava flows have been well mapped, and zonation depicted showing the chances of more lava flow for all parts of the island. In recent years, improved mapping programs have moved away from the discrete zonation boundaries to indicate more realistic probabilities for hazard areas and transition regions. Lava shed programs, analogous to water flooding maps, are under development. Planning, zoning, and insurance factors now mitigate against unwarranted development in high hazard areas.
- Warning systems. HVO, in conjunction with Civil Defense and other County agencies, is on standby to provide warning and evacuation when an eruption occurs. Though most lava flows have been slow enough to allow easy evacuation and even removal of some structures, an eruption from Mauna Loa toward Kona can (and has) required rapid response in that area as communities may be both threatened and escape routes cut.
- Structural protection. One lava diversion dike has been constructed. On Mauna Loa, it protects the government's long term atmospheric observatory on the mountain. Ad hoc diversions using bulldozers, bombs, and water spray have been tried in the past, with varied and generally minimal results.

4.2.6 Droughts and Wildfire

The mitigation actions for drought are primarily structural and non-structural programs to withstand droughts (since rain-enhancing measures have proven ineffective). Wildfire mitigation includes preventive land use measures, improved hazard identification, and critical facilities development.

- Identification of hazard areas. Presently, there are no GIS data and maps for wildfire hazard areas based on vegetation fuel loads. For high hazard areas, appropriate conditions to zoning and subdivision applications need to be developed, such as requiring fire-resistive materials or maintenance of fire breaks.
- Critical facilities and training. Potential water sources to fight wildfires need to be inventoried. Roads that may be closed by wildfires and lava flows need to be identified and bypass routes or other contingencies planned. In addition to recently acquiring brush trucks, the County Fire Department sponsored 45 volunteer firefighters (from rural areas) to participate in the Firewise Community Development Workshop and helped establish the Big Island Wildfire Coordination Group. This group is expected to improve procedures to rapidly provide the most effective response to wildfires in the island.
- Structural and nonstructural projects. Mitigation measures practiced or recommended by agriculturists include ample reservoirs, longer irrigation ditches, drought-resistant crops in certain areas, low rainfall cultivation/tillage practices, changing planting to better areas during droughts, and moving cattle. More usage of catchment reservoirs can help growers get through dry periods without crop loss. The National Resource Conservation Service provides technical assistance with establishing ponds and reservoirs, and may also provide grants. The U.S. Department of Agriculture (USDA), with support from other agencies, maintains a drought mitigation center which assists states in developing drought mitigation plans. The County will defer to the plan being developed by the State Water Commission. Crop insurance is available for mac nuts and some other primary local crops through the Cooperative Extension Service, a program of the USDA and the University of Hawaii. This organization also provides information on drought-resistant plants and tillage.

4.2.7 Landslides and Sea Cliff Erosion

Mitigation actions include structural protection measures and preventive land use controls.

- Structural projects. The major problem with landslides is road closure. Heavy rainfall or earthquakes could cause the landslide. Structural slope stabilization along highways are expensive, but is often the best long-term solution.
- Preventive land use measures. Existing shoreline setback regulations require a minimum of 40’ setback from the certified shoreline. Whether this 40’ provides adequate buffer relative to the rate of sea cliff erosion such as in the Hamakua area requires further study. Based on the findings, the shoreline setback requirement should be adjusted accordingly for these areas.

4.3 PRIORITY CRITERIA

Mitigation actions were selected for implementation based on community acceptance criteria referred to as the STAPLEE criteria (**S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**conomic, and **E**nvironmental) and then prioritized.[10] The STAPLEE evaluation criteria analyzes the appropriateness of alternative mitigation actions by considering the following questions:

- Social
  - Will the proposed action adversely affect one segment of the population?
  - Is the proposed action culturally insensitive?
- Technical
  - Is the proposed action technically feasible?
  - Is the proposed action a long-term solution or a short-term "band-aid"?
  - Are there secondary effects resulting from the proposed action?
- Administrative
  - Does the proposed action require additional staffing?
  - Does the proposed action require additional training?
  - Does the proposed action require ongoing maintenance?
- Political
  - Is the proposed action controversial?
  - Does the proposed action require legislative approval?
  - Does the proposed action affect multiple stakeholders and have they all had an opportunity to be involved?
- Legal
  - Does the County have jurisdiction to implement the proposed action?
  - Are new laws required to implement the proposed action?
  - Are there liability risks involved with the proposed action?
- Economic
  - What are the costs involved to implement the project?
  - Is the proposed action eligible for outside funding?
  - Is the burden of the choice of funding borne by those who benefit?
  - Is a more detailed cost-benefit analysis warranted?
- Environmental
  - Does the proposed action protect or restore the environment?
  - Does the proposed action have potentially negative effects on the environment?
  - Is an EA or EIS required?

10. Priority-setting methodology from FEMA, How-To Guide #3: Developing The Mitigation Plan; Identifying Mitigation Actions And Implementing Strategies, FEMA No. 386-3, April 2003.

The selected actions that passed the STAPLEE criteria were then prioritized using the following criteria:

- *Critical to public health or safety.* Actions that significantly improve emergency services.
- *Hazard severity.* Actions that mitigate priority hazards based on loss estimation analyses.
- *Ease of implementation*. Actions that have negligible cost and/or require minimal effort.
- *Multi-objective*. Actions that meet multiple objectives (e.g., flood control project that provides recreational benefits) or address multiple hazards.
- *Time*. Actions that can be quickly accomplished. Once the easy actions are done, then can focus on more difficult actions.
- *Post-disaster mitigation*. Actions that may be more appropriate for post-disaster implementation when there is the political will and access to post-disaster assistance funding.

4.4 IMPLEMENTATION PLAN

Table 4-1 identifies the actions to achieve the mitigation objectives. The actions are sorted into the following categories:

- Administrative actions not requiring major funding;
- Ongoing funded studies that need to be incorporated into future updates of this plan;
- Actions requiring funding.

Evaluation, Ranking, And Approval Of Mitigation Projects

The County of Hawaii Civil Defense Agency will establish a special committee to evaluate, screen, and prioritize eligible hazard mitigation projects submitted by county government agencies and private nonprofit agencies. The county committee will use a scoring system that emphasizes projects that addresses repetitive losses, high risk to public safety, cost-effective, State and local priorities, and environmentally and technically sound. Committee members will be selected from the following organizations (note: The Administrator of the County Civil Defense Agency will act as chair of the committee):

- Fire Department
- Police Department
- Office of the Mayor
- Data Systems Management
- Department of Environmental Management
- Department of Planning
- Department of Public Works
- Department of Research and Development
- Department of Water Supply
- University of Hawaii at Hilo

According to State mitigation priorities, all of the four counties will receive equal priority for the following natural hazards because all jurisdictions are vulnerable: hurricane and high winds, floods, drought, wildland fire, landslides, coastal erosion, and tsunamis. The County of Hawaii will receive top priority for projects involving lava flow and VOG. Priorities (in order) for earthquake projects are: (1) County of Hawaii; (2) County of Maui; (3) City and County of Honolulu; and (4) County of Kauai.

The County and State will use FEMA's cost benefit models to include HAZUS-MH. Also, EPA standards and State Historical Preservation Guidelines will supplement the cost-effectiveness review of each project. State Civil Defense will train appropriate county personnel in the cost benefit models. Also, the State Mitigation Forum will be developing a program to better assess potential losses especially with wind events. This will involve windspeed maps for all counties and a customized hurricane simulation model with geocoded building inventory, user-defined damage functions, and other variables into a GIS-based hurricane loss estimation software package. All mitigation projects must also meet all appropriate Federal, State, and county laws and regulations.

The Committee will score and rank each project. These recommendations will be forwarded to the Mayor for final selection of projects.

The State Civil Defense Mitigation staff will provide technical assistance to the applicants in the preparation of the applications, cost-benefit analysis to include training, and acquisition of environmental data. In the past, staff members have personally visited potential applicants and explained the application process and requirements. This effective practice will be continued.

The following are the County priorities regarding hazard mitigation projects:

1 Hardening and Retrofitting of Critical Facilities

Facilities include emergency shelters, fire stations, police stations, hospitals, sewage treatment plants, water systems, communications sites, power plants, schools, harbors, airports, key transportation nodes, and other facilities/buildings providing critical services.

2 Flood Control

Floodproofing of critical facilities and improvement of drainage systems.

3 Mapping/Assessments/Studies

Re-mapping of existing flood prone areas and mapping of unmapped areas. Analysis of high hazard areas and studies to develop mitigation measures; enhancement of GIS capability (hardware, software, and personnel); mapping of all major natural hazards.

4 Public Awareness/Education

5 Upgrading of Warning Systems

6 Buy-Out/Acquisition/Relocation Program

7 Homeowners Retrofit Grant Programs/Safe Room

8 Wildfire Prevention

9 Prevention of Land/Rock Slides in Residential Areas and Highway Corridors.

Table 4-1. Implementation Actions

I.D. No.	Project Description	Hazards	Lead Agency	Budget	Funding Source	Priority	Objectives	STAPLEE Evaluation	Priority Rationale
1.0	**Administrative actions not requiring major funding:**								
1.1	Review the General Plan natural hazard policies in light of this mitigation plan and American Planning Association suggested policies	All hazards	Planning	minimal	County	High	2.1	Potentially controverial; requires legislative approval; affects multiple stakeholders who should have an opportunity to be heard	Multi-objective
1.2	Review the feasibility to adopt the 2003 International Building Code	Hurricane, Earthquake	Department of Public Works	minimal	County	High	2.2	Potentially controverial; requires legislative approval; affects multiple stakeholders who should have an opportunity to be heard	Multi-objective; mitigates most severe hazards
1.3	Update tsunami evacuation maps	Tsunami	Data Systems w/ Civil Defense	minimal	County	High	1.1	Technically feasible; County has jurisdiction	Relatively easy to implement; quickly accomplished
1.4	Develop relocation policies for repetitive loss structures	All hazards	Civil Defense w/ Public Works	minimal	County	Medium		Potentially controverial; requires legislative approval; affects multiple stakeholders who should have an opportunity to be heard	Appropriate for post-disaster mitigation
1.5	Work with hotels, cruise ship industry, nursing homes, schools, hospitals, and shopping centers to develop emergency response plans	Hurricane, Earthquake, Tsunami	Civil Defense	minimal	County, private (visitor industry)	High	6.1, 6.4, 7.2	Requires cultural sensitivity; multiple stakeholders	Critical to publich health and safety
1.6	Study feasibility of participating in the Community Rating System	Flooding	Public Works	minimal	County	Low	1.1, 1.2, 2.3, 5.1, 7.1	May require additional staff and training	May reduce flood insurance premiums

Table 4-1. Implementation Actions

I.D. No.	Project Description	Hazards	Lead Agency	Budget	Funding Source	Priority	Objectives	STAPLEE Evaluation	Priority Rationale
1.7	Study feasibility of including non-structural earth-quake damage prevention into building code	Earthquake	Public Works	minimal	County	Low	2.2	May require additional staff and training	Mitigates most severe hazard
1.8	Identify harden-ing projects to implement 1993 seismic evalua-tion study of fire stations and hospitals	Earthquake, Hurricane	Civil Defense, with Public Works, Fire, and Hospitals	minimal	County	High	3.1	Costly projects	Critical of public health and safety
1.9	Explore with utilities feasibil-ity of under-ground power lines	Hurricane, Earthquake, Tsunami	Civil Defense, with Planning & utilities	to be determined	County shared w/ utilities	Medium	4.4	Need more infor-maiton on tech-nical feasibility and costs	Mitigates most severe hazards; multi-objective (aesthetics)
1.10	Conduct hazard loss estimation study; incorpo-rate cost-benefit methodology as a factor in priori-tizing projects	All hazards	Civil Defense	minimal	County	Medium	1.4	May require staff training	Relatively easy and quick to implement
1.11	Develop routine training pro-gram for disaster response and recovery	All hazards	Civil Defense	minimal	County	High	5.1, 8.4	Requires ongo-ing staff commit-ment	Relatively easy and quick to implement
1.12	Evaluate warn-ing sirens cover-age	All hazards	Civil Defense	minimal	County	Medium	1.5	Requires coordi-nation w/ State Civil Defense	Relatively easy and quick to implement
1.13	Develop a for-mal post-event reporting sys-tem and infor-mation clearinghouse	All hazards	Civil Defense	minimal	County	Medium	1.6, 8.4	Requires addi-tional staff train-ing	Multi-objective
1.14	Evaluate disas-ter-level search & rescue capa-bilities	All hazards	Civil Defense, w/ Fire, Police, DPW	minimal	County	High	3.5	Requires inter-agency coordi-nation	Critical to public health and safety
1.15	Evaluate vulner-ability of County water systems and water truck-ing capacity	Hurricane, Earthquake	Dept of Water Supply, w/ Civil Defense	minimal	County	Medium	4.5	May require additional staff	Relatively easy and quick to implement

Table 4-1. Implementation Actions

I.D. No.	Project Description	Hazards	Lead Agency	Budget	Funding Source	Priority	Objectives	STAPLEE Evaluation	Priority Rationale
1.16	Evaluate waterless wastewater disposal options	Hurricane, Earthquake	Dept of Environmental Mgt	minimal	County	Medium	4.6	May require additional staff	Relatively easy and quick to implement
1.17	Implement Disaster Debris Action Manual	Hurricane, Earthquake, Tsunami, Flood	Dept of Environmental Mgt	minimal	County	Medium	4.7, 8.1	May require additional staff	Relatively easy and quick to implement
1.18	Develop post-disaster transit plan	Hurricane, Earthquake, Tsunami, Flood	Mass Transit Agency, w/ Civil Defense	minimal	County	Medium	4.8	May require additional staff	Relatively easy and quick to implement
1.19	Update debris estimation	Hurricane, Earthquake, Tsunami, Flood	Dept of Environmental Mgt	minimal	County	Medium	8.1	May require additional staff	Relatively easy and quick to implement
1.20	Coordinate TDSR sites	Hurricane, Earthquake, Tsunami, Flood	Dept of Environmental Mgt	minimal	County	Medium	8.1	May require additional staff	Relatively easy and quick to implement
1.21	Maintain list of debris management contractors and update boilerplate contracts	Hurricane, Earthquake, Tsunami, Flood	Dept of Environmental Mgt	minimal	County	Medium	8.1	May require additional staff	Relatively easy and quick to implement
2.0	**Ongoing funded studies that need to be incorporated into future updates of this plan**								
2.1	Emergency shelter evaluation	Hurricane	Army COE	budgeted elsewhere	Army COE	High	6.2, 6.3	Costly to implement; may require more detailed cost-benefit	Critical to public health and safety
2.2	GIS mapping of hotels, church shelters, hazardous waste sites	Hurricane, Earthquake, Tsunami, Flooding	Data Systems	budgeted elsewhere	FEMA	High	6.3, 3.1	Technically feasible	Relatively easy and quick to implement
2.3	Develop probalistic lava flow maps and modeling	Lava flow	Hawaii Volcanoes Observatory	budgeted elsewhere	USGS	High	1.1	Technically feasible	Multi-objective
2.4	Organize public awareness and preparedness program, including CERTs, through Project Kumiai; also include public education on pet care	All hazards	Civil Defense w/ Research & Development, Planning	budgeted elsewhere	FEMA, County	High	7.1, 7.2, 7.3, 8.2, 8.3, 8.4, 8.5	Need to be inclusive and culturally sensitive	Multi-objective

Table 4-1. Implementation Actions

I.D. No.	Project Description	Hazards	Lead Agency	Budget	Funding Source	Priority	Objectives	STAPLEE Evaluation	Priority Rationale
2.5	Update Emergency Operations Plan	All hazards	Civil Defense	budgeted elsewhere	FEMA	High	5.2	County has jurisdiction	Critical to public health and safety
2.6	Implement State Drought Plan	Drought	Civil Defense, with Fire and DWS	budgeted elsewhere	DLNR	Medium	1.1	Requires interagency coordination	Multi-objective
2.7	Identify wildfire hazard areas	Wildfire	State Drought Council, with Civil Defense & Fire	budgeted elsewhere	FEMA, State	Medium	1.1	Requires interagency coordination	Multi-objective
2.8	Adapt HAZUS-M or other hazard modeling to Hawaii Island	Hurricane, Earthquake, Flood	State Civil Defense	budgeted elsewhere	FEMA, State	Medium	1.4	Requires additional staff training; technical applicability needs to be validated	Applicable to most severe hazards
3.0	**Actions requiring funding**								
3.1	Harden public schools for emergency shelters	Hurricane, Flooding, Tsunami	Dept of Acctg and Gen Services (DAGS)	Included in State's mitigation plan	FEMA, State, County	High	3.1	Requires detailed cost-benefit analysis	Critical to public health and safety
3.2	Modernize FIRM maps in accordance with priority mutually established between County and DLNR	Flood, Hurricane, Tsunami	Dept of Public Works	$2,000,000 annually for approx. 5 years	FEMA, State, County	High	1.1	Costly	Multi-objective
3.3	Identify high windspeed areas and vulnerable structures	Hurricane, Earthquake	Civil Defense w/ Public Works	$300,000	FEMA, State, County	High	1.1	Technically feasible	Multi-objective
3.4	Identify earthquake-induced ground failure areas	Earthquake	Civil Defense w/ Public Works	$100,000	FEMA, State, County	Medium	1.1	Technically feasible	Applicable to severe hazard
3.5	Explore incentives for existing homeowners and businesses to retrofit their structures, and participate in building fairs to publicize	Hurricane, Earthquake, Flooding	Department of Public Works	$10,000	County	High	2.3	Affects multiple stakeholders; may require legislative approval	Multi-objective

Table 4-1. Implementation Actions

I.D. No.	Project Description	Hazards	Lead Agency	Budget	Funding Source	Priority	Objectives	STAPLEE Evaluation	Priority Rationale
3.6	Study hardening requirements for Hilo and Kawaihae Harbors	Tsunami, Hurricane, Earthquake	Dept of Transportation	included in State plan	Homeland Security, FEMA, State	High	4.1	Requires more detailed cost-benefit analysis	Critical to recovery
3.7	Study hardening and evacuation requirements for Hilo and Kona Airports	Hurricane, Earthquake	Dept of Transportation	included in State Plan	Homeland Security, FEMA, State	High	4.1	Requires more detailed cost-benefit analysis	Critical to public health and safety
3.8	Study hardening, floodproofing, and bypass alternatives for major highways	All hazards	Dept of Public Works	50,000	FEMA, State, County	High	4.2, 3.4	Requires more detailed cost-benefit analysis	Critical to public health and safety
3.9	Study hardening requirements for fuel storage and distribution to critical facilities	Hurricane, Earthquake, Tsunami	Civil Defense, with fuel providers	50,000	Homeland Security, FEMA, County	High	4.3	Requires more detailed cost-benefit analysis	Critical to public health and safety
3.10	Develop rainfall and streamflow gaging system suitable to flood monitoring	Flooding	USGS	200,000	USGS, State, County	High	1.2	May be costly	Multi-objective
3.11	Develop technology and training system for efficient field monitoring of in-progress event	All hazards	Civil Defense	30,000	FEMA, County	High	1.2, 5.1	May require additional staff training and expensive equipment	Multi-objective
3.12	Identify landslide and coastal erosion hazard areas and mitigation actions	Landslides	Civil Defense w/ Dept of Transportation, Public Works	DOT study done; 50,000 for coastal cliffs	FEMA, State, County	Low	1.1	Requires more detailed cost-benefit analysis landslide mitigation; may require new legislation for seacliff setbacks	Multi-objective
3.13	Upgrade and coordinate emergency communication system	All hazards	Civil Defense, w/ Fire, Police, military, ham operators, wired and wireless operators	to be determined	FEMA, State, County, private	High	3.1, 3.2, 3.3	May require interagency coordination, cost-benefit analysis	Critical to public health and safety
3.14	Study hardening requirements for electrical system	Hurricane	HELCO	to be determined	HELCO	Medium	4.4	Need to consider cost burden on utility vs. public	Mitigates a priority hazard

Table 4-1. Implementation Actions

I.D. No.	Project Description	Hazards	Lead Agency	Budget	Funding Source	Priority	Objectives	STAPLEE Evaluation	Priority Rationale
3.15	Upgrade EOC's GIS and communication systems	All hazards	Civil Defense	$100,000	FEMA, County	Medium	3.1, 3.2	May require additional staff training	Can be quickly accomplished
3.16	Develop scenario training and mitigation planning capabilities	All hazards	Civil Defense	to be determined	FEMA, County	Medium	5.1, 1.4	May require additional staff training	Multi-objective
3.17	Prepare multi-objective open space plan	All hazards	Planning	200,000	various	Medium	9.1	Protects or restores environment	Multi-objective