
Section 8
Drought Planning

8. DROUGHT PLANNING

Droughts have affected the islands throughout Hawaii's recorded history, with the most severe events occurring in the past 15 years associated with the El Niño phenomenon. Drought is a persistent and extended period of below normal precipitation where abnormal moisture deficiencies induce a variety of adverse effects. Impacts due to drought, both direct and indirect, manifest as changes in the environment, economy, public health, and long-term water supply. This chapter reviews and assesses drought mitigation planning efforts undertaken in the State of Hawaii.

8.1. Goals and Objectives

The State Water Code recognizes the need for comprehensive water resource planning to address water supply and conservation. Drought planning activities are integral to water conservation and resource protection. The State Water Code identifies the *Water Resources Protection Plan* as the document in which to include programs to conserve, augment, and protect the resource, as well as other elements necessary or desirable for inclusion. Although HRS §174C does not require drought planning, the *Statewide Framework for Updating the Hawaii Water Plan (2000)* specifically recommends drought planning to be included in the Hawaii Water Plan update, and reinforces the need for drought planning in support of water conservation and water shortage planning.

The drought from 1998 to 2003 had devastating impacts throughout the islands, including numerous wildland fires, record-low rainfall, cattle losses, and major crop damage. In mid-2000, a statewide drought declaration was issued by the Governor, and the State, together with federal and county agencies, private organizations, and affected stakeholders, identified and executed various drought response projects. Initiatives were also undertaken towards the development of a drought plan for the State to mitigate and plan for the long-term effects of drought. The Commission Water Resource Management assumed the role of lead agency in the development of the State's emerging drought program.

The Hawaii Drought Council and its subcommittees were established in 2000 to oversee drought response and mitigation efforts. The chair of CWRM and the director of the Department of Agriculture serve as co-chairs of the Hawaii Drought Council. CWRM provides administrative support to the Hawaii Drought Council and its committees, and provides coordination support to the county-level drought committees through the State Drought Coordinator, who is a CWRM staff member. The Hawaii drought program has grown considerably since its inception in 2000, resulting in the solidification of agency coordination, communication, and involvement at both the State and county levels. CWRM remains committed to drought mitigation, and has set forth the following goals for the drought program:

- Fulfill the State's responsibility, as trustee of water resources, to protect and ensure the long-term viability of resources through implementation of the drought program and regular updates of the Hawaii Drought Plan (HDP).
- Support legislative budget appropriations that strengthen the drought program and achieve the Hawaii Drought Plan priority implementation actions.

- Expand and improve outreach and public education programs, including the Hawaii Drought Monitor website and the production and distribution of drought awareness public service announcements in multiple media formats.
- Support and encourage the efforts of the Hawaii Drought Council through the efforts of the State Drought Coordinator.
- Continue to provide advisory and liaison support to county drought committees in communications with State and federal agencies, and encourage implementation of county drought mitigation strategies.
- Seek to improve drought risk assessment methods, drought impact assessment methodologies, and apply new information in developing and updating drought mitigation strategies.
- Maintain and foster positive relationships with federal agencies involved with drought hazard mitigation, response, and relief including the Federal Emergency Management Agency (FEMA), the U.S. Bureau of Reclamation (Reclamation), and the U.S. Department of Agriculture (USDA).
- Cultivate partnerships with business, agriculture, and environmental organizations and professional associations to expand participation in drought planning and mitigation activities and increase public awareness and support of drought issues.

8.2. Overview of Drought

Drought is a normal and temporary climate abnormality, but it can have profound effects on the environment and the lifestyles of affected communities. Drought diminishes natural stream flow, depletes soil and subsoil moisture, and the resultant variety of social, environmental, and economic impacts can be numerous and widespread.

8.2.1. Understanding Drought

The National Drought Mitigation Center (NDMC) uses two main types of drought definitions: conceptual and operational. Conceptual definitions of drought are general and help people understand the concept of drought. Operational definitions help to define the onset, severity, and end of a drought. Operational definitions of drought include the following:

- **Meteorological Drought:** Meteorological drought is usually an expression of the precipitation level's departure from normal over some period of time. Meteorological measurements are the first indicators of drought.
- **Agricultural Drought:** Agricultural drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agriculture is usually the first economic sector to be affected by drought.
- **Hydrological Drought:** Hydrological drought refers to deficiencies in surface and subsurface water supplies, reflected in declining surface and ground water

levels. There is lag time between a lack of rainfall and the observed decrease of water levels in streams, rivers, lakes, reservoirs, and aquifers; therefore, hydrological drought will not be reflected until precipitation is deficient over an extended period of time.

- **Socioeconomic Drought:** Socioeconomic drought occurs when a physical water shortage affects people such that the demand has exceeded supply, as a result of a water deficit. This can affect human and animal population and growth rates, water and fodder requirements, agricultural drought impacts, and various industries.

8.2.2. Drought Impacts

The direct impacts of drought include: reduced cropland, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat. Indirect drought impacts are the consequences of direct impacts.

Drought impacts can also be categorized by the sector that experiences the impacts. These types of impacts are economic, environmental, or social. Many of the economic impacts occur in agriculture and related sectors, due to their reliance on rainfall and on surface and ground water supplies. In addition to losses in yields to both crop and livestock production, impacts can be indicated by income loss to farmers, which has a ripple effect, impacting income to retailers and others who supply goods and services to farmers.

Environmental impacts refer to the losses incurred as direct or indirect results of drought, such as wildfire damage to plant and animal species. Direct and indirect negative impacts can include: degradation of wildlife habitat; degradation of air, water, and landscape quality; loss of biodiversity; and soil erosion. Social impacts involve public safety, health, water use conflicts, quality-of-life issues, and socio-spatial inequities in the distribution of impacts and disaster relief. Many impacts that have economic and environmental effects have social components as well.

8.2.3. Drought Response versus Mitigation

The term “drought response” refers to emergency actions that are implemented directly in response to drought conditions. In contrast, “drought mitigation” is defined as short- and long-term actions and/or programs that may be implemented prior to, during, and after drought events to reduce the degree of risk to human life, property, and the economy. Examples of response actions and corresponding examples of mitigation actions are listed in Table 8-1 below. Effective drought planning and mitigation programs can reduce the need for extensive federal, state, and county emergency response and relief expenditures to rebuild local economies and reduce competition for water during drought.

Drought Response	Drought Mitigation
- Alert appropriate agencies of emerging rainfall deficits.	- Expand current network of rain gages to improve rainfall monitoring.
- Implement agency-coordination actions enumerated in an existing drought plan.	- Develop a drought plan to coordinate drought response between agencies.
- Alert appropriate agencies of declining ground and surface water storage.	- Establish alert procedures for declining water level conditions.
- Implement voluntary and/or mandatory water use restrictions.	- Establish conservation programs to reduce water consumption.
- Mobilize contractors to truck water to ranches without sources.	- Establish contingency water-hauling programs for livestock.
- Modify and utilize monitor wells to provide emergency sources of water.	- Seek authorization and funding for development of additional storage, alternative water sources and new water supply sources.
- Utilize models and monitoring data to assess drought recovery or escalation of drought conditions.	- Identify areas at risk to drought and plan for regional response actions and strategies.
- Release regular and timely media advisories.	- Develop and implement drought-related public awareness programs.

8.2.4. Hawaii's Need for Drought Mitigation

Drought can lead to difficult decisions regarding the allocation of water, as well as stringent water use limitations, water quality problems, and inadequate water supplies for fire suppression. In Hawaii, droughts and wildland fires threaten all islands in any given year. Also, there are additional issues such as growing conflicts between agricultural uses of surface water and instream uses, "surface and ground water" interrelationships, and the effects of growing water demands on traditional and cultural uses of water.

In the past, drought was addressed as a temporary emergency. Actions were taken in response to impacts, in a reactionary fashion. The most important lesson learned in recent years is that the best time to reduce the impacts of drought is before they occur. Therefore, it is important to develop drought planning programs that advocate a proactive management approach.

Droughts have been prevalent in the past and will continue to adversely affect the environment, economy, and the citizens of the State, due to Hawaii's strong dependency on rainfall and the lack of adequate water supply and/or infrastructure in certain areas of the State. Historical patterns indicate that Hawaii will continue to suffer damaging droughts, and the loss potential will only increase as the need for economic growth and revitalization

amplify pressures upon the State's limited water supply. Aggressive planning and the utilization of alternative resources are necessary to avoid a situation where future population and economic growth cannot be sustained, due to insufficient quantity and quality of water resources. Since water is limited and precise rainfall predictions are not possible, effective water resource planning and management is critical to the long-term sustainability of our island communities.

8.3. Existing Drought Planning Context

State efforts to establish a drought plan were undertaken in recognition of and in coordination with the various federal agencies that administer drought assistance programs, including FEMA, Reclamation, the U.S.D.A. Farm Service Agency, the Natural Resources Conservation Service (NRCS), the U.S. Forest Service, and the Small Business Administration. The following sections provide background information on federal legislation and the resultant State and county actions that have contributed to the development of Hawaii's drought program.

8.3.1. Federal Disaster Management Act

Hazard mitigation is an action or number of actions taken to reduce or eliminate long-term risk to people and their property from the effects of natural hazards. The purpose of hazard mitigation is two-fold: 1) to protect people and structures from harm and destruction; and 2) to minimize the costs of disaster response and recovery. Hazard-mitigation planning is the process that analyzes a community's risk from natural hazards, coordinates available resources, and implements actions to reduce risks.

In the past, funding for hazard mitigation was typically available only following a disaster declaration, based on a percentage of the estimated damages. Since the early 1990s, FEMA and the United States Congress have witnessed large increases in disaster response and recovery costs, and as a result, they have provided funds to communities, counties, and states to reduce impacts from natural hazards through hazard mitigation. The Federal Disaster Management Act of 2000 requires each state and territory to conduct hazard mitigation planning and to implement projects to reduce hazard impacts prior to a disaster occurrence. This Act marked a fundamental shift in policy. Rather than placing primary emphasis on response and recovery, FEMA's focus broadened to incorporate mitigation as the foundation of emergency management.

8.3.2. State Hazard Mitigation Planning

Changes in federal laws have resulted in pre-disaster mitigation project funding and mitigation planning requirements. However, future funding for public assistance subsequent to disasters will be largely contingent upon mitigation plan completion. Additionally, states are required to have an approved Standard State Mitigation Plan in order to receive additional pre-disaster mitigation funds for state or local mitigation projects after November 1, 2004. Planning efforts are independent of any specific hazard event.

The Standard State Mitigation Plan will also be required for non-emergency assistance provided under the Stafford Act, including Public Assistance restoration of damaged facilities and Hazard Mitigation Grant Program funding. A state with a FEMA-approved Enhanced State Mitigation Plan at the time of a disaster declaration is eligible to receive

increased funds under the Hazard Mitigation Grant Program, based on 20 percent of the total estimated eligible Stafford Act assistance. Therefore, the development of State and local hazard mitigation plans is key to maintaining eligibility for future FEMA mitigation and disaster-recovery funding.

8.3.3. Hawaii State Hazard Mitigation Plan

The Hawaii State Hazard Mitigation Forum, which is composed of county, State, and federal agency representatives, as well as private individuals with interest in hazard mitigation planning, agreed that the Hawaii State Hazard Mitigation Plan should be a multi-hazard plan. For the purpose of the plan, the term “multi-hazard” shall not be limited to discrete natural hazards, and will include anthropogenic activities that could exacerbate hazard event impacts and potentially threaten the life and safety of the citizens of Hawaii. The goal of the plan is to mitigate the impact of such potential disasters.

The Hawaii State Hazard Mitigation Plan encompassed the broadest possible scope of disaster occurrences, focusing on nine natural hazards: hurricanes, tsunamis, earthquakes, floods, volcanic eruptions and lava flow, coastal erosion, landslides, wildfire, and drought. For each of these specific categories of disasters, additional mitigation plans or strategies targeted at these disasters will be appended to the Hawaii State Hazard Mitigation Plan. Several of these hazard categories have current advisory boards or task forces that have developed recommendations and strategies.

In September 2003, CWRM completed a statewide Drought Risk and Vulnerability Assessment. This document is referenced in the Hawaii State Hazard Mitigation Plan. The Drought Risk and Vulnerability Assessment illustrates the extent and severity of drought risk for different impact sectors throughout the islands, and will facilitate the development of drought response and mitigation strategies.

The State Hazard Mitigation Plan must highlight any gaps in data collection and analysis, as well as propose or recommend specific projects to address such gaps as well as short- and long-term drought risk reduction. Therefore, the Drought Risk and Vulnerability Assessment is an important tool for future drought hazard mitigation planning. The Hawaii Drought Plan incorporates the results of the risk and vulnerability assessment. These results provide input and context for drought response actions and drought mitigation strategies.

8.3.4. County Hazard Mitigation Plans

As noted above, the Disaster Mitigation Act of 2000 requires that each state develop a hazard mitigation plan in order to receive future funding following a disaster. This new requirement provides some funding for each state to engage in planning activities and plan preparation. Federal law also requires the development of local or county plans for that particular county to be eligible for post-disaster funding. The purpose of these requirements is to ensure that there are local programs and projects in place that will help minimize the loss of life, property, and total cost of disasters.

As is the case with the State-level plan, the county Hazard Mitigation Plans are multi-hazard plans. The initial county plans do not include specific drought mitigation projects, however pertinent elements of the Hawaii Drought Plan and the Drought Risk and

Vulnerability Assessment and GIS Mapping Project (see section 8.3.5.1) have been incorporated into the drought mitigation components of the plans. County-specific drought mitigation and response strategies were completed in 2005 through county, CWRM, and stakeholder efforts.

8.3.5. Hawaii Drought Plan, Phase I

As drought conditions emerged and continued through the late 1990s, CWRM and the Department of Agriculture, with assistance from Reclamation and cooperation from affected agencies, organizations, and stakeholders, undertook efforts to develop a statewide drought planning document.

One of the major objectives of the Hawaii Drought Plan, Phase I was to develop a planning framework in which to address a multitude of drought-related issues. The plan, completed in 2000, was structured to be dynamic in nature, utilizing a “living document” approach to address more than just response-oriented actions. Under this approach, provisions were established to accommodate changes in the drought leadership structure established by the plan, as well as to allow for periodic evaluation and revision to the plan itself.

8.3.5.1. Drought Risk and Vulnerability Assessment and GIS Mapping Project

In 2003, CWRM, on behalf of the Hawaii Drought Council and as part of the priority implementation actions recommended in Phase I of the HDP, completed a geographic and sector-based risk assessment and vulnerability analysis with applications toward statewide drought planning.

The Drought Risk and Vulnerability Assessment and GIS Mapping Project was designed to focus drought mitigation planning by delineating risk areas through the analysis of interrelated parameters. Follow-up mitigation planning would provide for protection of resources, public safety, property, and the economy by allowing for the implementing specific projects in identified risk areas.

The Drought Risk and Vulnerability Assessment and GIS Mapping Project utilizes Geographic Information System (GIS) mapping techniques to incorporate geographic, environmental, and social data to determine areas at risk to meteorological, hydrologic, and agricultural drought, as well as environmental and socioeconomic impacts that may occur due to drought conditions.

The report results include maps of drought frequency, vulnerability, and at-risk areas for each county, as well as recommendations for both mitigation actions and future studies. The maps are intended for public dissemination and use by the counties and local stakeholders in the development of mitigation strategies and projects. Recommendations for future studies and actions include:

- Develop new and improved methods for drought forecasting, tailored to Hawaii. More accurate forecasts will facilitate early identification of impending drought conditions and reduce the vulnerability of climate-sensitive activities like agriculture, water resource management, public health, and forestry.

- Conduct advanced drought frequency analysis and GIS mapping. Compile data from State and federal rain gage networks to improve accuracy and reliability of drought frequency analyses and to resolve microclimate variations.
- Conduct multi-year drought frequency and recurrence interval analyses. Study the frequency, as well as the spatial and temporal variations associated with longer-duration drought events (on the order of several years).
- Analyze drought patterns and severity during El Niño and La Niña years. Conducting such studies would help in anticipating drought patterns and severity as El Niño and La Niña events are developing. It would also be of interest to investigate the changes in drought frequency and patterns during different phases of the Pacific Decadal Oscillation, as a guide for future long-term, drought risk management.
- Conduct drought impact studies to understand how people are impacted and how best to reduce these impacts. An accurate accounting system of economic data on drought loss, including qualitative information and anecdotal reports, would be useful in quantifying, or even qualifying, the degree of drought severity from event to event.

8.3.6. Hawaii Drought Plan Update

The *Hawaii Drought Plan, Phase I* was completed in August 2000 and submitted to the U.S. Bureau of Reclamation for review. Reclamation subsequently provided comments and recommendations for refinements that would facilitate the plan's eventual submission to and acceptance by the United States Congress. CWRM, on behalf of the Hawaii Drought Council and with additional technical and financial assistance from Reclamation, revised the plan to address Reclamation's comments and well as to include additional information on drought related projects and programs that developed between 2000 and 2005.

The updated document is entitled the *Hawaii Drought Plan, 2005 Update*. It provides the most up-to-date, statewide drought response and mitigation plan for Hawaii as of its publication date. This plan strives to retain the dynamic structure and flexibility of the previous drought planning effort, while delineating program-specific actions and recommendations for planning future activities, within a document that is user-friendly and that facilitates action implementation.

Since the development of the *Hawaii Drought Plan, Phase I* in 2000, the State has completed several actions toward the implementation of the plan and further development of the drought program:

- Requested and received Emergency Drought Assistance from Reclamation under Title I of the Reclamation States Emergency Drought Relief Act of 1991, in addition to technical/planning assistance under Title II of the same Act;

- Participated as a member of the Western Governors Association's Drought Working Group, to help draft the proposed National Drought Preparedness Act of 2003 for submission to Congress;
- Established in 2002, through successful legislative authorization, a permanent State Drought Coordinator position within the Commission on Water Resource Management;
- Applied for and received a FEMA Pre-Disaster Mitigation grant to develop a Statewide Drought Risk and Vulnerability Assessment and GIS Mapping Analysis in support of the Hawaii Drought Plan and the State/County Hazard Mitigation Plans;
- Developed public outreach and education tools, including the completion of the Hawaii Drought Monitor Website and the production and distribution of drought awareness public service announcements in both radio and television;
- Established County/Local Drought Committees (CLDCs), starting with the County of Kauai in 2001 with the Kauai Department of Water in the leadership role;
- Applied for and received funding to undertake the development of the *Agricultural Water Use and Development Plan* component of the *Hawaii Water Plan*;
- Developed a DLNR prototype *State Agency Water Conservation Plan* with assistance from Reclamation for application across State government agencies.

CWRM continues to serve as the lead agency for the State's overall drought program and the update/implementation of the *Hawaii Drought Plan*. The drought program has grown since 2000, resulting in the solidification of agency coordination, communication, and involvement at both the State and county levels. The HDP describes: the drought program leadership structure for the State of Hawaii; the purpose, responsibilities, and involvement of agency and stakeholder representatives on various drought committees; and the communication protocol for effective drought response, monitoring, recovery, and post-drought evaluations.

8.3.7. County Drought Mitigation Strategies

In 2004 and 2005, a series of county meetings were held involving agencies and stakeholders who agreed to participate in the CLDCs. Through these meetings, county drought mitigation strategies were developed to coordinate government agency and stakeholder actions, and projects were identified for integration within the *County Hazard Mitigation Plans*. Implementation of these projects would be championed by the CLDCs. The HDP emphasizes local drought response, mitigation, and organizational efforts at the county level. While the Hawaii Drought Council and the State Drought Coordinator seek to assist local government agencies and stakeholders in coordinating drought response and mitigation, project implementation is dependent upon input and action by the CLDCs, who provide local and regional knowledge, information, and resources.

8.4. Evaluation of Current Drought Planning, Mitigation, and Response in Hawaii

Although the drought program was initiated only seven years ago, the program's expansion and execution of planning efforts, mitigation projects, and response actions have increased drought awareness and preparedness. That program committee member participate and agency contributions are voluntary makes the program's gains even more deserving of celebration.

The following sections provide brief evaluations of specific aspects of the drought program, including the leadership structure, the drought communication protocol, and drought declarations, response actions, and mitigation actions.

8.4.1. Evaluation of Drought Leadership Structure

Drought risk management encompasses human, financial, economic, social, environmental, and political aspects, which often have complex interactions. Given the range, complexity, and interaction of drought-related risks, and the potential range of decision makers involved, an integrated, interdisciplinary approach is required to provide a rounded appreciation of the problem. Close cooperation between entities with different but relevant technical specialties is required because of the occurrence of multiple ecological issues at different phases of a drought event.

The drought leadership structure described in the *Hawaii Drought Plan* addresses the need for cooperation and coordination in risk management, as well as in the implementation of response and mitigation measures. The HDP is, in essence, a framework for facilitation the timely and effective execution of drought planning, assessment, response, and mitigation actions statewide.

It should be emphasized, however, that there is no State or county statutory authority requiring the establishment of a task force or committee to address drought issues across the State. The current drought leadership structure functions on an ad-hoc volunteer basis. Implementation of any actions pursued by the Hawaii Drought Council and its committees is dependent upon public-private partnerships, interagency cooperation, and ultimately, the solidification and fortification of strong stakeholder-government relationships.

Formalization of the Hawaii Drought Council through legislation should be given appropriate consideration by government agencies and stakeholders, especially in light of federal mitigation initiatives discussed in Section 8.3.

8.4.2. Evaluation of Drought Communication Protocol and Drought Declarations

The Drought Communication Protocol described in the HDP is designed to facilitate the timely dissemination of clear and precise information to affected agencies and the public for periods before, during, and after drought events. The Drought Communication Protocol is reflected in Figure 8-1 and incorporates three elements as follows:

1. **Declaration of drought conditions:** The Hawaii Drought Council adopted three drought stage categories defined as "Normal," "Drought," and "Recovery." It was determined that this approach would effectively facilitate development and implementation of appropriate drought response actions.

2. **General communication and coordination guidelines:** The HDP provides guidelines to facilitate and coordinate drought information sharing and the release of drought status information.
3. **Specific communication and coordination responsibilities:** The Hawaii Drought Council and its committees, with the State Drought Coordinator, are the core entities for HDP implementation, and the plan sets forth actions to be undertaken by each entity under “Normal”, “Drought”, and “Recovery” conditions.

Hawaii Drought Leadership Structure

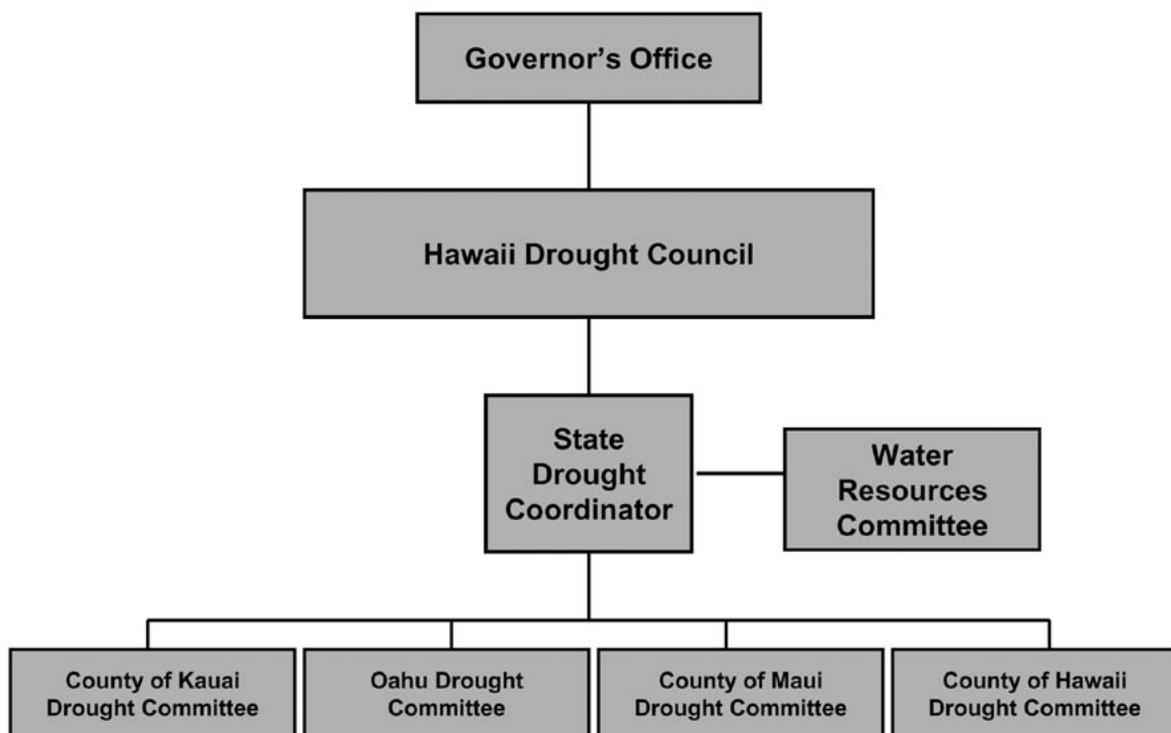


Figure 8-1. Hawaii Drought Leadership Structure

The process for declaring drought conditions, the general communication guidelines, and the specific communication responsibilities are described in the HDP. The protocol is clear and useful, but highly dependent upon volunteer commitment from the CLDCs and federal, county, State, and private entities. Formalization of the drought leadership structure should be given appropriate consideration by government agencies and stakeholders to solidify agency commitment and follow-up response actions that will address specific impacts.

8.4.3. Drought Response Actions

The HDP provides a list of actions that may be executed voluntarily by State agencies in response to drought conditions. These are emergency actions that are implemented

directly in response to drought conditions, and the HDP further recommends that the agency consult and coordinate with the Hawaii Drought Council and the State Drought Coordinator.

While State actions may address some drought emergencies, it is often at the county or local level where the greater part of emergency response will occur. The establishment of the CLDCs resulted in the appropriate delineation of county roles and responsibilities, and perhaps more importantly, re-emphasized the counties' authority to pursue independent actions in response to drought. In this way, the drought leadership structure accommodates jurisdictional issues between county agencies, while maintaining coordination between the various counties and the State.

The HDP includes recommended county response actions, but the execution of these actions is within the purview and jurisdiction of the respective county agencies. County governments should consider formalizing the CLDCs and local drought programs to maintain communication with the Hawaii Drought Council and the State Drought Coordinator regarding drought stage status and response requirements. The CLDCs are key in the initial identification of the onset of drought and are best informed as to needed relief and response.

8.4.4. Drought Mitigation and Preparedness

The Hawaii Drought Plan recommends near-term and long-term State mitigation strategies. Strategies are presented in seven categories as listed below:

- Statewide water resources monitoring and impact assessments;
- Development of new or alternative water sources;
- Water conservation practices;
- Public education, awareness, and outreach;
- Watershed protection partnerships;
- Legislation; and
- Land use planning.

Additional strategies to reduce drought risk are also included as an appendix to the HDP.

As with the county drought response actions, the county drought mitigation strategies have been developed by the CLDCs, and the implementation of mitigation projects falls within the purview and jurisdiction of appropriate county agencies. Formalization of the CLDCs would help facilitate project implementation and reduce drought risk.

8.5. Recommendations for Drought Planning

The drought program in Hawaii has been successful in raising public awareness of drought hazard and in creating an effective planning framework. The HDP establishes a leadership structure to coordinate drought monitoring, mitigation, and response activities, and formalizes a protocol for communication among agencies and stakeholders. The HDP also serves as a guide for government agencies to develop mitigation and response strategies within their areas of jurisdiction and serves as a resource document for private stakeholders to develop appropriate strategies to prepare for and respond to drought.

The *Hawaii Drought Plan* delineates several State- and county-level priority implementation actions, which are included below and are incorporated herein as recommendations for statewide drought planning:

- The Water Resources Committee of the Hawaii Drought Council should continue to refine drought indices for each impact sector by correlating historical drought impact data with past drought events.
- Additional monitoring of surface water sources, including stream diversions, ditch systems, and reservoirs should be undertaken. The Water Resources Committee, the State Drought Coordinator, and the County/Local Drought Committees should discuss ways in which agencies can achieve better coordination of program activities to facilitate monitoring of these surface water resources.
- The National Weather Service Climate Prediction Center (CPC) presently provides minimal drought forecast information for the State of Hawaii. The State Drought Coordinator should work with the CPC to determine if additional drought-forecasting products can be developed for Hawaii. Similarly, the State Drought Coordinator should continue to correspond and work together with other drought-related agencies such as the National Drought Mitigation Center, Western Regional Climate Center, Western Governors' Association, University of Hawaii, National Weather Service–Honolulu Office, State Civil Defense, etc. to coordinate data collection and access to such data in a reasonable time frame and to provide real-time data where possible through the sharing of electronic databases.
- A methodology to conduct statewide drought impact assessments should be developed. The HDC, through its Water Resources Committee, the State Drought Coordinator and CLDCs should work together to develop a uniform system for the assessment of drought impacts. CLDCs should establish and implement a mechanism for conducting impact assessments on a regular basis after each drought event and report such information to the HDC.
- County/Local Drought Committees should continue their work towards developing county-level drought mitigation and response strategies. CLDCs should also continue to work with State and county civil defense agencies to incorporate additional drought mitigation projects into the *County Hazard Mitigation Plans*.

- Similarly, implementation of water conservation measures at State agency facilities (e.g., irrigation and fixture retrofits) should be encouraged. Funding for implementation of water conservation measures should be pursued, including public/private partnership financing options (i.e., performance contracting).
- Further refinement of the *Drought Risk and Vulnerability Assessment and GIS Mapping Project* (2003), should be conducted. The assessment should be updated to include data from State rain gages and analyses of multi-year drought events, recurrence intervals, drought patterns, and drought severity during El Niño and La Niña years.
- The Hawaii Drought Monitor website should be maintained and utilized to promote public education and awareness of drought-related program activities and initiatives.

8.5.1. Recommendations for Future HDP Updates and Revisions

The Hawaii Drought Plan should undergo timely updates and revisions at least every five years. Plan recommendations and the drought communication protocol should likewise be reevaluated and revised as appropriate.

The plan has been designed as a dynamic “living” document, which should be utilized and updated to reflect changing conditions, new information, and an evolving leadership structure. Additional public and private sector resources should be continually sought, and the participation of all appropriate agencies and stakeholder representatives should be expanded and fortified. The net effect of the HDP implementation will be the effective coordination of people and resources to reduce and minimize drought impacts to the State of Hawaii.