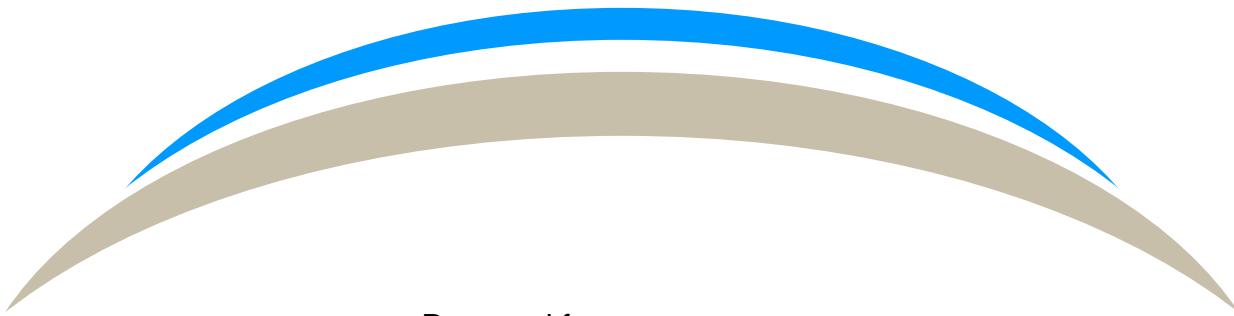


Hawaii Drought Plan

2005 UPDATE



Prepared for:
State of Hawaii
Department of Land & Natural Resources
Commission on Water
Resource Management



Prepared by:
Wilson Okamoto Corporation
Engineers | Planners | Consultants

February 2005

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LIST OF ACRONYMS

AWUDP	Agricultural Water Use and Development Plan
BMDI	Bhalme and Mooley Drought Index
BWS	Board of Water Supply (Honolulu, Oahu)
CD	Civil Defense (State or County)
CLDC	County/Local Drought Committee
COE	Army Corps Of Engineers
CPC	Climate Prediction Center
CWRM	State Commission on Water Resource Management
DBEDT	State Department of Business, Economic Development and Tourism
DLNR	State Department of Land and Natural Resources
DOA	State Department of Agriculture
DOFAW	State Division of Forestry and Wildlife
DOH	State Department of Health
DOW	Department of Water (Kauai)
DWS	Department of Water Supply (Maui or Hawaii)
EMOWP	East Molokai Watershed Partnership
EMWP	East Maui Watershed Partnership
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
FCIC	Federal Crop Insurance Corporation
FEMA	Federal Emergency Management Agency
FSA	Farm Service Agency
FWS	U. S. Fish and Wildlife Service
HACD	Hawaii Association of Conservation Districts
HAR	Hawaii Administrative Rules
HASS	Hawaii Agricultural Statistics Service
HDC	Hawaii Drought Council
HFO	Honolulu Forecast Office
HARNG	Hawaii Army National Guard
HRS	Hawaii Revised Statutes
HSCO	Hawaii State Climatology Office
KMWP	Koolau Mountain Watershed Partnership
MOU	Memorandum of Understanding
NDMC	National Drought Mitigation Center
NFDR	National Fire Danger Rating
NOAA	National Oceanic and Atmosphere Agency

LIST OF ACRONYMS

(continued)

NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
PDO	Pacific Decadal Oscillation
PDSI	Palmer Drought Severity Index
PUC	State Public Utility Commission
RAWS	Remote Automated Weather Station
Reclamation	U. S. Bureau of Reclamation
SBA	Small Business Administration
SDC	State Drought Coordinator
SDWB	Safe Drinking Water Branch
SFA	State Fire Assistance
SOI	Southern Oscillation Index
SPI	Standardized Precipitation Index
SWCD	Soil and Water Conservation Districts
TNC	The Nature Conservancy
UH Ext.	University of Hawaii Cooperative Extension Service
UHM	University of Hawaii at Manoa
USDA	U. S. Department of Agriculture
USGS	U. S. Geological Survey
VFA	Volunteer Fire Assistance
WMWP	West Maui Watershed Partnership
WRC	Water Resources Committee

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EXECUTIVE SUMMARY

The *Hawaii Drought Plan* (HDP) has been updated for use by the Hawaii Drought Council to improve coordination and implementation of drought management strategies for the State of Hawaii. The revised plan is intended to serve as a “framework” through which State and local entities can work together to proactively implement mitigation measures and appropriate response actions during periods of drought. Effective coordination of these activities can help reduce and minimize the effects upon the people and natural resources of Hawaii.

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 encompassing the Hawaii Drought Council, Water Resources Committee and the recently established County/Local Drought Committees. The plan will be made available on the Hawaii Drought Website (<http://www.state.hi.us/dlnr/cwrm/drought>) to facilitate public access and the review of future plan updates.

The updated Hawaii Drought Plan acknowledges and incorporates in pertinent parts the following elements undertaken and/or implemented since the development of the initial Hawaii Drought Plan (Phase 1) in 2000:

1. Establishment of a State Drought Coordinator (SDC) position within the Commission on Water Resource Management responsible for statewide coordination of drought-related activities.
2. Formation of a County/Local Drought Committee (CLDC) in each of the counties, thereby completing the envisioned drought leadership structure recommended in the initial plan.
3. Completion of a statewide drought risk and vulnerability assessment to identify sector-based vulnerability, response/mitigation limitations and possible solutions. The preliminary results and analysis of the study areas will be used by the newly established County/Local Drought Committees to develop local drought mitigation projects as part of an overall county-based drought mitigation strategy.
4. Re-evaluation of the proposed drought indices and triggers identified in the initial Hawaii Drought Plan (Phase 1) resulting in the adoption of a simplified and more practical approach to planning for, and responding to, the onset of drought conditions. Plan refinements emphasize the need for pre-drought mitigation including the development of a coordinated drought communication protocol for periods of Normal, Drought, and Recovery conditions.

5. Development of county-based drought mitigation strategies and delineation of county roles and responsibilities. The jurisdiction and responsibilities of each county and the authorization for independent actions that may be taken by each county in responding to drought conditions are briefly highlighted. Although not included as part of the updated plan, county-based drought mitigation strategies will provide for: 1) leadership and stakeholder representation at the county/local level; 2) improved coordination and implementation of local drought mitigation and response actions; 3) identification of current mitigation measures and existing data gaps in local drought information/planning; 4) development of priority mitigation projects, which may be eligible for government funding; and 5) a transition from “emergency response” to early “proactive” mitigation. These specific county actions are being designed as stand-alone county mitigation strategies to be maintained and updated at the local level through the CLDCs. Notwithstanding the jurisdictional authority vested within each county, the continued need for statewide coordination was validated and remains an integral component of the updated plan.

Much progress and success has been realized since the preparation of the initial plan in 2000, particularly with regard to implementation of specific recommended actions. However, continued successful implementation of recommended plan provisions will remain a key challenge to the Hawaii Drought Council and its member agencies and stakeholder representatives. Appropriate government and private sector resources will need to be identified to address the recommended priority mitigation actions identified in the plan. The success of the plan will ultimately be measured by the ability of government agencies, stakeholders, and the general public to function as a team in achieving the necessary goals and objectives for successful mitigation of drought impacts in the State of Hawaii.

1. INTRODUCTION

Drought is perhaps the most obstinate and pernicious of natural disasters, which at its most severe form decimates crops and livestock, creates vast, windblown dust bowls, erodes the landscape, damages terrestrial and aquatic wildlife habitat, contributes to widespread wildfire, and results in hundreds of millions of dollars in damage. Drought moves slowly and manifests after months of below normal precipitation, and recovery requires much more than one good rainfall. Weather isn't the only cause of drought. Drought results from both natural events and from human activities that increase demand for water. Increasing domestic demand, increasing irrigation requirements, and enhanced environmental awareness all point toward the need for better management of our limited water resources.

For years farmers and ranchers, scientists, economists, small business owners, environmentalists, wildlife managers, and county, state, and federal agencies have grappled with the far-reaching consequences of drought. Drought can lead to tough decisions regarding allocation of water, stringent water-use limitations in large urban areas, problems in ensuring safe drinking water and adequate water supplies for fire fighting efforts.

In Hawaii, 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 a plan that advocates a proactive drought management approach. The *Hawaii Drought Plan* has been developed with this approach in mind.

1.1 Purpose

Droughts and wildland fires threaten all islands of the State of Hawaii in any given year. In early 1998, two counties in Hawaii declared drought emergencies and imposed water conservation practices. In December 2002, the Maui Department of Water Supply declared a drought emergency for Upcountry Maui, and in 2003, Hawaii County declared a drought emergency that was followed by a statewide drought proclamation issued by the Governor. With continued economic growth and development in the wildland/urban interface areas, the negative impacts of drought throughout the State of Hawaii will increase in the future. Drought planning, including aggressive preparedness and mitigation measures and regular updating of the *Hawaii Drought Plan*, will be effective in reducing property losses and in enhancing public safety.

Drought planning holds great promise for reducing drought impacts, which occur arguably with greater warning and frequency than impacts due to other types of disasters. This plan is based on the idea that with foresight, commitment, technology, and citizen and government cooperation, more can be done to reduce the effects of drought. Preparation for drought should be an ongoing activity to successfully mitigate impacts upon the onset of drought. Therefore, the *Hawaii Drought Plan*, in addition to serving as a compendium of drought-related information, also identifies two key activities: 1) short-term, immediate response actions to address specific, imminent drought impacts, and 2) long-term, ongoing mitigation actions that will help prepare for future drought occurrences.

The purpose of this plan is to provide a coordinated and consistent program and a framework for integrating federal, state, county, and private sector actions to reduce the impact of human suffering and to minimize property losses due to drought. The *Hawaii Drought Plan* should undergo regular updates to incorporate new information and to revise response and mitigation actions in light of recent drought experiences. The plan is intended to serve as a working guide for those agencies that have the capabilities and resources to develop effective response and mitigation programs within their areas of jurisdiction. The success of this plan is heavily dependent upon coordination and commitment from all levels of government, as well as the private sector. Effective drought planning and mitigation programs can reduce the need for extensive federal, state and county emergency relief expenditures to rebuild local economies, and to reduce conflicts over competition for water during drought.

1.2 Scope

Key elements to a successful drought plan include:

- A comprehensive rainfall pattern and climate monitoring system to provide early warning of emerging drought conditions and provide data to decision makers, stakeholders, and the general public.
- A network of people and organizations who can effectively assess evolving impacts of water shortages on agriculture, recreation, hydropower, municipal and domestic water supplies, wildlife, and other sectors that are sensitive to reduced rainfall and fluctuations in water supply.
- Clear policies and the establishment of entities to implement immediate, short-term response measures to reduce drought impacts and to carry out long-term mitigation measures to reduce the impacts of future droughts.

A drought plan should also include a description of historical occurrences, climatological statistics, risk assessments of susceptibility and vulnerability to drought, as well as the identification of potential impacts related to specific geographical locations.

The *Hawaii Drought Plan* was designed to include the elements noted above, as well as to emphasize the identification of pre- and post-drought preparedness and mitigation measures for implementation by government agencies, stakeholders, and the general public.

The *Hawaii Drought Plan* establishes the following leadership structure:

- Hawaii Drought Council
- State Drought Coordinator
- Water Resources Committee
- County/Local Drought Committees

Participation in these groups is designed to include, but not be limited to, individuals and/or organizations that can best share their knowledge and experience regarding local issues, resources, and priorities for drought response and mitigation. Perhaps, more importantly, membership in these committees should include agencies and individuals who can effectively communicate and interact with their constituents regarding implementation of mitigation measures recommended in this plan.

The *Hawaii Drought Plan* also proposes development of a public outreach component consisting of drought-related projects, educational-based programs, and development and initiation of statewide water conservation measures. In addition, the drought plan makes several recommendations regarding performance of risk management assessments pertaining to potential drought impacts.

1.3 Goals and Objectives

The goals and objectives of the *Hawaii Drought Plan* can be briefly described as follows:

- Timely prediction and monitoring of pre- and post-drought conditions;
- Risk assessment of drought-related impacts to the (1) agriculture and commerce, (2) municipal water supply, and (3) environment, public health and safety sectors;

- Mitigation of drought effects through effective planning actions during both drought and non-drought periods;
- Timely dissemination of drought-related information and data through the Hawaii Drought Monitor website to the general public and affected federal, State and county agencies; and
- Delineation of drought communication and response actions for the HDP leadership structure.

As noted above, the success of any plan is tied to the effectiveness of its communication and public outreach component. Accordingly, the *Hawaii Drought Plan* appropriately recognizes the need for an effective information dissemination system that incorporates several communication techniques targeting water users statewide. These techniques include, but are not limited to, e-mail, faxes, agency/community newsletters, public notices, press releases, and/or internet websites. Similarly, TV and radio spots (i.e., public service announcements) can be used as communication options to address major drought affected customer groups. The net effect of these efforts must, however, result in timely delivery and accurate communication of needed data to government decision-makers, the general public and stakeholders groups.

1.4 Plan Development

The National Drought Mitigation Center (NDMC) has developed a guide to drought planning titled *The Basics of Drought Planning: A 10-Step Process*. Since its first publication in 1990, this planning process has been revised and updated numerous times as the drought planning process was refined. The NDMC drought planning methodology is described below.

10 Steps for Drought Planning

1. Appoint a Drought Task Force
2. State the Purpose and Objectives of the Drought Plan
3. Seek Stakeholder Participation and Resolve Conflict
4. Inventory Resources and Identify Groups at Risk
5. Develop Organizational Structure and Prepare Drought Plan
6. Integrate Science and Policy, Close Institutional Gaps

7. Publicize the Proposed Plan, Solicit Reaction
8. Implement the Plan
9. Develop Education Programs
10. Post-Drought Evaluation

With assistance from the U.S. Bureau of Reclamation (Reclamation), the Commission on Water Resource Management (CWRM), and State Department of Agriculture (DOA), together with affected agencies, organizations, and stakeholders, undertook efforts to develop a statewide drought planning document.

1.4.1 Initial Planning Effort: *Hawaii Drought Plan, Phase I*

The NDMC methodology was used to develop the initial *Hawaii Drought Plan, Phase I*. This document, completed in August 2000, did not reflect all ten NDMC planning steps, however, it provided for subsequent planning efforts to address outstanding points.

It should be noted that 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 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, as well as to allow for periodic evaluation and revision to the plan itself.

1.4.2 Current Planning Effort: *Hawaii Drought Plan*

The *Hawaii Drought Plan, Phase I* was completed in August 2000 and submitted to the U.S. Department of Interior, Bureau of Reclamation (Reclamation). After reviewing the document, Reclamation provided comments and recommendations for refinements that would facilitate the plan’s eventual submission to and acceptance by the United States Congress.

Since that time, the Commission on Water Resource Management on behalf of the Hawaii Drought Council and with additional technical and financial assistance from the Bureau of Reclamation, has revised the plan to address Reclamation’s comments as well as to include additional information on drought-related projects and programs that have developed over the past four years.

This current document is entitled the *Hawaii Drought Plan* and represents the most up to date statewide drought response and mitigation plan for Hawaii as of the 2004 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 future planning activities within a document that is user-friendly and that facilitates action implementation.

2. RELATIONSHIP TO OTHER PLANS AND POLICIES

This section provides information on various State and County mandates and responsibilities that influence the design and application of the *Hawaii Drought Plan*. This section concludes with a discussion of current drought-related issues relating to action implementation, legislation, and the importance of drought planning. Such issues further contribute to the drought planning context in Hawaii and are described herein for background and orientation.

2.1 State Water Code

The State Water Code, Chapter 174C, Hawaii Revised Statutes (HRS) was passed by the Hawaii State Legislature in July 1987 for the purpose of protecting Hawaii's water resources. It provides for the legal basis and establishment of the Commission on Water Resource Management and its authorities and responsibilities.

The Commission on Water Resource Management administers the State Water Code. The Water Commission's general mission is to protect and enhance the water resources of the State of Hawaii through wise and responsible management. As specified in the Water Code, the Code shall be liberally interpreted to obtain maximum beneficial use of the waters of the State for purposes declared to be in the public interest, such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. The Code also specifies that adequate provision shall be made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation.

The State Water Code acknowledges the need for a program of comprehensive water resources planning to address the problems of supply and conservation of water. The multi-component Hawaii Water Plan serves as a comprehensive guide for developing and implementing this policy. Of the Hawaii Water Plan's five component parts, the Water Commission is responsible for the preparation of the Water Resource Protection Plan, which shall include programs to conserve, augment, and protect the resource, as well as other elements necessary or desirable for inclusion. Drought planning activities are integral to water conservation and resource protection.

The Water Commission's staff provides administrative support to the Hawaii Drought Council and the Water Resources Committee, and provides coordination support to the County/Local Drought Committees through the State Drought Coordinator, who is a member of the Water Commission's staff. The Chairperson of

the Commission on Water Resource Management (along with the Director of the Department of Agriculture) also serves as a co-chair of the Hawaii Drought Council.

2.2 State Hazard Mitigation Plan

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 twofold: 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 has typically been available only following a disaster declaration, based on a percentage of the estimated damages. Since the early 1990s, the Federal Emergency Management Agency (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.

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.

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 purposes 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 the State of Hawaii. The goal of the plan is to mitigate the impact of such potential disasters.

The State Hazard Mitigation Plan encompassed the broadest possible scope of disaster occurrences, focusing on nine natural hazards: hurricanes, tsunami, 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 will be developing recommendations and strategies.

In September 2003, the Commission on Water Resource Management 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 spatial 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 ultimately highlight any gaps in data collection and analysis and 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 in Section 6. These results provide input and context for the drought response action plan presented in Section 7, as well as the drought mitigation strategies discussed in Section 8.

2.3 County Hazard Mitigation Plan

As noted in the section 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 to each state to engage in planning activities to prepare the plan. The 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.

Rather than create separate plans for each type of hazard, the county plans have been designed as multi-hazard mitigation plans. A multi-hazard plan has several advantages: 1) certain hazards cause cascading hazard effects (e.g., earthquakes may cause landsliding, local tsunami, or dam break flooding; hurricanes cause wind damage and flooding); 2) priorities can be established to allocate limited resources to areas susceptible to the most severe or frequent hazards; 3) areas identified as susceptible to multiple types of risks may require special attention; 4) common responses often apply to different hazards; and 5) resources or mitigation measures can be leveraged where they can benefit multiple hazards; for example, proposed changes to building design standards could consider both wind-loading (hurricane) and ground-shaking (earthquake).

The initial County Hazard Mitigation Plans have not detailed specific drought mitigation projects. In the interim, pertinent elements of the *Hawaii Drought Plan* and the Drought Risk and Vulnerability Assessment have been incorporated as part of the drought mitigation component of the County Hazard Mitigation Plans. County-specific drought mitigation and response strategies are expected to be completed by the end of 2004.

Section 6 of the *Hawaii Drought Plan* discusses how the results of the risk assessment may be applied in the development of drought mitigation strategies and specific mitigation projects. These strategies and projects may be developed for topics including, but not limited to, conservation, storage, source development, reuse, desalination, public education, and land use planning.

The Drought Risk and Vulnerability Assessment identifies areas prone to drought risk in each county with regard to several impact sectors. Risk was determined based on a drought frequency analysis and a drought vulnerability analysis. The assessment report will be useful in future efforts to update the County hazard mitigation plans, enhancing the ability of agencies, officials, and community members to develop drought mitigation projects and programs that are locally customized to reduce drought risk and drought impacts.

2.3.1 County Drought Mitigation Strategies

Efforts are presently underway to prepare drought mitigation strategies for each of the four counties. County Drought Mitigation Strategies will be developed through a series of county meetings involving agencies and stakeholders that have a role in drought mitigation and response. Projects identified through this process will be integrated within the County Hazard Mitigation Plans, and the strategies developed shall incorporate the necessary coordination between government agencies and affected stakeholders. County mitigation projects will be implemented through the County/Local Drought Committees in coordination with the Hawaii Drought Council and the State Drought Coordinator.

2.4 Other Drought Planning Issues

2.4.1 Ad-hoc Drought Leadership and Volunteer Participation

It is important to note that there is no State or County statutory authority requiring the establishment of a task force or committee to address the issues of drought across the State of Hawaii. The current drought leadership structure, as further described in Section 4, 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, upon 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.

2.4.2 Drought Risk Management and the Importance of Drought Planning

Drought risk management encompasses human, financial, economic, social, environmental, and political aspects, which often interact in complex ways. The extent and severity of impacts will depend on the scale, intensity, and duration of the drought event. Drought risks and associated impacts may differ from situation to situation and thus requires an effective risk management and planning strategy.

Impacts that result from drought episodes are wide-ranging and complex, affecting the economy, the environment, and society in general. Examples of direct or primary drought impacts include increased fire hazard and reduced crop productivity. Examples of indirect or secondary impacts include reduced income for farmers and political conflict.

Drought impacts can also be categorized by the sector that experiences drought impacts. These sectors are the water supply, agriculture and commerce, and environment, public health and safety sectors and are discussed in detail in Section 3.4.

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. The occurrence of multiple ecological issues at different phases of a drought event requires close cooperation between entities having different technical specialties within relevant sciences, government, and the private sector.

Drought Leadership Structure described in Section 4 of 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 Plan is, in essence, a framework for facilitating the timely and effective execution of drought planning, assessment, response, and mitigation actions statewide.

3. OVERVIEW OF DROUGHT IN HAWAII

Drought is a significant problem in the State of Hawaii and drought conditions affect some part of the State at least once every five years. One of the main problems associated with drought is Hawaii's limited water resources. It is acknowledged that some parts of Hawaii may be approaching the limits of existing water supply. It is possible that within the next 25 years, the ground water supply on Oahu may be fully committed, thus requiring the use of more costly alternatives such as wastewater reclamation, surface water treatment, and brackish or ocean water desalination. Growing water demands may lead to water shortages and stresses to major aquifer systems. Inadequate source development planning will result in short- and long-term impacts to existing water resources.

Drought conditions are compounded by the lack of adequate water supply infrastructure in certain parts of the State (i.e., Hawaii and Maui). Increasing water consumption and demand can lead to shortages, as water distribution systems in some cases are neither flexible nor sufficient to accommodate the shortfall without exercising extraordinary emergency actions and measures.

Droughts have been prevalent in the past and will continue to adversely affect the environment, economy, and the citizens of the State, due to the 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 is necessary. Failure to execute appropriate actions may result in 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 adequately precise rainfall predictions are not possible, the effective planning and management of water resources is critical to the long-term sustainability of our island communities.

3.1 Historical Occurrences

Droughts have affected the Hawaiian Islands throughout its history. Farmers, cattle ranchers, and individuals who rely on catchment water systems and surface stream diversions are the communities most immediately affected by drought. Areas susceptible to wildland fires are more vulnerable during very dry conditions, and incidences of wildland fire have increased considerably throughout the State. Droughts have impacted almost every island in Hawaii with the most severe events occurring in the past 15 years associated with the El Niño phenomenon. During the El Niño years, droughts occurred during the winter-spring period. 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 the norm (NWS Honolulu Forecast Office). The 0.14 inches of rain recorded for the city of Hilo is the lowest monthly total ever observed for any month since records have been kept. Normal January average rainfall for Hilo is 9.88 inches. Parts of the island of Hawaii continued to receive less than 10% of the normal rainfall until May 1998. Also, rainfall was lower than average on Oahu, with many areas experiencing only one-third of normal levels.

Drought conditions will continue to affect Hawaii's environment, but the extent of drought and the respective consequences will probably increase in severity. Severe drought conditions may result in crisis-level shortages in water supplies for human consumption, agricultural irrigation, and fire suppression for severe wildland fire hazards. Failure to develop sufficient water resources, storage, and interconnected water distribution systems to accommodate increases in population may result in water shortages that become critical. Crop damage and cattle losses have been major concerns during periods of severe drought, resulting in the implementation of both voluntary and mandatory water conservation measures. The most recent drought of 1998 to 2003 has wreaked havoc on the farmers and ranchers of Hawaii, especially those on the southeastern end of the State. Ranchers are grass farmers whose cattle suffer from decreased grazing areas during drought conditions. The recent drought left the State of Hawaii with reduced cattle carrying capacity, lower calf production, and lower weaning weights, resulting in an enormous loss of revenue. The consequences of this economic impact is compounded by the additional costs to ranchers for supplemental feed and minerals required to sustain the animals during these periods.

The economic impacts of drought on Hawaii's cattle industry (i.e., estimated drought-related loss) for 1999 and 2000 have been evaluated. Increased cattle mortality and reduced calving rates led to a direct loss in the total number of marketable cattle. The average live weight for all marketed cattle in 1999 decreased by about 10% resulting in decreased revenue. In addition to realized financial losses, overall cattle inventory was reduced by lower calving rates and sell-off of mature cattle due to the unavailability of inexpensive feed or forage. This inventory reduction will contribute to economic losses for several years following drought resolution. Cattle loss due to death increased by 4% and weaned weights were lower by 89 lbs/head in 1999. The dollar losses are as follows:

Drought-Related Impact	1999 Estimated Revenue Loss (\$)
Reduced wean weight	\$3,291,241
Reduced calf crop	\$687,940
Increased mortality	\$2,495,750
Total:	\$6,474,931

The total financial loss for the year 2000 in the same areas of cattle-related impacts shown in the above table is estimated at \$9,078,360.

Most severe droughts on record in Hawaii have occurred during the years associated with El Niño – 1982/1983 and 1997/1998. According to the Pacific El Niño-Southern Oscillation Application Center, the dry conditions, in general, have been associated with persistent zones of high-pressure systems throughout the islands. This feature related to El Niño is typical in the tropical Pacific.

Table 3.1 summarizes the history of severe droughts and Table 3.2 summarizes annual precipitation totals within each County during the 1998 to 2003 drought.

3.2 Understanding Drought

A generic definition of drought can be offered as follows: “Drought is a persistent and extended period of below normal precipitation causing abnormal moisture deficiency having adverse effects on people, animals, and crops.” Drought is a temporary climate abnormality and is not the same as aridity, which is a permanent feature of climate in regions with low rainfall.

Drought can have profound effects on the environment and the lifestyles of affected communities, diminishing natural stream flow, depleting soil and subsoil moisture, and the resultant variety of social, environmental, and economic impacts can be numerous, and widespread. A definition of drought must be flexible enough to include a variety of drought situations, yet specific enough to distinguish between situations, such as a true drought emergency versus normal cyclical conditions.

The National Drought Mitigation Center uses two main types of drought definitions: conceptual and operational. Conceptual definitions are general and help people understand the concept of drought. Operational definitions help to define the onset, severity and end of a drought, however there is no single operational definition of drought that encompasses all circumstances. Although conceptual definitions may also be philosophically important in establishing drought policy, operational definitions are more useful in recognizing and planning for drought. The operational definitions of drought, as described by the NDMC, are summarized below.

3.2.1 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, and definitions of meteorological drought are usually region-specific and presumably based on a thorough understanding of regional climatology. Assessing the extent of meteorological drought requires data sets

Table 3.1: History of Most Severe Droughts

Year	Areas	Remarks
1901	North Hawaii	Severe drought, destructive forest fires.
1905	Kona, Hawaii	Serious drought and forest fires.
1908	Hawaii and Maui	Serious drought.
1912	Kohala, Hawaii	Serious drought and severe sugarcane crop damage for two years.
1952	Kauai	Long, severe dry spell.
1953	Hawaii, Kauai, Maui, and Oahu	Water rationing on Maui; water tanks in Kona almost empty; 867 head of cattle died; pineapple production on Molokai reduced by 30%; rainfall in the islands 40% less than normal.
1962	Hawaii and Maui	State declared disaster for islands of Hawaii and Maui; crop damage, cattle deaths, and severe fire hazards; losses totaled \$200,000.
1965	Hawaii	State water emergency declared; losses totaled \$400,000.
1971	Hawaii and Maui	Irrigation and domestic water users sharply curtailed.
1975	Kauai and Oahu	Worst drought for sugar plantations in 15 years.
1977-1978	Hawaii and Maui	State declared disaster for islands of Hawaii and Maui.
1980-1981	Hawaii and Maui	State declared disaster; heavy agricultural and cattle losses; damages totaling at least \$ 1.4 million.
1983-1985	Hawaii	El Niño effect; State declared disaster; crop production reduced by 80% in Waimea/Kamuela area; \$96,000 spent for drought relief projects.
1996	Hawaii, Maui, and Molokai	Declared drought emergency; heavy damages to agriculture and cattle industries; losses totaling at least \$49.4 million.
1998	Hawaii and Maui	State declared drought emergency for Maui; County declared emergency for Hawaii due to water shortages.
2000-2002	Hawaii, Maui, Molokai, Oahu, Kauai	Counties declare drought emergencies; Governor proclaims statewide drought emergency; Secretary of Agriculture designates all Counties as primary disaster areas due to drought (2000); east Maui streams at record low levels; Statewide cattle losses alone projected at \$9 million.
2003	Hawaii, Maui, Molokai, Oahu, Kauai	Secretary of Agriculture designates all Counties as primary disaster areas due to drought (2003); Governor proclaims statewide drought emergency.

Table 3.2: Annual Precipitation Totals (percent of normal)					
Year	Hilo Airport	Kahului Airport	Molokai Airport	Honolulu Airport	Lihue Airport
1998	86%	36%	48%	22%	64%
1999	92%	51%	52%	59%	80%
2000	114%	52%	44%	35%	43%
2001	89%	56%	43%	45%	71%
2002	106%	80%	89%	61%	77%
2003	72%	74%	95%	63%	87%

such as daily rainfall information, temperature, humidity, wind velocity and pressure, and evaporation.

3.2.2 Agricultural Drought

Agricultural drought occurs when there isn't enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought occurs after meteorological drought, but before hydrological drought, and is identified by linking the characteristics of a meteorological drought to agricultural impacts. Agriculture is usually the first economic sector to be affected by drought. Assessing the drought susceptibility of crops during different stages of growth would require the examination of data sets on soil texture, fertility, and moisture; crop type and area; crop water requirements; pests and climate.

3.2.3 Hydrological Drought

Hydrological drought refers to deficiencies in surface and subsurface water supplies, reflected in declining surface and ground water levels. There is a time lag between a lack of rainfall and the observed decrease of water levels in streams, rivers, lakes, reservoirs, and aquifers. Therefore, hydrological measurements are not the earliest indicators of drought. Drought will not be reflected in declining surface and subsurface water levels until precipitation is deficient over an extended period of time. Although it is a natural phenomenon, hydrological drought is often exacerbated by human activities and land use. To assess the degree of hydrological drought, the following data sets should be evaluated: surface water area and volume, surface runoff, stream flow measurements, infiltration, and ground-water levels.

3.2.4 Socioeconomic Drought

Socioeconomic drought occurs when a physical water shortage affects people, individually and collectively. Most socioeconomic definitions of drought associate it with the supply and demand of an economic good or product, where the demand has exceeded supply as a result of a water deficit. An assessment of socioeconomic drought can be very complex, and possible data sets for consideration include human and animal population and growth rates; water and fodder requirements; agricultural drought impacts; and industry types and their respective water requirements.

3.3 Drought Impacts

Drought produces complex impacts that, in general, can be described as direct and indirect. When referring to droughts, direct impacts 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 impacts are characterized as the consequences of these 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 the agriculture and related sectors, due to their reliance 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, air and water quality, 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 also have social components as well.

3.3.1 Drought Impact Sectors

The *Hawaii Drought Plan* describes three drought impact sectors that are critical to the health and welfare of Hawaii's people in terms of social, economic and environmental aspects. These impact sectors include: the Water Supply Sector; the Agriculture and Commerce Sector; and the Environment, Public Health and Safety Sector. These sectors are not mutually exclusive and, as such, impacts in one sector may result in secondary or cumulative impacts in other sectors.

3.3.2 Water Supply Sector

The Water Supply Sector encompasses public/private urban and rural drinking water systems, agriculture water systems, and other water networks. Because fresh water is crucial to human survival in a variety of direct and indirect ways, minimizing the impact of drought to Hawaii's drinking water supply and other fresh water supplies is very important.

3.3.2.1. Description of Sector

According to the Environmental Protection Agency (EPA), 1,292,059 people statewide were served by Hawaii's public water systems in 2002. A public water system (PWS) is defined by the EPA as a system that provides water to the public for human consumption through pipes or other constructed conveyances. To be considered a PWS, the system must support at least fifteen service connections or regularly serve at least twenty-five individuals.

Across the four counties of Hawaii, there are 58 public water systems administered by the County Water Departments, 62 private water systems, and 13 military systems. Most of the systems are supplied by groundwater sources, but there are also 11 surface water systems and four catchment water systems that are considered public water systems by the Department of Health.

In 2001, there were a total of 242,092 service connections, covering approximately 367,869 acres statewide. Of those service connections, the City and County of Honolulu had a total of 157,429 service connections by the Honolulu Board of Water Supply, servicing 123,963.78 acres. This indicates that there are approximately 1.27 service connections per acre. Whereas, Hawaii County, which only had a total of 35,962 total service connections has a much larger service area coverage (178,008.831 acres), resulting in the lowest service rate of 0.20 service connections per acre. However, given the spatial extent of the population distribution and the size of the county, the service rate is not necessarily revealing of any service shortcomings.

3.3.3 Agriculture and Commerce Sector

The Agriculture and Commerce Sector experiences severe negative drought impacts due to the dependence upon both surface water and rainfall. Rainfall shortage-induced impacts are often exacerbated by the limits placed on ground-water pumping during drought periods. A persistent rainfall shortage and the resultant lack of soil moisture can result in reduced ground cover and lower agricultural crop yields. Reduced ground cover can result in the reduction of

livestock herd sizes and is also associated with increased incidence of erosion. In future updates of the *Hawaii Drought Plan*, this sector should be expanded to include impacts to non-agricultural operations or industries. Examples include the tourism and hospitality industry, retail sales, and other types of businesses that may suffer indirect or cumulative impacts due to drought.

3.3.3.1. Description of Sector

The history of agriculture in Hawaii can be traced back to pre-1778 when the first foreigners arrived in the islands. Several key points in history mark the beginnings of Hawaii's plantation and ranching agriculture activities. The Parker Ranch had its beginnings in 1809, when John Palmer Parker began domesticating wild cattle and horses on the Island of Hawaii. The first successful sugarcane plantation began in 1835 at Koloa, Kauai. The first documented plantings of pineapple in Hawaii took place in 1813, and in 1882 pineapple was commercially canned in Kona. For nearly a century, agriculture was the leading economic activity in the State of Hawaii. It provided Hawaii its major source of employment, tax revenues, and new capital through exports of raw sugar and other farm products. The islands of Oahu and Hawaii saw their last sugarcane harvests in 1996. Today, sugarcane is grown on about 46,000 acres farmed by two plantations on Kauai and Maui, yielding, some 340,000 tons of raw sugar annually. Agriculture is still an important part of Hawaii's economic mix. The largest agricultural acreage remains devoted to sugar, which produces the fourth largest value in crop sales statewide.

How much of a role does agriculture play in Hawaii's economy? Sales value is the most common measure of economic activities. It includes the out-the-door value, or what is referred to as farm-gate value that is routinely reported by the Hawaii Department of Agriculture. Total agriculture sales (farm production, agricultural service, forestry and fisheries, and food processing) decreased from \$2.14 billion in 1992 to \$1.87 billion in 1997, but rebounded to \$1.94 billion in 2000.

Sales value does not provide a comprehensive measure of the contribution of an industry to the economy due to double counting. Despite its double-counting problem, sales value measures the size of economic transactions within an industry and provides the general basis for collection of sales taxes. To avoid double counting, economists use the value-added concept to measure the contribution of an industry. An industry's gross state product (GSP) is the value added in production by the labor and property utilized in the industry. It is equivalent to the value of production minus the value of intermediate goods that producers buy from other producers.

During the period from 1992–2000, sugarcane production declined drastically at an annual rate of more than 10%, while annual pineapple production remained stable at \$102 million/year after a slight decline in 1997. The continual decrease in sugarcane production was largely offset by the tremendous growth of diversified agriculture (including seed crops, coffee, macadamia nuts, fruits, vegetables, flowers and nursery products), which increased at an annual rate of 3.8%. Sales value of diversified agriculture increased from just over 50% of total farm production in 1992 to almost 70% in 2000. Diversified agriculture posted record sales of \$357 million in 2000. While sales values of fisheries and forestry remained stable during the period, sales of agricultural and related services has increased at an annual rate of 2.4% to \$285 million in 2000. Within the food processing sector, both sugar and pineapple processing decreased steadily at annual rates of 12.6% and 10.0%, respectively. Part of these large decreases is made up by a slight increase in other food processing. However, the value of the overall food processing sector declined 2.6% annually.

The share of agricultural sales as compared to total sales in Hawaii decreased from 4.5% in 1992 to 3.6% in 1997 and slightly again to 3.3% in 2000. When distribution margins are included, these shares become 5.6, 4.5, and 4.1%, respectively, in 1992, 1997, and 2000. In other words, total agriculture sales including distribution margins amount to 4.1% of the total sales in Hawaii's economy in 2000.

The 2002 State of Hawaii Data Book provides information on the total number of land acreage, number of crop farms, and number of sales in \$1000s of dollars for the year 2001 for each of the four counties in both diversified agriculture and land intensive crop agriculture. Based on these figures, Maui County has the most land being used by agriculture (45,700 acres), with 9,100 acres in pineapple and 35,400 acres in sugarcane. Also, based on the figures provided by the DBEDT, Kauai County has 16,500 acres and the City and County of Honolulu has a total of 15,900 acres in agriculture, most of which is in pineapple (11,000 acres). Hawaii County has the least acreage in agriculture (10,800 acres).

As for livestock operations, Hawaii County had 460 cattle operations in 2001, compared to 60 in the City and County of Honolulu. According to the U.S. Department of Agriculture's National Agriculture Statistics, a livestock operation is defined as a place that has one or more head of the species on hand at any time during the year. It does not have to meet the definition of a farm. Hence, these figures represent both small and big producers, which have many acres of rangeland that are vulnerable to drought conditions.

3.3.4 Environment, Public Health, and Safety Sector

The Environment, Public Health, and Safety Sector presently focuses on wildfire incidence as drought conditions heighten the potential incidence and spread of wildfire. In future updates to the *Hawaii Drought Plan*, this sector should be expanded to include environmental impacts, including impacts to habitat, water quality, endangered species, and other natural resources. Secondary and cumulative impacts of wildfires, such as erosion and pollution in nearshore areas, should be considered.

Wildland fires not only endanger human lives at the urban/wildland interface, but also endanger species of flora and fauna that may already be especially susceptible due to drought conditions.

3.3.4.1. Description of Sector

The Environment, Public Health and Safety Sector currently examines the vulnerability of human settlements to wildland fire. This sector is linked directly to the issues surrounding the wildland-urban interface. The wildland-urban interface is an area where human settlements such as homes, ranches, and farms abut areas considered wildlands. Urban expansion has driven increases in both the incidence and the extent of wildland-urban interface areas. Many individuals may desire to have a few acres of land and the seclusion of being on the outskirts of town, but what they may fail to realize is the potential danger from wildfire in these areas.

Drought is one of many factors contributing to the complexity of forest ecosystems adapted to frequent fires. Although drought increases the potential for catastrophic wildfire, drought cannot be singled out as the sole cause or key factor in wildfires. Other factors include wildland fuels, overcrowded tree stands, and the overgrowth of brush and grasses mixing with urban fuels at the wildland-urban interface. A more appropriate way of characterizing the relationship is that wildland fires tend to be exacerbated by, rather than caused by, drought conditions.

Wildland fire is a growing and serious problem all over the United States, posing a threat to life and property, particularly when it moves from forest or rangeland into developed areas. Wildland fires leave behind numerous secondary impacts. When wildland fires scorch and burn acres of forestland, steep slope areas become potential hazard areas for debris, mud, and rock flows during periods of torrential rains. During intense wildland fire, all vegetation may be destroyed. Additionally, the organic material in the soil may be burned away or may decompose into water-repellent substances that prevent water from percolating through the soil. As a result, even normal

rainfall may result in unusual erosion or flooding below a burned area, and heavy rain can produce destructive debris flows. Water supplies are also affected by fire: the loss of ground and surface cover, such as needles and small branches, and the chemical transformation of burned soils hinder the watershed recharge rate, especially during heavy rainfall events. Drought and subsequent wildland fires can have indirect impacts to nearshore waters and coral reef ecosystems. Erosion and sediment from burned and denuded watersheds during post drought conditions (i.e., intense rainfall events) can result in polluted runoff into streams and end up on our coral reefs.

In Hawaii, much of our wildfire protection and prevention activities on state-owned lands are managed by the Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW).

According to DOFAW, from 1994 to 2002, there were a total of 1299 fires that burned approximately 94,691 acres of wildland. Although a greater proportion of fire incidents consumed between 0.25 to 9 acres, approximately 83 percent of the total acreage scorched was consumed by fires that burned between 1000 to more than 5000 acres. Approximately 62 percent of these large wildfires are attributed to arson or other miscellaneous causes (not including lighting, campfires, smoking, debris burning, equipment fires, railroad fires, and children).

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4. HAWAII DROUGHT PROGRAM

Over the past six years, the Hawaiian Islands have been subject to dry weather conditions and the El Niño phenomenon, resulting in record-low rainfall, reduced stream flows and low ground water levels. 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, embarked upon the task of developing a drought plan for the State of Hawaii in an effort to mitigate and plan for the long-term effects of drought (see discussion in Section 1.4). The State Commission on Water Resource Management, a division of the Department of Land and Natural Resources, assumed the role of lead agency in the development of the State's emerging drought program.

State efforts to establish a drought plan have been undertaken in recognition of and in coordination with the various federal agencies that administer drought assistance programs, including the Bureau of Reclamation, Federal Emergency Management Agency, Farm Service Agency, Risk Management Agency, Natural Resources Conservation Service, Forest Service, and Small Business Administration. A summary of the drought assistance programs administered by these federal agencies and contact information are provided in Appendix A.

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 Hawaii drought program:

- Requested and received Emergency Drought Assistance from the Bureau of 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;
- Participation 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 the U.S. Congress;
- Established through successful legislative authorization, a permanent State Drought Coordinator position in 2002 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 media formats;
- Establishment of County/Local Drought Committees, starting with the County of Kauai in 2001 with the Kauai Department of Water in a 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*;
- Development of a DLNR prototype State agency water conservation plan with assistance from the U.S. Bureau of Reclamation that may be applied across State government agencies.

The 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. Sections 4.1 through 4.3 describe the drought program leadership structure for the State of Hawaii and the purpose, responsibilities, and involvement of agency and stakeholder representatives on the various drought committees.

4.1 State-Level Drought Program Leadership

The implementation of an effective drought plan is a dynamic process requiring government agencies and private entities to coordinate monitoring, assessment, response, and mitigation actions from the onset of drought through recovery. The *Hawaii Drought Plan* seeks to establish a clear hierarchy of leadership to coordinate the actions of government agencies and private entities. At the State-level, drought mitigation and response efforts are guided by the Hawaii Drought Council, State Drought Coordinator, and the Water Resources Committee.

4.1.1 Hawaii Drought Council

4.1.1.1. Purpose

The Hawaii Drought Council (HDC) is the steering group that oversees the coordination of drought-related activities. The HDC currently functions within existing agency authorities and responsibilities, and facilitates access to services and/or assistance to lessen the impacts of drought.

The primary goal of the HDC is:

"To prepare and implement a state drought plan to coordinate and enhance current response measures and to implement priority mitigation actions to reduce the effects of drought impacts in Hawaii."

The HDC serves as the liaison between the various entities involved with drought planning/response and the Office of the Governor. It also assumes the lead role in intergovernmental drought response coordination and media information releases.

4.1.1.2. Membership

The HDC consists of representatives from the following entities (see Appendix B for contact information):

- Governor's Office
- State Department of Land and Natural Resources (Co-Chair)
- State Department of Agriculture (Co-Chair)
- State Department of Defense
- Four (4) County Government Officials
- Hawaii Association of Conservation Districts (Ex-Officio)
- Hawaii Farm Bureau (Ex-Officio)
- Hawaii Cattlemen's Council (Ex-Officio)
- East Maui Irrigation Co., Ltd. (Ex-Officio)

4.1.1.3. Responsibilities

The Hawaii Drought Council provides leadership to accomplish the following:

- With approval of the Governor, develop, implement and maintain a State drought plan;
- Review and report drought monitoring information to affected government agencies, organizations, and the general public;
- Coordinate timely drought impact assessments;
- Identify areas of the State at risk to drought and target data collection and assistance efforts in those areas;
- Support and facilitate the organization of County/Local Drought Committees;
- Authorize State agency staff to provide technical assistance to local drought committees;

- Promote ideas, programs and activities that may be implemented by groups and individuals to mitigate impacts and reduce drought vulnerability;
- Propose legislation to State and county legislative bodies in support of drought program activities;
- Facilitate access to federal, State, and local assistance programs and assist with acquiring funding for program implementation;
- Act as coordinating entity for application and disbursement of emergency aid/funding obtained from available sources; and
- Promulgation of statutes and/or rules, as may be necessary to implement recommended drought mitigation measures.

The HDC meets at least twice a year to review current drought conditions, ongoing monitoring activities, and planned mitigation and public out-reach efforts identified in the drought plan. The HDC may meet more often during periods of drought or if conditions or circumstances warrant. The meeting time, location, and agenda will be coordinated by the co-chairs in consultation with the other council members.

4.1.2 State Drought Coordinator

4.1.2.1. Purpose

The establishment of the State Drought Coordinator position was one of the highest priorities of the 2000 Hawaii Drought Plan, Phase I. As stated in the plan, “[t]he position should be established and operational by October 2000, and should be appropriately funded and used to support successful implementation of the *Hawaii Drought Plan*.” Legislative authorization for the establishment of a permanent State Drought Coordinator position became effective as of July 2002. The position resides within the Commission on Water Resource Management.

4.1.2.2. Responsibilities

The SDC is responsible for coordinating drought-related actions and communications between federal, State, and county agencies, stakeholders, and the general public. Some of the key duties of the SDC include:

- Updating and maintaining the *Hawaii Drought Plan*;
- Providing coordination with federal, State and local assistance programs and acquiring funding for program implementation;
- Developing and implementing specific projects and programs to facilitate drought mitigation;

- Providing administrative support to the Hawaii Drought Council and other drought committees;
- Ensuring timely distribution of drought forecasts and other water resource data to government agencies, organizations, and the general public; and
- Enhancing public awareness and drought education.

4.1.3 Water Resources Committee

4.1.3.1. Purpose

The Water Resources Committee (WRC) monitors all available climatological data, soil moisture readings, reservoir storage levels, ground water conditions, weather forecasts and other pertinent information necessary to analyze the current status and forecasted level of drought conditions throughout the State. This group includes water resource, agricultural, and climate professionals who assess information, evaluate the current and future status of drought in the State, advise other work groups and committee members as to the current status level of drought in the State, and, as necessary, recommend implementation of further actions by other entities.

4.1.3.2. Membership

The Water Resources Committee consists of members from the following entities (see Appendix B for contact information):

- Commission on Water Resource Management (Co-Chair)
- Honolulu Board of Water Supply (Co-Chair)
- County Water Departments (4)
- Department of Agriculture
- Hawaii Agricultural Statistics Service
- National Weather Service
- State Civil Defense
- U.S. Geological Survey
- State Climatologist (University of Hawaii)

4.1.3.3. Responsibilities

The Water Resources Committee collects and coordinates the dissemination of drought-related information, provides technical assessment of drought conditions, and analyzes drought forecast information. The Water Resources Committee operates as the central core of the *Hawaii Drought Plan* and is responsible for monitoring all available data pertinent to analyzing the current status and forecasted level of drought conditions in the

State of Hawaii. Perhaps more importantly, is the role of the WRC to regularly communicate such information to the HDC and CLDCs. Such data would include, but not be limited to, climatological data, soil moisture readings, reservoir storage levels, ground water conditions, weather forecasts and other available information. These types of data will be used to assess current conditions, under which further actions may be taken by the respective entities identified in the drought leadership structure.

The *Hawaii Drought Plan* prescribes that the WRC will provide at a minimum, semi-annually updated reports during *Normal* non-event conditions. Reports will be cleared with the co-chairs of the Hawaii Drought Council prior to release and dissemination to other drought committee members, the general public or posting on any existing agency or other drought website. During periods of increasing drought severity, more frequent reports (quarterly/monthly) may be utilized to maintain up-to-date communications with the HDC, the CLDCs, and the public. Meetings of the WRC will be held on a quarterly basis (or more often as needed) during periods of *Drought* to review the status of current conditions and the outcomes/results of any recent studies that may have been undertaken. In addition, the WRC should review and update current drought monitoring efforts and assess the need for additional plans or actions necessary to update committee members on forecasts or other issues related to drought. Conference calls and/or other informal communication means may be used to communicate and provide information to the other drought committees. Issuance of public notifications will follow all legal and generally accepted means of communication currently utilized to inform key stakeholders and the general public.

4.2 County-Level Drought Program Leadership

The *Hawaii Drought Plan* emphasizes local drought response, mitigation, and organizational efforts at the county level. While the HDC and WRC seek to assist local government agencies and stakeholders in coordinating drought response and mitigation, implementation of such actions will be highly dependent upon input from county-level drought committees to provide local/regional knowledge, information, and resources.

4.2.1 County/Local Drought Committees

4.2.1.1. Purpose

County/Local Drought Committees (CLDCs) are essential elements to the effective implementation of drought planning and mitigation for Hawaii. These local-based organizations will be the first to identify drought effects, will be responsible for initial implementation of mitigation activities, and will

generally be the first to respond to, and manage public health, safety and fire related issues. Planning for situations in advance increases the likelihood that response will be timely, minimizing potential economic and resource losses. Local drought committees should engage in long-term activities to prepare for and address droughts, including water conservation education; recommendation of appropriate water use ordinances; and public service announcements. CLDCs should also address technical needs/support from State or federal agencies; including assistance from municipal water suppliers to ensure that county water needs are addressed.

In order to ensure that local and regional information is available prior to the onset of drought conditions, the CLDCs should undertake the following actions: 1) Comprehensively and regularly assess drought conditions and impacts throughout each county; 2) Identify and prioritize (in advance) emergency drought assistance projects; and 3) Develop long-term drought mitigation strategies to minimize the effects/impacts of drought. The information provided by the CLDCs' will also facilitate the planning, coordination, and implementation of statewide drought response and mitigation measures undertaken by the SDC in support of the CLDCs.

CLDCs will serve as focal points for the exchange of information between the counties and HDC. As of September 2004, the CLDCs in each county were undertaking efforts to develop locally based drought mitigation and response strategies. Workshops were held to identify and describe drought mitigation projects. As CLDC drought mitigation strategies are developed, they will be incorporated by reference in subsequent updates to the HDP.

4.2.1.2. Membership

It is recommended that CLDC membership include participation from a variety of backgrounds and professions. Participants with experience in drought response/mitigation and individuals/businesses directly affected by drought should be involved. Each CLDC should include representation from appropriate county government agencies, stakeholders, and the private sector. (See Appendix B for committee member list.) Participants will be called upon to share local knowledge and information about current drought conditions, past experiences in dealing with drought, and will be asked to collectively develop local and regional drought mitigation strategies to minimize the effects of drought upon the domestic and municipal water supply, fire suppression activities, agricultural water uses, and the environment.

4.2.1.3. Responsibilities

Primary activities of the CLDCs include monitoring, assessing, and reporting drought conditions and impacts, as well as executing drought mitigation and response actions. CLDCs should meet at least twice a year during normal conditions to review and discuss drought-related data collected by county, State, and federal agencies. County drought preparedness should include identification of response and mitigation actions that can be implemented to address increasing drought severity and assess the cumulative social and economic impacts of drought conditions. Such planning efforts may be based on drought event scenarios, or impact sectors, or any appropriate planning context agreed to be most advantageous to the local situation.

The CLDCs should monitor and document drought status and impacts to the three drought impact sectors described earlier in Section 3.4. The objective being to identify drought impacts, track their occurrence, determine intensity, including quantification of economic impacts resulting from drought events.

4.3 State and County Coordination

The *Hawaii Drought Plan* is intended to serve as a “framework” through which State and local entities can work together to proactively implement mitigation measures and appropriate response actions during periods of drought. State and county coordination within the established drought leadership structure will provide for timely and effective implementation of such measures. A key element of this coordination is communication: sharing of drought-related information monitored and collected by the respective State and county entities.

The CLDCs should monitor and assess current and potential impacts of impending or ongoing drought, focusing upon the local economy, environment and natural resources. The CLDCs shall initiate any and all appropriate drought responses within the capabilities of local government agencies, and advise the HDC of any needs that cannot be met through existing county resources. Post-drought evaluation and the findings therein (e.g., impact assessments generated by the CLDCs) will assist in the documentation of statewide drought impacts and the appraisal of effectiveness realized from the specific response and mitigation measures implemented at both the State and county level. More discussion regarding the coordination of drought related actions and information sharing is presented in Section 7.

The State Drought Coordinator will coordinate the exchange of information between the HDC, WRC and the CLDCs. The HDC and CLDCs will rely heavily on the WRC to provide drought monitoring and forecasting information. In similar fashion, the HDC will depend upon the CLDCs to monitor and assess local impacts within each

county during periods of drought. The CLDCs are uniquely qualified (and in many respects serve as the “front line” source) to provide information on crop and livestock impacts, reservoir water levels, stream conditions, ground water levels, and other drought impacts.

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5. DROUGHT MONITORING, FORECASTING, AND IMPACT ASSESSMENT

5.1 Drought Indices

Drought indices use observational data to gauge the severity of drought conditions. Raw data is analyzed and an index is computed, which compares current values of hydrologic data to historical norms. Many states use combinations of indices, as they apply to the area's climate and physical characteristics. There are several indices used across the United States to assess drought conditions. Drought indices that have traditionally been used are the Palmer Drought Severity Index (PDSI), the Standardized Precipitation Index (SPI), and the Surface Water Supply Index (SWSI). In addition, Percent of Normal Rainfall Index (PNRI) can also be used to gauge drought conditions.

5.1.1 Hawaii Drought Indices

It is not practical to use the PDSI in Hawaii because of the very limited amount of information available on soil moisture and evapotranspiration. Furthermore, the PDSI is more applicable to broad climate areas and is not suited to representing conditions within the micro-climates typical to the Hawaiian Islands. The SWSI is also not appropriate for Hawaii since there is no snowpack component or streamflow forecast available for the islands. Therefore, the Standardized Precipitation Index and the Percent of Normal Rainfall Index were adopted to monitor drought conditions and rainfall deficits for Hawaii. The SPI and PNRI require only a single variable (precipitation), and this is a major advantage in the context of Hawaii's rather dense rain gage network, which has long periods of record available for analysis.

Standardized Precipitation Index

The Standardized Precipitation Index is based on the probability of precipitation for a given time scale. The SPI measures the precipitation deviation from the long-term mean. The SPI can quantify the precipitation deficit over multiple time scales – typically three, six, twelve, and twenty-four month periods, depending on the impact sector. Developed in Colorado by the Colorado Climate Center (McKee et al. 1993), the SPI provides an early warning of drought and an intensity level for each month in which the drought occurs.

The Standardized Precipitation Index is the most suitable drought index for Hawaii because of its ability to assess the wide range of rainfall conditions across Hawaii. The ability to generate SPI values for multiple time scales is also extremely useful for monitoring purposes because of the varying effects of drought upon the different sectors/uses over a given drought period. Additionally, since the SPI uses standard statistical principles, it can also be

Table 5.1: SPI Values and Drought Intensity

SPI Value	Drought Intensity
2.0 and above	Extremely Wet
1.5 to 1.99	Very Wet
1.0 to 1.49	Moderately Wet
-.99 to 0.99	Near Normal
-1.0 to -1.49	Moderately Dry
-1.5 to -1.99	Severely Dry
-2.0 and less	Extremely Dry

used to monitor other data such as stream flow, reservoir levels, and ground water levels.

Positive SPI values indicate above average precipitation, while negative values indicate below normal precipitation. Therefore, negative SPI values are of interest with respect to drought. The departure from zero on the left half of the standard Gaussian distribution is indicative of the severity of drought. The larger the departure, the more severe the drought condition. Relative drought intensities associated with SPI values (McKee et al., 1993) are provided in Table 5.1.

It should be noted that the time scales for calculating SPI values provided in Table 5.1 vary when determining drought conditions for different sectors. For example, because the agricultural sector would be affected by drought sooner than the water supply sector, a 3-month SPI interval may be appropriate for the agricultural sector while a 12-month SPI may be more appropriate for the water supply sector. The use of SPI indicators to gauge drought severity are further discussed in Section 5.4.

Percent of Normal Rainfall

The Percent of Normal Rainfall Index is based on the percentage of current rainfall value compared against the long-term mean. Percent of Normal Rainfall is one of the simplest methods of comparing current precipitation amounts to historical averages. The index is calculated by dividing the actual precipitation amount by a (typically) 30-year precipitation mean. Time scales are generally stated in months or a year. The PNRI is effective for comparing a single region or season in easily understood terms.

PNRI can also be used to gauge the relative amount of rainfall a region has received for a given time period. This index is particularly useful given the

ease with which it can be calculated, the relatively dense network of rain gages in Hawaii, and the long history of precipitation data available for many of these rain gages. PNRI also has the advantage of being easily understood by the general public.

5.2 Current Monitoring and Data Collection

Taking a proactive approach to drought management requires continuous monitoring of factors that may indicate the onset and extent of drought conditions. This approach serves to lessen the element of surprise and allows time for planning and implementing drought mitigation strategies. During a drought, monitoring activities are increased as warranted by drought conditions, and continue until normal conditions reappear. Monitoring also provides continuous feedback to decision makers and helps determine short-term actions and response measures. The Water Resources Committee, under the leadership of the Hawaii Drought Council, monitors drought conditions, evaluates data, and makes predictions/forecasts of drought. The WRC also makes recommendations to the HDC and CLDCs regarding declarations of local and/or statewide drought conditions, and also monitors drought impact information. Data, analyses, and links to other sources of drought information are available on the Hawaii Drought Monitor website.

The monitoring of physical and hydrological conditions can be grouped into three categories: climate and weather monitoring, surface water monitoring, and ground water monitoring. A fourth monitoring category includes data on the social and economic impacts of drought, however, this type of data is minimally collected, and any data that is collected is not readily disseminated. Table 5.2 summarizes and compares the ongoing hydrologic monitoring efforts and data collection activities carried out by various federal, State, and county agencies, and private entities.

5.2.1 Deficiencies in Monitoring and Data Collection

As indicated in Table 5.2, a number of agencies and private entities are involved in data collection and drought monitoring. Additional data collection and monitoring, however, can improve our current ability to gauge the onset and severity of drought conditions. One area where additional monitoring and data collection is needed is the surface water sources – including stream diversions, ditch systems, and reservoirs. Although the USGS, CWRM, State DOA, and county water departments presently collect data for some surface water resources, data collection efforts should be expanded and such data should be shared with stakeholders to further the understanding of hydrologic drought impacts.

Research regarding soil moisture content under varying rainfall conditions should be conducted throughout the state. Presently, there is no ongoing monitoring of soil

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Table 5.2: Federal, State and County Agency Monitoring and Data Collection Activities

Agency/Entity	Climate Monitoring and Data Collection Activities	Surface Water Monitoring and Data Collection Activities	Ground-Water Monitoring and Data Collection Activities
Federal Agencies			
National Weather Service (NWS)	<ul style="list-style-type: none"> • Operates 70 real-time rainfall stations (located for flood purposes) with 15 stations co-located with long term stations • Oversees 220 cooperative network stations (4-5 month delay in receiving data) • Has access to Climate Prediction Center forecasts • Monthly <i>Rainfall Summary</i> for the State <ul style="list-style-type: none"> • Percent of normal rainfall maps • SPI maps • Co-produces U.S. Drought Monitor and U.S. Seasonal Drought Outlook 		
U.S. Geological Survey (USGS) (Most monitoring stations cooperatively funded with other government agencies)	<ul style="list-style-type: none"> • Operates 40 rainfall stations 	<ul style="list-style-type: none"> • Operates 74 continuous stream, spring, and ditch gages throughout the State • Real-time data from 7 stream gages published on the Internet (http://hi.water.usgs.gov) • Annual peak flood discharges monitored at 88 crest stage gages • Water quality data collected at 6 stream gage locations, and at 28 other miscellaneous sites • Publishes annual report: "Water Resources Data-Hawaii" • Drought Watch and Water Watch website 	<ul style="list-style-type: none"> • Water levels recorded at 84 observation wells • Water quality data taken at 40 wells

Table 5.2: Federal, State and County Agency Monitoring and Data Collection Activities (continued)

Agency/Entity	Climate Monitoring and Data Collection Activities	Surface Water Monitoring and Data Collection Activities	Ground-Water Monitoring and Data Collection Activities
Federal Agencies (continued)			
National Park Service (NPS)	<ul style="list-style-type: none">• Remote Automated Weather Stations (RAWS) in Haleakala National Park and Hawaii Volcanoes National Park• National Fire Danger Rating (NFDR) computed for RAWS stations		
Department of the Army	<ul style="list-style-type: none">• RAWS stations in Makua Valley (3) and Schofield Barracks Area on Oahu, and at the Pohakuloa Training Area on the Big Island		
U.S. Department of Agriculture/Hawaii Agricultural Statistics Service (HASS)	<ul style="list-style-type: none">• Publishes weekly Hawaii Crop Weather showing impact of weather on crops• Publishes Monthly Livestock Review• Both reports available at http://www.nass.usda.gov/hi		

Table 5.2 (continued)
Federal, State and County Agency Monitoring and Data Collection Activities

Agency/Entity	Climate Monitoring and Data Collection Activities	Surface Water Monitoring and Data Collection Activities	Ground-Water Monitoring and Data Collection Activities
State Agencies			
University of Hawaii at Manoa (UHM)	<ul style="list-style-type: none"> Hawaii State Climate Office focuses on climate research and functions as a historic climate data clearinghouse Operates non-federal rainfall collection program across the State 		
Commission on Water Resource Management (CWRM)	<ul style="list-style-type: none"> Operates two rainfall stations on the Big-Island, data is compiled and archived within the CWRM 	<ul style="list-style-type: none"> Collects limited data on surface water diversions; data is compiled and archived within CWRM 	<ul style="list-style-type: none"> Collects data from eight deep monitor wells: (4) on Oahu, (2) on Hawaii and (2) on Maui Collects pumping reports from major water users in the State (includes majority of all permitted users on Oahu and Molokai) Collects water level data in the Kona region on the Island of Hawaii
Division of Forestry and Wildlife (DOFAW)	<ul style="list-style-type: none"> RAWS on Makaha Ridge and Moloaa Dairy, Kauai; Polipoli (Kula), Maui; and Puuwaawaa, Hawaii Fire Danger Rating computed for certain RAWS stations 		
Department of Agriculture (DOA)		<ul style="list-style-type: none"> Collects surface water data and monitors reservoir levels on all State irrigation systems 	
Department of Health, Safe Drinking Water Branch (DOH SDWB)		<ul style="list-style-type: none"> Collects and monitors drinking water quality data for public water systems 	<ul style="list-style-type: none"> Collects and monitors drinking water quality data for public water systems

Table 5.2 (continued)
Federal, State and County Agency Monitoring and Data Collection Activities

Agency/Entity	Climate Monitoring and Data Collection Activities	Surface Water Monitoring and Data Collection Activities	Ground-Water Monitoring and Data Collection Activities
County Agencies			
Kauai Department of Water (Kauai DOW)	<ul style="list-style-type: none"> Allows co-locating of USGS rainfall stations at some DOW facilities 		<ul style="list-style-type: none"> Meters wells Collects chloride data Collects water level data Works cooperatively with USGS on groundwater level monitoring at some monitor wells in Lihue
Honolulu Board of Water Supply (Honolulu BWS)	<ul style="list-style-type: none"> Operates 17 manually-read rain gages Computes rainfall index (% of average) 		<ul style="list-style-type: none"> Meters wells Collects data from: 20 groundwater monitor wells 13 deep monitor wells (transition zone) Chloride levels monitored Monthly and weekly reports of pumpage, rainfall, and groundwater levels (internal) Developing groundwater index for monitoring
Maui Department of Water Supply (Maui DWS)		<ul style="list-style-type: none"> Raw water reservoirs monitored daily Wailoa Ditch flows monitored and recorded daily Water treatment plant production recorded daily Upcountry Water Report prepared daily (combines surface and ground water sources) 	<ul style="list-style-type: none"> Pumping recorded daily County-wide pumping data summarized monthly Iao and North Waihee aquifer pumping summarized weekly and monthly Collects chloride data Collects water level data
Hawaii Department of Water Supply (Hawaii DWS)	<ul style="list-style-type: none"> Monitors rainfall stations (in cooperation with NWS) 	<ul style="list-style-type: none"> Reservoir levels monitored daily Spring outputs monitored Surface water flows monitored daily 	<ul style="list-style-type: none"> Meters pump hours and consumption for deep wells and booster pumps on a daily basis Collects chloride data Collects water level data

Table 5.2 (continued)
Federal, State and County Agency Monitoring and Data Collection Activities

Agency/Entity	Climate Monitoring and Data Collection Activities	Surface Water Monitoring and Data Collection Activities	Ground-Water Monitoring and Data Collection Activities
Private Entities			
(Various)	<ul style="list-style-type: none">• Collection of rainfall data• Weather monitoring conducted by private agricultural interests• HC&S has network of RAWS stations for plume management	<ul style="list-style-type: none">• Surface water monitoring by private agricultural interests.	

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moisture content within the State. This type of information would be especially beneficial to agricultural stakeholders as it could help predict the impact of drought conditions on crops and pastures.

There is also a need to expand the State's water resources monitoring network and update data from existing monitoring stations. The existing network of rain gages and stream and ditch flow monitoring gages should be evaluated and additional gages should be installed where gaps exist. Data received from monitoring stations should be compiled in a standard format in order to develop long-term data sets for valid statistical analysis and to facilitate data sharing.

There are currently coordination gaps between agencies regarding data accessibility, distribution, integration, and analyses. The SDC, WRC, and CLDCs should work to improve access and sharing of available data, including coordination of real-time data collection and the sharing of electronic databases. As of July 2004, efforts to establish a National Integrated Drought Information System (NIDIS) were being undertaken by the Western Governors Association. It is hopeful that adoption of this proposal by Congress will lead to greater nationwide access to available drought monitoring and forecasting information which will help address current deficiencies in monitoring and data collection. The NIDIS report and status of this effort can be found at the WGA Web site at www.westgov.org.

Lastly, but arguably one of the most important, is the need for coordinated drought impact assessments between government and the private sector. The current lack of accurate and quantifiable empirical drought impact data makes it difficult to determine the economic, social, and environmental losses due to droughts. Examples of drought impact data needed include crop and livestock losses, type and amount of assistance provided through federal programs, number of wildland fires and acres burned, the fire suppression costs associated with each wildland fire event, etc. Collection of this type of impact data should be given high priority by each of the CLDCs.

5.3 Drought Forecasting

Drought forecast models can be important tools for the mitigation of drought impacts. Accurate forecasts can give valuable lead-time to implement mitigation and preparedness activities. From a meteorological perspective, drought in Hawaii has been a subject of intense research since the 1970s. Over the past several decades, research has been conducted on the correlation between drought in Hawaii and certain climate phenomena, namely the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO).

5.3.1 El Niño, La Niña and the Southern Oscillation

El Niño is a quasi-periodic large-scale oceanic/atmospheric phenomenon defined by unusually warm sea surface temperatures and weakened surface westerly winds in the equatorial Pacific Ocean. The return period of El Niño events vary from two to seven years. The intensity and duration of El Niño events also vary and are hard to predict, but they typically last anywhere from 14 to 22 months. In recent decades, scientists have recognized that El Niño is linked with shifts in global weather patterns.

The Southern Oscillation (SO) is a seesaw pattern observed in atmospheric pressure that centers between the equatorial Pacific and Indo-Australian area and is closely linked to El Niño. It is measured by an index called the Southern Oscillation Index (SOI). High negative values of the SOI represent an El Niño event, or “warm event”. ENSO events are those in which both a Southern Oscillation extreme and an El Niño event occur together.

High positive values of the Southern Oscillation Index indicate a La Niña event, or “cold event”. La Niña is the counterpart of El Niño and represents the other extreme of the cycle. La Niña years often, but not always, follow El Niño years.

With regard to drought in Hawaii, Horel and Wallace (1981) proposed a conceptual model to relate dryness in the Hawaiian Islands with the Southern Oscillation (SO). Chu (1995) further refined the relationship between El Niño and rainfall in Hawaii by analyzing historical rainfall variations throughout an El Niño cycle. Based on 20 El Niño events since 1905, this study indicated that the probability of having a dry winter (or spring) following the onset of El Niño is 90% (or 80%). Thus, deficient rainfall observed during an El Niño winter is unlikely to have occurred by random chance.

5.3.2 The Pacific Decadal Oscillation

Rainfall in Hawaii is not only affected by inter-annual climate variations such as ENSO, but also by a longer time scale variation known as the Pacific Decadal Oscillation (PDO). The PDO is observed as long-term variations of the North Pacific sea-surface temperatures (Mantua et al., 1997), and may be regarded as a slowly varying mean climate state with a period of 30 to 40 years. During 1946-1977 when the PDO was in the negative (cool) phase, rainfall was above normal in Hawaii. Conversely, since 1977, the PDO has been in the positive (warm) phase, and Hawaii rainfall has tended to be below normal. The shifting climate regime over the North Pacific since the late 1970s has caused an unfavorable condition for rainfall in Hawaii. The causes of PDO-induced dryness are still unclear and warrant future research.

5.3.3 Forecasting Agencies

5.3.3.1. National Weather Service Honolulu Forecast Office

The Honolulu Forecast Office (HFO) of the National Weather Service (NWS) has a number of weather forecast and monitoring programs, including programs relating to drought. The NWS HFO operates real-time and long-term rainfall stations, and oversees a network of 220 cooperatively funded rainfall stations. The NWS HFO generates the monthly *Rainfall Summary* for the state, as well as percent normal rainfall maps and SPI maps. The office also contributes to the production of the U.S. Drought Monitor and the U.S. Seasonal Drought Outlook.

5.3.3.2. National Weather Service Climate Prediction Center

The National Weather Service Climate Prediction Center produces forecasts that assess short-term climate variability. Applicability of current drought-forecasting products by the National Weather Service Climate Prediction Center (CPC) is limited with respect to Hawaii. However, the CPC produces a monthly (30 – 90 day) rainfall and temperature outlook and seasonal (13-month) rainfall outlook for the four major airports in the State of Hawaii.

5.3.3.3. U.S. Drought Monitor

Although the U.S. Drought Monitor is not a forecasting agency, it is listed here as an operational drought monitoring tool produced and maintained by the Joint Agricultural Weather Facility, Climate Prediction Center, National Climatic Data Center, and other federal, state, and academic partners. The U.S. Drought Monitor is a suite of drought monitoring and forecasting products, which is “a synthesis of multiple indices, outlooks and news accounts, that represents a consensus of federal and academic scientists”. Products include the U.S. Seasonal Drought Outlook, streamflow forecasts, the Palmer Drought Severity Index, and soil moisture forecasts. With the exception of the seasonal drought outlook, the other forecast products are not currently available for the State of Hawaii.

5.4 Drought Severity

Drought severity refers to the geographic and temporal extent of drought and the relative degree of abnormally dry weather experienced. A given drought event may have varying effects on different sectors and stakeholder groups. For example, a severe, but short, drought may have little impact on ground water resources and the operations of the county water departments, but the same drought may have a

significant effect on farmers and ranchers. The following sections explain drought severity with regard to major impact sectors.

5.4.1 Agriculture and Commerce Sector

The agriculture and commerce sector is usually the first sector to be affected by drought conditions. 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, the 3-month SPI drought interval is best suited to evaluate drought severity for this sector. Other indicators that can be used to evaluate severity in this sector include reservoir storage levels, surface water and ditch flow levels, soil moisture, and impacts to crops and livestock. Table 5.3 describes SPI values that can be used by the WRC to evaluate drought severity for the agriculture and commerce sector.

5.4.2 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, the 12-month SPI is typically the best interval to evaluate drought severity for this sector. Other indicators that can be used to evaluate drought severity for the water supply sector include ground water levels, streamflow levels, ground water chloride concentrations, and reservoir storage levels. Table 5.3 describes SPI values that can be used by the WRC to evaluate drought severity for the water supply sector.

5.4.3 Environment, Public Health and Safety Sector

Drought can have a number of effects on the environment, public health and safety sector. However, for purposes of the current plan the present focus is on 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. Other indicators that may be used include the fire weather index, fuel loading index, and soil moisture data. Table 5.3 describes SPI values that can be used by the WRC to evaluate drought severity for the (wildfire component of the) environment, public health and safety sector.

5.5 Drought Impact Assessments

The HDP includes information and preparatory activities that support the eventual completion of a statewide drought impact assessment, however, there are numerous obstacles that prevent the current completion of a thorough investigation.

Table 5.3: Drought Stage Characteristics			
Drought Stage	SPI Time Interval and Value		
	Water Supply Sector	Agriculture & Commerce Sector	Environment, Public Health & Safety Sector
Normal	12-month SPI 0.99 to –0.99	3-month SPI 0.99 to –0.99	3-month SPI 0.99 to –0.99
Moderate	12-month SPI -1.00 to –1.49 for two consecutive months	3-month SPI -1.00 to –1.49 for two consecutive months	3-month SPI -1.00 to –1.49 for two consecutive months
Severe	12-month SPI -1.50 to –1.99 for two consecutive months	3-month SPI -1.50 to –1.99 for two consecutive months	3-month SPI -1.50 to –1.99 for two consecutive months
Extreme	12-month SPI less than –2.00 for two consecutive months	3-month SPI less than –2.00 for two consecutive months	3-month SPI less than –2.00 for two consecutive months

Some of the more common types of drought impacts are listed in Table 5.4, and for practical purposes, have been classified into the Water Supply, Agricultural and Commerce, and Environment, Public Health and Safety Sectors. It should be noted that certain impacts may span more than one sector and are thus listed accordingly.

Impact assessments are important in that they examine and attempt to quantify the consequences of a given event or change. For example, in the Agriculture and Commerce sector direct impacts, such as reduced crop yields, livestock losses, and reservoir depletion, often lead to secondary and cumulative impacts, such as reduced profits, increased feed costs, forced sale of land or assets, and physical and emotional stress.

To a certain degree, drought impact assessments can be accomplished through the careful collection and documentation of anecdotal impact data. This type of qualitative information is available from a variety of sources, including newspapers, personal interviews, and photographs. However, anecdotal data is not necessarily useful in the comprehensive quantification of drought-induced losses.

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Table 5.4: Potential Drought Impacts		
Water Supply	Agriculture & Commerce	Environment, Public Health & Safety
<ul style="list-style-type: none"> • Increased ground water depletion • Reservoir and lake draw-down • Reduced flow from springs • Water quality (chloride concentration, water temperature, pH, dissolved oxygen, turbidity) • Disruption of water supplies • Decline in revenue for water suppliers • Increased ground water depletion • Increased conflicts over water use • Mental and physical stress • Reduced quality of life/change in lifestyle 	<ul style="list-style-type: none"> • Loss from crop production • Loss from dairy and livestock production • Loss from timber production • Loss from fishery production • Income loss for farmers • Unemployment from drought-related production declines • Loss to recreational and tourism industry • Loss to manufacturers and sellers of recreational equipment • Increased energy demand and reduced supply from drought-related power curtailment • Decline in food production • Reduced tax base • Loss of impaired navigability of streams, rivers and canals • Cost of water transport • Reduction of economic development • Decreased land prices • Mental and physical stress • Reduced quality of life/change in lifestyle • Population migration • Increased wind and water erosion 	<ul style="list-style-type: none"> • Mental and physical stress • Health-related low flow problems (cross connection contamination, diminished sewage flows, increased pollutant concentrations, reduced fire fighting capability) • Loss of human life • Public safety from forest and range fires • Increased number and severity of fires • Increased respiratory ailments due to fires • Increased disease caused by wildlife concentrations • Increased conflicts over water use • Disruption of cultural belief systems • Loss of cultural sites • Reduction or modification of recreational activities • Loss of aesthetic values • Reduced quality of life/change in lifestyle • Population migration • Damage to animal and plant species • Loss of wetlands • Estuarine impacts • Loss of biodiversity • Increased wind and water erosion

Adapted from: Western Drought Coordination Council, *How to Reduce Drought Risk*, March 1998.

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5.6 A Drought Impact Assessment Methodology

According to the handbook *How to Reduce Drought Risk* (March 1998) prepared by the Western Drought Coordination Council, the following methodology is typically followed for drought impact assessment:

1. Create a list of drought impacts that have occurred.
2. Rank the impacts according to their importance. To be effective and equitable, the ranking should take into consideration concerns such as cost, areal extent, trends over time, public opinion, fairness, and the ability of affected areas to recover. A number of groups and individuals should be involved in ranking drought impacts for informed and equitable policy formulation.
3. After the list of drought impacts have been prioritized, consideration should be given to which impacts should be addressed. This step should result in a list of the highest priority impacts to be further investigated.
4. The next step entails conducting vulnerability analyses on high priority impacts. Vulnerability assessments provide a framework for identifying the social, economic, and environmental causes of drought impacts. It bridges the gap between impact assessment and policy formulation by directing policy attention to the underlying causes of vulnerability. Drought vulnerability specific to the State of Hawaii is further discussed in Chapter 6.
5. The final step of drought impact assessment is to identify action items for reducing drought risk. The actions may include response actions, which are typically short-term emergency response actions, or mitigation actions, which are long-term risk management actions. Drought response and mitigation actions are further discussed in Chapters 7 and 8.

5.6.1 Value of Drought Impact Assessments

There are a number of benefits to conducting drought impact assessments. First, such assessments enable stakeholders to take proactive measures to plan for drought, thereby minimizing the severity of impacts. Rather than simply taking a crisis management approach to drought, drought impact assessment enables stakeholders to manage and reduce the long-term risk of impacts associated with drought.

Second, drought impact assessment helps to ensure that resources are allocated to higher priority impacts. During a drought, it is likely that a number of affected stakeholders will be competing for a limited amount of resources for emergency

relief. By having a list of prioritized impacts, resources and funding can be allocated to impacts that have been determined to have highest priority.

Third, drought impact assessment leads to a better understanding of the causes of direct and indirect impacts associated with drought. By understanding the causes of drought impacts, policies and practices can be implemented to reduce future impacts.

Finally, drought impact assessment simply makes for better government. If agencies do not plan for drought before it occurs, they will be forced to react to immediate competing needs, which is not conducive to good decision making. Drought impact assessments also reduce costs to government since response actions implemented during a crisis are often more costly than preventive mitigation actions.

5.6.2 Limitations of Drought Impact Assessments

While there are clear benefits to conducting drought impact assessments, there are limitations that stakeholders and decision makers should be aware of. First, it may not be possible to quantify all impacts associated with drought. For example, although damage to ecosystems and aesthetic resources are tangible impacts that may be directly attributed to drought, assigning a value to these impacts may not be possible. The same is true for indirect impacts. A drought may lead to a decrease in agricultural production that in turn leads to the lay-off of agricultural production workers. However, determining the number of persons who are unemployed directly or indirectly because of the drought rather than general economic conditions can be difficult to distinguish. Anecdotal impact data can be collected from a variety of sources, including newspapers, personal interviews, and photographs, but there is no standard methodology to quantify drought-induced losses.

Second, long-term data may not be available to conduct impact analysis. Ideally, when conducting a drought impact assessment for a region, long-term data would be available for rainfall, hydrologic conditions, and areas of concern such as agricultural production and wildfire so that the correlation between drought events and impacts can be evaluated. Unfortunately, this type of data is not always available.

A third limitation to drought impact analysis is that data collection techniques may vary among data providers or may have changed over time. For example, agricultural production may be measured in terms of total revenue by some producers or by total quantity harvested by others. This could hamper the comparison of data from different sources and between time periods.

6. DROUGHT RISK AND VULNERABILITY IN HAWAII

The identification of areas vulnerable to drought impacts is difficult due to the variations in microclimates and impact sectors across the State. In 2000, the *Hawaii Drought Plan, Phase I* included a simplified assessment of sector vulnerability based upon input from the Drought Task Forces, which included representation from various drought stakeholders. Their assessment was based upon local knowledge of past drought impacts and was not derived from, or intended to be construed as a quantitative analysis of drought events. Table 6-1 below summarizes the areas identified as vulnerable to drought within each water use sector.

Table 6-1: Sector Vulnerability Assessment				
	C&C of Honolulu	County of Hawaii	County of Maui	County of Kauai
Water Supply Sector		South Kohala, Makapala, Niulii, Kukuihaele, Haina, Papaikou, Paukaa, Waiohinu, Naalehu, Pahala, Waimea (DHHL), Puna, Kahuku, Kau, South Kona	Maui – Upcountry, Keokea (DHHL), Kahikinui (DHHL) Molokai – Hoolehua (DHHL)	Kokee, Waimea, Anahola (DHHL), Various County and Private Systems
Agriculture and Commerce Sector	Waianae, Haleiwa, Waialua, Kunia	Kohala, Waiohinu, Naalehu, Pahala, Kona, Kau, Hamakua, Waimea, Puna, Volcano, Waimea (DHHL)	Maui – Kula, Upcountry, Ulupalakua, Lahaina, Central Maui, Kahikinui (DHHL) Molokai – Hoolehua (DHHL)	Kokee, Waimea, Various Private Systems, West Kauai
Environment, Public Health and Safety	Nanakuli, Makaha, Mililani, Schofield, Waialua, Mokuleia, Aina Haina, Hawaii Kai, Makakilo, Ewa Plains	Kona, Kau, South Kohala	Maui – Maalaea, Napili, Kihei, Wailea, Polipoli Molokai – South and West	Hanapepe, Barking Sands, Kokee, Koloa

In 2003, the 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 for the State of Hawaii. This study achieved the following sections discuss the findings of this project and its applications toward statewide drought mitigation planning.

6.1 The Drought Risk and Vulnerability Assessment and GIS Mapping Project

The *Drought Risk and Vulnerability Assessment and GIS Mapping Project* (September 2003) was designed to provide a comprehensive drought risk and vulnerability assessment for the State of Hawaii. In addition to discussion and analysis, the report contains maps of at-risk areas by county and recommendations for both mitigation actions and future studies. The following sections summarize the areas identified in each county as potentially at-risk to drought within each impact sector. Maps describing the locations of at-risk areas for each county are provided in Appendix C.

6.1.1 Background and Purpose

In support of the State Hazard Mitigation Plan and Hawaii Drought Plan Update, the Commission on Water Resource Management, in cooperation with the Hawaii Drought Council, sought the development of a statewide drought risk and vulnerability assessment. The premise of such an assessment is that hazard mitigation planning, including the delineation of drought risk areas through the analysis of interrelated parameters, is essential to ensuring aspects of public safety, protecting against adverse drought-related agricultural impacts, and safeguarding property. Such an assessment of drought risk areas is consistent with the drought preparedness recommendations from the National Drought Mitigation Center, and is supportive of the priority implementation actions initially identified in the *Hawaii Drought Plan, Phase I*.

Identifying areas at risk to drought can have a tremendous benefit in planning for drought occurrences. If areas at risk to drought are recognized, specific projects can be implemented prior to the onset of a drought to mitigate potential impacts. The statewide *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 initial phase of the assessment, completed in September 2003, includes maps of at-risk areas (see Appendix C) and recommendations for both mitigation actions and future studies. The maps have been prepared for public dissemination and use

by the counties to assist in the development of mitigation strategies and projects to be included in the State and County Hazard Mitigation Plans.

It is expected that the results of the project will provide a starting point to identify areas that may be at risk to drought. Unfortunately, the project does not represent the severity of impacts experienced by residents or businesses in these locations. For example, a farmer in a drought area may have used an irrigation system with an interrupted source of water and may have experienced minimal drought impacts, while a cattle rancher may have been without any suitable drinking water for his herd resulting in the loss of several of the animals. Understanding how people are impacted and have responded to drought would provide greater insight on how to reduce impacts.

The maps produced by the *Drought Risk and Vulnerability Assessment and GIS Mapping Project* are intended as “tools,” which should be reviewed by county agencies and local stakeholders to verify that they accurately represent drought risk areas on each of the islands. As part of these follow-on actions, residents and businesses affected by drought should also be interviewed to determine the magnitude of past drought impacts, identify existing response mechanisms used to address drought occurrences, and assess what type of mitigation measures worked best and were the most effective. A standardized system to account for and compile drought losses should also be developed. Such a system would assist in comparing drought occurrences, evaluating the effectiveness of response and mitigation measures, and help prepare for the next episode of drought.

6.1.2 Findings and Results

Maps depicting drought frequency, vulnerability, and risk areas for each county have been produced as part of the initial phase of the *Drought Risk and Vulnerability Assessment and GIS Mapping Project*. Drought frequency analyses were performed by using GIS to graphically represent the spatial distribution of drought occurrences by county. The Standardized Precipitation Index (SPI) and historical rainfall data were used for the analysis to create drought frequency maps depicting moderate, severe and extreme drought conditions for 3- and 12-month SPI timescales.

A sector based drought vulnerability analysis was performed by overlaying land use, population, infrastructure, and rainfall GIS layers to identify areas that may be susceptible to effects of drought. Maps showing vulnerable areas for the water supply, agriculture and commerce, and public health and safety sectors were prepared for each county. However, some of the available data layers used may reflect outdated information. Nonetheless, this data was the only information available at the time of the study and should be verified by each of the CLDCS.

Finally, drought risk analyses were performed by integrating the results of the drought frequency analysis and sector based drought vulnerability analysis. Drought risk maps were prepared for each county for the water supply, agriculture and commerce, and public health and safety sectors for 3- and 12-month SPI timescales for moderate, severe, and extreme drought conditions.

The findings of the statewide *Drought Risk and Vulnerability Assessment and GIS Mapping Project* are discussed for each county in sections 6.3 to 6.6 of this report.

6.1.3 Caveats and Data Limitations

In this project, the adverse effects of drought are expressed conceptually as a product of drought frequency and corresponding drought vulnerabilities. Risk areas are identified for each county within each sector. Although this approach is sound and viable, results from this project should be verified independently with future studies that may be based on other parameters. Furthermore, farmers, ranchers, public safety officials, water supply managers, and other stakeholders may have additional information regarding drought risk, and gathering such information may provide a means to assess the validity of the results of this project.

This model serves as a heuristic planning tool; the results of the study should be refined as more information becomes available. The drought risk maps produced through the risk assessment have been evaluated and applied to the degree practicable in the development of the *County Drought Mitigation Strategies* (anticipated for completion in December 2004), which ultimately identify specific areas, systems, populations, and resource at risk to drought. Further information regarding the limitations of the drought risk assessment are included in the 2003 report.

6.2 Drought Risk Areas: City and County of Honolulu

Drought risk to the City and County of Honolulu is not like that of the other counties. Although a greater proportion of the State's population lives on Oahu, drought vulnerability to the extent found on the islands of Hawaii and Maui does not exist on Oahu. With an integrated water system, a service area that covers the majority of the island, and groundwater as the primary source for potable water, the public water supply sector is not as vulnerable to minor drought conditions. If a severe drought persists for more than one or two years, the ground-water supply would be depleted to a large extent and the entire island would be affected despite the extensive ground-water integrated public water system. Other problems include the growing population occurring in the leeward or central portion of the island where rainfall is low.

In terms of risk to the agriculture and commerce sector, although there is some risk within the central portion of the island near Kunia for the moderate and severe drought stages, the City and County of Honolulu does not have as many lands devoted to this sector as compared to other islands. Hence, there is a need for refinement of the assumptions and methodology used to identify and quantify risk to account for the differences from county to county within each of the sectors.

The environment, public health and safety sector is somewhat different from the other two sectors. Although wildland fires can be induced by the symptoms of drought, a fire usually is started through man's influence. Still, based on the analysis, the area near the Mililani/Waipio region seems to be at high risk for the moderate and severe drought stages. This area is in an urban/wildland interface where the highway passes through acres of open scrub land. Hence, a fire poses a threat to the developed land and public transportation system in the area. Table 6-2 summarizes the drought risk areas identified for the City and County of Honolulu.

6.3 Drought Risk Areas: County of Hawaii

The risk of drought impact on the three sectors within the County of Hawaii is similar in terms of spatial variation. Most of the areas of concern are on the western side of the island, coinciding with low rainfall zones. What differs between each sector is the stage (moderate, severe, or extreme) where drought risk may produce the most significant impacts. For the water supply sector, all stages produce significant risk

Table 6-2: Drought Risk Areas for the City and County of Honolulu

Sector	Drought Stage		
	Moderate	Severe	Extreme
Water Supply	Central Oahu (Mililani / Waipio)	Central Oahu	Ewa, Haleiwa
Agriculture and Commerce	Central Oahu from Kunia to Helemano	Kunia	North of Helemano
Environment, Public Health (based on 12-month interval)	Central Oahu near Mililani	Central Oahu near Mililani and Kunia	Waipio / Pearl City

Source: Table 6.1 Drought risk areas for the City and County of Honolulu, *Drought Risk and Vulnerability Assessment and GIS Mapping Project*. Prepared for the Commission on Water Resource Management. September 2003.

on the western side of the island. The southern part of the island is also vulnerable to drought risk. The potential risk to this sector is clearly illustrated by applying the 12-month SPI.

In terms of the agriculture and commerce sector, again the western side of the island is at most risk, but the severe drought stage seems to coincide best with low rainfall areas on the west and southwest ends of the island, where various kinds of agricultural activities thrive. The use of a 3-month SPI shows well the potential risk to this sector.

For the environment, public health and safety sector, the 3-month drought interval does not coincide with historical wildfire burn areas. That is, there appears to be no clear overlap between high drought frequency percentages and past wildland fire locations. However, the moderate stage for the 12-month interval in conjunction with the vulnerability analysis for this sector provides the best representation of risk, as areas of relatively high drought frequency coincide with past wildfire burn areas. Table 6-3 summarizes the drought risk areas identified for the County of Hawaii.

Table 6-3: Drought Risk Areas for the County of Hawaii

Sector	Drought Stage		
	<i>Moderate</i>	<i>Severe</i>	<i>Extreme</i>
Water Supply	Kona, South Point	Kona, Kau	Kona, windslopes of Hamakua
Agriculture and Commerce	Kona, windward slope of Hamakua	Kona / western slopes of Mauna Loa near Kealekekua	Kona / Kailua
Environment, Public Health (based on 12-month interval)	Waikoloa, Kona	Kona coast	Kona

Source: Table 6.1 Drought risk areas for Hawaii County, *Drought Risk and Vulnerability Assessment and GIS Mapping Project*. Prepared for the Commission on Water Resource Management. September 2003.

6.4 Drought Risk Areas: County of Maui

For Maui, the area of greatest risk to the public water supply and environment, public health and safety sectors is within the Kula region. This was shown to exist throughout all stages from moderate, severe, and extreme drought. The 12-month SPI moderate drought contours are of note, as high frequency areas coincide with intensive agriculture areas, particularly in central Maui. In West Maui, given a low mean annual rainfall and its remote location and limited accessibility, the collective effect of a high frequency of both moderate and severe drought suggests that Hana is more vulnerable to drought impacts as far as water supply is concerned. The southern area of Lanai is characterized by a relatively high percentage of severe drought frequency and low annual rainfall, posing a great risk to the water supply and environment, public health and safety sectors. The central area of Molokai has a high percentage of drought frequency and is particularly vulnerable to fire hazards.

Of concern in this study is the analysis of the agriculture and commerce sector for the County of Maui. This analysis did not indicate where the risk may be the greatest. Because this analysis was based on the assumption that conditions and characteristics in examining each sector remained constant across each county, there was little room for individual adjustments for each county, let alone each island within a county. In reality, this may not be the case; each island would have its own physical characteristics that may have to be taken into account if any detailed examination of risk is to be conducted. Table 6-4 summarizes the drought risk areas identified for the County of Maui.

6.5 Drought Risk Areas: County of Kauai

The risk of impact to the County of Kauai from drought can be summarized as follows. Nearly the entire island of Kauai is served by municipal or private water systems. However, many of these systems are not interconnected, thereby increasing drought vulnerability due to the inability to transfer water between systems. Additionally, it was determined that the majority of all the developed lands coincide with low rainfall zones; hence, it would appear that these lands are susceptible to drought risk. Still, only a few of these lands fall in the zones of maximum drought frequency. One area that stands out through the severe and extreme drought stages is the Koloa region. Therefore, one may say that this area is at risk to the water supply sector.

Table 6-4: Drought risk areas for Maui County

Sector	Drought Stage		
	Moderate	Severe	Extreme
Water Supply	Kula, Kahului, Wailuku, Hana, Lahaina	Kula, Hana	Kula
Agriculture and Commerce	Western Molokai, central / south Lanai	South Lanai	
Environment, Public Health (based on 12-month interval)	Kula	Kula, central Molokai	Kula

Source: Table 6.2 Drought risk areas for Maui County, *Drought Risk and Vulnerability Assessment and GIS Mapping Project*. Prepared for the Commission on Water Resource Management. September 2003.

Because the vulnerability of the agricultural lands is high due to the fact that most of these lands are in low rainfall zones, one would expect a greater risk. However, upon examination of the drought risk maps, this is not always the case. In fact, the vulnerable areas that coincided with the high drought frequency regions were very few. One noteworthy riskarea in both the moderate and severe drought stages, is the Anahola region. Other areas that are of concern are located near Lihue.

An examination of the environment, public health and safety sector did not yield any apparent or significant outcomes to determine the relative risk levels to this sector. The exception is a small area in the Lihue/Poipu region at both the severe and extreme drought stages based on the 12-month SPI interval. Thus, the County of Kauai would appear to have little risk in terms of wildland fires. Because wildland fires are induced by drought conditions, there is no clear indicator as to where the greatest risk would occur based solely on drought frequency and low rainfall. One could say that each one of the "Communities at Risk" that are within low rainfall zones and coincide with high drought frequency would be at risk. Without greater knowledge of past wildland fires on Kauai, the assumption of this analysis would not provide information as to the areas at risk. Table 6-5 summarized the drought risk areas identified for the County of Kauai.

Table 6-5: Drought risk areas for the County of Kauai			
Sector	Drought Stage		
	Moderate	Severe	Extreme
Water Supply		Koloa, Anahola, Kapaa, Lihue and Poipu	Koloa, Lihue and Poipu
Agriculture and Commence	Lihue, Poipu, Anahola	Kekaha / Mana, Anahola	Southwest of Lihue
Environment, Public Health (based on 12-month interval)		Lihue / Poipu	Lihue, Poipu, and Koloa region

Source: Table 6.4 Drought risk areas for Kauai County, *Drought Risk and Vulnerability Assessment and GIS Mapping Project*. Prepared for the Commission on Water Resource Management. September 2003.

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7. DROUGHT COMMUNICATION AND RESPONSE ACTIONS

7.1 Drought Communication Protocol

Successful implementation of the *Hawaii Drought Plan* depends in large part on the timely dissemination of clear and precise information to affected agencies and the public for periods preceding, during, and following a drought event. Four entities in the drought leadership structure are identified as having key communication responsibilities during normal, drought, and recovery periods. These entities are: the Hawaii Drought Council (HDC), the State Drought Coordinator (SDC), the Water Resources Committee (WRC), and the County/Local Drought Committees (CLDCs).

Each of these entities has specific roles within the recommended communication protocol, which provides for the necessary coordination and dissemination of drought information to agencies, stakeholders, and the general public. The Drought Communication Protocol described in this section incorporates the following three elements:

- Declaration of Drought Conditions;
- General Coordination Guidelines; and
- Specific Communication Responsibilities.

These communication guidelines, set forth to effectuate the coordination and sharing of interagency and public information, are described more fully in the following sections:

7.2 Declaration of Drought Conditions

Section 7.2 provides descriptions of drought conditions defined for the State of Hawaii by the Hawaii Drought Council and communication protocols for proclamation of a statewide drought and for county drought declarations. The section also provides general communication and coordination guidelines for disseminating drought information.

7.2.1 Defining Drought Conditions

Drought conditions in Hawaii are described according to a simple and practical three-stage classification system. The Hawaii Drought Council moved to adopt (3) drought stage categories defined as “Normal,” “Drought,” and “Recovery.” It was determined that this approach to delineating drought status and drought communication actions would effectively facilitate development and implementation of appropriate drought response actions.

7.2.1.1. Normal Conditions

“Normal” conditions are broadly inclusive of non-drought periods, where normal rainfall occurs and water supplies are at typical levels. Normal conditions include seasonal variations that generally correlate with historical data and include the period immediately preceding determination of drought conditions by the WRC and HDC.

Normal conditions continue until a determination of drought is made by the WRC and HDC. The continuance of (and transition from) Normal conditions shall be based upon the assessment and consensus of the HDC, with input from the WRC and the CLDCs. Upgrading from normal conditions to drought conditions may be based upon observation of measurable trends, index values, resource deficiencies, and/or other pertinent information, as determined by the HDC.

7.2.1.2. Drought Conditions

The commencement of “Drought” conditions shall be based upon the determination of the HDC, which shall incorporate input from the WRC and the CLDCs.

The HDC’s recommendation for drought conditions shall be based upon an overall evaluation of available data and/or evidence of drought impacts in any of the three impact sectors. The HDC may consider anecdotal data and other immeasurable factors within the context of quantitative observations and shall not be restricted to the use of any particular trigger or valuation in its appraisal of drought conditions. The designation of drought conditions shall remain in effect until the HDC determines otherwise.

7.2.1.3. Recovery Conditions

The designation of “Recovery” conditions becomes effective upon the recommendation of the HDC. Recovery conditions would continue until the HDC, with input from the WRC and the CLDCs, determines that impacted sectors and water resources have sufficiently improved, and that favorable (i.e., Normal) climate conditions are likely to continue. The HDC shall not be restricted to the use of any particular trigger or valuation in its appraisal of drought recovery and/or the return of Normal conditions.

7.2.2 Statewide Proclamation of Drought

The issuance of a Statewide Proclamation of Drought shall be based upon a recommendation from the Hawaii Drought Council to the Office of the Governor.

Such recommendation shall be preceded by the evaluation of current and forecasted climate and other drought-related conditions presented to the HDC by the State Drought Coordinator. The SDC's report to the HDC shall include, but not be limited to, information, analyses, and findings of the Water Resources Committee and the County/Local Drought Committees.

The Governor's representative, and other agencies/organizations on the HDC, shall be apprised of all data and information confirming the existence and/or immediate onset of statewide drought conditions. In addition, affected counties should be consulted in the formulation of any statewide drought-related recommendation. County consultation may be effectuated through communication with each Mayor's representative on the HDC.

Upon concurrence by the Governor, a formal proclamation of drought shall be issued through the Office of the Governor. Statewide proclamations of drought by the Governor shall focus upon, and address specific sector impacts to raise public awareness of statewide drought conditions. Proclamations may be issued for purposes of seeking appropriate federal and/or State assistance to impacted stakeholders (e.g., federal relief assistance through the U.S. Department of Agriculture). The Statewide Proclamation of Drought shall be posted onto the Hawaii Drought Website, and a drought press release originating from the Office of the Governor shall be issued to the general public, media outlets, Hawaii's congressional delegation, and affected federal, State, and county agencies.

It is important to note that a Statewide proclamation of drought, as described above, is different, but does interfere with any drought related action taken under the authority of HRS Chapter 127, *Disaster Relief*, or Chapter 209, Disaster Relief and Rehabilitation.

7.2.3 County Declaration of Drought Conditions

County declarations of drought may include countywide, island-specific, or regional declarations of drought conditions. Formal pronouncements of prevailing drought conditions may originate from the Office of the Mayor, or where local water supply is impacted, by the County Water Departments. County-based drought declarations may be based upon information/data from the Water Resources Committee and/or recommendations from the County/Local Drought Committee. Additionally, county-specific declarations of drought may be issued at the sole discretion of the Mayor of the County. Similarly, in instances where local water supply may be affected by existing drought conditions, the affected County Water Department may on their own volition issue drought-related water conservation notices.

County declarations of drought conditions issued by the Mayor or County Water Department should be designed to address county-specific impacts and to raise

public awareness of local drought conditions. Declarations may be issued for purposes of seeking voluntary water conservation and/or implementation of mandatory water conservation measures at the county/local level (e.g., the issuance of a water conservation notice for the Upcountry area on Maui).

The appropriate county agency, in cooperation with the CLDC, should coordinate the release of any drought status report or issuance of county drought declarations with the State Drought Coordinator, whom shall report such action to the HDC and WRC. As in the case of a statewide drought proclamation, each County declaration of drought, whether issued by the Office of the Mayor or the County Water Department, should be accompanied by a drought press release targeting the general public, media outlets, Hawaii's congressional delegation, and affected federal, state, and county agencies. Such information, upon transmittal to the SDC, shall be posted on the Hawaii Drought Monitor website for public dissemination.

7.3 General Communication and Coordination Guidelines

The following points provide guidelines for the coordination of drought information sharing and the release of drought status information:

- Drought-related information should be shared on a timely basis with all affected agencies, organizations, and impacted stakeholders. To the extent possible, dissemination of drought-related information between agencies and with the general public should be coordinated with the Hawaii Drought Council through the State Drought Coordinator. Coordination through the HDC will ensure timely notification of the Office of the Governor and the other member organizations regarding critical drought information/data. Priority shall be given to the dissemination of drought information that pertains to assistance or other drought-related services required by individuals and/or organizations.
- The release of any State drought status report or response information should be coordinated with the Office of the Governor through the HDC. To the extent possible, county drought-related announcements should be coordinated with the HDC through the State Drought Coordinator.
- The issuance of Drought Press Releases or Public Service Announcements for use by radio and/or television media in drought-affected counties should be coordinated with the SDC. Such coordination will facilitate dissemination of pertinent drought-related information, including the posting by the SDC of critical information/announcement on the Hawaii Drought Monitor website (www.hawaiidrought.com).

7.4 Specific Communication Responsibilities

As described in the preceding sections, the following entities form the communication (and implementation) core of the *Hawaii Drought Plan*:

- Hawaii Drought Council
- State Drought Coordinator
- Water Resources Committee
- County/Local Drought Committees

Table 7-1 sets forth the communication protocol for these organizations, expressed in terms of actions associated with Normal conditions, the declaration of Drought conditions, Drought conditions, the rescinding of Drought conditions, and Recovery conditions.

7.5 Drought Response Actions

7.5.1 Drought Response Versus Drought Mitigation

This section provides specific actions to be undertaken by State agencies in response to drought conditions. For the purposes of this report, “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 drought response versus drought mitigation actions are presented in Table 7-2.

7.5.2 State Agency Response Actions

Under the current drought leadership structure, the Hawaii Drought Council, Water Resources Committee, and State Drought Coordinator take on lead roles in coordinating and responding to drought at the State level. As part of this effort, the *Hawaii Drought Plan* identifies a number of specific State agencies, which have individual responsibilities for drought-related response actions within their respective program areas. An index of these agencies is included as Appendix D. These response actions are summarized in Table 7-3 and represent a “menu” of recommended response measures that should be considered for implementation at the discretion of the agency. Consultation and coordination of response actions should be carried out through the HDC and SDC.

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Table 7-1: Drought Communication Protocol

Drought Stage	Communication Actions and Guidelines			
	Hawaii Drought Council	State Drought Coordinator	Water Resources Committee	County/Local Drought Committees
Normal	<ul style="list-style-type: none"> Convene semi-annually to assess drought conditions statewide. The Office of the Governor shall be updated semi-annually on current conditions through its representative on the HDC and/or the SDC. As conditions warrant, more frequent HDC meetings may be convened. 	<ul style="list-style-type: none"> Based on consultation with the WRC, the SDC shall provide semi-annual reports to the HDC (and CLDCs) on current climate conditions. Regularly update and post current climate data/information on the Hawaii Drought Website. In the event of forecasted drought conditions, the SDC shall notify the HDC and CLDCs and convene additional meetings as necessary. Serve as principal point of contact and reference for drought-related information. Serve as legislative liaison for communication of drought-related information to the legislature. 	<ul style="list-style-type: none"> Convene at least semi-annually to review/evaluate current statewide climate and other hydrologic conditions and report to the SDC. WRC shall review and evaluate any reports/data received from the CLDCs. The WRC report to the SDC shall incorporate pertinent information from the CLDC and/or other sources. As conditions warrant, more frequent WRC meetings may be convened. 	<ul style="list-style-type: none"> Convene at least semi-annually to review/evaluate local climate conditions and report to the SDC. CLDC should communicate and notify the SDC, local members/agencies regarding forecasted drought conditions. Monitor county hydrologic conditions and other local indicators for the onset of drought conditions. Such information should be communicated to CLDC members and the SDC. Reports of any local drought impacts should be reported to the SDC. As conditions warrant, more frequent CLDC meetings may be convened.

Table 7-1: Drought Communication Protocol (continued)

Drought Stage	Communication Actions and Guidelines			
	Hawaii Drought Council	State Drought Coordinator	Water Resources Committee	County/Local Drought Committees
Declaration of Drought Condition	<ul style="list-style-type: none"> If necessary, recommend Governor's issuance of a Statewide Proclamation of Drought Such recommendation shall be based upon evaluation of current and forecasted drought conditions by the WRC/CLDCs. Counties shall be consulted in the formulation of any statewide drought-related recommendation. County consultation may be effectuated through communication with each Mayor's representative on the HDC. Declare drought conditions for affected areas based on WRC recommendations 	<ul style="list-style-type: none"> The SDC shall assimilate information/data received from the WRC/CLDCs, and shall report such findings to the HDC. Priority shall be given to the reporting of imminent or existing statewide, county, or local drought conditions to the HDC. Maintain close contact with HDC, WRC, CLDCs, and stakeholders to convene meetings as necessary. 	<ul style="list-style-type: none"> The WRC shall, at a minimum, meet monthly to evaluate current and forecasted climate conditions and available drought-related information/data. Evidence of the immediate onset or existence of statewide and/or local drought conditions shall be reported to the SDC. Recommend that the HDC issue a drought declaration for affected areas 	<ul style="list-style-type: none"> Issue county drought declarations as necessary, which may include countywide, island-specific, or regional declarations of drought conditions. County drought declarations may originate from the Office of the Mayor or the County Water Department. County declarations may be issued independently or upon recommendations by the County/Local Drought Committee. Issuance of any county drought-related declarations should be coordinated with the SDC and the CLDCs.

Table 7-1: Drought Communication Protocol (continued)

Drought Stage	Communication Actions and Guidelines			
	Hawaii Drought Council	State Drought Coordinator	Water Resources Committee	County/Local Drought Committees
Drought	<ul style="list-style-type: none"> Convene quarterly HDC meetings to monitor current and forecasted drought conditions. The Office of the Governor shall be updated quarterly on current conditions through its representative on the HDC and/or the SDC. As conditions warrant, more frequent HDC meetings may be convened. HDC State agency members (e.g., Department of Agriculture) may issue Public Service Announcements (PSA), water conservation and/or other Public Notices, as appropriate. Issuance of State agency PSAs and/or Public Notices should be coordinated with the SDC. 	<ul style="list-style-type: none"> Based on consultation with the WRC, the SDC shall provide quarterly updated reports to the HDC (and CLDCs) on current and forecasted drought conditions. If drought conditions worsen, monthly drought reports shall be submitted to the HDC and CLDCs. SDC shall update and post current and forecasted drought information onto the Hawaii Drought Website. Initiate regular monthly (and if necessary, weekly) communication and coordination with the WRC and CLDCs via email, fax, phone, or meetings. 	<ul style="list-style-type: none"> Convene at least quarterly to review/evaluate current and forecasted statewide drought conditions and report to the SDC. WRC shall evaluate and incorporate CLDC drought information within reports to the SDC. As conditions warrant, monthly WRC meetings may be convened. In this event, monthly drought reports shall be made to the SDC. 	<ul style="list-style-type: none"> Convene at least quarterly to review/evaluate local drought conditions and report to the SDC. As conditions warrant, more frequent CLDC meetings should be convened. CLDC shall communicate and notify local members regarding current and forecasted drought conditions. Reports of drought impacts should be solicited from local stakeholders and reported to the SDC. CLDC agency members (e.g., county water departments) may issue Public Service Announcements (PSA), water conservation and/or other Public Notices, as appropriate. Issuance of county PSAs and/or Public Notices should be coordinated with the SDC.

Table 7-1: Drought Communication Protocol (continued)

Drought Stage	Communication Actions and Guidelines			
	Hawaii Drought Council	State Drought Coordinator	Water Resources Committee	County/Local Drought Committees
Rescinding of Drought Conditions	<ul style="list-style-type: none"> A formal notice, if necessary, rescinding a statewide drought proclamations may be issued by the Office of the Governor upon recommendation by the HDC. Actions to rescind a statewide drought proclamation should be coordinated with the CLDCs and the County Mayors. HDC coordination requirements shall be carried out by the SDC. 	<ul style="list-style-type: none"> Information concerning current drought conditions, particularly the forecasted cessation of statewide or county/local drought conditions shall be reported to the HDC and the CLDCs by the SDC. 	<ul style="list-style-type: none"> The WRC shall continue to monitor current and forecasted drought conditions and other available drought information. Evidence of improving conditions shall be reported to the HDC and CLDCs through the SDC. 	<ul style="list-style-type: none"> The CLDC shall monitor local drought conditions and report to the SDC regarding improving drought conditions. A formal notice rescinding County Drought Declarations may be issued by the Office of the Mayor or the County Department of Water. Actions to rescind a County drought declaration should be coordinated with the SDC.
Recovery	<ul style="list-style-type: none"> Maintain (at least initially) quarterly schedule of HDC meetings to review and evaluate impact assessment data provided by the CLDCs. 	<ul style="list-style-type: none"> Evaluate effectiveness of statewide drought response and mitigation actions, and report back to the HDC and CLDCs. 	<ul style="list-style-type: none"> Maintain (at least initially) quarterly schedule of WRC meetings to review and evaluate statewide and local monitoring data provided by the CLDCs. 	<ul style="list-style-type: none"> Maintain (at least initially) quarterly schedule of CLDC meetings to evaluate and assess local conditions and monitoring data.

Table 7-1: Drought Communication Protocol (continued)

Drought Stage	Communication Actions and Guidelines			
	Hawaii Drought Council	State Drought Coordinator	Water Resources Committee	County/Local Drought Committees
Recovery (continued)	<ul style="list-style-type: none"> Review and evaluate drought response and mitigation strategies implemented at the state and county level, and report back to the Governor. Resume semi-annual HDC meeting schedule as recommended by the SDC. 	<ul style="list-style-type: none"> Update and post current and forecasted drought information onto the Hawaii Drought Website. Maintain (at least initially) regular monthly communication and coordination with the WRC and CLDCs via email, fax, phone, or meetings. Resume normal semi-annual reporting to the HDC and CLDCs. 	<ul style="list-style-type: none"> Review and evaluate efficacy and sufficiency of drought monitoring data and forecast information at the state and county level, and issue report back to the HDC and CLDCs through the SDC. Resume semi-annual WRC meeting schedule as recommended by the SDC. 	<ul style="list-style-type: none"> Continue to monitor current and forecasted climate conditions and other available drought related information to ascertain emergence from Recovery to Normal conditions. Review and evaluate efficacy and sufficiency of drought response and mitigation actions taken at the county level, and issue report back to the HDC through the SDC. Conduct county/local impact assessments and report findings to the HDC and WRC through the SDC. Evidence of improving conditions shall be reported to the HDC and WRC through the SDC. Resume semi-annual CLDC meeting schedule as recommended by the SDC.

Table 7-2: Drought Response Actions versus Drought Mitigation Actions

Drought Response:	Drought Mitigation:
<ul style="list-style-type: none">• Alert appropriate agencies of emerging rainfall deficits.• Implement agency coordination actions enumerated in the framework.• Alert appropriate agencies of declining ground- and surface-water storage.• Implement voluntary and/or mandatory water use restrictions.• Seek available funding and authorization to mobilize contractors to truck water to ranches without sources.• Seek authorization to convert and utilize monitor wells to provide emergency sources of water.• Utilize models and monitoring data to assess drought recovery or escalation of drought conditions.• Implement pre-determined response measures for impacted areas.• Provide for regular and timely media advisories.• Initiate requests for federal drought assistance.	<ul style="list-style-type: none">• Expand current network of rain gages to improve rainfall monitoring.• Develop a framework to coordinate drought response between agencies.• Enhance current monitoring of ground- and surface-water levels.• Establish alert procedures for declining water level conditions.• Establish conservation programs to reduce water consumption.• Establish contingency water-hauling programs for livestock.• Seek authorization and funding for development of new water supply sources.• Identify areas at risk to drought and plan for regional response actions and strategies.• Develop additional storage and/or alternative sources of water supply.• Develop and implement drought-related public awareness programs.• Develop incentive programs for drought-resistant practices.

Table 7-3: Recommended State Agency Drought Response Actions

Agency	Normal	Drought	Recovery
DOA	<ul style="list-style-type: none"> • Monitor reservoir levels. • Monitor stream levels at existing diversion locations. • Report any observed change in resource and ground-water aquifer conditions for irrigation source wells. • Notify system users of low reservoir conditions. • Notify the WRC, CLDCs, and SDC of declining reservoir levels. • Advise all users to prepare for possible implementation of voluntary and/or mandatory water conservation plans. • Advise and encourage water users to implement appropriate water conservation measures, wherever possible (e.g., voluntary reduction of water use for equipment/vehicle washdown and for premarket washing of produce and flowers, and utilization of efficient irrigation methods). 	<ul style="list-style-type: none"> • Implement more frequent monitoring of reservoir, stream, and well levels. • Continue notification of system users regarding storage and supply conditions. • Implement more frequent updates to the WRC, CLDCs, and the SDC regarding storage and supply conditions, and emerging drought impacts. • Document supply conditions and drought impacts, and use this information to prepare emergency drought relief requests for submittal to the HDC. • Implement voluntary and/or mandatory water restrictions for system users. • Implement available water conservation measures and agency water shortage plans, if any. 	<ul style="list-style-type: none"> • Continue frequent monitoring of reservoir, stream, and well levels. • Continue periodic notification of system users regarding storage and supply conditions. • Continue regular updating of the WRC, CLDCs, and the SDC regarding storage and supply conditions, improving drought conditions. • Conduct post-drought impact assessments and data collection on economic losses. • Evaluate the effectiveness of drought response and mitigation measures implemented by the agency pursuant to the drought episode. • Re-evaluate the adequacy of source and storage facilities. • Evaluate the quantity and water use for large agricultural water users.

Table 7-3: Recommended State Agency Drought Response Actions (continued)

Agency	Normal	Drought	Recovery
DOA (cont.)	<ul style="list-style-type: none"> • Complete preparation necessary for the use of pre-identified alternative sources (equipment preparation, staging area identification, notification to users, etc.). • Participate in CLDC activities and provide agriculture related information as appropriate. • Propose legislation to state and county legislative bodies in support of drought mitigation and response actions. • Act as recipient for federal grants and direct appropriations in support of agriculture-related drought assistance. 	<ul style="list-style-type: none"> • Seek authorization and available funding to mobilize contractors to truck water to ranches without sources. • Seek authorization to convert and utilize nearby USGS monitoring wells for emergency water use. • Seek authorization for use of private reservoir sources and coordinate installation and use of standpipes for ranchers for livestock drinking water. • Advise farmers and ranchers regarding required documentation and data collection for federal assistance and disaster relief programs. • Coordinate and facilitate access to federal assistance programs, low interest State loans, federal crop loss programs and agriculture loans. 	<ul style="list-style-type: none"> • Evaluate the effectiveness of aid and loan programs accessed by agricultural stakeholders. • Evaluate the effectiveness of water conservation programs implemented during the drought episode. • Advise farmers and ranchers to submit appropriate documentation for federal assistance and disaster relief programs. • Continue facilitating access to federal assistance programs, low interest State loans, federal crop loss programs and agriculture loans.

Table 7-3: Recommended State Agency Drought Response Actions (continued)

Agency	Normal	Drought	Recovery
DOA (cont.)		<ul style="list-style-type: none"> • Seek authorization for use of military surplus equipment to transport equipment and/or water to drought stricken areas. • Coordinate and seek authorization for emergency use of “gray water” and surface water. • Make recommendations, where applicable, for deferral of State land lease rent and taxes. 	
CWRM	<ul style="list-style-type: none"> • Maintain communication with HDC, WRC, and CLDCs and convene regular meetings through the SDC. • Consult with county water departments regarding water supply status and resource conditions. • Promote and facilitate implementation of statewide water conservation measures. 	<ul style="list-style-type: none"> • Seek (on behalf of the HDC) available emergency drought assistance and coordinate disbursement of aid/funding. • Implement State drought response projects as directed by the HDC and in coordination with the CLDCs. • Assist CLDCs with coordination of local drought response strategies developed and implemented by individual county agencies. 	<ul style="list-style-type: none"> • Coordinate compilation of post-drought impact assessment data. • Evaluate (in consultation with the WRC and CLDCs) impact data, drought “triggers” and sufficiency of monitoring data. • Evaluate the effectiveness of drought mitigation and response actions implemented by State agencies.

Table 7-3: Recommended State Agency Drought Response Actions (continued)

Agency	Normal	Drought	Recovery
CWRM (cont.)	<ul style="list-style-type: none"> • Propose legislation to state and county legislative bodies in support of drought mitigation and response actions. • Facilitate access to federal, state and local assistance programs and assist with acquiring funding for program implementation. • Continue refinement of statewide drought risk and vulnerability assessment. • Monitor (in consultation with the WRC) climatological and hydrologic data, soil moisture readings, reservoir storage levels, weather forecasts and other pertinent information necessary to assess and forecast drought conditions. • Coordinate (through the SDC) dissemination of drought-related information to pertinent agencies and the general public. 	<ul style="list-style-type: none"> • Consult with county water departments regarding water supply status and low ground water conditions/levels. • Advise water use permittees within designated water management areas of existing drought conditions, as appropriate. Such notification may be issued in the CWRM's Monthly Bulletin. • Implement voluntary water conservation measures for water use permittees within designated water management areas. • Implement regional water shortage plans for designated water management areas upon CWRM declaration of a water shortage (ref. 174C-62, HRS) • On behalf of the HDC, submit requests to the media to run drought/water conservation public service announcements. 	<ul style="list-style-type: none"> • Convene CLDC meetings to evaluate the effectiveness of county drought mitigation and response actions. • Subject to available data, review and evaluate the effectiveness of conservation programs and mandatory restrictions, if any. • Refine drought mitigation and response strategies, as appropriate, in consultation with the CLDCs. • Notify water use permittees within designated water management areas of improving drought conditions. Such notification may be issued in the CWRM's Monthly Bulletin.

Table 7-3: Recommended State Agency Drought Response Actions (continued)

Agency	Normal	Drought	Recovery
CWRM (cont.)	<ul style="list-style-type: none"> • Continue update and refinement of the HDP. • Authorize agency staff to provide technical assistance to the CLDCs. • Serve (on behalf of the HDC) as the principle agency and initial contact person for statewide drought-related issues. • Alert water use permittees within designated water management areas, appropriate agencies and stakeholders of impending drought conditions. 		
DLNR	<ul style="list-style-type: none"> • Authorize agency staff to provide technical assistance to the CLDCs. • Check and maintain existing fire access roads into remote areas and State Forest Reserve lands. 	<ul style="list-style-type: none"> • Close hiking, camping, and hunting areas at high risk to wildland fires. • Make pre-arrangements for access ways for fire engines, water tenders, and helicopter assets (e.g., water sources, heliports, helispots, etc.). 	<ul style="list-style-type: none"> • Assess and document drought-related ecological damages, if any. • Assess and document damage caused by wildfires.

Table 7-3: Recommended State Agency Drought Response Actions (continued)

Agency	Normal	Drought	Recovery
DLNR (continued)	<ul style="list-style-type: none"> • Review and update fire response and mobilization plans for Conservation Districts and State Forest Reserve areas. • Monitor areas where vegetative growth may constitute a significant threat for fire. Mitigate fuel loading by several fuel modification actions (e.g., establish control lines in strategic locations and high threat areas located within and adjacent to high value agricultural, urban, and industrial zones and forest areas). • Conduct routine thinning, grazing, pruning, and limited use of prescribed burning to reduce fuel loading. • Post hiker/hunter education and awareness information regarding prevention of wildland fires. • Fill reservoirs and holding tanks dedicated to fire suppression activities. • 	<ul style="list-style-type: none"> • Maintain close coordination among fire service agencies. • Implement action for early detection and rapid response to fire occurrence. • Conduct aggressive campaign to implement voluntary reduction of fuel in high threat areas by private landowners and stakeholders. • Disseminate wildfire awareness information to the HDC, CLDCs, and the general public. • Aggressively check the NWS fire forecast on a daily basis. Issue appropriate fire danger rating notices for public safety. Allocate/stage fire fighting resources commensurate with threat levels. • Mobilize helicopter assets to augment and support ground attack resources. 	<ul style="list-style-type: none"> • Review and evaluate effectiveness of agency wildfire mitigation and response strategies (e.g., review and evaluate the sufficiency of existing wildfire fighting resources). • Assess the response of vegetative growth to annual climatic conditions and post-fire regrowth. • Implement erosion control measures and reforestation programs on lands affected by wildfire (subject to available resources). • Assess and document effectiveness of fire prevention strategies. • Assess and document fire occurrence and fire behavior. Make adjustments to the Hawaii Fire Danger Rating System as appropriate. • Evaluate communication protocols with HDC and CLDCs to determine if drought-related information is adequate for relief activities.

Table 7-3: Recommended State Agency Drought Response Actions (continued)

Agency	Normal	Drought	Recovery
State Civil Defense	<ul style="list-style-type: none"> • Maintain communication and coordination with the HDC, WRC, and CLDCs. The SDC shall be the primary point of contact for State CD regarding statewide drought status. • Coordinate and serve as the primary liaison for access to FEMA funding/assistance for drought mitigation and response. • Maintain and administer federal wildland fire programs as authorized under the Stafford Act. • Continue to coordinate the implementation of the State of Hawaii Drought and Wildland Fire Mitigation Plan. • Update the pertinent sections of the State Hazard Mitigation Plan 	<ul style="list-style-type: none"> • Upon appropriate disaster declaration (Chapter 127, HRS), facilitate access to available emergency assistance. (Such assistance may include emergency loans and access to military aid.) • Coordinate with FEMA and other federal agencies for assistance. 	<ul style="list-style-type: none"> • Request assistance from FEMA and other Federal agencies. • Implement action items listed in the State Hazard Mitigation Plan.

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Local Contacts for State Agencies	
State of Hawaii Department of Agriculture	Agriculture Resource Management Division 1428 S. King Street E-mail: hdoa.info@hawaii.gov Phone: (808) 973-9473 / 973-9467 (Fax)
State of Hawaii Commission on Water Resource Management	State Drought Coordinator 1151 Punchbowl Street, Room 227 Honolulu, Hawaii 96813 E-mail: dlnr.cwrm@hawaii.gov Phone: (808) 587-0214 / (808) 587-0219 (Fax)
State of Hawaii Department of Land and Natural Resources	Division of Forestry and Wildlife 1151 Punchbowl Street, Room 325 Honolulu, Hawaii 96813 Phone: (808) 587-0166 / (808) 587-0160 (Fax)
State of Hawaii Department of Defense	Civil Defense Division Address: 3949 Diamond Head Road Phone: (808) 733-4300 / (808) 733-4227 (Fax)

While the State actions in Table 7-3 may address some drought emergencies, it is often at the county/local level where the greater part of emergency response will occur. These actions will be developed and executed by the County/Local Drought Committees in coordination with the HDC and SDC. Such actions will be described in the forthcoming County Drought Mitigation Strategies.

7.5.3 County Drought Response Actions

Completion of the Hawaii drought leadership structure called for the establishment of County/Local Drought Committees and the development of county-based drought mitigation strategies. 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. The drought leadership structure is an integral component of the updated HDP. In fact, the leadership structure not only accommodates any jurisdictional issues between county agencies, it also facilitates coordination between the various counties and the State.

Local response actions, which by jurisdiction may be undertaken independently from State sponsored actions, should be implemented in coordination with the Hawaii Drought Council and affected State agencies to achieve maximum efficiency and best use of government resources. A key role of the State Drought Coordinator shall be to achieve the highest level of interagency and stakeholder communication/coordination at both the State and county level.

County drought response actions have purposefully been separated from the updated *Hawaii Drought Plan* document. The HDP was developed to clarify and delineate state-level actions that may be taken to respond to and mitigate the statewide effects of drought. Whereas, specific county response actions taken at the local level fall within the appropriate purview and current jurisdiction of the respective county agencies (e.g., the Mayor of each county, the respective county water departments, etc.), these actions and strategies and are thus acknowledged by reference to the forthcoming *County Drought Mitigation Strategies*, which are anticipated to be completed in December 2004. However, Table 7-4 provides a listing of recommended drought response actions to be executed at the county level. These recommended actions are presented for consideration by the CLDCs and other local entities.

7.6 Prioritization of Water Use During Drought

During extended drought periods, conflicts concerning water uses may arise due to increased demand and reduced supply. Ground and surface water supplies may become threatened by drought and measures must be taken to balance protection of these water resources and meeting demands for water. There are several state and county government entities in Hawaii that have authority over water systems in specific political jurisdictions. Privately owned water systems have control over their water supply and customers. The prioritization of uses of water during drought will be determined on a case-by-case basis by the appropriate government agency or private water purveyor. Coordinated efforts should be made to develop guidelines for prioritization of water use in advance of drought or water shortage conditions. Government agencies and municipalities have existing statutes, rules, and plans for water conservation and cutbacks, both voluntary and mandatory. The following sections describe these entities, their authority, and any rules or plans to address water use priorities and/or conflicts.

7.6.1 Commission on Water Resource Management

The Commission on Water Resource Management administers the State Water Code, Chapter 174C, Hawaii Revised Statutes (HRS). The Water Code establishes the Commission's broad statewide authority. HRS §174C-10 gives the Commission statewide jurisdiction to hear and resolve any dispute on water resources across the state.

Table 7-4: Recommended County Drought Response Actions			
Entity	Normal	Drought	Recovery
CLDCs	<ul style="list-style-type: none"> Designate a lead agency to be responsible for coordination with the HDC and SDC. Update drought response and mitigation measures developed by the CLDC and/or individual county agencies. Monitor local conditions and coordinate dissemination of information to the SDC. Report drought impact data to the SDC. 	<ul style="list-style-type: none"> Coordinate county sponsored drought response and mitigation actions with the HDC and SDC. Maintain communication and consultation with the HDC and SDC regarding access to available emergency relief programs. Implement drought response strategies identified in county agency response plans, if any. Implement county water shortage plans (e.g., voluntary and mandatory water conservation) as may be determined by the county water departments. Report drought impact data to the SDC. 	<ul style="list-style-type: none"> Evaluate effectiveness of drought mitigation and response measures. Assess socio-economic and ecological damage caused by drought and compile information for dissemination with the HDC and SDC. Review and update county drought mitigation and response strategies. Report drought impact data to the SDC.

Local Contacts for County/Local Drought Committees			
Kauai CLDC	County Agency: Address: E-mail: Phone:	Department of Water 4398 Pua Loke St. Lihue HI, 96766 (808) 245-5400	Civil Defense Agency 3990 Kaana Street, Suite 100 Lihue, HI 96766 emops@kcda.state.hi.us (808) 241-1800
Oahu CLDC	County Agency: Address: E-mail: Phone:	Board of Water Supply 630 S. Beretania Street Honolulu, HI 96843 (808) 748-5000	Oahu Civil Defense Agency 650 S. King Street Honolulu, HI 96813 msamson@co.honolulu.hi.us (808) 523-4121
Maui CLDC	County Agency: Address: E-mail: Phone:	Department of Water Supply 200 South High Street Wailuku, HI 96793 (808) 270-7816	Civil Defense Agency 200 South High Street Wailuku, HI 96793 civil.defense@co.maui.hi.us (808) 270-7285
Hawaii CLDC	County Agency: Address: Phone:	Department of Water Supply 345 Kekuanaoa St., Suite 20 Hilo, HI 96720 (808) 961-8050	Civil Defense Agency 920 Ululani St. Hilo, HI 96720 (808) 935-0031

Occasionally, Commission rulings are appealed to the Hawaii State Supreme Court. Regarding water rights, the Hawaii State Supreme Court recently ruled in its decision on the appeal of the Waiahole Ditch Contested Case Hearing that the under the public trust doctrine, protection shall be given to domestic uses, natural instream flows, and Native Hawaiian traditional and customary uses. However, the Court noted that the Commission should make any decisions on water conflicts on a case-by-case basis. Further, the Hawaii State Constitution Article XI, Section VII protects appurtenant water rights and Article VII, Section I, recognizes the Hawaiian Homes Commission Act of 1920 (Act of July 9, 1921, c 42, 42 Stat 108), which protects adequate reserves of water for the Department of Hawaiian Home Lands.

HRS §174C-41 allows the Commission to designate water management areas, and HRS §174C-48 requires permits for use of water in these areas. Under the Administrative Rules of the State Water Code §13-171-42 (c), permit holders are required to develop their own water shortage plan.

HRS §174C-62 allows the Commission to develop a water shortage plan and outlines provisions for the declaration of a water shortage in water management areas and gives authority to the Commission to impose restrictions on permitted uses in these areas on a case-by-case basis. Further, the Commission may declare a water emergency and take actions (such as restrictions on a case-by-case basis) to meet such emergencies both within and outside a water management area. At the time of this writing, a draft Pearl Harbor Water Shortage Plan for the Pearl Harbor Water Management Area establishes the following classification system (highest to lowest priority) for water uses permitted through Commission:

- | | |
|------------------|-------------------------------|
| 1. Domestic Use | 4. Agricultural Use |
| 2. Municipal Use | 5. Industrial Use |
| 3. Military Use | 6. Golf Course Irrigation Use |

The Commission's statewide authority and responsibility for water resource management and protection provides for specific regulatory and planning measures to address water shortage conditions, which may affect the State's ground and surface water resources. Other State and county agencies have related jurisdictional authority/responsibilities established for agricultural and municipal water systems in each of the counties. It should be noted, however, that these authorities and prescribed actions therein, focus on demand-side and supply-side management issues, as opposed to the Commission's resource protection mandate. Accordingly, the following agency water shortage provisions address the aspects of "customer" water use and established conditions for implementation of both voluntary and mandatory water restrictions.

7.6.2 State of Hawaii Department of Agriculture

The DOA Agricultural Resource Management Division (ARMD) operates five irrigation systems across the state. The ARMD Administrative Rules for these systems, §4-150-4, §4-151-4, §4-152-4, §4-155-4, §4-156-4, Conservation Measures and Interruption of Water Supply, enables the Department to impose water restriction and rationing to prevent water shortage and subsequent emergencies. Further, during times of drought, the Department shall assure all consumers a fair share of available irrigation water. Violations to any restrictions can result in discontinuance of water service and removal of the water connection.

7.6.3 County Municipal Water Departments

7.6.3.1. Kauai Department of Water

Kauai Department of Water Rules and Regulations, Part II, Section III, Conservation and Interruption of Water Supply, allow the Department to restrict customers' water use to prevent water shortages or emergencies. The Department may fine customers violating any water restrictions.

7.6.3.2. Honolulu Board of Water Supply

Honolulu Board of Water Supply Rules and Regulations Sec. 3-318 to Sec. 3-323 define three levels of groundwater conditions: Caution Low Groundwater Condition, Alert Low Groundwater Condition, and Critical Low Groundwater Condition; and possible actions that can be taken to reduce consumer demands. Voluntary water conservation measures and irrigation schedules may be requested of customers under Caution Low Groundwater Conditions. Mandatory water use restrictions may be placed upon customers under Alert and Critical Low Groundwater Conditions. The BWS may also impose surcharges, fines or discontinue service to customers violating any water restrictions.

7.6.3.3. Maui Department of Water Supply

Maui Department of Water Supply Rules and Regulations Sec. 3-2, Conservation and Interruption of Water Supply, allow the Department to restrict customers' use of water to prevent water shortages and emergencies. The Department also advises customers on its Kula water system to install private water storage facilities with the capacity of not less than 1000 gallons. Sec. 4-1, Declaration of Drought, allow the Department to make proclamations of drought and restrict customers' use during drought periods. Under Sec. 4-2, Penalties, the Department may also fine customers violating any water restrictions.

County of Maui Board of Water Supply Resolution No. 98-18 establishes Upcountry Maui (service area) drought guidelines. The Resolution defines phases of drought as follows:

Drought Watch, Drought Warning, Drought Emergency, Drought Emergency to Drought Warning, Drought Warning to Drought Watch, and Drought Watch to Normal. Within each of these phases there are specific triggers and corresponding actions to be taken, including resource monitoring, conservation outreach, voluntary and mandatory reduction in use, and postponement of new service connections.

7.6.3.4. Hawaii Department of Water Supply

Hawaii Department of Water Supply Rules and Regulations Sec. 3-2, Conservation Measures and Interruption of Water Supply, allow the Department to restrict customers' water use to prevent a water shortage or emergency condition. In determining the priorities in restricting the use of water, the health and safety of the public shall be given first consideration over other uses. The Department may also fine customers violating any water restrictions.

7.7 Post Drought Evaluation

One essential component of a successful drought plan is the post-drought evaluation. A post-drought evaluation documents the assessment methods and response actions taken by government and private sector organizations, as well as individuals and other stakeholders. The evaluation analyzes the effectiveness of these drought response actions and makes recommendations for improvement or other changes. Only by developing a post-drought evaluation can the affected organizations and stakeholders learn from the past successes and mistakes.

Post-drought evaluations should include a thorough drought impact assessment, which involves a standardized methodology that allows for accurate estimates of economic losses, as well as climatic, environmental, and social impacts due to drought.

Post-drought evaluations should also analyze the efficacy of pre-drought mitigation planning and projects and identify areas where improvements can be made. Besides identifying deficiencies in the system, the post-drought evaluation should also point out situations where drought mitigation and response were effective and successful.

The post-drought evaluation should be documented in a post-drought report, which should be coordinated by the State Drought Coordinator and completed with the cooperation of the drought leadership structure.

8. DROUGHT MITIGATION AND PREPAREDNESS

Mitigation can be defined as actions or activities that reduce the overall risk to drought and ultimately reduce the severity of drought impacts. Drought mitigation should be executed prior to the onset of drought conditions. Moreover, mitigation activities should be ongoing and continually funded if the benefits of such efforts are to be fully realized.

Drought mitigation comprises a broad range of proactive measures. “Risk management,” or using a proactive approach to drought management, is preferable to the usual reactive or “crisis management” approach. The key element to reducing drought impacts for individuals, communities, and the environment is having a coordinated drought preparedness program. If progress is to be made towards improving our ability to manage drought, it will require an integrated approach within and between levels of government, and appropriate involvement of local organizations and the private sector.

Many of the mitigative measures implemented by different states during recent droughts can be characterized as emergency or short-term actions taken to alleviate the crisis at hand. Other activities, such as legislative actions, drought plan updates, and the development of water conservation and other public awareness programs are considered actions with a longer-term emphasis. In Hawaii, State and county agencies have been actively involved with drought mitigation projects such as seeking alternative water sources, imposing conservation practices as required, and improving municipal water systems.

An effective drought mitigation plan should thoroughly examine and address the needs of each of the drought impact sectors through risk assessment and prioritization of mitigation activities within each impact sector. Mitigation is most effective when there are strong commitments for implementing a variety of strategies.

A comprehensive, statewide drought mitigation strategy looks at ways to reduce risk to all drought impact sectors and promotes coordination of drought mitigation between all levels of government, the private sector, and stakeholders. Drought preparedness and public education should be a continuing and cooperative process. Both elements are considered-essential components of a comprehensive drought management program.

Recommended mitigation actions have been clustered into the following categories:

- 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

The sections below describe specific State mitigation strategies that address each of the mitigation categories listed above. An additional list of potential mitigation strategies is provided in Appendix E.

8.1 State Mitigation Strategies

8.1.1 Statewide Water Resources Monitoring and Impact Assessment

Taking a proactive approach to drought management requires continuous monitoring of factors indicating the onset and extent of drought conditions as well as drought impacts to stakeholders. This approach serves to lessen the element of surprise and allows time for planning and implementing drought mitigation strategies. As shown in Chapter 5, there are numerous government agencies monitoring physical drought conditions across the State, and such information can be accessed and shared between agencies.

However, monitoring and assessment of drought impacts to stakeholders, society, the environment, and the economy is currently limited with very little data available. Examples of such data include crop and livestock loss estimates; the amount and number of applications for drought-relief assistance; number of incidents and areas burned by wildland fire and their associated loss estimates; and revenue losses in the recreation and tourism industry. These types of information are not readily available and, in many cases, are not usually collected at all making it very difficult to quantify the socio-economic effects of drought. Economic impacts and dollar cost equivalents are, therefore, often underestimated or unreported.

In consideration of the above, the statewide strategy for drought monitoring and impact assessment includes the following near-term and long-term actions:

Near-Term Actions (0 – 24 months):

1. Monitoring activities described in Table 5.2 should be continued. The information gathered through these monitoring activities is essential to preparing drought forecasts, evaluating drought conditions, and for correlating drought conditions with drought impacts.

2. A statewide program to gather soil moisture content should be considered. This information may be valuable to agricultural stakeholders to the extent that it could help farmers and ranchers predict the impact of drought on crops and pastures.
3. The existing system of rain gages and stream and ditch flow monitoring gages should be evaluated and additional gages should be installed where gaps exist. In addition, a standard methodology should be developed for reporting data from monitoring stations in order to develop long-term data for valid statistical analysis.
4. Coordination of monitoring and data dissemination between federal, State, and county agencies should be improved.
5. Review and assess existing monitoring activities to ensure adequate coverage and seek access to other existing sources of government and private sector information.
6. Develop a standardized system and methodology to collect and analyze data regarding social/economic impacts of drought, including the standardization and application of a post-drought evaluation methodology.
7. Continue updating of the Hawaii Drought Monitor to increase and improve public dissemination of drought information.

Long-Term Actions (>24 months):

1. Expand current data collection and drought monitoring at the State and local level.
2. Improve and expand compilation of data on the various indicators of drought, including physical/hydrological data, as well as socio-economic and environmental impact data.
3. Integrate new data into interpretive tools that are easily accessible and understandable, and provide timely and useful information to decision-makers and the general public.
4. Maintain active involvement in the Western Governors Association's Drought Working Group and support establishment of a National Integrated Drought Information System (NIDIS), which will facilitate access to, and sharing of, nationwide drought information.

5. Current seasonal rainfall forecasting products for Hawaii issued by the CPC do not include ground water recharge areas, thus limiting the use of such forecasting products with respect to the water supply sector. The SDC and WRC should work with CPC and other agencies (e.g., universities, research organizations, etc.) to explore the use of new technologies to develop improved drought forecasting tools tailored for Hawaii.
6. Develop a statewide drought climatology study to address multi-year drought events based on SPI and/or other drought indices. This should include the determination of drought recurrence intervals for ranges of drought severity.
7. Develop an analysis of drought patterns and severity during anomalous ocean/atmosphere events (e.g., El Nino, La Nina, Pacific Decadal Oscillation) as well as the effects of global climate change.
8. Explore the feasibility of determining the paleoclimatology for Hawaii.

8.1.2 Development of New and Alternative Water Sources

In several areas of the State, increasing demands are approaching the sustainable yield of the ground water supply. In certain regions of the counties of Hawaii and Maui, below normal rainfall combined with the inflexible nature of existing water distribution systems can exacerbate the situation and cause water shortages. Developing new surface and ground water sources can mitigate impacts in the event of a drought. In areas of the State where water resources are limited, the development of alternative water supply sources such as wastewater reuse, surface water treatment, desalting brackish or ocean water, constructing water reservoirs, and storm water runoff reclamation should be explored. There should be a coordinated effort between federal, State, and county government to study the feasibility of these alternate sources to meet long-term supply issues and to address short-term drought mitigation concerns.

Increasing water storage capacity can also help to prevent adverse impacts associated with drought, especially for the water supply and agricultural sectors. Increasing water storage capacity can be especially beneficial for shorter drought periods as it can help to ensure that normal practices can continue. Water storage projects may include constructing potable water reservoirs that are part of a water supply system, as well as open reservoirs for agricultural use.

State agencies and other entities that could work with county water departments to develop new and alternative water sources and storage facilities include the Department of Agriculture, the Department of Land and Natural Resources, the

Commission on Water Resources Management, and the HDC's Water Resources Committee.

The statewide strategy for the development of new and alternative water sources includes the following near-term and long-term actions:

Near-Term Actions (0 – 24 months):

1. Develop a water supply inventory and map that can be used during drought-related emergencies, such as for fire suppression. The inventory should include existing and alternate sources of water such as dams, reservoirs, and public and private water systems.
2. Develop policies allowing emergency access to standby water sources and/or storage facilities in drought prone regions for public and private use during a declared drought emergency.
3. Identify private water system issues and available response/mitigation measures.
4. Seek necessary agreements with landowners, operators and purveyors for access and use of private water systems, wells, and reservoirs during emergency drought conditions.
5. Encourage military involvement in subsequent drought planning activities and incorporate military drought response/mitigation in future revisions of the plan.

Long-Term Actions (>24 months):

1. Clarify requirements for use of reclaimed water over safe drinking water sources, including the use of "gray" water for agricultural/livestock purposes during a drought declaration emergency. Initiate studies, as necessary, to investigate issues including but not limited to nitrate loading, increased salinity, and other potential impacts.

8.1.3 Water Conservation Practices

An aggressive water conservation program is an essential component of drought mitigation. To ensure that an adequate supply of water is available throughout the year, potable and non-potable water must be used wisely year-round and especially during the dry and/or summer months. Water conservation should be promoted statewide and practiced within all water use sectors. Currently, a comprehensive water conservation program for State agencies and facilities has yet to be developed. However, the Commission on Water Resource Management is

preparing a prototype State agency water conservation plan for the Department of Land and Natural Resources. In addition, the State Department of Agriculture can currently impose water conservation restrictions on its various irrigation systems. County water departments also have existing water conservation programs targeting their customer base and local plumbing codes require low-flow fixtures for new construction and renovation.

Existing water conservation programs should be continued and improved. All levels of government, the private sector, and stakeholders should be involved in conservation activities and should actively develop new water conservation programs where needed.

Water conservation measures should include, but not be limited to the following activities:

- Development of coordinated plans to implement water restriction practices, voluntary and mandatory, if a drought is either imminent or exists;
- Dissemination of information to the public about water conservation measures at community events and through the schools;
- Development of media campaigns to solicit public support and cooperation for the effective and prudent use of water;
- Solicitation of voluntary water use cutbacks from large users;
- Continuation or development of incentive programs, such as rebates for installing water saving fixtures and free inspections to identify leaking toilets and plumbing fixtures;
- Reduction of water supply system losses due to leakage and metering problems; and
- Support and encouragement of water-conserving irrigation systems, irrigation water management practices, and other water conservation practices, such as windbreaks and cover crops.

The statewide strategy for encouraging and implementing water conservation practices by State agencies includes the following specific near-term and long-term actions:

Near-Term Actions (0 – 24 months):

1. Seek funding for phased implementation of the prototype State agency

water conservation plan for the Department of Land and Natural Resources.

2. Initiate development of facility water conservation plans for each State agency.

Long-Term Actions (>24 months):

1. Develop a comprehensive Statewide Water Conservation Plan incorporating existing State, county, military, and private-sector water conservation measures.
2. Establish regional water shortage provisions (e.g., water shortage plans for designated water management areas) and policy for future guidance and implementation during drought-related emergencies.
3. Complete the development of facility water conservation plans for each State agency and provide recommendations for timely plan updates.

8.1.4 Public Education Awareness and Outreach

A key element of successful drought preparedness is public education. Educational programs such as workshops, newsletters, public service announcements, press releases, community meetings, school curricula, bill stuffers for utilities, and interactive participatory decision-making processes can increase awareness of the value of preparing and planning for droughts. As part of this effort, the Hawaii Drought Council developed several public service announcements on drought awareness for both radio and television media to be aired during drought periods.

Public education and awareness provides opportunities for the general public to become involved and invested in drought-related decisions. Public education also emphasizes local solutions based on consideration of all affected entities and related issues, including legal, economic, geographic, climate, cultural, fairness and equity issues; and environmental concerns. These opportunities, however, are lost where people are not sufficiently trained to engage in drought planning or lack adequate technical assistance to do so.

Hands-on training and technical assistance programs can help stakeholders formulate and implement plans that incorporate drought planning and mitigation processes. Such programs can help farmers in Hawaii decide whether to include drought-resistant crops, on-farm wells, crop insurance, conservation systems, restoration of wetlands and wildlife habitat, and other important factors into their risk-management strategies. These measures can help farmers implement water management practices and gain a better understanding of the soils and climate conditions in their areas and the types of crops and plants suitable to mitigating

adverse changing conditions. Such assistance can also help them understand (and plan for) complicated marketing options and other methods to manage risks.

Training and technical assistance programs can also help Hawaii communities as they determine their own priorities for incorporating drought concerns, protection of environmental resources, and land-use and community planning into comprehensive water management plans. USDA Natural Resources Conservation Service has several programs available to assist the agricultural sector in developing conservation plans for farmers and ranchers. Government agencies and stakeholders may need training and technical assistance in gathering drought-related information, devising drought impact-reduction strategies, and preparing public education and involvement campaigns to develop appropriate solutions. State climatologists and researchers in university drought-related programs, as well as federal experts, are potential sources for training assistance.

The statewide strategy for promoting public education and awareness includes the following specific near-term and long-term actions:

Near-Term Actions (0 – 24 months):

1. Update and expand the Hawaii Drought Monitor website to increase and improve public dissemination of drought information.
2. Work with schools to develop drought and water conservation awareness through Project WET and speaker presentations.
3. Encourage and promote wildland fire awareness through the Firewise Program. Continue to cooperate with the county water departments and support public education, outreach, and awareness activities as appropriate.

Long-Term Actions (>24 months):

1. Develop a comprehensive public service announcement campaign for all drought impact sectors, with materials appropriate for radio, television, and print media.
2. Seek partnerships with private entities and community organizations to support and augment government outreach activities and to access different target audiences.
3. Seek cooperative opportunities with agricultural agencies and organizations, such as the USDA Farm Services Agency and the Hawaii Farm Bureau, to develop educational workshops and materials on training and technical assistance programs to help stakeholders formulate and

implement plans that incorporate drought mitigation processes, such as the use of drought-resistant crops, crop insurance, conservation systems, restoration of wetlands and wildlife habitat, and other important factors into their risk-management strategies.

4. Seek cooperative opportunities with agricultural agencies and organizations, such as the USDA Farm Services Agency and the Hawaii Farm Bureau, to develop educational workshops and materials on implementing water management practices, understanding soil and climate conditions, and the types of crops and plants suitable to mitigating adverse changing conditions. Farmers should also be provided with information to further their understanding of marketing options and other methods to manage risks, including conservation planning through the USDA Natural Resources Conservation Service.
5. Develop drought educational exercises and learning tools that may be incorporated into school science curriculums.
6. Incorporate emerging natural resource conservation approaches, such as watershed-based management, into drought-related outreach activities. Promote the importance of considering drought risk at the local level in watershed-based planning activities.

8.1.5 Watershed Protection Partnerships

Developing watershed protection partnerships between federal, State, and county governments and large private landowners can be an effective method of mitigating drought impacts. Because surface and groundwater resources typically span across multiple private land holdings and agency jurisdictions, partnerships are an effective means to manage these resources. The partnerships could specify responsibilities for resource protection, maintaining stream corridors, desired uses in watersheds, prioritization of water uses, the development of water supply and infrastructure, and response actions to be taken in the event of a drought.

Within State government, the Department of Land and Natural Resources should take the lead in developing watershed protection partnerships between federal and county agencies and large private landowners. Near-term and long-term actions have been identified as follows:

Near-Term Actions (0 – 24 months):

1. Encourage military involvement in watershed planning activities and incorporate military drought response/mitigation in future revisions of the plan.

2. Seek necessary agreements with landowners, agencies, and organizations for watershed management, including the access and use of private water systems, wells, and reservoirs during emergency drought conditions.

Long-Term Actions (>24 months):

1. Support the NRCS PL-566, EQIP, and DLNR Forest Stewardship programs as appropriate.

8.1.6 Legislation

New legislation may be required to formalize the specific authority of the current drought leadership structure, including leadership responsibilities and mechanisms to fund any resultant additional responsibilities of State agencies involved in drought mitigation and response. Legislation may also be required to fund and implement mitigation and response actions. Examples of possible actions are listed below:

- Development of additional water supply and storage for agricultural and livestock purposes.
- Provision of tax credits for agricultural losses due to drought.
- Expansion of current data collection at the State and local level.
- Development of improved forecasting and monitoring tools at the State and local level.
- Creation of incentives to facilitate water recycling.

The Hawaii Drought Council and the State Drought Coordinator should work with State and county agencies to develop legislation to facilitate the implementation of drought mitigation projects and activities. Such legislation could include:

- Formal establishment and authorization for the Hawaii Drought Council and its leadership structure;
- Agricultural loans or grants covering drought impacts, damages, or losses;
- Clarification regarding the use of reclaimed water over potable water sources, including the use of “gray” water for agricultural and livestock purposes during drought declaration emergency; and
- Tax credits for farming losses due to drought.

8.1.7 Land Use Planning

Because drought risk is directly related to land use, the link between land use planning and drought management should be carefully considered in the review and approval of State land use district designations, county general plans, county zoning ordinances, community plans, and development plans. Where opportunities exist, county plans and zoning ordinances should be amended to incorporate drought management principles.

The following practices may be employed by the counties to encourage drought management in land use planning:

- Delineate areas on each island where non-potable water can be used for fire suppression purposes and, inversely, where non-potable water should not be used for fire suppression (due to the environmental concerns, such as the presence of native or endangered species).
- Consider an area's vulnerability to drought (i.e., water shortages, etc.) when reviewing general and community plan and zoning amendments
- Require developers to use available non-potable water for landscape irrigation;
- Require developers to practice xeriscaping in landscaped common areas;
- Ensure that new developments can demonstrate sufficient water supply and storage facilities;
- Initiate rezoning applications or amend existing ordinances to protect water recharge areas and encourage appropriate uses in areas at risk to drought; and
- Carefully review water supply development plans that deviate from county water system standards.

Actual mitigation actions taken will vary depending on drought impact sector needs and resources available to implement such actions.

8.2 County Mitigation Strategies

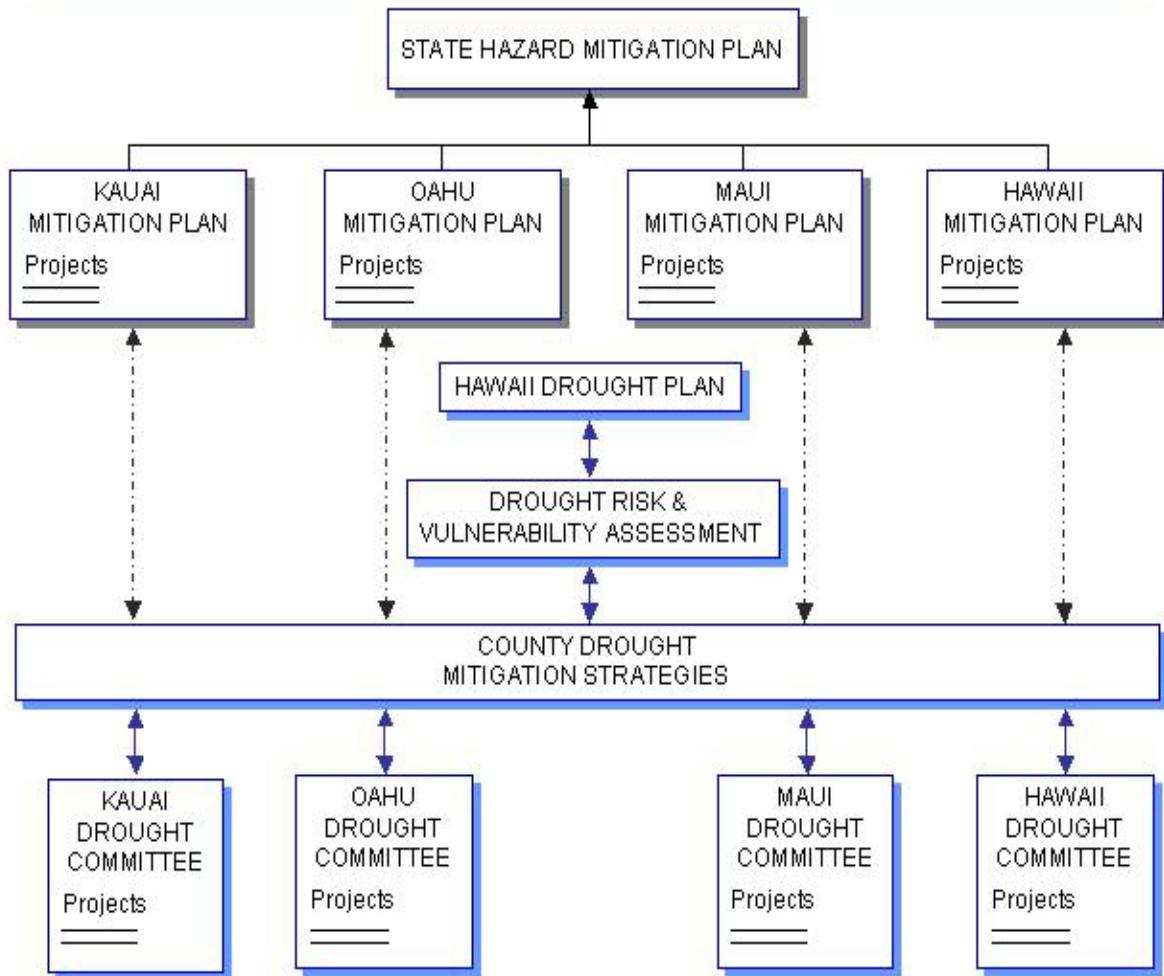
At the time of this update, *County Drought Mitigation Strategies* were under development by each of the County/Local Drought Committees. Although these documents are not included as part of the *Hawaii Drought Plan*, each of the CLDCs has been charged with the responsibility for developing these county-based drought mitigation strategies, which upon completion, will provide for the following:

- 1) Leadership and stakeholder representation at the county/local level;
- 2) Improved coordination/implementation of local drought mitigation and response actions;
- 3) Identification of current mitigation measures and existing data gaps in local drought information/planning;
- 4) Development of priority mitigation projects, which may be eligible for government funding; and
- 5) A transition from “emergency response” to early “proactive” mitigation.

The county-based strategies/projects will be developed for appropriate local implementation by the respective members of the CLDCs, and will be designed as stand-alone planning documents to be maintained and updated by each of the CLDCs. Specific drought mitigation projects will be developed and prioritized by the CLDCs for future incorporation within each County Hazard Mitigation Plan (see Figure 8-1). The State and County Hazard Mitigation Plans serve as integral components of an overall mitigation strategy, and together with the *Hawaii Drought Plan*, comprises a comprehensive strategy calling for a shift from emergency drought assistance to aggressive drought mitigation.

As with the county drought response strategies described in Section 7.5.3, county drought mitigation actions have purposefully been separated from the updated Hawaii Drought Plan document. Whereas, specific county response actions taken at the local level fall within the appropriate purview and current jurisdiction of the respective county agencies (e.g., the Mayor of each county, the respective county water departments, etc.), these actions and strategies and are thus acknowledged by reference.

Figure 8-1: Drought Plan Role in the State Hazard Mitigation Plan



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9. RECOMMENDATIONS AND IMPLEMENTATION ACTIONS

When planning for drought, the question is not “if drought will occur,” but rather, “when will the next drought occur.” Drought is now recognized as a natural hazard for which we can and should prepare, rather than addressing each occurrence as a temporary emergency. The *Hawaii Drought Plan* establishes a leadership structure to coordinate drought monitoring, mitigation, and response activities and formalizes a protocol for communication among pertinent agencies and entities. The Plan 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. Although significant strides have been made since the initial *Hawaii Drought Plan, Phase I* was prepared in 2000, there is a need for continued updates to the Plan and for additional follow-on actions.

The importance of the Hawaii drought leadership structure and the respective functions of Hawaii Drought Council members, the Water Resources Committee, and the State Drought Coordinator cannot be emphasized enough. The inter-agency and private-sector coordination activities currently being carried out by the SDC should be maintained, and if possible, expanded to facilitate the implementation of the drought mitigation strategy actions identified in Section 8 of this plan. Appropriate legislative and agency provisions should be formulated to support the continued efforts of the State drought program.

Equally important is the role of the County/Local Drought Committees. Every effort must be made to continue the function of these committees and to maintain the participation of key county agencies and stakeholder members. In addition to the ongoing development and implementation of priority drought mitigation projects, the CLDCs should review and evaluate current county drought response measures to identify areas where procedural improvements may be beneficial in achieving more effective coordination and execution. As with the State drought program, appropriate support and endorsement of the CLDCs should be effectuated to maintain the necessary and critical functions of these local committees.

9.1 Priority Implementation Actions

Priority State- and county-level implementation actions are delineated as follows:

1. The Water Resources Committee should continue to refine drought indices for each impact sector by correlating historical drought impact data with past drought events.
2. Additional monitoring of surface water sources, including stream diversions, ditch systems, and reservoirs should be undertaken. The

WRC, SDC and CLDCs should discuss how agencies can better coordinate program activities which facilitate monitoring of these surface water resources.

3. 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 CPC to determine if additional drought-forecasting products can be developed for Hawaii. Similarly, the SDC 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.
4. A methodology to conduct statewide drought impact assessments should be developed. The HDC, WRC, SDC and CLDCs should work together to develop a uniform system for the assessment of drought impacts . County/Local Drought Committees 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.
5. County/Local Drought Committees should continue their work towards developing county-level drought mitigation and response strategies. The 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.
6. 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).
7. 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.
8. The Hawaii Drought Monitor website should be maintained and utilized to promote public education and awareness of drought-related program activities and initiatives.

9.2 Future Hawaii Drought Plan Updates and Revisions

The *Hawaii Drought Plan* should undergo timely updates and revisions at least every five years. Plan recommendations (Section 9) and the drought communication protocol (Section 7) 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.

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APPENDIX A
FEDERAL DROUGHT ASSISTANCE PROGRAMS

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APPENDIX A FEDERAL DROUGHT ASSISTANCE PROGRAMS

Federal agencies provide several types of assistance to those adversely affected by drought. One type of assistance is to access hydrological and meteorological data that agencies collect as part of their mission or mandate and disseminate them to the states for timely drought assessment. Monetary and technical assistance are available for agricultural producers and business owners to mitigate losses related to drought. Technical assistance reduces the vulnerability of agricultural operations to drought.

There are 88 drought related federal programs that were funded over the last 14 years. These programs are categorized into four broad areas: (1) Preparedness, including planning and mitigation; (2) Information, Including monitoring/prediction and research; (3) Risk management; and (4) Emergency response. Seven of these programs provide assistance for drought planning, 42 for drought mitigation, 22 for drought-related monitoring/prediction and research, and 47 for response. Some of these programs cover more than one of the four categories.

The following sections provide information on Federal agencies and their divisions and programs that are related to drought planning, relief, and mitigation.

1. U.S. Department of Homeland Security, Federal Emergency Management Agency

In 1988, the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §§ 5121-5206, was enacted to support state and local governments and their citizens when disasters overwhelm them. This law, as amended, establishes a process for requesting and obtaining a Presidential disaster declaration, defines the type and scope of assistance available from the Federal government, and sets the conditions for obtaining that assistance. The Federal Emergency Management Agency (FEMA), now part of the Emergency Preparedness and Response Directorate of the Department of Homeland Security, is tasked with coordinating the response.

FEMA provides disaster assistance to states, local governments and nonprofit organizations when the President declares an emergency. FEMA also provides unemployment insurance, temporary housing, and crisis counseling to individuals and families adversely affected by disasters or emergencies.

FEMA's Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It includes organizational activities to promote protection, prevention, and partnerships at the Federal, state, local, and

individual levels. FEMA also provides grants to states for the suppression of forest and grassland fires.

The Mitigation Division's overall mission is to protect lives and prevent the loss of property from natural hazards. National programs focus on the protection of life and property and the prevention of future losses through partnerships with governments at the State and local levels as well as the private sector. The Mitigation Division administers the following nationwide, risk-reduction programs and congressionally authorized efforts:

- The National Flood Insurance Program
- The National Dam Safety Program
- The National Earthquake Hazards Reduction Program
- The National Hurricane Program
- The Hazard Mitigation Grant Program
- Flood Mitigation Assistance Program, and
- Pre-Disaster Mitigation authorized by the Disaster Mitigation Act of 2000

As noted in Section 2.2 and 2.3, 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. Federal laws have provided pre-disaster mitigation project funding and mitigation planning. However, future funding for public assistance subsequent to disasters will be largely contingent upon the completion of Mitigation Plans. States are required to have a FEMA-approved Standard State mitigation plan in order to receive additional Pre-Disaster Mitigation funds for state or local mitigation projects after November 1, 2004.

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.

The State of Hawaii Hazard Mitigation Plan incorporates drought mitigation planning and preparedness by referencing and appending the *Hawaii Drought Plan* to the State Hazard Mitigation Plan. Likewise, the multi-hazard mitigation plans prepared by each of the four counties also reference the *Hawaii Drought Plan*.

2. U.S. Department of Agriculture

Within Federal government programs, water supply and droughts are considered together. A number of programs within the U.S. Department of Agriculture (USDA) provide assistance for actions that can lead to drought mitigation. The Small Watershed Act, for example, gives the USDA authority to help rural communities address natural resource concerns in small watersheds. Eligible purposes include watershed management, emergency watershed restoration, water conservation, municipal and industrial water supply, recreation, and fish and wildlife protection.

In 1964, Congress passed the Resources Conservation and Development Act to assist local units of government address erosion problems, water management problems, and economic development needs. This program provides technical and financial assistance, but available funding has been limited to technical assistance for local Resource Conservation and Development Councils. The annual appropriation of about \$36 million provides each Council with a coordinator position and clerical support.

The 1985 Food Security Act directed the Secretary of Agriculture to enroll 45 million acres of highly erodible lands into the Conservation Reserve Program. This amount was reduced in subsequent farm bills to 36.4 million acres as a cost-savings measure. Farmers receive technical and financial assistance as well as an annual rental payment for installing and maintaining this area in permanent vegetative cover.

2.1. USDA Farm Service Agency

The USDA Farm Service Agency (FSA) provides emergency grant programs during periods of drought to eligible producers that are suffering losses due to drought. FSA also provides guaranteed and insured loans to assist family farmers, ranchers, and aquaculture operators in recovering from losses resulting from droughts. FSA Disaster Assistance is provided through the Agriculture Assistance Act of 2003 or through other FSA Disaster Assistance Programs described below.

2.1.1. Agricultural Assistance Act of 2003

The Agriculture Assistance Act of 2003 provides assistance to producers who have suffered losses due to weather-related disaster or other emergency conditions. The total estimated cost of the Act is \$3.099 billion. The Act contains the programs described below.

Crop Disaster Program (CDP). This program provides payments to producers for qualifying losses to agricultural commodities (other than sugar or tobacco) due to damaging weather or related conditions. The damages must be in excess of 35 percent for either the 2001 or 2002 crop, and the program has no set funding limit. A producer is ineligible if he/she did not purchase crop insurance or noninsured crop disaster assistance program (NAP) coverage, unless the producer agrees to purchase crop insurance and/or NAP for each of the next two years. If the producer fails to purchase coverage, the producer must refund the disaster payment.

Livestock Compensation Program (LCP). This program was originally announced by the Administration in 2002. The Agriculture Assistance Act of 2003 expands the counties eligible for the Livestock Compensation Program by changing the program's date restrictions. Program payments are based on losses per head of eligible livestock.

Livestock Assistance Program (LAP). The Agriculture Assistance Act of 2003 includes \$250 million for the Livestock Assistance Program, which reimburses producers for grazing losses. The producer has a choice of receiving payments for 2001 or 2002 losses. The program addresses the needs of producers who were not adequately covered by the Livestock Compensation Program discussed above. Because the LAP and LCP may provide assistance for the same loss, producers cannot receive payments under both programs.

Other Assistance Provisions. The Agriculture Assistance Act of 2003 also provides the following assistance:

- \$60 million in payments to certain sugarcane producers and processors (payable in the form of 150,000 tons of commodities or the dollar-equivalent) for hurricane losses;
- \$60 million for sugar beet producers for losses due to flooding and drought;
- tobacco assistance payments of 5.55 cents per pound for losses associated with quota reductions, pests, and diseases;

- \$50 million for losses to the cotton-seed industry from hurricanes in the fall of 2002; and
- other assistance that may be administered by other agencies or state governments.

2.1.1.1. FSA Disaster Assistance Programs

The FSA provides disaster assistance through the programs described below:

Emergency Conservation Program (ECP). This program provides emergency funding for farmers and ranchers to rehabilitate farmland damaged by wind erosion, floods, hurricanes, or other natural disasters, and for carrying out emergency water conservation measures during periods of severe drought.

Noninsured Crop Disaster Assistance Program (NAP). This program provides financial assistance to eligible producers affected by natural disasters. This federally funded program covers noninsurable crop losses and planting prevented by disasters.

Emergency Loans. The FSA provides emergency loans to help producers recover from production and physical losses due to drought, flooding, other natural disasters, or quarantine. Emergency loan funds may be used to restore or replace essential property; pay all or part of production costs associated with the disaster year; pay essential family living expenses; reorganize the farming operation; and refinance certain debts. Emergency loans may be made to farmers and ranchers who own or operate land located in a county declared by the President as a disaster area or designated by the Secretary of Agriculture as a disaster area or quarantine area.

Emergency Haying and Grazing Assistance. Emergency haying and grazing of certain Conservation Reserve Program acreage may be made available in areas suffering from weather-related natural disaster. Harvesting of hay and/or livestock grazing can be approved on cropland that has been removed from production of annual program crops, such as wheat and feed grains, and devoted to a long-term resource-conserving cover. To protect wildlife during the primary nesting season, other limits also may be imposed.

2003 Non-fat Dry Milk Livestock Feed Assistance. On April 8, 2003, Agriculture Secretary Ann M. Veneman announced that the U.S.

Department of Agriculture will provide surplus USDA stocks of non-fat dry milk to livestock producers in areas hardest hit by continuing drought. This assistance will provide timely relief for livestock producers in areas hit hardest by drought by making available surplus stocks of non-fat dry milk, which are not intended for nor destined for human consumption. The stocks will be provided at a minimal cost to several states and tribal governments in areas designated as severely impacted by drought.

The U.S. Drought Monitor will be used to determine which counties are eligible, and eligibility will be re-evaluated to ensure the program is targeted to producers in greatest need. Currently, twelve states meet the eligibility criteria: Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, Oregon, South Dakota, Utah, and Wyoming. Eligible livestock are foundation herds (breeding and replacement stock) of beef cattle, buffalo, sheep, and goats.

2.2. USDA Risk Management Agency

The USDA Risk Management Agency (RMA) promotes, supports, and regulates sound risk management solutions to preserve and strengthen the economic stability of America's agricultural producers. Buying a crop insurance policy is one risk management option. Producers should always carefully consider how a policy will work in conjunction with their other risk management strategies to insure the best possible outcome each crop year. Crop insurance agents and other agribusiness specialists in the private and public sectors can assist farmers in developing a good management plan.

RMA provides policies for more than 100 crops. RMA is also currently conducting studies to determine the feasibility of insuring many other crops and is conducting pilot programs for some new crop policies in selected states and counties. Federal crop insurance policies typically consist of the Common Crop Insurance Policy, the specific crop provisions, and the policy endorsements and special provisions.

Farmers may select from various types of policies. Multiple Peril Crop Insurance (MPCI) policies are available for most insured crops. Other plans may not be available for some insured crops in some areas. Some of the policies described below are not available nationwide as they are being tested in pilot programs and are only available in selected states and counties.

2.2.1. Yield-based Insurance Coverage

Actual Production History (APH). These policies insure producers against yield losses due to natural causes such as drought, excessive moisture, hail,

wind, frost, insects, and disease. The farmer selects the amount of average yield he or she wishes to insure; from 50 to 75 percent (in some areas to 85 percent). The farmer also selects the percent of the predicted price he or she wants to insure; between 55 and 100 percent of the crop price established annually by RMA. If the harvest is less than the yield insured, the farmer is paid an indemnity based on the difference. Indemnities are calculated by multiplying this difference by the insured percentage of the established price selected when crop insurance was purchased.

Group Risk Plan (GRP). These policies use a county index as the basis for determining a loss. When the county yield for the insured crop, as determined by the National Agricultural Statistics Service (NASS), falls below the trigger level chosen by the farmer, an indemnity is paid. Payments are not based on the individual farmer's loss records. Yield levels are available for up to 90 percent of the expected county yield. GRP protection involves less paperwork and costs less than the farm-level coverage described above. However, individual crop losses may not be covered if the county yield does not suffer a similar level of loss. This type of insurance is most often selected by farmers whose crop losses typically follow the county pattern.

Dollar Plan. The dollar plan provides protection against declining value due to damage that causes a yield shortfall. The amount of insurance is based on the cost of growing a crop in a specific area. A loss occurs when the annual value of the crop is less than the amount of insurance. The maximum dollar amount of insurance is stated on the actuarial document. The insured may select a percent of the maximum dollar amount equal to CAT (catastrophic level of coverage), limited, or additional coverage levels. The dollar plan is available for several crops, including fresh market tomatoes, strawberries, and cherries (on a pilot proram basis in limited areas only).

2.2.1.1. Revenue Insurance Plans

All revenue-based options determine revenue differently. Each policy includes provisions for their definition of revenue.

Group Risk Income Protection (GRIP). GRIP makes indemnity payments only when the average county revenue for the insured crop falls below the revenue chosen by the farmer.

Adjusted Gross Revenue (AGR). AGR insures the revenue of the entire farm rather than an individual crop by guaranteeing a percentage of average gross farm revenue, including a small amount of livestock revenue. The plan uses information from a producer's Schedule F tax forms to calculate the policy revenue guarantee.

Crop Revenue Coverage (CRC). CRC provides revenue protection based on price and yield expectations by paying for losses below the guarantee at the higher of an early-season price or the harvest price.

Income Protection (IP). IP protects producers against reductions in gross income when either a crop's price or yield declines from early-season expectations. To determine coverage, see the policy provisions.

Revenue Assurance (RA). RA provides dollar-denominated coverage by the producer selecting a dollar amount of target revenue from a range defined by 65-75 percent of expected revenue. To determine coverage, see the policy provisions.

2.3. USDA Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment. Local, state and federal agencies and policymakers also rely on NRCS expertise. NRCS provides technical assistance that is suited to a customer's specific needs and based on sound science. Cost shares and financial incentives are available in some cases. Most NRCS work is executed with local partners, and NRCS partnerships with local conservation districts serves almost every county in the nation, and the Caribbean and Pacific Basin. Participation in NRCS programs is voluntary.

NRCS is responsible for preparing monthly Surface Water Supply Index (SWSI) reports and monitoring soil moisture conditions in the continental U.S. In Hawaii, NRCS does not currently prepare water supply forecasts. NRCS provides technical assistance to the agricultural community on matters such as farm conservation practices, water conservation, water quality improvement, and diversion of irrigation water. Technical assistance for grazing land management is also available for ranchers. NRCS conducts soil surveys and soil suitability studies, together with conservation partners, to provide cost-shared financial assistance for the implementation of conservation practices. NRCS programs that are directly related to drought are described in the following sections.

2.3.1.1. Defending Against Drought

With good planning, good management, and good information, farms and ranches can reduce the impacts of drought. The Department of Agriculture's Joint Agricultural Weather Facility and the NRCS's National Water and Climate Center, along with the U.S. Department of Commerce and Interior, and the National Drought Mitigation Center at the University of Nebraska, Lincoln, help people prepare for and deal with drought.

These partnerships make a variety of drought information available on the Internet, as well as ideas on water, land, and crop management for farmers and ranchers to consider while creating drought plans for their operations.

2.3.1.2. Emergency Watershed Protection

The purpose of the Emergency Watershed Protection (EWP) program is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.

It is not necessary for a national emergency to be declared for an area to be eligible for assistance. The program objective is to assist sponsors and individuals in implementing emergency measures to relieve imminent hazards to life and property created by a natural disaster. Activities include providing financial and technical assistance to remove debris from streams, protect destabilized streambanks, establish cover on critically eroding lands, repair conservation practices, and purchase of flood plain easements. The program is designed for installation of recovery measures.

In 1996, Congress consolidated several of the USDA's cost-share programs and created the Environmental Quality Incentive Program. The primary purpose of this program is to help farmers address their water quality problems, but it also provides technical and financial assistance for the installation of water conservation measures, as well as livestock watering facilities. Cost-share is provided through long-term agreements that address an entire farm's resource needs. However, this program sometimes limits the public's ability to obtain financial assistance to install drought mitigation measures, such as cross fencing and livestock water development.

2.4. USDA Forest Service

The USDA Forest Service manages public lands in national forests and grasslands. The mission of the USDA Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.

The Fire and Aviation Management part of the USDA Forest Service seeks to advance technologies in fire management and suppression, maintain and

improve mobilization and tracking systems, and reach out in support of federal, state, and international fire partners. The program assists states with wildland fire fighting and fire planning activities. The forest service also maintains current national wildfire occurrence maps and seasonal wildfire outlook maps to assist local entities in fire management.

3. U.S. Department of the Interior

3.1. Bureau of Reclamation

The Bureau of Reclamation (Reclamation) is one of eight bureaus within the U.S. Department of Interior. The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. Reclamation is the nation's largest wholesale water supplier, administering 348 reservoirs with a total storage capacity of 245 million acre-feet. These projects provide water supplies for agricultural, municipal, industrial, and domestic uses. Fish and wildlife protection is also an additional benefit provided by the Reclamation projects. Reclamation, in concert with states, tribes, water users, and others, provides assistance to develop drought management contingency plans and implements effective drought management measures and activities.

Although Hawaii is not a "Reclamation State" under the Reclamation Act of 1902, the Bureau of Reclamation has provided assistance in helping address Hawaii's water resource issues for nearly 50 years. In 1954, Congress authorized the Secretary of the Interior to investigate water resources on the islands of Hawaii, Oahu, and Molokai. In the Hawaii Omnibus Act of 1960, various existing statutes, including the Small Reclamation Project Act, were made to apply to the new state of Hawaii. Under the small loan provisions of that Act, Hawaii completed a water storage project on the island of Molokai in 1965.

In 1998, Hawaii requested Reclamation assistance in addressing emerging water resource needs. Reclamation representatives visited some of the projects in need of rehabilitation, but funding did not become available to proceed. In 2000, Congress passed the Hawaii Water Resources Act of 2000 (Title I of P.L. 106-566), which authorized the Department of the Interior to complete a water resource study in Hawaii. The Act also included Hawaii in Title XVI of the Reclamation Wastewater and Groundwater Study and Facilities Act. Title II of P.L. 106-566 extended the Reclamation States Emergency Drought Relief Act of 1991 and included the State of Hawaii within its authority. In fiscal year 2001, emergency drought assistance in the amount of \$210,000 was provided to Hawaii to mitigate impacts of drought conditions. Technical and financial assistance were also provided to help Hawaii prepare a draft drought plan (see

Sections 1.4.1 and 1.4.2). Congress subsequently appropriated \$300,000 into Reclamation's fiscal year 2002 budget for completion of the planning study authorized by P.L. 106-566.

Reclamation also provided technical engineering and design services in the development of a constructed wetland at the Kealakehe Wastewater Treatment Plant in Kailua-Kona that would promote wastewater reclamation and provide habitat for an endangered bird species. Construction designs were nearing completion at the time of this writing.

As part of its water conservation field services program, Reclamation provided a \$50,000 grant in fiscal year 2002 toward the development of a water conservation plan to help Hawaii meet increasing water demands with available supplies.

3.1.1. General Water Resource Planning Program

Planning is typically considered a necessary precursor to implementation of an action in order to promulgate a rational decision-making process. Definitions of problems and needs to be addressed, inventory and forecast of resources available to apply to the problems and needs, development of alternative solutions, analysis of alternatives, comparison of alternatives, and selection of the best plan are considered the basic steps in the planning process. Planning can be done at an appraisal level, where the outcome is used to determine whether or not continuation of the project is warranted, or at the feasibility level, where the outcome can be used to authorize and fund a proposed project.

Reclamation can participate with the state or local entity in a planning effort, but must develop a budget two years in advance. The budget proposal is initiated in the appropriate Reclamation regional office and must receive the concurrence of Reclamation, the Department of the Interior, the Office of Management and Budget, and Congress. Federal funding would necessitate a national interest in the project and cost sharing is normally required.

3.1.2. Water Reclamation and Reuse Program

Recognizing the rapid increase in water demand in many parts of the western United States and the difficulty in finding new sources to meet those demands, Congress authorized Reclamation to participate with local entities in the development of wastewater reclamation projects. Particularly where sewage treatment plants discharge effluent into the ocean or other location where such discharge is not recoverable, additional treatment of the discharge can create a new water supply for subsequent beneficial use. A

typical reclamation process could include macro filtration, reverse osmosis treatment, and disinfection.

The Water Reclamation and Reuse Program originated with the passage of the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992 (P.L. 102-575), which directed the Secretary of the Interior to undertake a program to investigate and identify opportunities for water reclamation and reuse. The Act authorized Reclamation to participate in the construction of five recycling projects; authority under this Act was limited to the "Reclamation states" defined in the Reclamation Act of 1902. In 1996, Congress enacted the Reclamation Recycling and Water Conservation Act, which amended Title XVI of Public Law 102-575 and authorized Reclamation to participate in 18 additional projects. Title XVI was amended again in 1998 by the Oregon Public Lands Transfer and Protection Act to include construction authorization for an additional water recycling project in Oregon. The Hawaii Water Resources Act of 2000 included Hawaii as one of the states covered by Title XVI of Public Law 102-575, as amended.

3.1.3. Water Conservation Field Services Program

As the demand for water puts increasing pressure on supply, more attention is paid to conservation. Reclamation has encouraged wise use of water throughout the west, but particularly in areas where water from Reclamation projects constitutes a significant supply. In 1996, the Water Conservation Field Services Program was instituted to actively encourage water conservation, assist water users with their responsibility to develop 5-year conservation plans, and complement and support state and other conservation programs. The program provides an opportunity to develop partnerships with water districts and other entities to encourage the development and implementation of the following:

- Five-year conservation plans,
- Strong information and education programs,
- Demonstration of innovative conservation technologies, and effective efficiency measures.

The principle statutory authority for requiring the preparation of five-year conservation plans by entities who contract with Reclamation for water delivery is the Reclamation Reform Act of 1982, as amended, Section 210(a-c) (P.L. 97-293). However, to the extent funding is available, Reclamation can participate with other entities through grants and cooperative agreements for purposes of providing conservation planning assistance and

technical and financial assistance for implementation of conservation plans. Authorities for providing technical and financial assistance include the Soil and Moisture Conservation Act and the Fish and Wildlife Coordination Act.

Reclamation has the technical capability to support conservation planning and implementation efforts. Reclamation provides technical reviews of conservation plans in development and has expertise available for supporting implementation of conservation plan goals such as pilot studies and retrofit studies for a variety of measures that support efficient water management. Funding, however, is limited.

Reclamation provided a grant to the State of Hawaii in fiscal year 2002 in the amount of \$50,000 to initiate conservation planning efforts. A phased approach will be undertaken with respect to the development of a series of conservation plans that will support a statewide framework for conservation.

3.1.4. Drought Program

Enacted through the Reclamation States Drought Relief Act of 1991 (P.L. 250), Reclamation's Drought Program supports planning and emergency needs of its constituents. The Act authorizes emergency response and planning assistance to minimize and mitigate losses and damages resulting from drought conditions. The program makes available a process for supporting requests for our partners' needs to plan for and respond to drought situations. Constituents of the Drought Program include federal, state, tribal, and local entities.

Reclamation States Emergency Drought Relief Act of 1991 (P.L. 250), 106, Stat. 53, as amended, is the authority for the Drought Program. Title I assistance allows for undertaking activities to minimize or mitigate drought damages or losses within the 17 Reclamation States, tribes within those states, and Hawaii. Any construction activities undertaken under Title I is limited to temporary facilities, with the exception of well construction. Title II authorizes planning assistance to the 50 U.S. States and territories and to tribal and local government entities.

Reclamation has experience in the development of drought plans and can provide assistance to entities seeking such help. Although local entities normally take responsibility for implementation of water conservation actions, Reclamation can provide technical support in the areas of plan execution, contracting, and environmental compliance.

4. U.S. Small Business Administration

The U.S. Small Business Administration (SBA) maintains and strengthens the nation's economy by aiding, counseling, assisting and protecting the interests of small businesses and by helping families and businesses recover from national disasters. The SBA administers the economic injury loan program for small businesses, including agricultural cooperatives, which are adversely affected by community agricultural losses. Businesses that depend on the business of agricultural producers affected by drought are eligible if an SBA disaster declaration is in effect in the state.

Local Contacts for Federal Agencies		
Federal Management Agency	Emergency	Hawaii State Civil Defense 3949 Diamond Head Road Honolulu, HI 96816 www.scd.state.hi.us Phone: (808) 733-4300
US Department of Agriculture		Hawaii State and Pacific Basin Farm Service Agency 300 Ala Moana Blvd., Room 5-112 Honolulu, HI 96850 Phone: (808) 541-2600 www.fsa.usda.gov/HI
USDA Risk Management Agency	Risk Management	USDA Risk Management Agency Davis California Regional Office 430 G Street #4168 Davis, CA 95616-4168 Phone: (530) 792-5870 www.rma.usda.gov/aboutrma/fields/ca_rso

USDA Natural Resources Conservation Service	NRCS Hawaii State Office 300 Ala Moana Blvd, Room 4-118 Honolulu, HI 96850 Phone (808) 541-2600 www.hi.nrcs.usda.gov
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APPENDIX B

HAWAII DROUGHT LEADERSHIP CONTACT INFORMATION

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APPENDIX B
HAWAII DROUGHT LEADERSHIP CONTACT INFORMATION

HAWAII DROUGHT COUNCIL

<u>Agency</u>	<u>Member</u>	<u>Contact Information</u>
Governor's Office	Governor's Representative	
Department of Land and Natural Resources	Peter T. Young (HDC Co-chair)	P.O. Box 621, Honolulu, HI 96809, 587-0400
Department of Agriculture	Sandra Kunimoto (HDC Co-chair)	1428 S. King St., Honolulu, HI 96814, 973-9550
Department of Defense, Civil Defense Division	Larry Kanda	3949 Diamond Head Rd., Honolulu, HI 96816-4495, 733-4300
Kauai Department of Water	Edward Tschupp	4398 Pua Loke St., Lihue, HI 96766, (808) 245-5408
Honolulu Board of Water Supply	Barry Usegawa	630 S. King St., Honolulu, HI 96813, 748-5900
Maui Department of Water Supply	George Tengan	200 South High St., Wailuku, HI 96793, (808) 270-7816
Hawaii Department of Water Supply	Shari Komata	345 Kekuanaoa St., Ste. 20, Hilo, HI 96720, (808) 961-8070

Hawaii Association of Conservation Districts (Ex-Officio)	Executive Director	
Hawaii Farm Bureau (Ex-Officio)	Warren Watanabe	P.O. Box 148, Kula, HI 96790, (808) 878-2917
Hawaii Cattlemen's Council (Ex-Officio)	Calvin Lum	P.O. Box 236, Haleiwa, HI 96712
East Maui Irrigation Co., Ltd. (Ex-Officio)	Garret Hew	P.O. Box 266, Puunene, HI 96784

WATER RESOURCES COMMITTEE

<u>Agency</u>	<u>Member</u>	<u>Contact Information</u>
Commission on Water Resource Management (DLNR)	Yvonne Izu (WRC co-chair)	P.O. Box 621, Honolulu, HI 96809, 587-0214
Honolulu Board of Water Supply	Barry Usagawa (WRC co-chair)	630 S. King St., Honolulu, HI 96813, 748-5900
Agricultural Statistics Service (DOA)	Donald Martin	1428 S. King St., Honolulu, HI 96814-2512, 973-9588
Agricultural Resource Management Division (DOA)	Brian Kau	1428 S. King St., Honolulu, HI 96814-2512, 973-9473
Commission on Water Resource Management (DLNR)	Neal Fujii	P.O. Box 621, Honolulu, HI 96809, 587-0264

Division of Forestry and Wildlife (DLNR)	Patrick Costales	2135 Makiki Heights Drive, Honolulu, HI 96822, 973-9787
Hawaii County Department of Water Supply	Shari Komata	345 Kekuanaoa St., Ste. 20, Hilo, HI 96720, (808) 961-8070
Kauai County Department of Water	Edward Tschupp	4398 Pua Loke St., Lihue, HI 96766, (808) 245-5408
Maui Department of Water Supply	George Tengan	200 South High St., Wailuku, HI 96793, (808) 270-7816
National Weather Service	Kevin Kodama	2525 Correa Rd., Rm. 250, Honolulu, HI 96822-2219
State Civil Defense Division (DOD)	Larry Kanda	3949 Diamond Head Rd., Honolulu, HI 96816-4495, 733-4300
U.S. Geological Survey	Richard Fontaine	677 Ala Moana Blvd., Ste. 415, Honolulu, HI 96813, 587-2400
University of Hawaii	Dr. Pao-Shin Chu	2525 Correa Rd., Honolulu, HI 96822, 956-8775

KAUAI DROUGHT COMMITTEE

<u>Agency</u>	<u>Member</u>	<u>Contact Information</u>
Kauai County Fire Department	Daryl Date	4444 Rice St., Ste. 295, Lihue, HI 96766, (808) 241-6500

Princeville Utility Co.	Larry Dill	P.O. Box 223040 Princeville, HI 96722, (808) 826-3180
Hawaii Cattleman's Council	Robert Ferreira	
Kauai Department of Water	Gregg Fujikawa	4398 Pua Loke St., Lihue, HI 96766, (808) 245-5408
Grove Farm	Mike Furukawa	3-1850 Kaumualii Highway, Lihue, HI 96766, (808) 246-9470
Gay and Robinson	Howard Greene	PO Box 156, Kaumakani, HI 96747, (808) 335-3133
Pacific Missile Range Facility	Steven Hironaka	P.O. Box 128, Kekaha, Hawaii 96752-0128
East Kauai Soil and Water Conservation District	Ted Inouye	
USDA, Farm Service Agency	Robert Ishikawa	4334 Rice Street, Room 103, Lihue, HI 96766, (808) 245-9014
DLNR, Division of Forestry and Wildlife	Alvin Kyono	3060 Eiwa St., Rm. 306, Lihue, HI 96766, (808) 274-3436
DLNR, Land Division	Mike Laureta	3060 Eiwa St., Rm. 306, Lihue, HI 96766, (808) 274-3491
DHHL, Homestead Services Division	Roland Licona	3060 Eiwa St., Rm. 203, Lihue, HI 96766, (808) 274-3131

Kauai Coffee Co.	Richard Loero	P.O. Box 530 Kalaeo, HI 96741, (808) 335-5497
Kauai Civil Defense Agency	Mark Marshall	4396 Rice St., Lihue, HI 96766, (808) 241-1762
DLNR, Land Division	Thomas Oi	3060 Eiwa St., Rm. 306, Lihue, HI 96766, (808) 274-3436
Kauai Farm Bureau	Roy Oyama	P.O. Box 3895, Lihue, HI 96766, (808) 828-2120
USDA, NRCS	Lex Riggle	4334 Rice St., Ste. 104 Lihue, HI 96766-1801 (808) 245-9014
DLNR, State Parks Division	Wayne Souza	3060 Eiwa St., Rm. 306, Lihue, HI 96766, (808) 274-3446
Kauai Department of Water	Edward Tschupp	4398 Pua Loke St., Lihue, HI 96766, (808) 245-5408
Kauai Department of Water	Wynn Ushigome	4398 Pua Loke St., Lihue, HI 96766, (808) 245-5408
Kauai Coffee Co.	Greg Williams	P.O. Box 530 Kalaeo, HI 96741, (808) 335-5497

OAHU DROUGHT COMMITTEE

<u>Agency</u>	<u>Member</u>	<u>Contact Information</u>
DHHL	Rebecca Alakai	P.O. Box 1879, Honolulu, HI 96805, (808) 587-6423
Department of the Army	Kent Anderson	
DLNR, Division of Forestry and Wildlife	Wayne Ching	1151 Punchbowl St., Rm. 325, Honolulu, HI 96813, 587-4173
Martin & Chock Inc., Structural Engineers	Gary Chock	1132 Bishop St., #1550, Honolulu, HI 96813, 521-4513
DLNR, Division of Forestry and Wildlife	Patrick Costales	2135 Makiki Heights Drive, Honolulu, HI 96822, 973-9787
Navy Public Works Center	Paul Eyre	
U.S. Geological Survey	Richard Fontaine	677 Ala Moana Blvd., Ste. 415, Honolulu, HI 96813, 587-2400
The Nature Conservancy	Mark Fox	923 Nu`uanu Avenue, Honolulu, HI 96817, 537-4508
Oahu Civil Defense Agency	Ken Gilbert	650 S. King St., Honolulu, HI 96813, 523-4121
DLNR, Division of Aquatic Resources	Glenn Higashi	1151 Punchbowl St., Rm. 330, Honolulu, HI 96813, 587-0100
Aina Hui Corporation	George Hiu	

City and County of Honolulu Mayor's Office	Steve Holmes	650 S. King St., Honolulu, HI 96813, 523-4141
Department of Agriculture	Brian Kau	1428 S. King St., Honolulu, HI 96814-2512, 973-9473
USDA, Natural Resources Conservation Service	Dudley Kubo	300 Ala Moana Blvd., Rm. 4118, Honolulu, HI 96850-4118, 541-2600
Honolulu Board of Water Supply	Chester Lao	630 S. King St., Honolulu, HI 96813, 748-5931
Hawaii Cattlemen's Council	Calvin Lum	
Hawaii Farm Bureau Federation	Paul Matsuo	2343 Rose St., Honolulu, HI 96819
Honolulu Fire Department	Nathan Ramos	3375 Koapaka St., H425, Honolulu, HI 96819, 831-7771
The Nature Conservancy	Pauline Sato	923 Nu`uanu Avenue, Honolulu, HI 96817, 537-4508
USDA, Farm Service Agency	Jason Shitanishi	99-193 Aiea Heights Drive, Suite 114, Aiea, HI 96701, 483-8600
Koolau Mountains Watershed Partnership	Jason Sumiye	
Hawaii Hotel and Lodging Association	Murray Towill	2250 Kalakaua Ave., Ste. 404-4, Honolulu, HI 96815-2564, 923-0407

Honolulu Board of Water Supply	Barry Usagawa	630 S. King St., Honolulu, HI 96813, 748-5900
Department of Health	William Wong	919 Ala Moana Blvd., Rm. 300, Honolulu, HI 96814, 586-4258
Honolulu Board of Water Supply	Jon Yoshimura	630 S. King St., Honolulu, HI 96813, 748-5316

MAUI DROUGHT COMMITTEE

<u>Agency</u>	<u>Member</u>	<u>Contact Information</u>
Maui Civil Defense Agency	Robert Collum	200 South High Street, Wailuku, HI 96793-2155, (808) 270-7285
DLNR, Division of Forestry and Wildlife	John Cummings	54 South High Street, Wailuku, HI 96793, (808) 984-8100
DLNR, Division of Forestry and Wildlife	Lance DeSilva	54 South High Street, Wailuku, HI 96793, (808) 984-8100
Molokai Ranch	Harold Edwards	P.O. Box 259, Maunaloa, HI 96770, (808) 660-2883
Ulupalakua Ranch	Sumner Erdman	HC1 Box 901, Kula ,HI 96790, (808) 878-1202
USDA, Natural Resources Conservation Service	Ranae Ganske	210 Imi Kala St., Ste. 209, Wailuku, HI 96793-1274, (808) 244-3100

Hawaii Farm Bureau Federation/Molokai Water Users' Advisory Board	Robert Granger	
East Maui Irrigation Company/Hawaiian Commercial and Sugar	Garret Hew	P.O. Box 266, Puunene, HI 96784
Hana Soil and Water Conservation District	Joloyce Kaia	
Lanai Water Company	Collins Lam	P.O. Box 630310 Lanai City, HI 96763, (808) 565-3352
Department of Agriculture	Robert Lum	1428 S. King St., Honolulu, HI 96814-2512, 973-9473
Central Maui Soil and Water Conservation District	Doug MacCluer	
DHHL, Molokai District	George Maioho	PO Box 2009, Kaunakakai, HI, 96748, (808) 560-6104
DHHL, Maui District	Vanessa Medeiros	655 Kaumualii St., Ste.1, Wailuku, HI 96793, (808) 760-5120
Maui Department of Water Supply	Jeff Pearson	200 South High St., Wailuku, HI 96793, (808) 270-7816
USDA, Farm Service Agency	James Robello	210 Imi Kala Street, Suite 207, Wailuku, HI 96793, (808) 244-3100
DLNR, Division of Forestry and Wildlife	Glenn Shishido	54 South High Street, Wailuku, HI 96793, (808) 873-3501

Maui Fire Department	Rex Takushi	200 South High Street, Wailuku, HI 96793- 2155, (808) 270-7561
Hawaii Farm Bureau Federation	Warren Watanabe	P.O. Box 148, Kula, HI 96790, (808) 878-2917
Farmer	Edwin Young	
Maui Land and Pineapple Company, Inc.	Warren Suzuki	P.O. Box 187, Kahului, HI 96733-6687, (808) 877-3351

HAWAII DROUGHT COMMITTEE

<u>Agency</u>	<u>Member</u>	<u>Contact Information</u>
Mac Farms Hawaii	Hillary Brown	89-406 Mamalohoa Highway, Captain Cook, HI 96704, (808) 328-2435
Kau Soil and Water Conservation District	Randy Cabral	
West Hawaii Wildfire Management Organization	Mick Castillo	P.O. Box 6611, Hilo, HI 96720, (808) 964-3507
DHHL	James DuPont	64-756 Mamalahoa Hwy., Kamuela, HI 96743, (808) 887-6053
Mayor's Office	Wendell Hatada	25 Aupuni St., Rm. 215, Hilo, HI 96720, (808) 961-8223
DLNR, Division of Forestry and Wildlife	Jay Hatayama	19 E. Kawaili Street Hilo, HI 96720, (808) 974-4221

USDA, Natural Resources Conservation Service	Gary Kam	64-1032 Mamalahoa Hwy., Kamuela, HI 96743-8441, (808) 885-6602
Mauna Kea Soil and Water Conservation District	Ken Kaneshiro	
Department of Agriculture	Brian Kau	1428 S. King St., Honolulu, HI 96814-2512, 973-9473
Hawaii Department of Water Supply	Shari Komata	345 Kekuanaoa St., Ste. 20, Hilo, HI 96720, (808) 961-8070
USDA, Farm Service Agency	Lee Kunitake	154 Waianuenue Ave., Rm. 322, Hilo, HI 96720-2452, (808) 933-8381
Hawaii Fire Department	Darryl Oliveira	466 Kinoole St., Hilo, HI 96720, (808) 961-8297
Kahua Ranch	Herbert 'Monty' Richards	P.O. Box 837 Kamuela, HI 96743, (808) 882-4646
USDA, Natural Resources Conservation Service	Harry Toki	154 Waianuenue Ave., Rm. 322, Hilo, HI 96720-2452, (808) 933-8381
Ponoholo Ranch	Pono Von Holt	59-927 Kohala Mt. Rd., Kamuela, HI 96743, (808) 884-5100

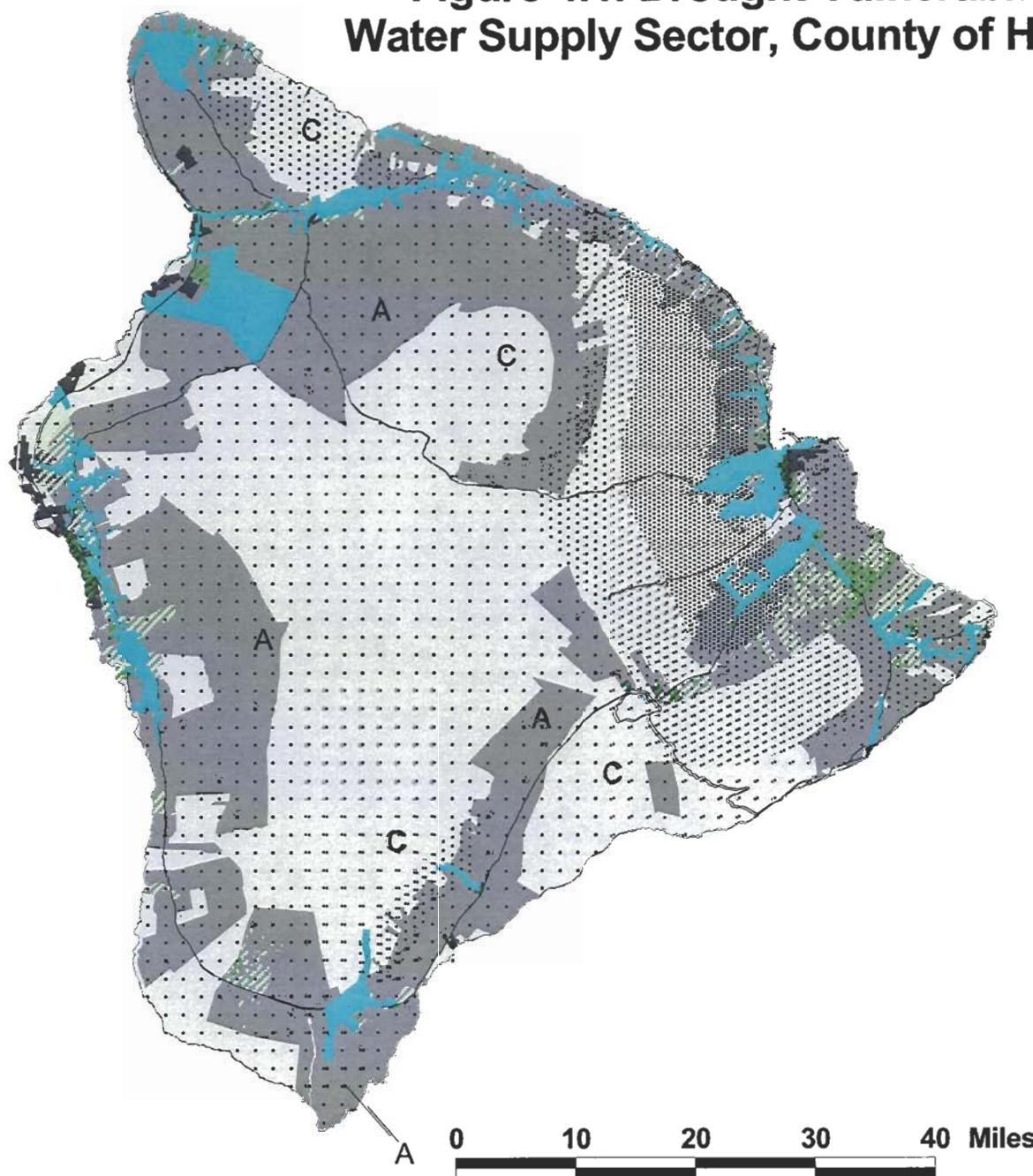
USDA, Natural Resources Conservation Service	Matthew Wung	64-1032 Mamalahoa Hwy., Kamuela, HI 96743-8441, (808) 885-6602
Puna Soil and Water Conservation District	Aileen Yeh	

APPENDIX C

DROUGHT RISK AND VULNERABILITY ASSESSMENT MAPS

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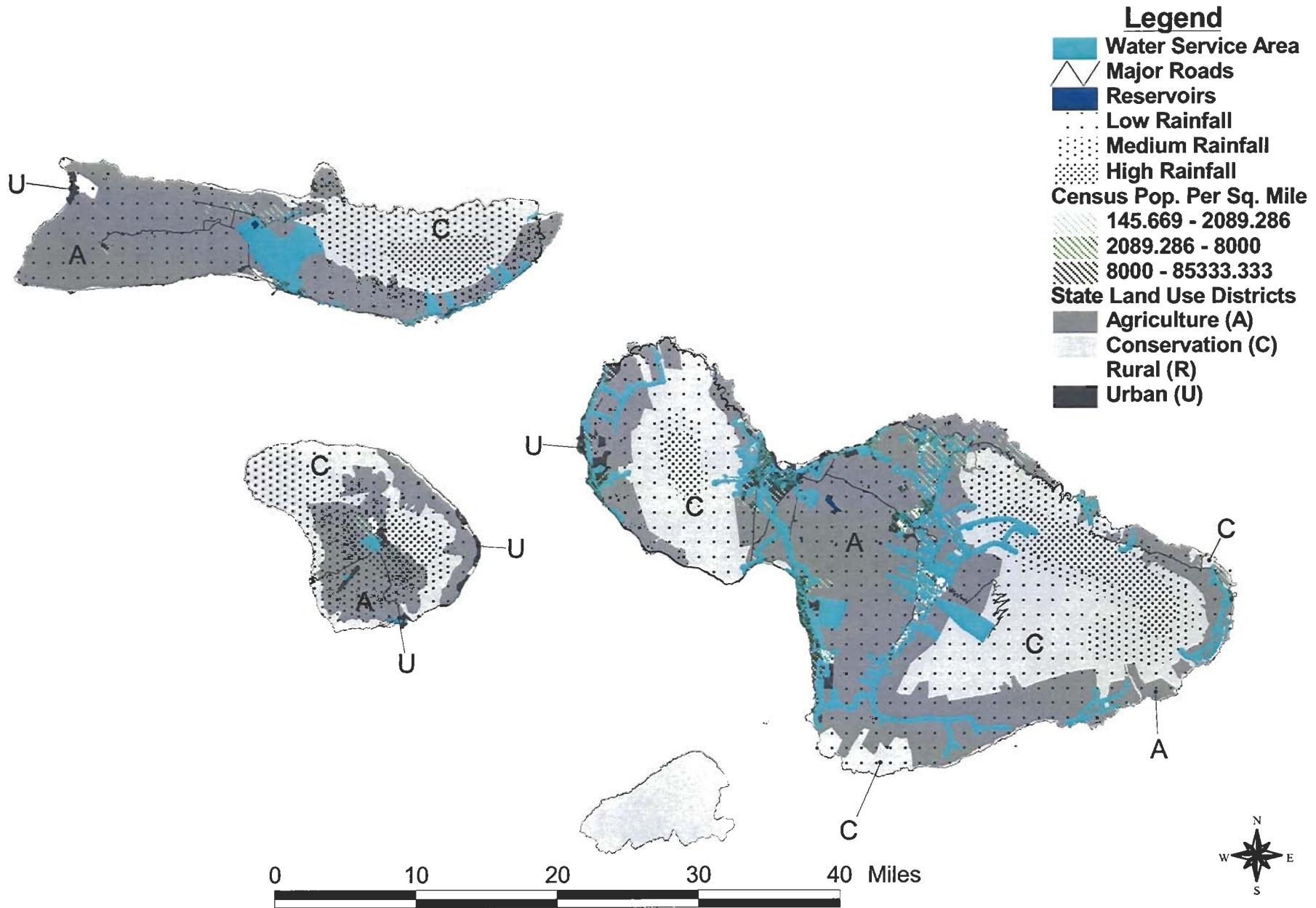
**Figure 4.1. Drought Vulnerability
Water Supply Sector, County of Hawaii**



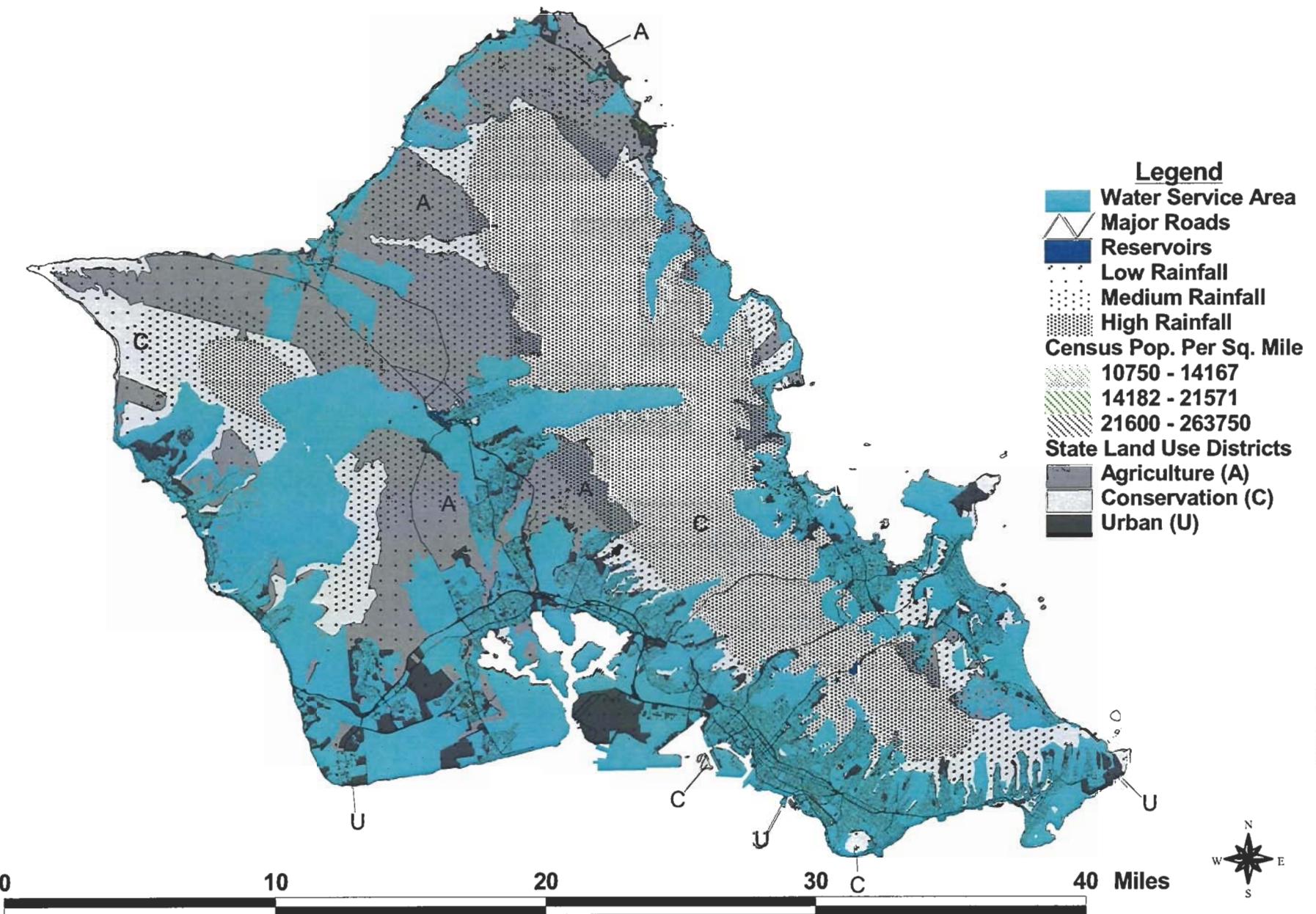
- Legend**
- Water Service Area
 - Major Roads
 - Reservoirs
 - Low Rain
 - Medium Rain
 - High Rain
 - Census Pop. Per Sq. Mile
 - 0.027 - 0.128
 - 0.128 - 0.705
 - 0.705 - 297872.34
 - State Land Use Districts
 - Agriculture (A)
 - Conservation (C)
 - Rural (R)
 - Urban (U)



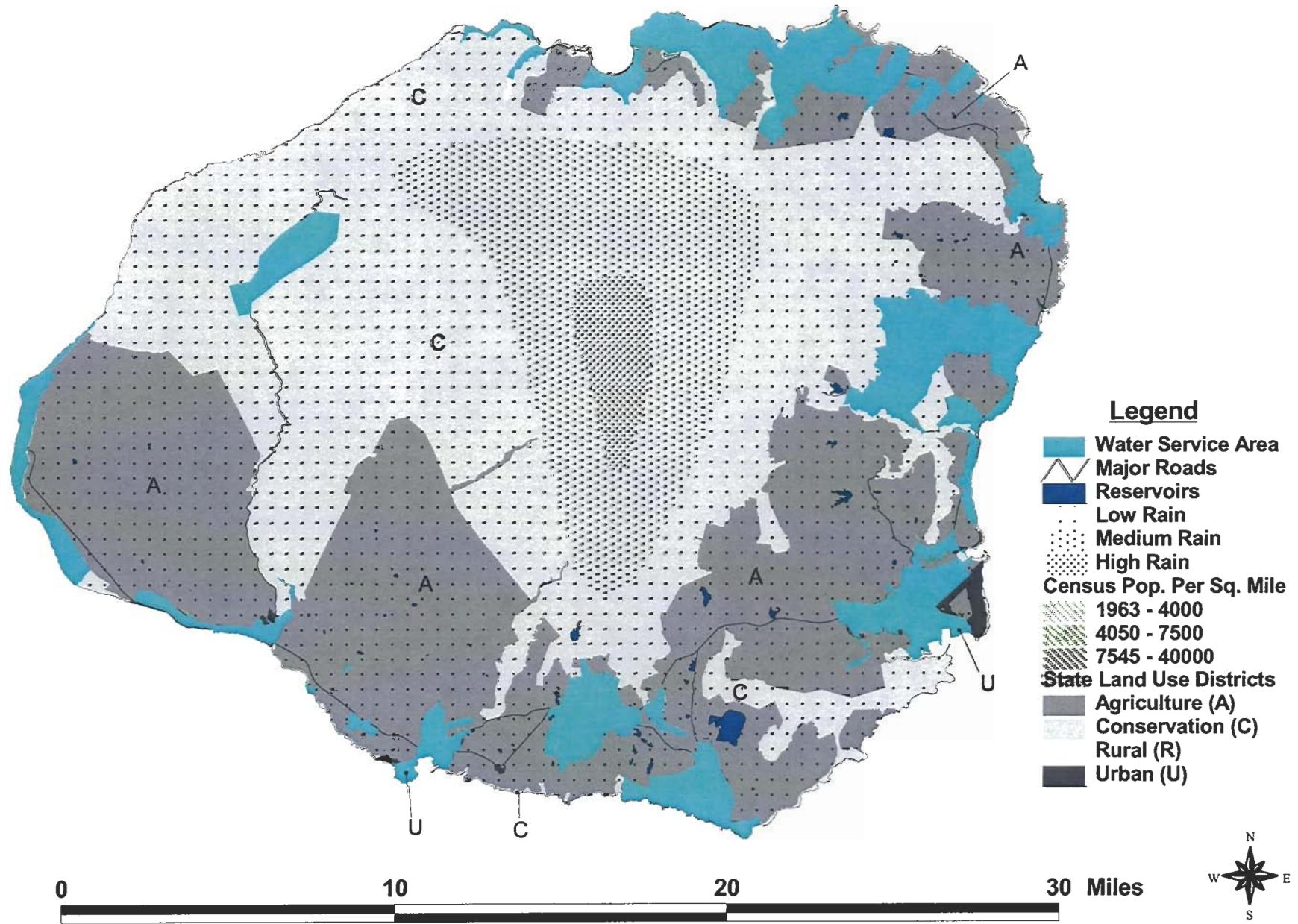
Figure 4.2. Drought Vulnerability Water Supply Sector, County of Maui



**Figure 4.3. Drought Vulnerability
Water Supply Sector, City and County of Honolulu**



**Figure 4.4. Drought Vulnerability
Water Supply Sector, County Of Kauai**



**Figure 4.5. Drought Vulnerability
Agriculture Sector, County of Hawaii**

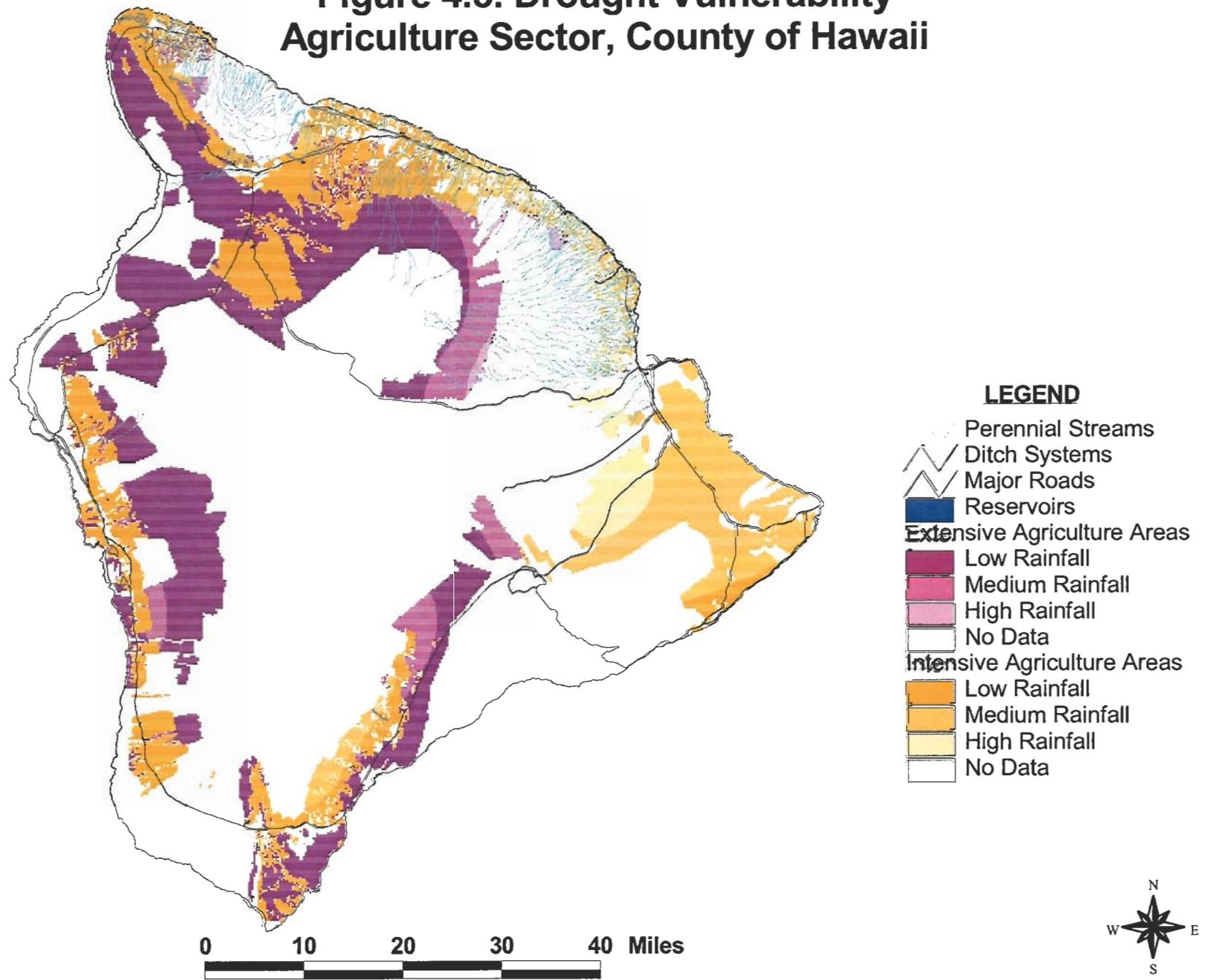


Figure 4.6. Drought Vulnerability Agriculture Sector, County of Maui

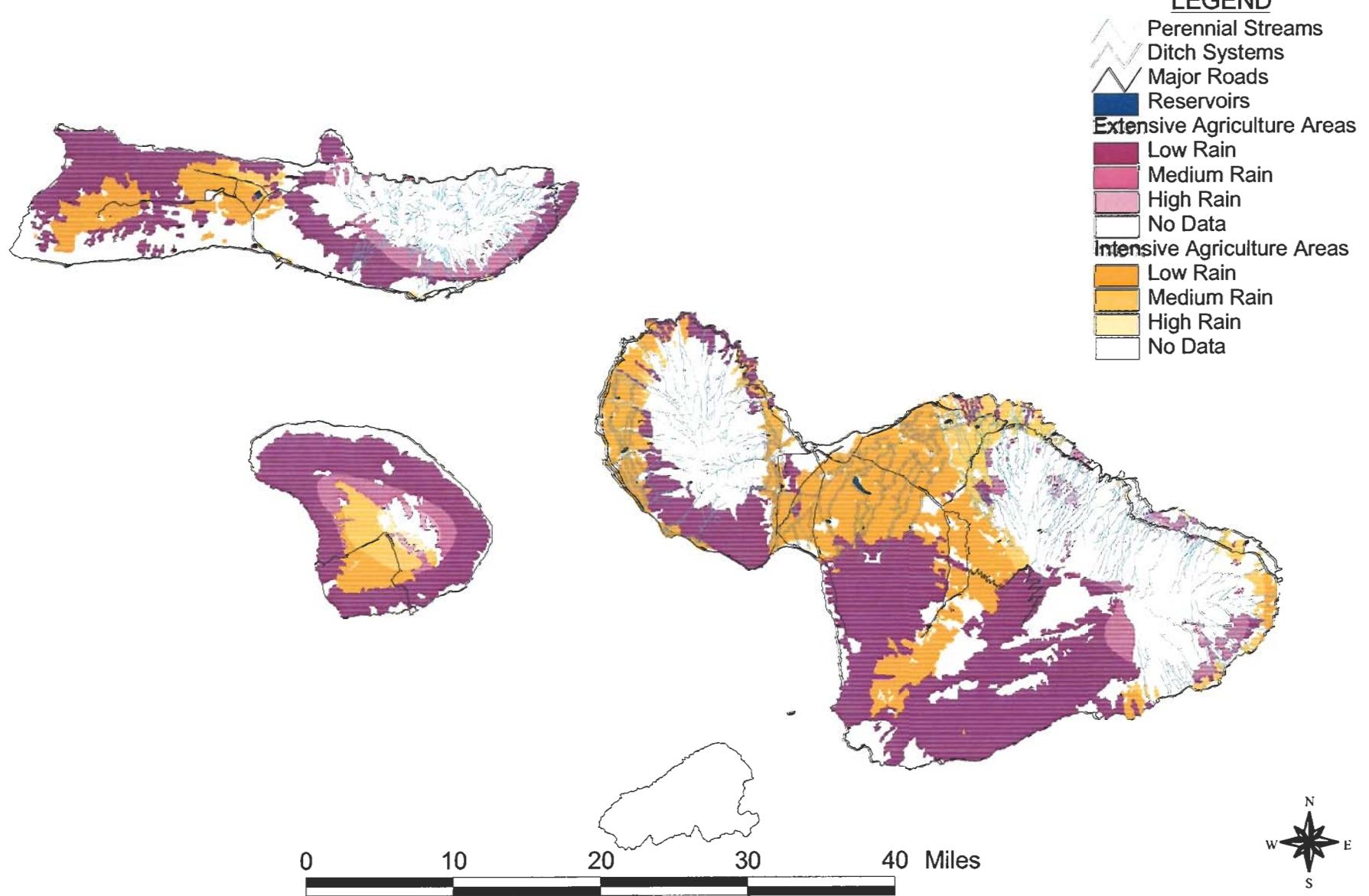
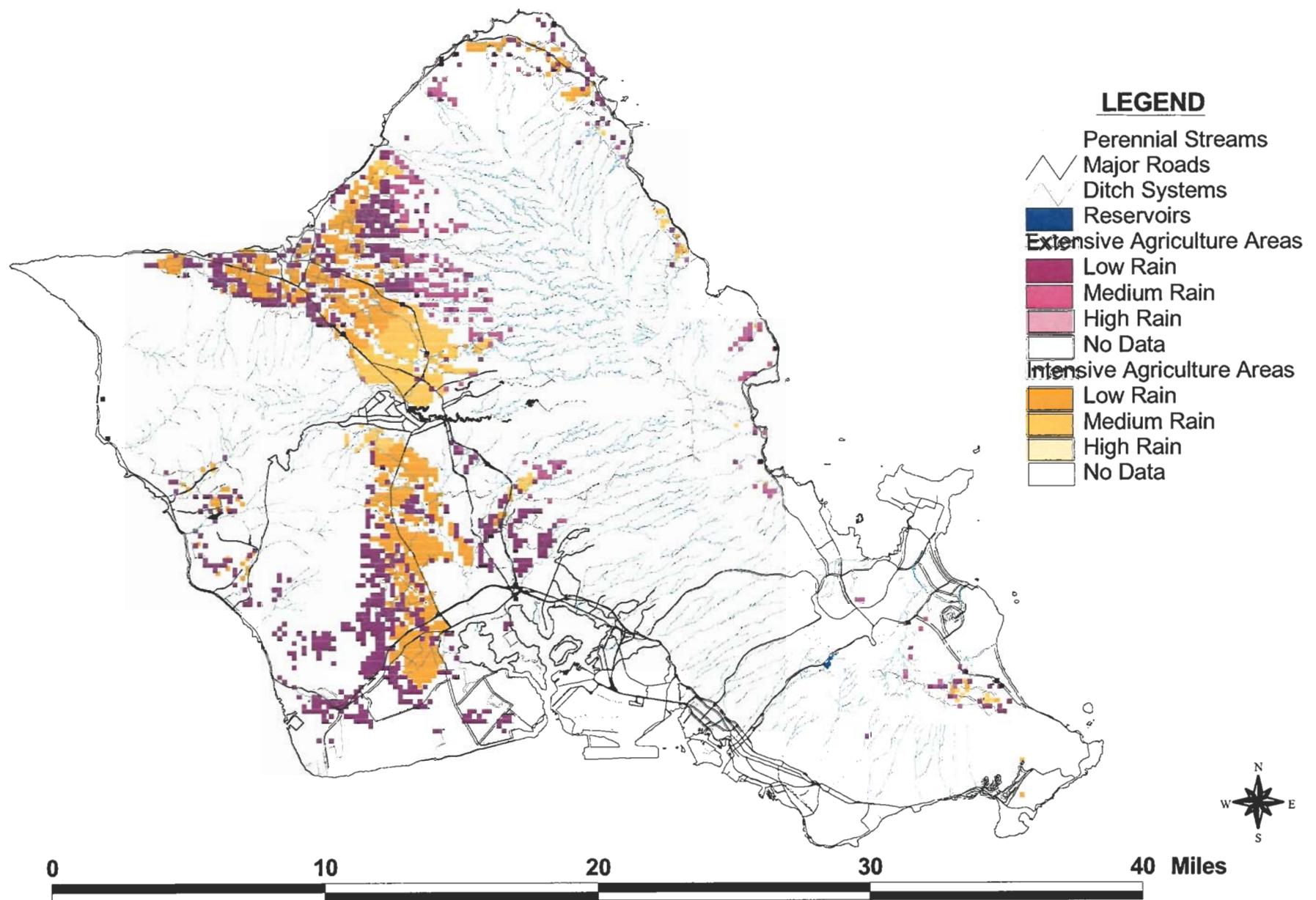
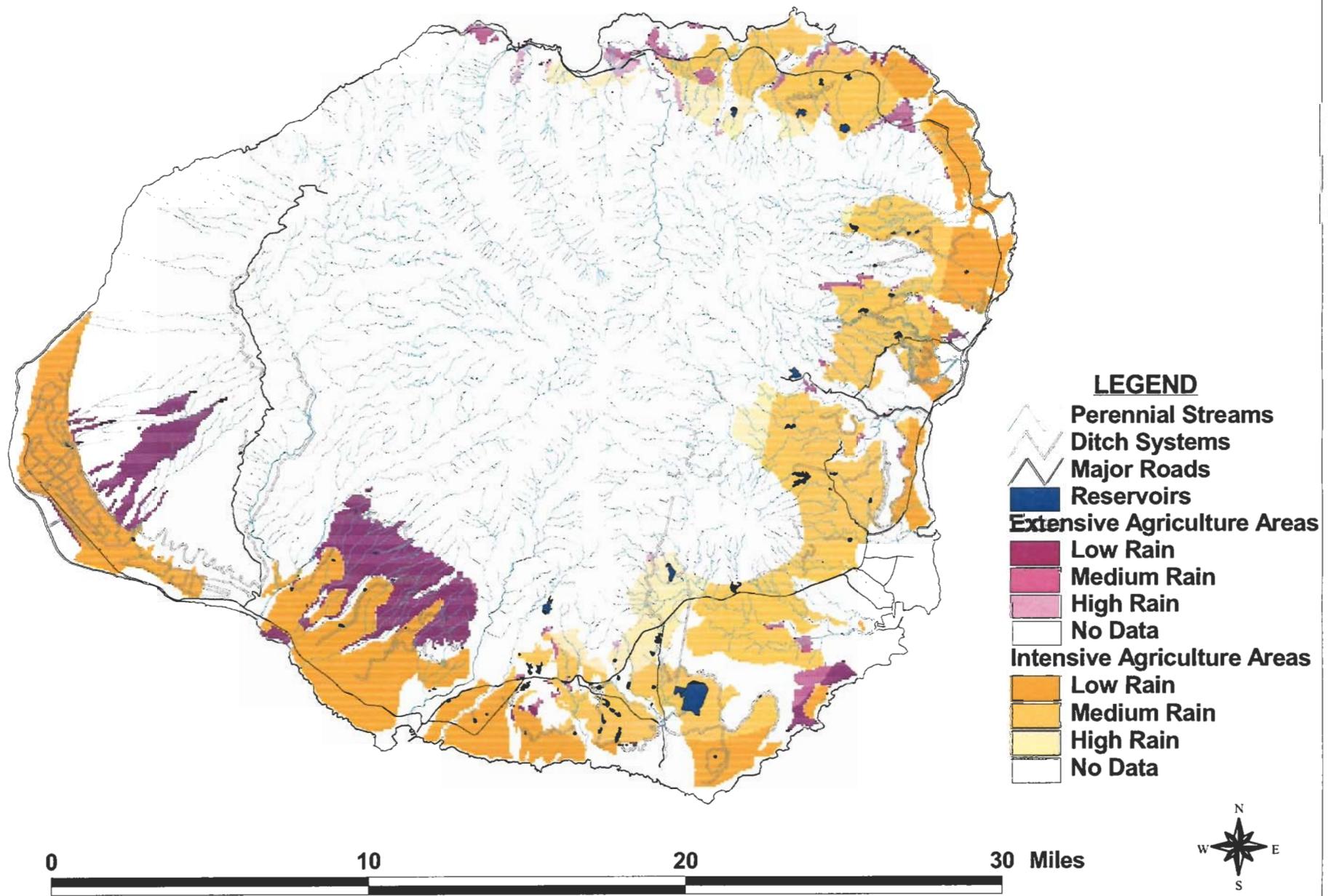


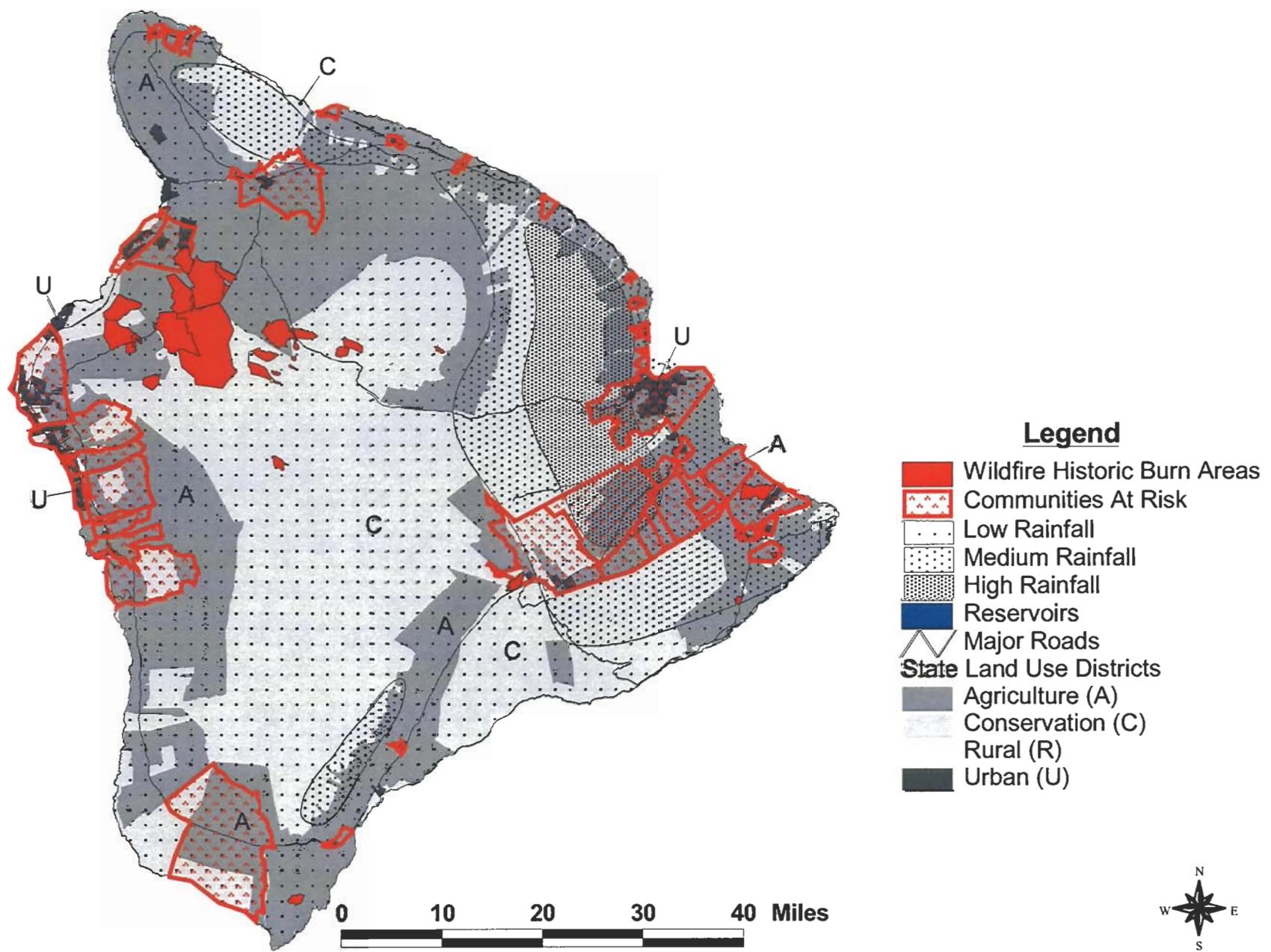
Figure 4.7. Drought Risk Areas
Agriculture Sector, City and County of Honolulu



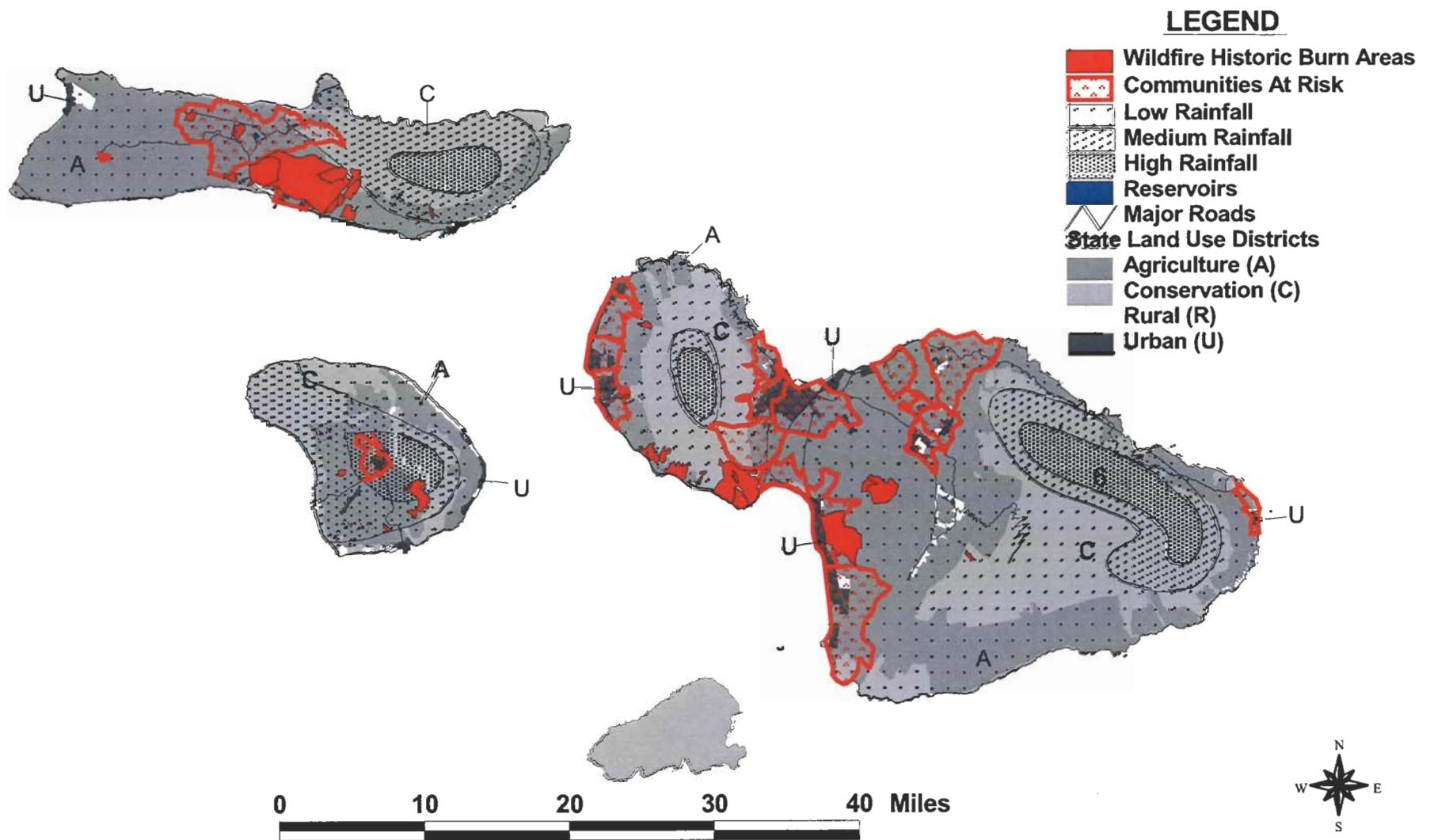
**Figure 4.8. Drought Vulnerability
Agriculture Sector, City of Kauai**



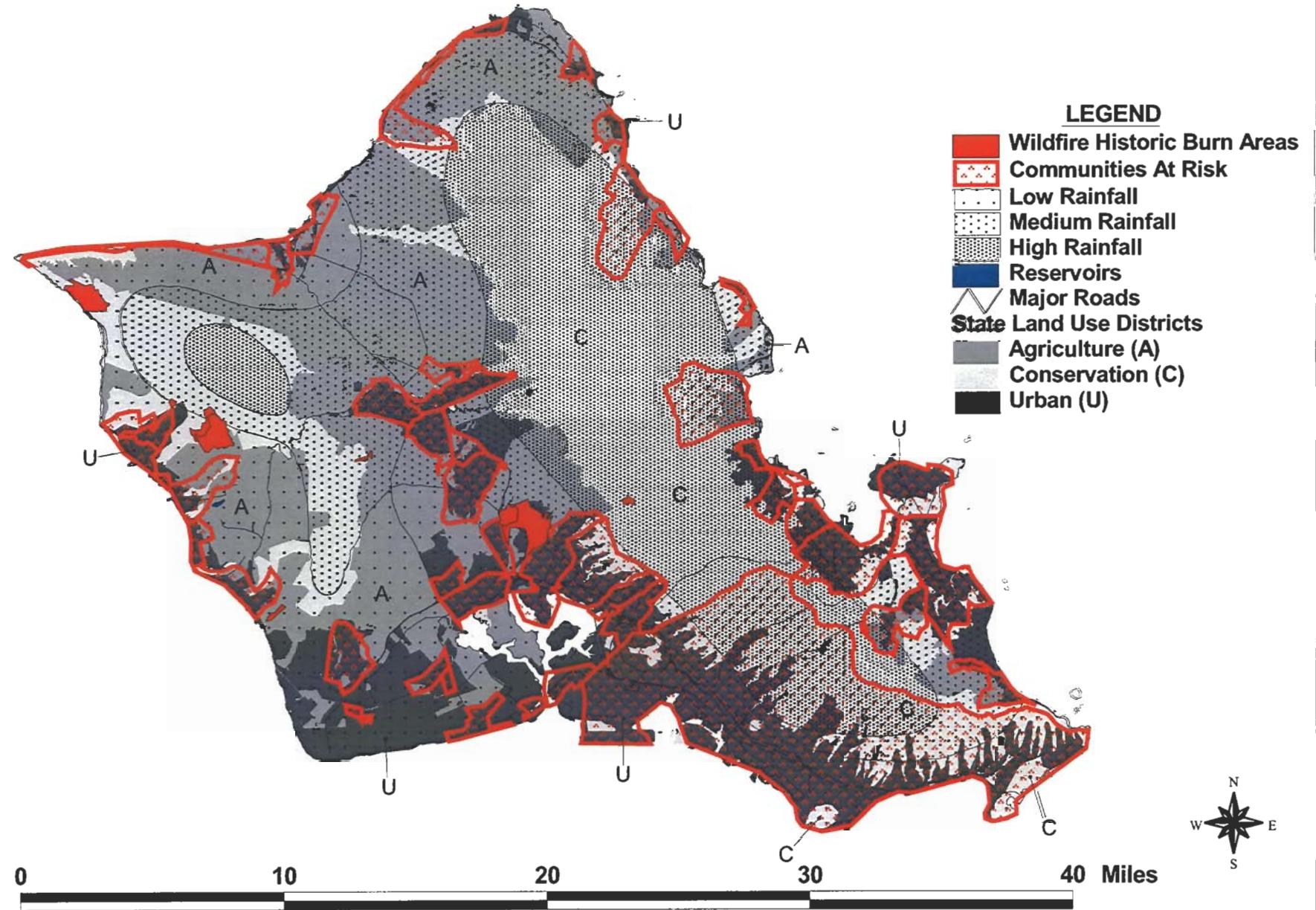
**Figure 4.9. Drought Vulnerability
Environment, Public Health, and Safety Sector, County of Hawaii**



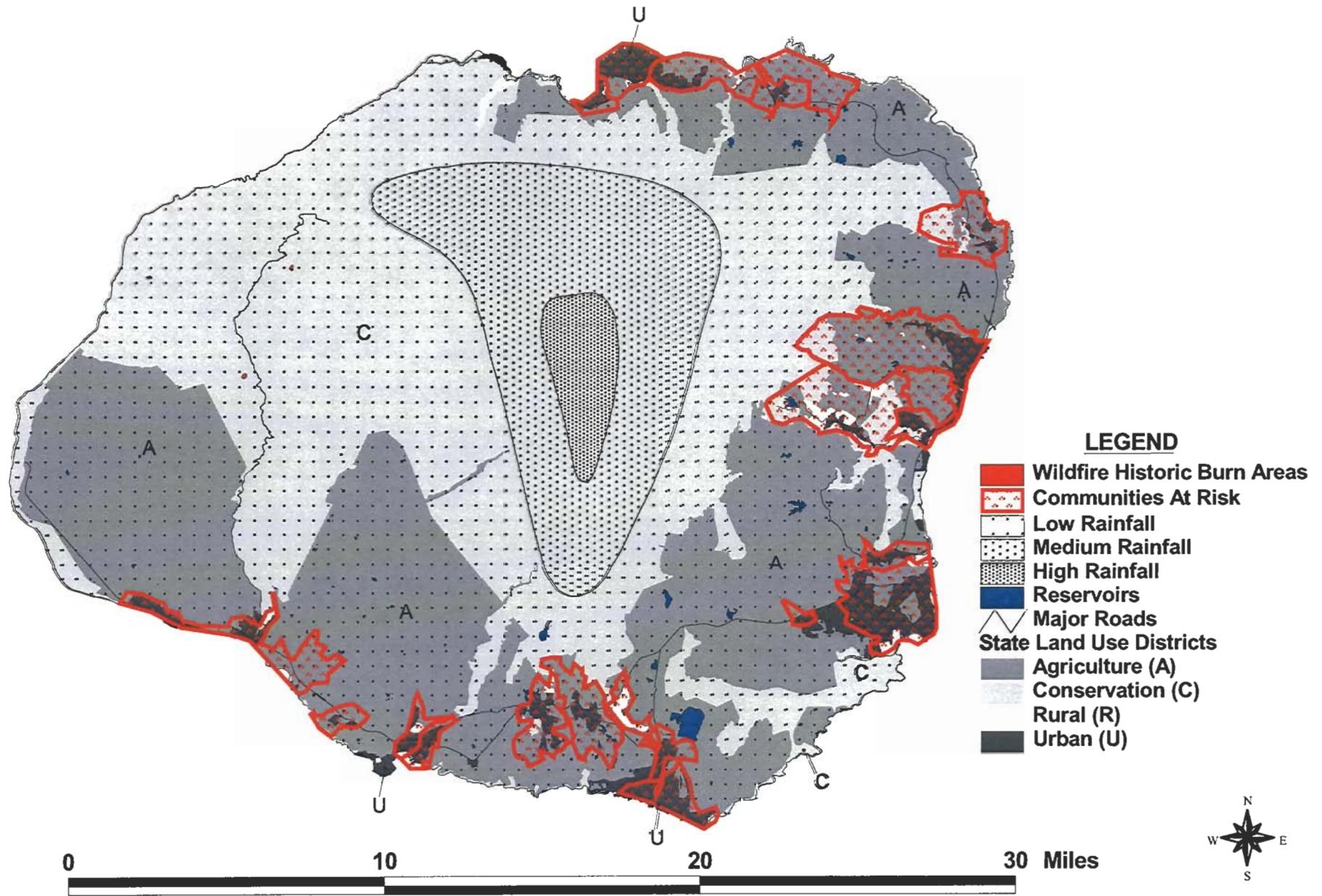
**Figure 4.10. Drought Vulnerability
Environment, Public Health, and Safety Sector, County of Maui**



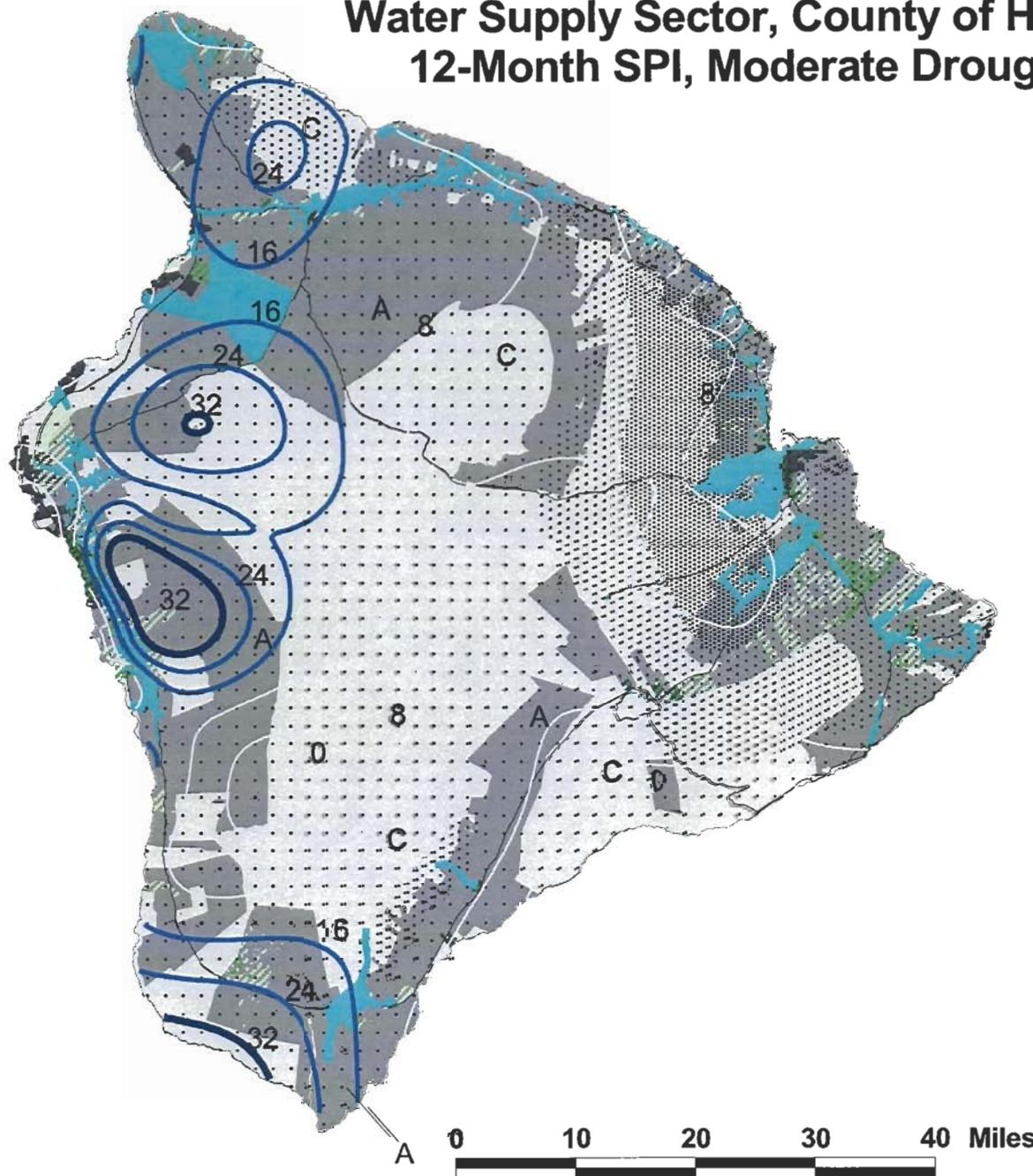
**Figure 4.11. Drought Vulnerability
Environment, Public Health, and Safety Sector, City and County of Honolulu**



**Figure 4.12. Drought Vulnerability
Environment, Public Health, and Safety Sector, County of Kauai**



**Figure 5.1. Drought Risk Areas
Water Supply Sector, County of Hawaii
12-Month SPI, Moderate Drought**

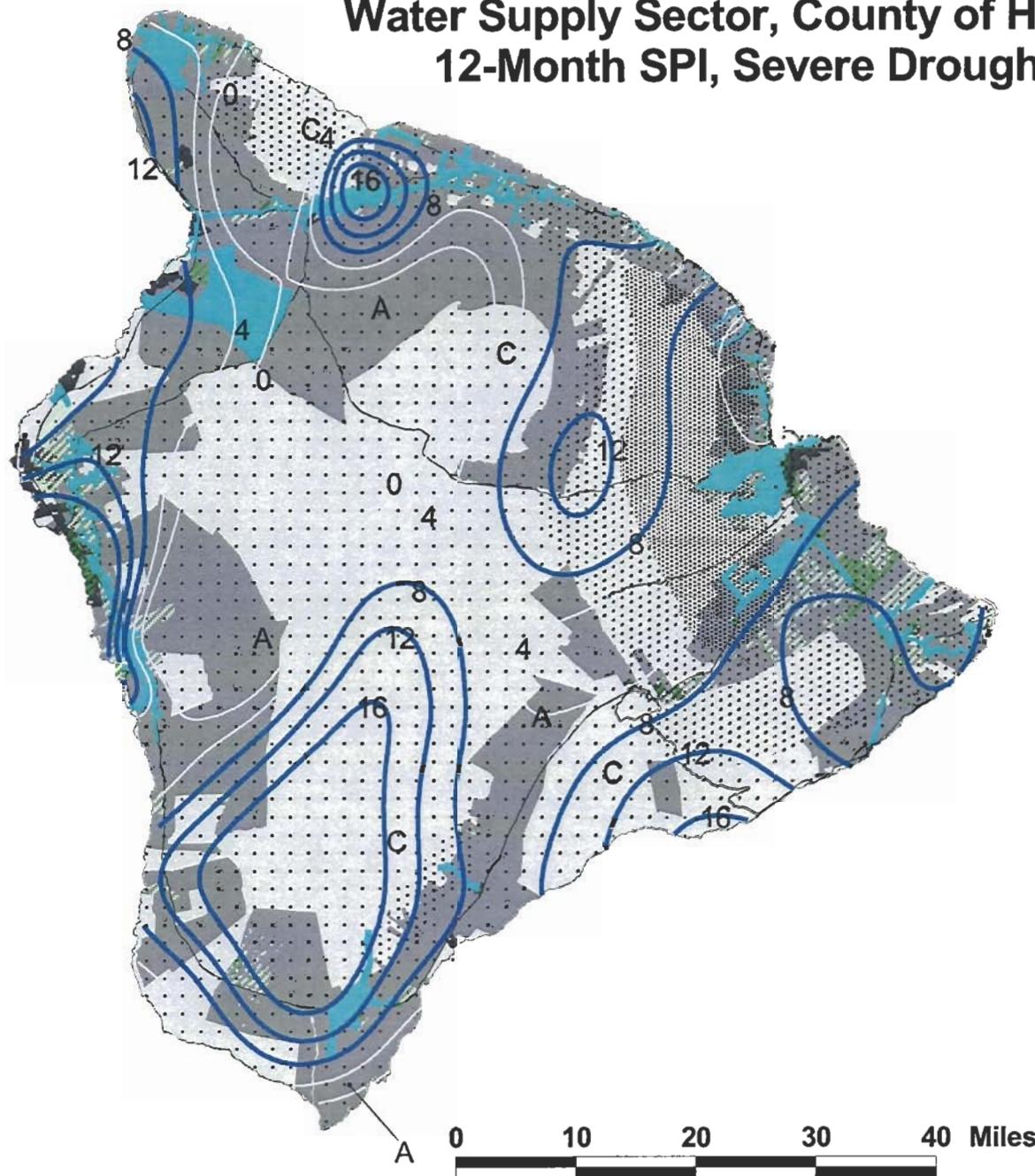


Legend

- 12-Month Moderate Drought
- 0 - 15
 - 16 - 28
 - 29 - 32
- Water Service Area
- Major Roads
- Reservoirs
- Low Rain
 - Medium Rain
 - High Rain
- Census Pop. Per Sq. Mile
- 0.027 - 0.128
 - 0.128 - 0.705
 - 0.705 - 297872.34
- State Land Use Districts
- Agriculture (A)
 - Conservation (C)
 - Rural (R)
 - Urban (U)



**Figure 5.2. Drought Risk Areas
Water Supply Sector, County of Hawaii
12-Month SPI, Severe Drought**

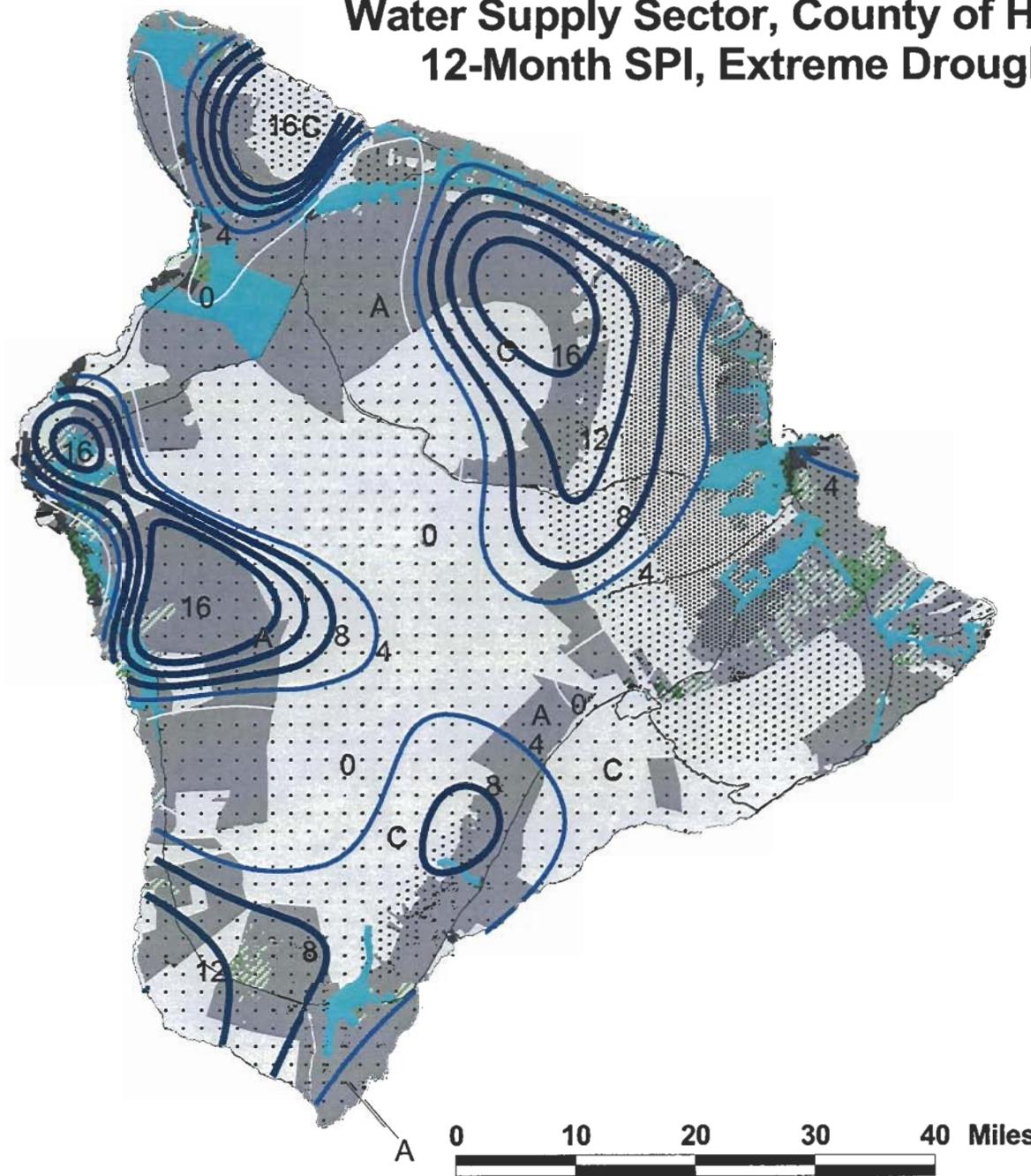


Legend

- 12-Month Severe Drought
- 0 - 7
 - 8 - 16
- Water Service Area
- Major Roads
- Reservoirs
- Low Rain
- Medium Rain
- High Rain
- Census Pop. Per Sq. Mile
- 0.027 - 0.128
 - 0.128 - 0.705
 - 0.705 - 297872.34
- State Land Use Districts
- Agriculture (A)
 - Conservation (C)
 - Rural (R)
 - Urban (U)



**Figure 5.3. Drought Risk Areas
Water Supply Sector, County of Hawaii
12-Month SPI, Extreme Drought**

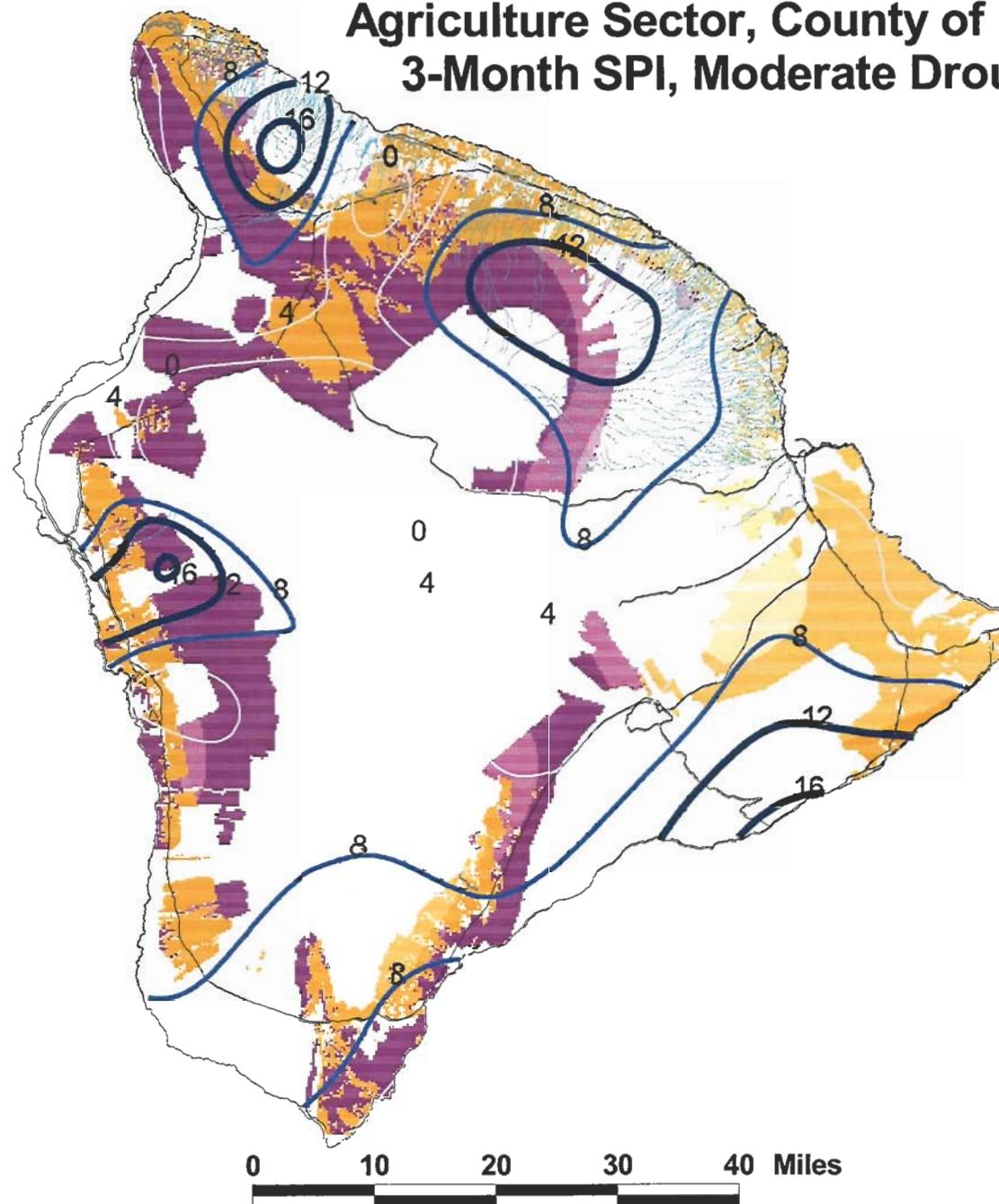


Legend

- 12-Month Extreme Drought
 - 0 - 3
 - 4 - 7
 - 8 - 16
- Water Service Area
- Major Roads
- Reservoirs
- Low Rain
- Medium Rain
- High Rain
- Census Pop. Per Sq. Mile
 - 0.027 - 0.128
 - 0.128 - 0.705
 - 0.705 - 297872.34
- State Land Use Districts
 - Agriculture (A)
 - Conservation (C)
 - Rural (R)
 - Urban (U)



Figure 5.4. Drought Risk Areas
Agriculture Sector, County of Hawaii
3-Month SPI, Moderate Drought



LEGEND

Big Island 3-Month Moderate Drought

0 - 7

8 - 11

12 - 16

Perennial Streams

Ditch Systems

Major Roads

Reservoirs

Extensive Agriculture Areas

Low Rainfall

Medium Rainfall

High Rainfall

No Data

Intensive Agriculture Areas

Low Rainfall

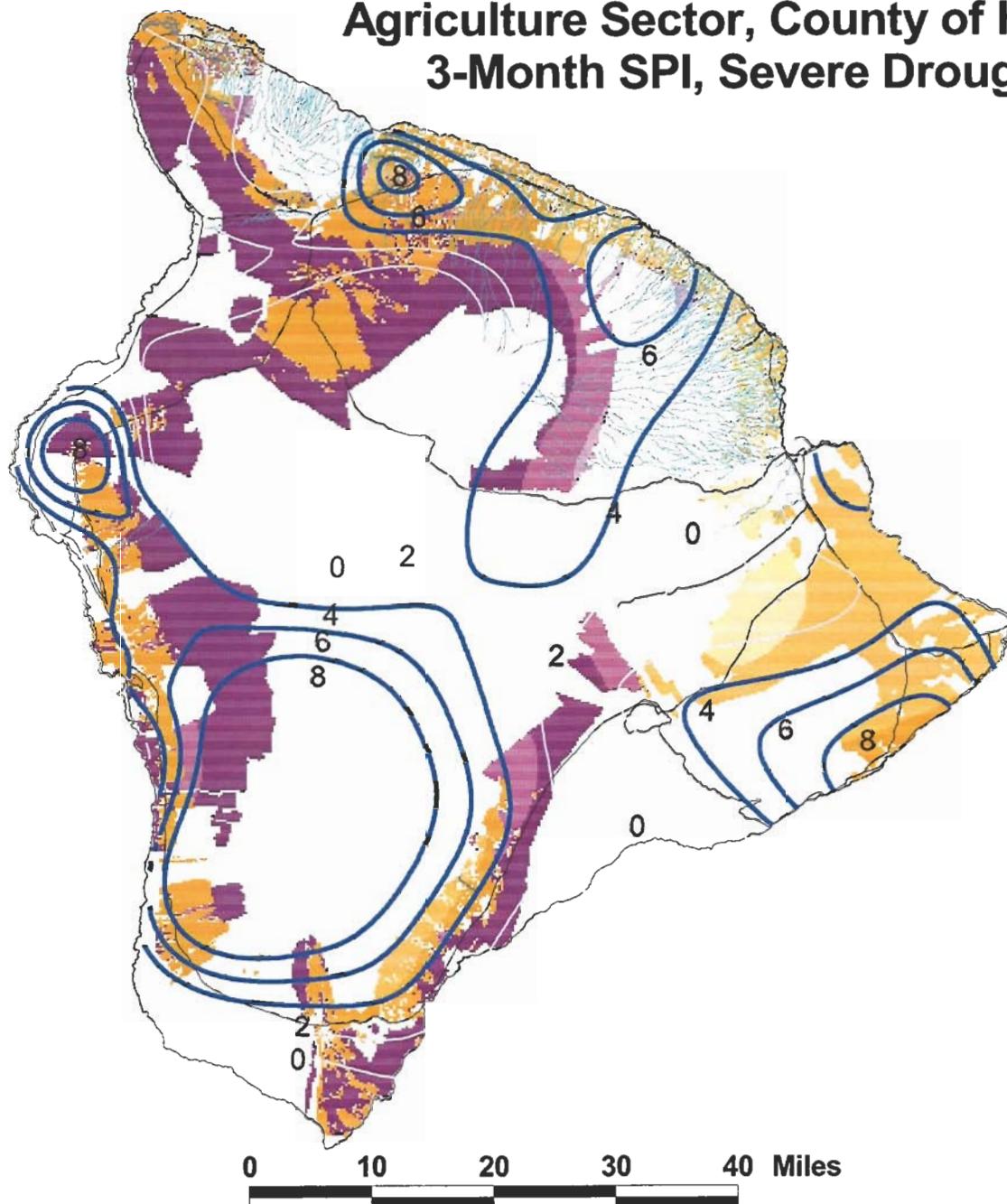
Medium Rainfall

High Rainfall

No Data



Figure 5.5. Drought Risk Areas
Agriculture Sector, County of Hawaii
3-Month SPI, Severe Drought

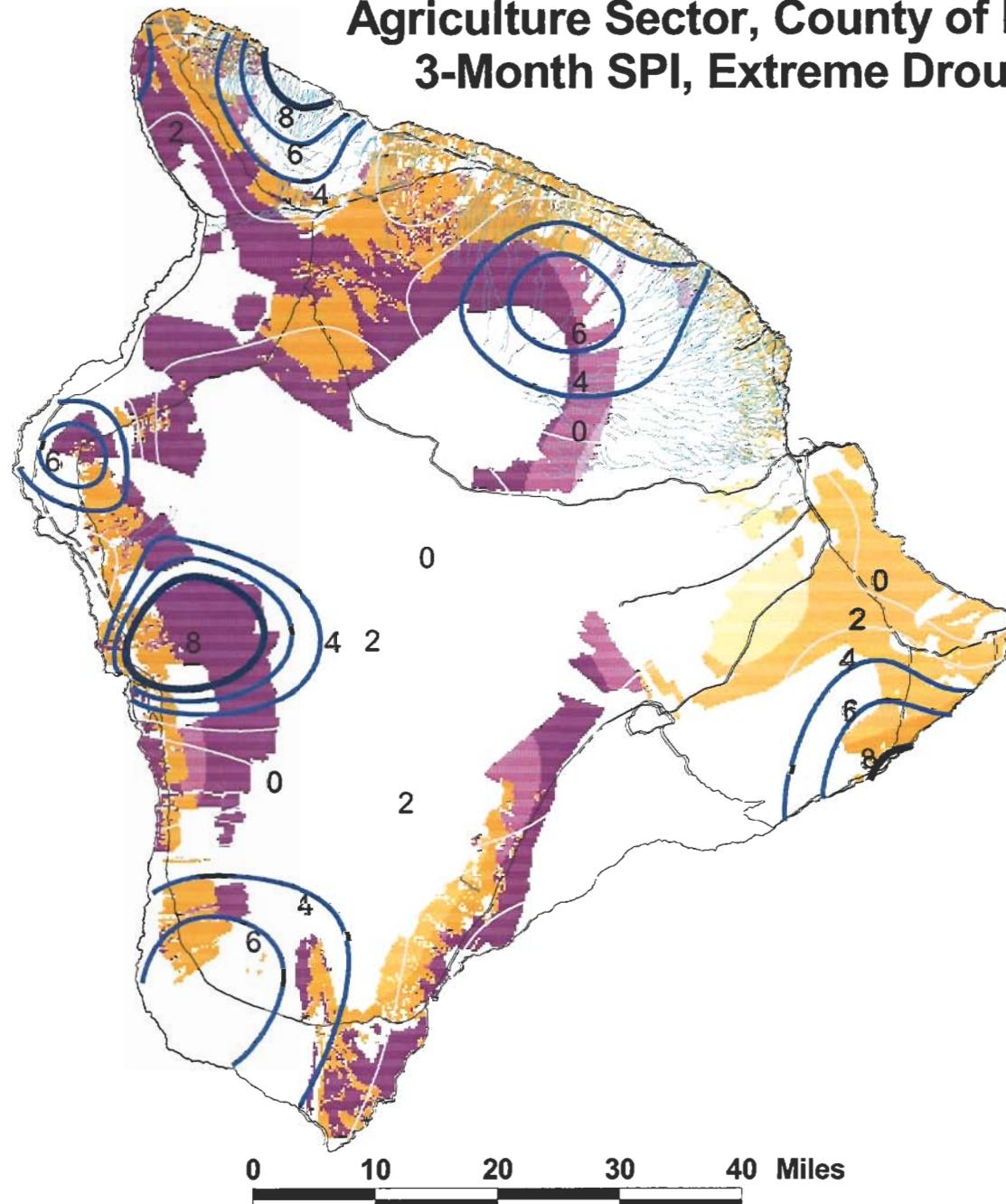


LEGEND

Big Island 3-month Severe Drought	
0 - 3	
4 - 8	
Perennial Streams	
Ditch Systems	
Major Roads	
Reservoirs	
Extensive Agriculture Areas	
Low Rainfall	
Medium Rainfall	
High Rainfall	
No Data	
Intensive Agriculture Areas	
Low Rainfall	
Medium Rainfall	
High Rainfall	
No Data	



Figure 5.6. Drought Risk Areas
Agriculture Sector, County of Hawaii
3-Month SPI, Extreme Drought



LEGEND

Big Island 3-Month Extreme Drought	
0 - 3	
4 - 7	
8	
Perennial Streams	
Ditch Systems	
Major Roads	
Reservoirs	
Extensive Agriculture Areas	
Low Rainfall	
Medium Rainfall	
High Rainfall	
No Data	
Intensive Agriculture Areas	
Low Rainfall	
Medium Rainfall	
High Rainfall	
No Data	



Figure 5.7. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Hawaii
3-Month SPI, Moderate Drought

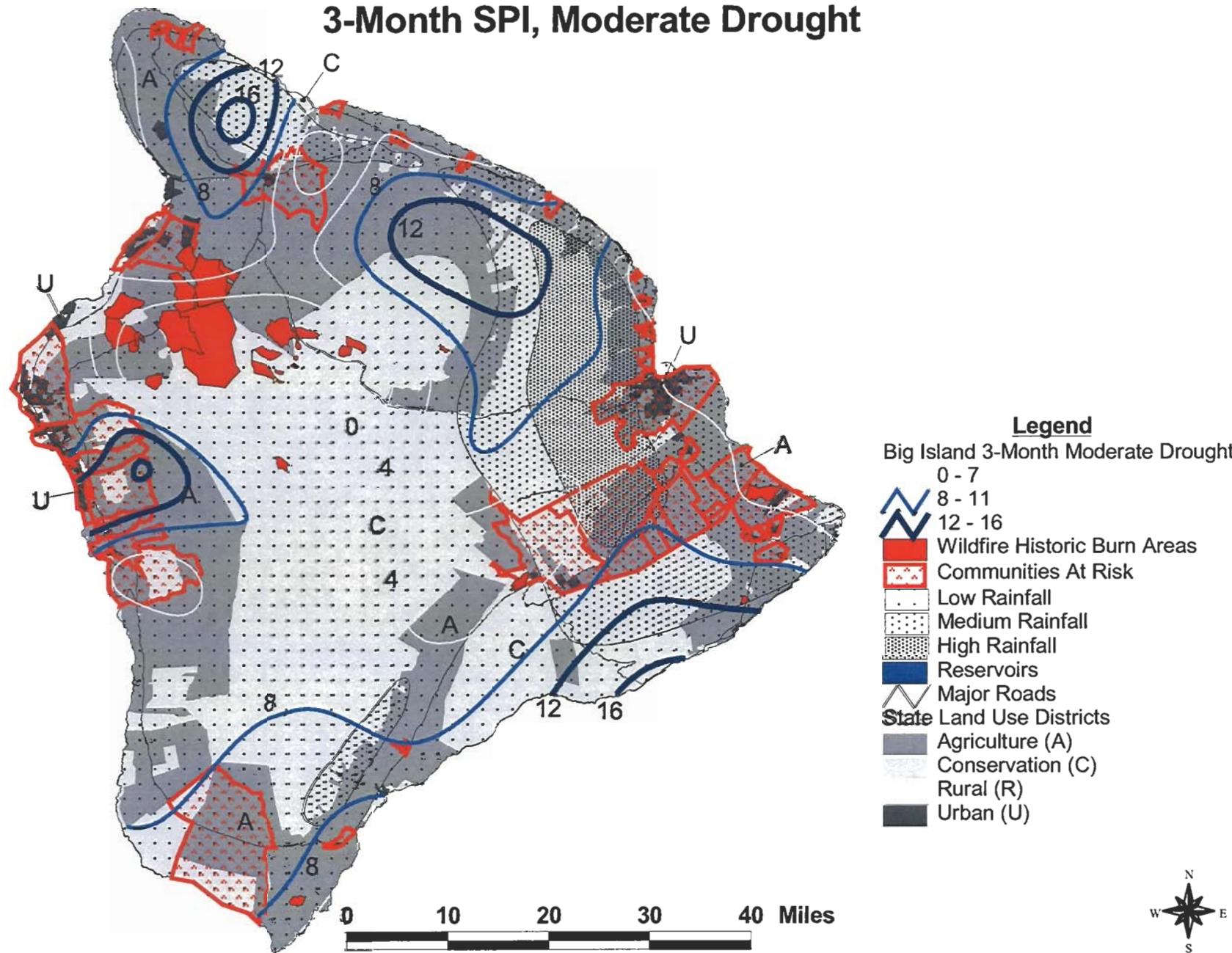
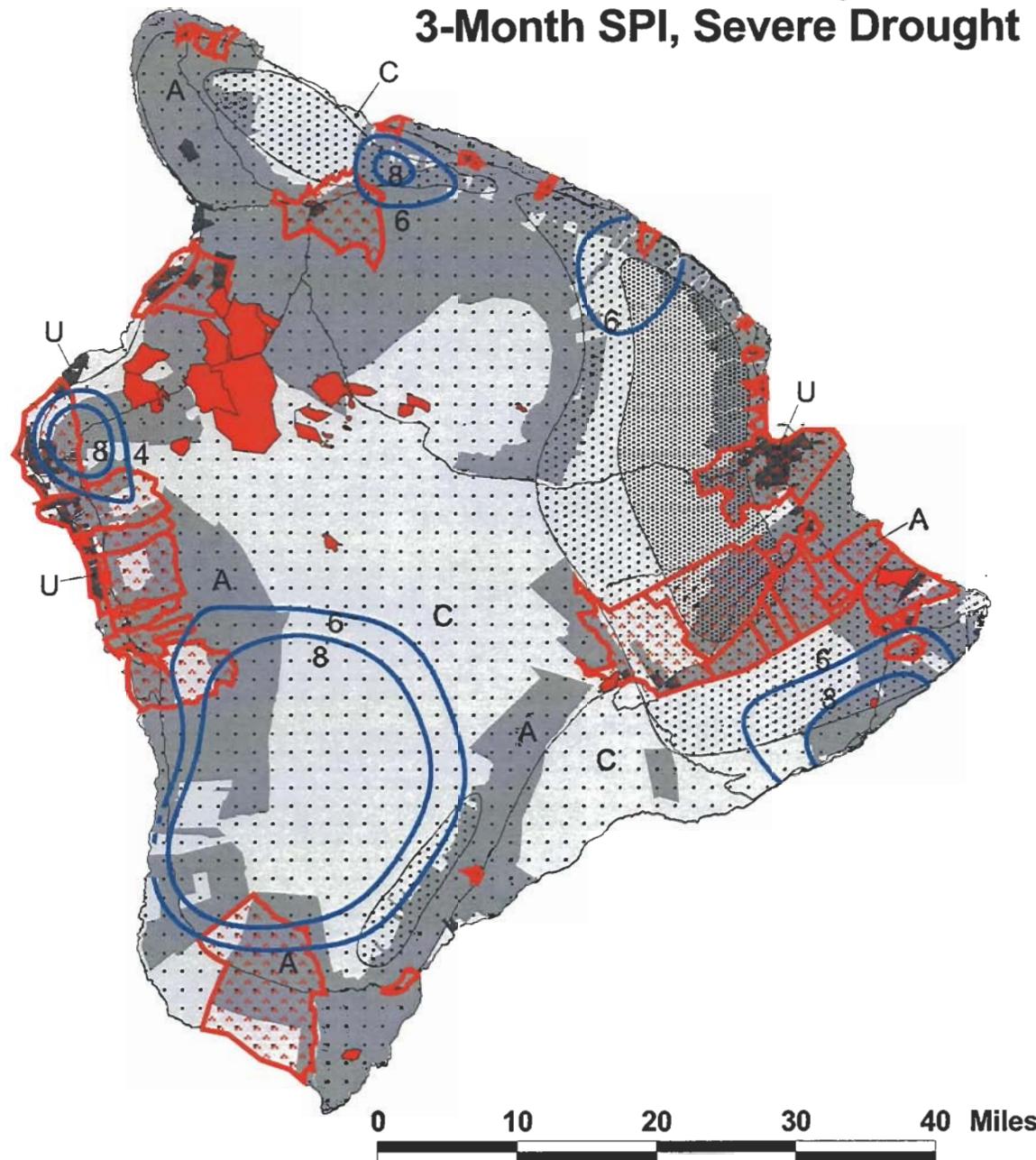
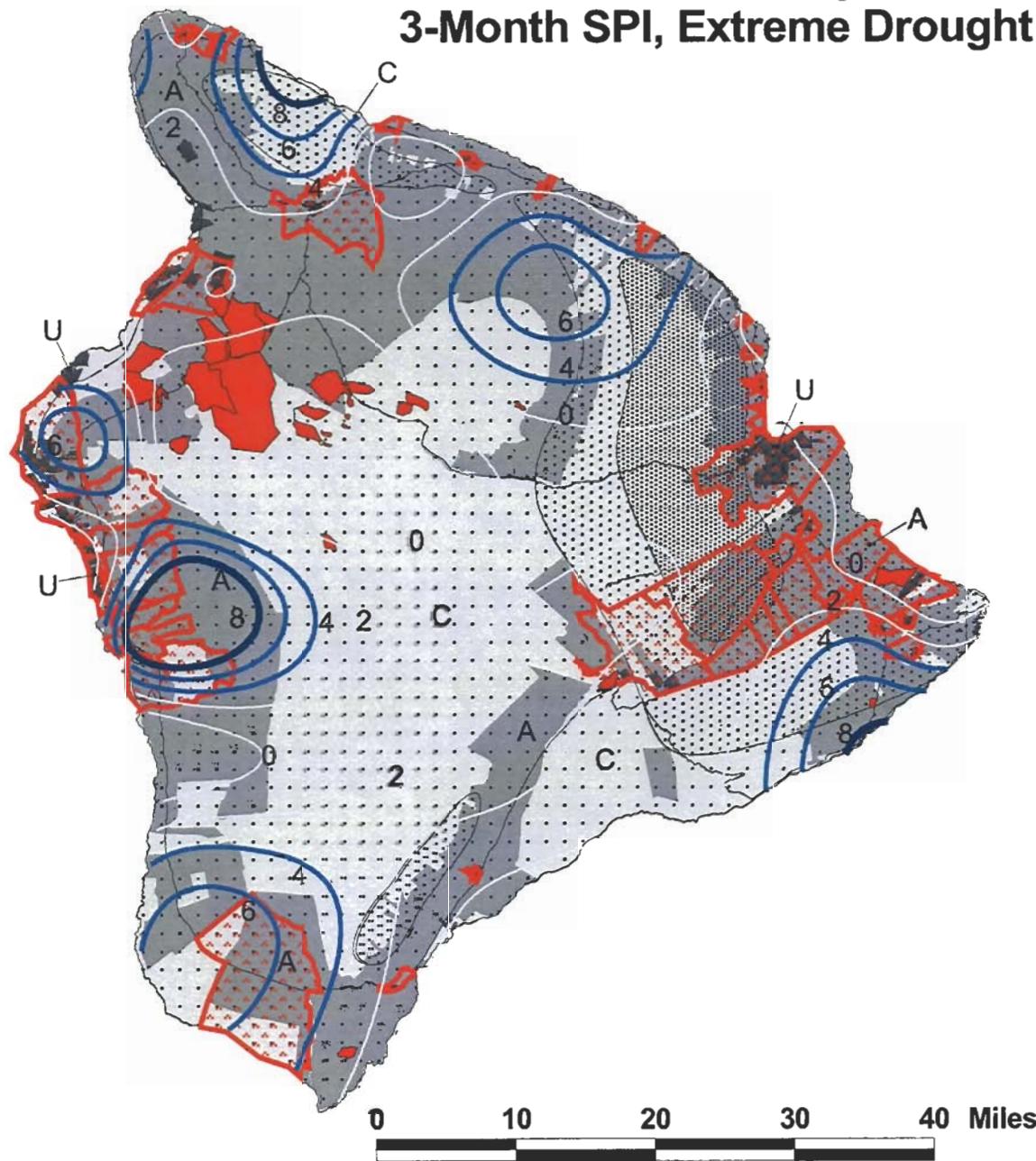


Figure 5.8. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Hawaii
3-Month SPI, Severe Drought



- LEGEND**
- Big Island 3-Month Severe Drought**
- 5 - 8
- Wildfire Historic Burn Areas**
- Communities At Risk**
- Low Rainfall**
- Medium Rainfall**
- High Rainfall**
- Reservoirs**
- Major Roads**
- State Land Use Districts**
- Agriculture (A)**
 - Conservation (C)**
 - Rural (R)**
 - Urban (U)**

Figure 5.9. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Hawaii
3-Month SPI, Extreme Drought

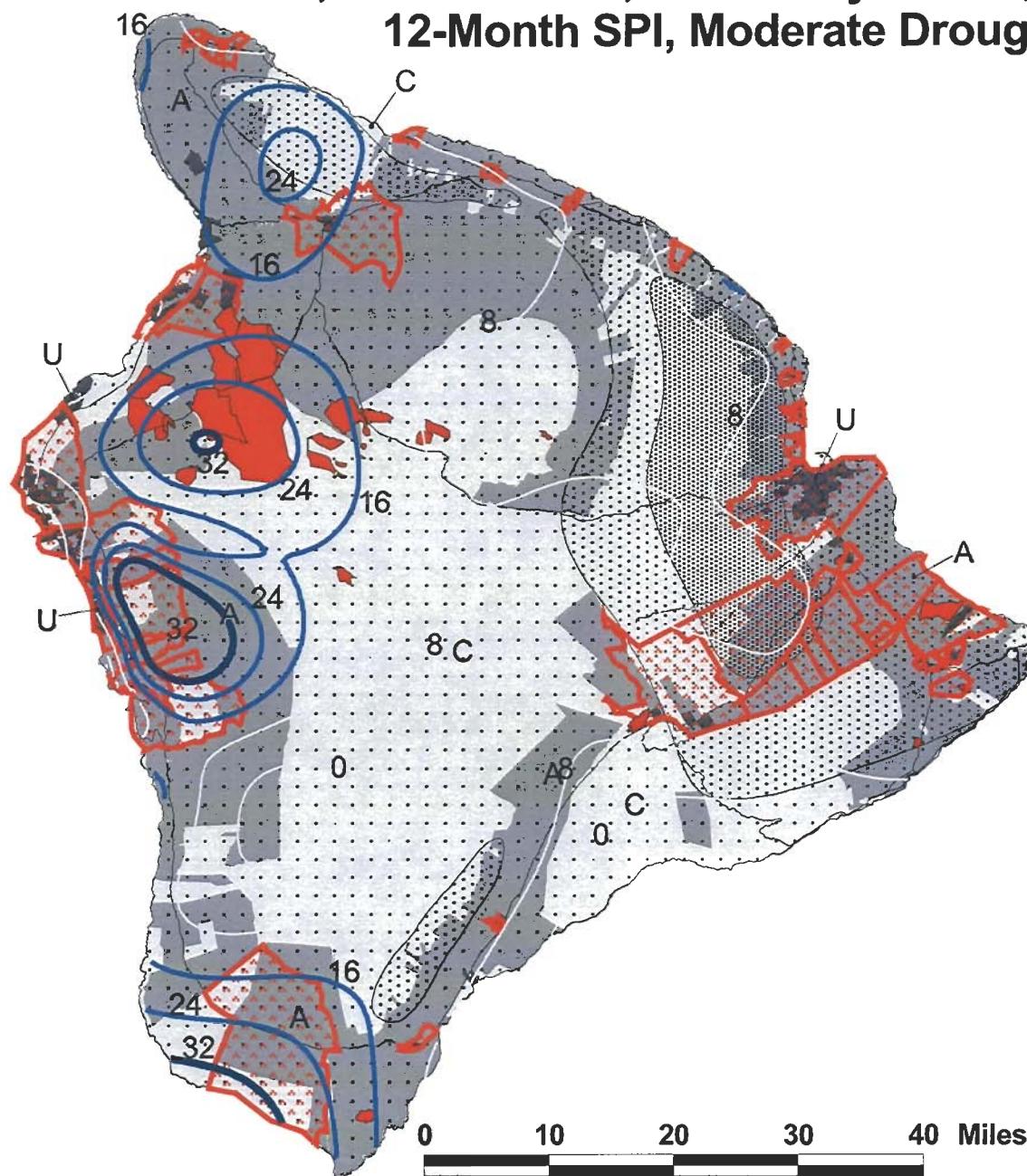


LEGEND

Big Island 3-Month Extreme Drought	
0 - 3	
4 - 7	
8	
Wildfire Historic Burn Areas	
Communities At Risk	
Low Rainfall	
Medium Rainfall	
High Rainfall	
Reservoirs	
Major Roads	
State Land Use Districts	
Agriculture (A)	
Conservation (C)	
Rural (R)	
Urban (U)	



Figure 5.10. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Hawaii
12-Month SPI, Moderate Drought



Legend

- Big Island 12-Month Moderate Drought**
- 0 - 15
 - 16 - 27
 - 28 - 32
- Wildfire Historic Burn Areas**
- Communities At Risk**
- Low Rainfall**
- Medium Rainfall**
- High Rainfall**
- Reservoirs**
- Major Roads**
- State Land Use Districts**
- Agriculture (A)
 - Conservation (C)
 - Rural (R)
 - Urban (U)

0 10 20 30 40 Miles



Figure 5.11. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Hawaii
12-Month SPI, Severe Drought

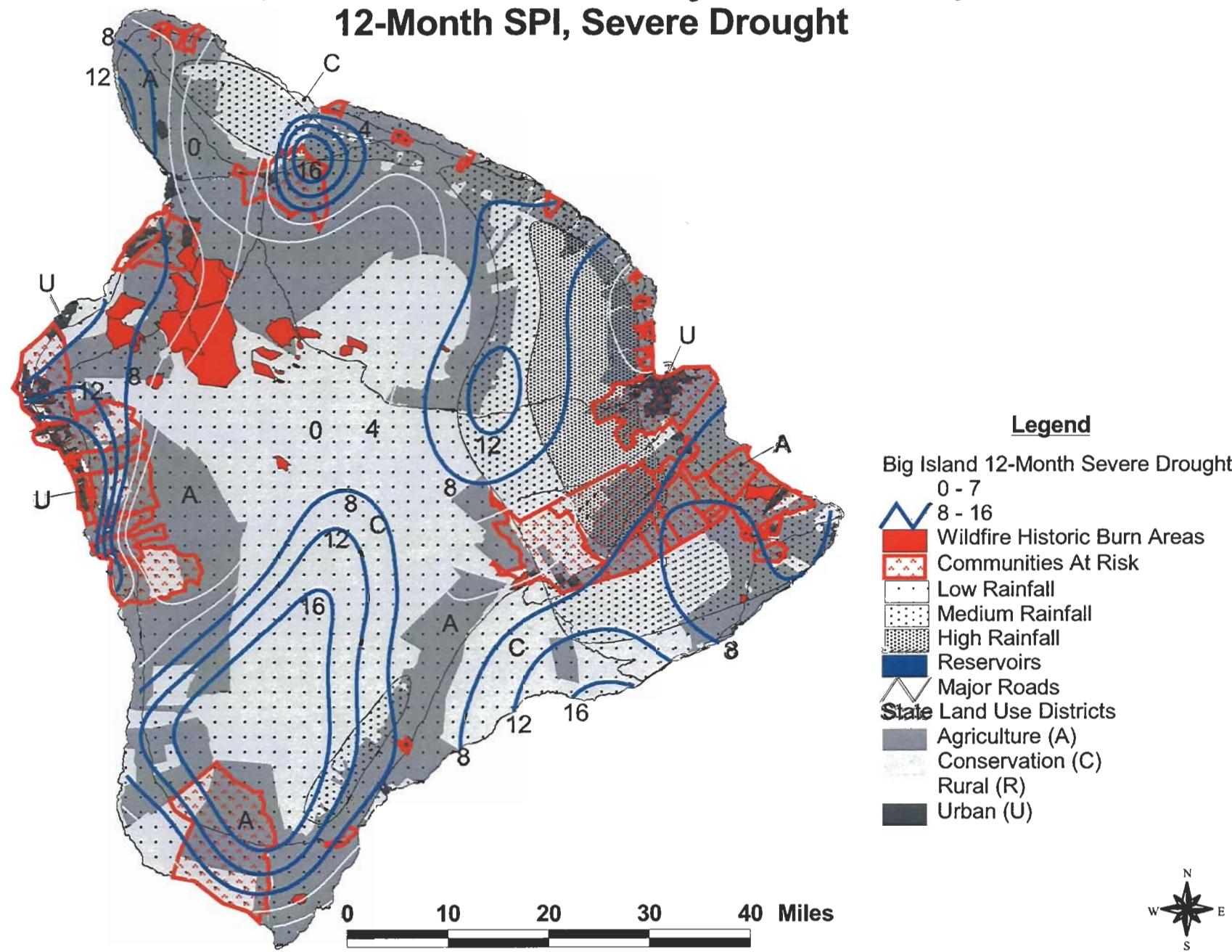


Figure 5.12. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Hawaii
12-Month SPI, Extreme Drought

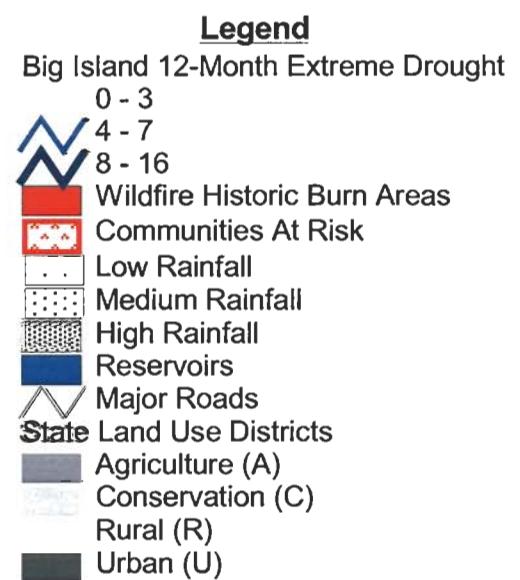
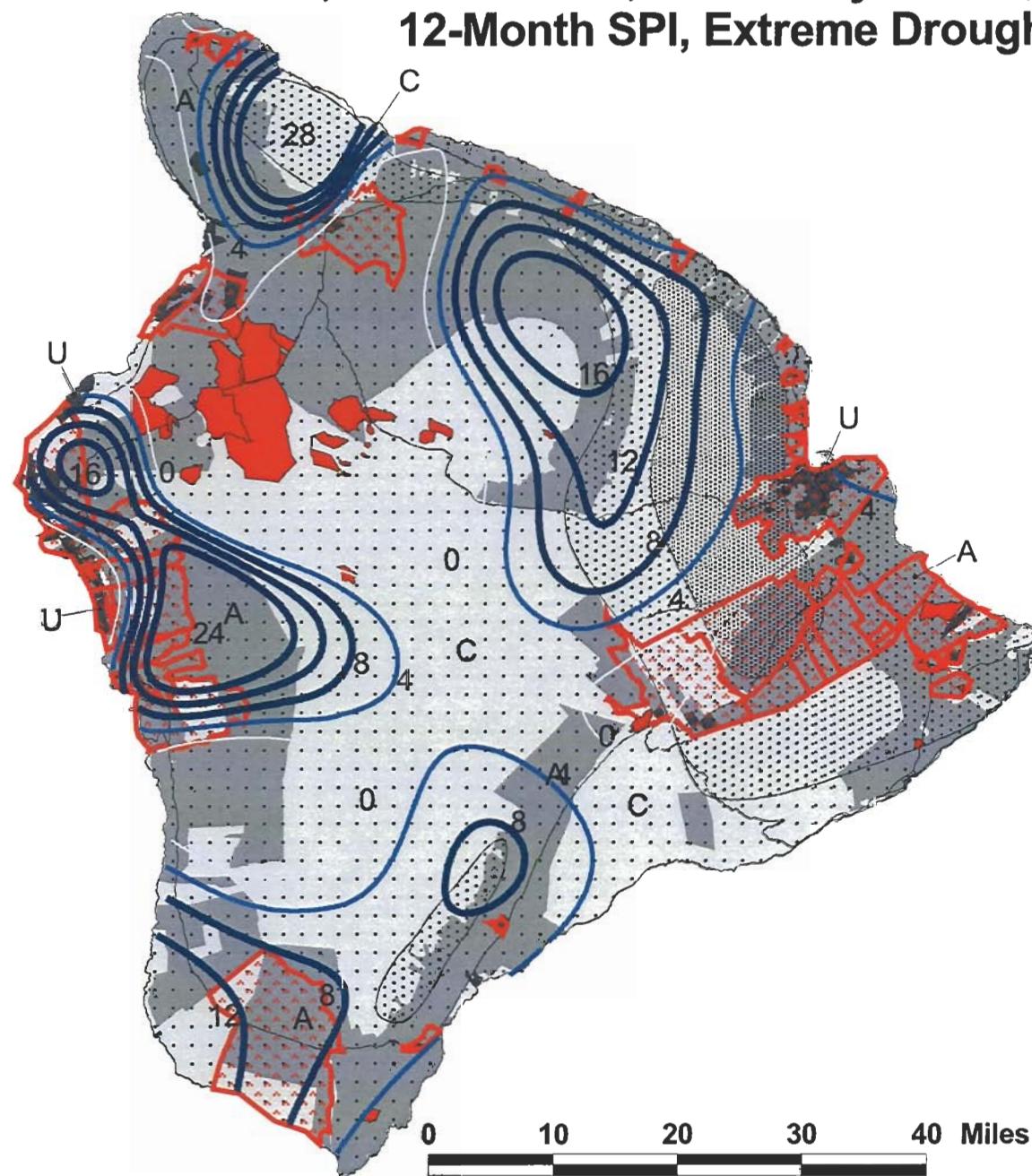
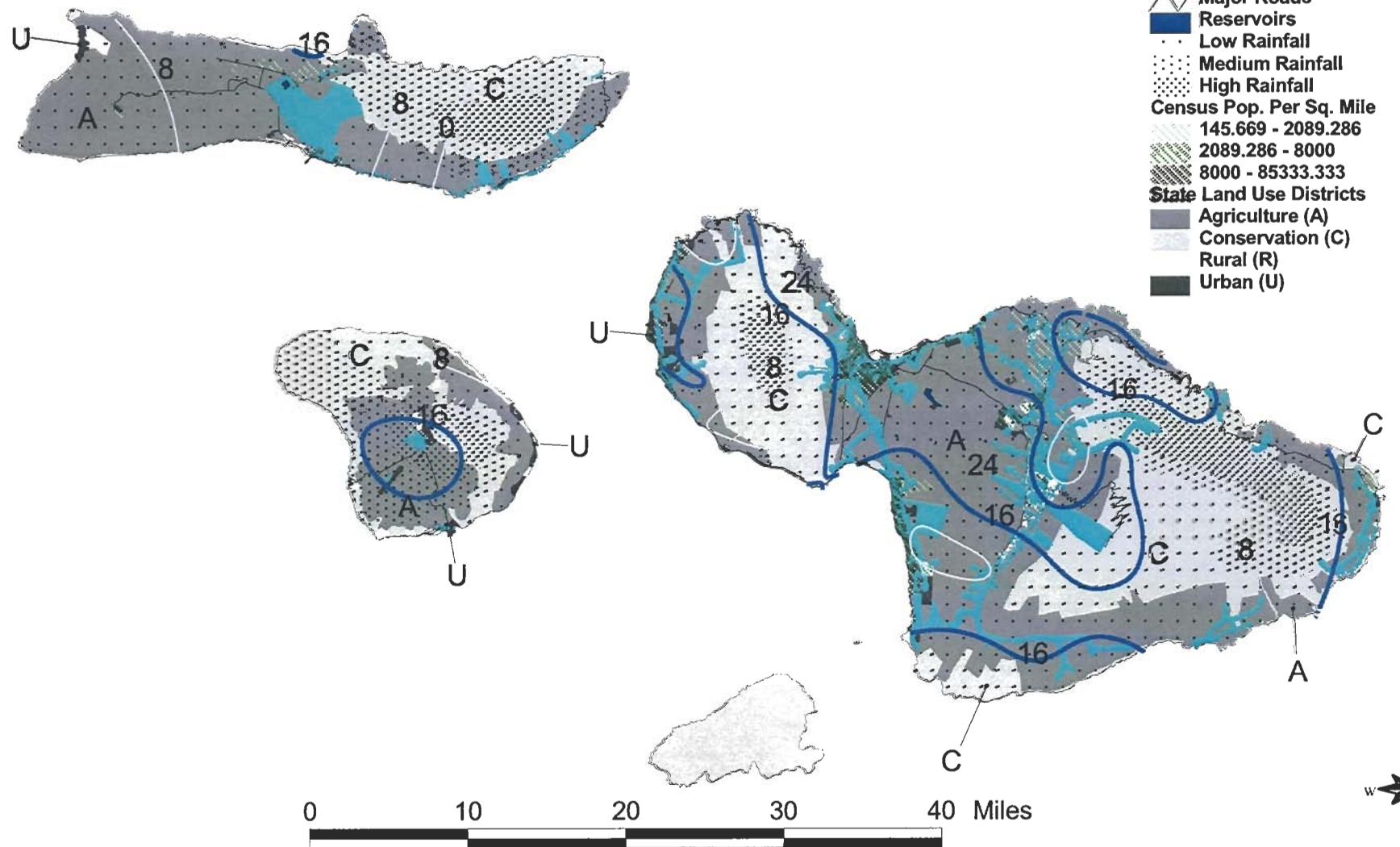
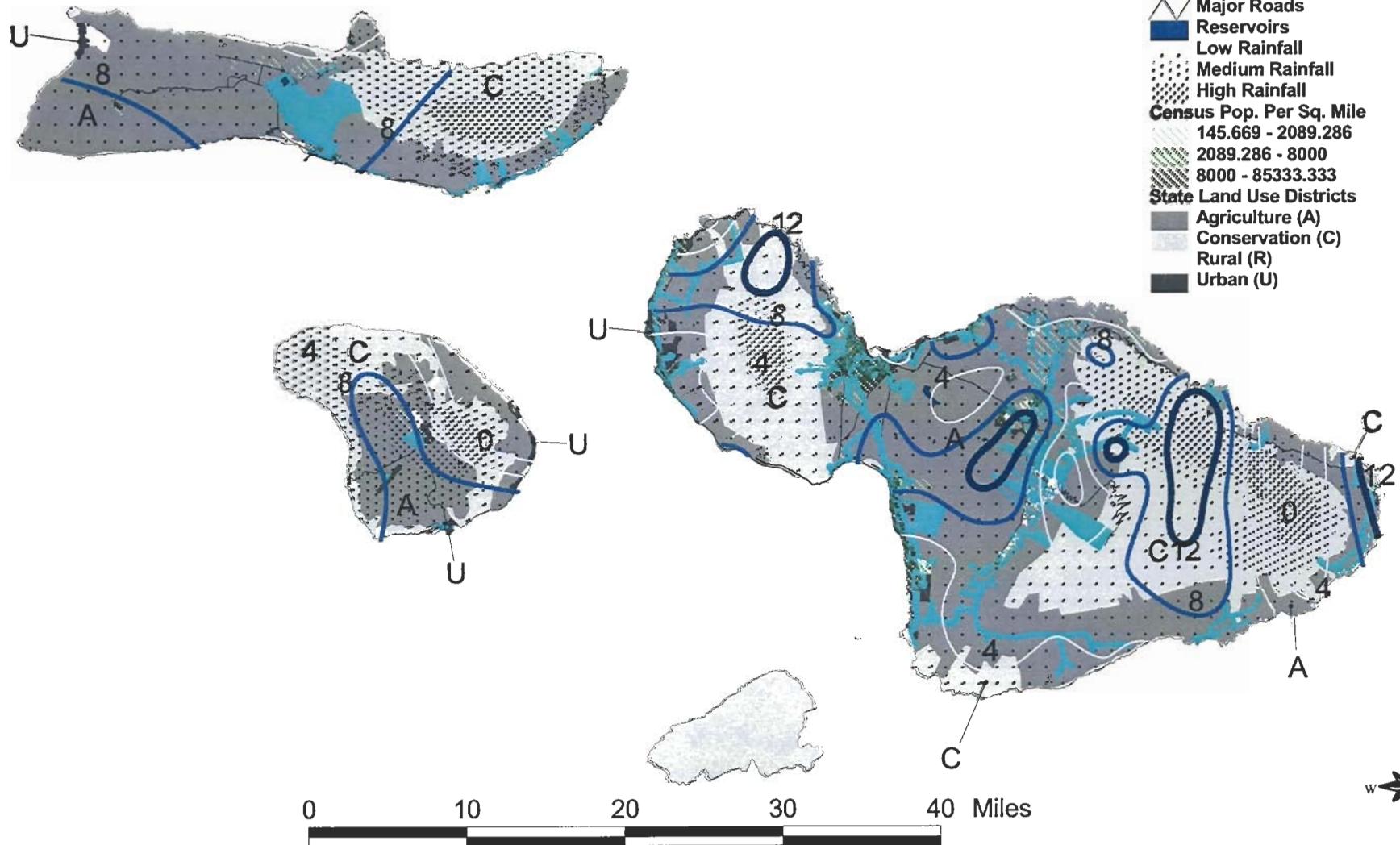


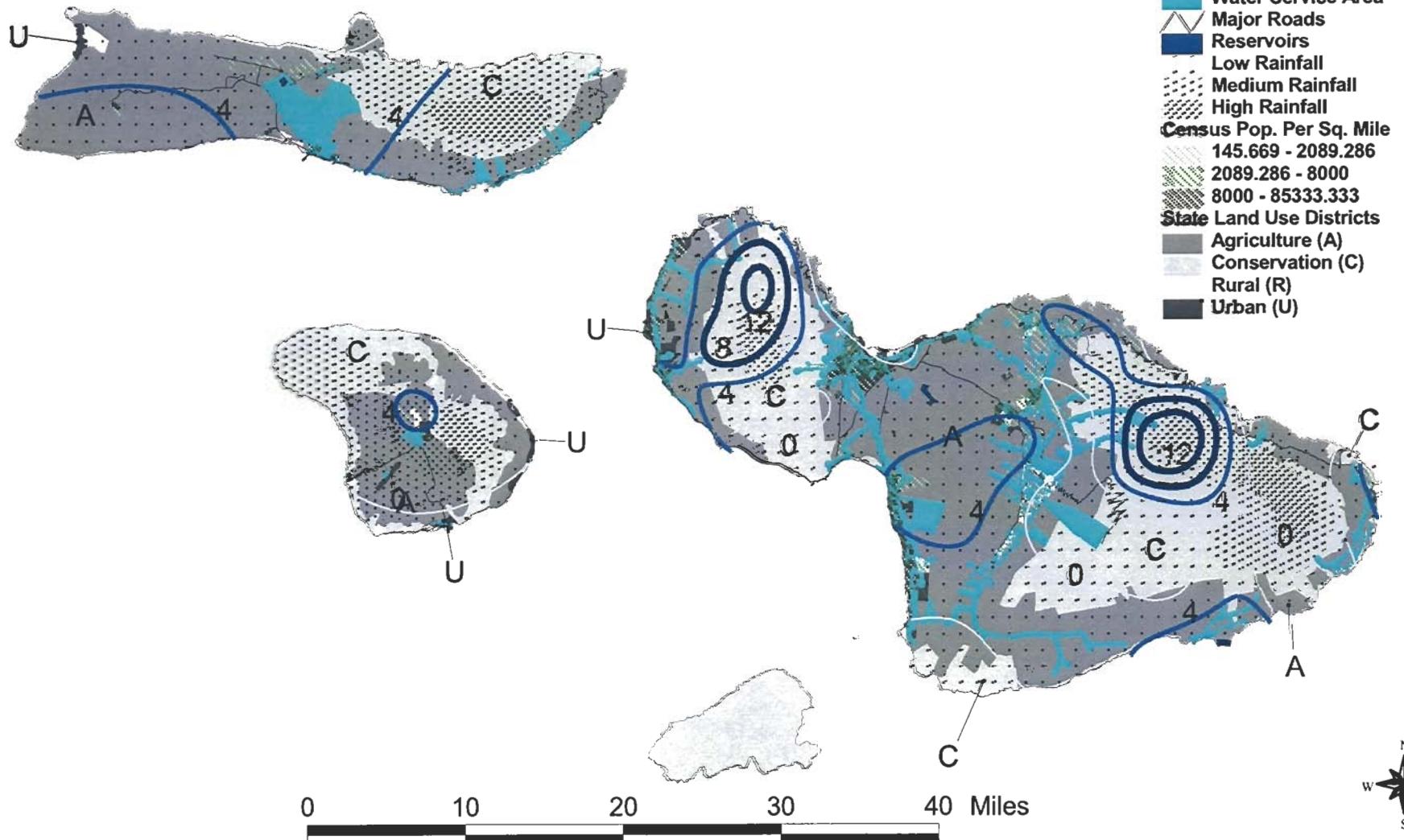
Figure 5.13. Drought Risk Areas Water Supply Sector, County of Maui 12-Month SPI, Moderate Drought



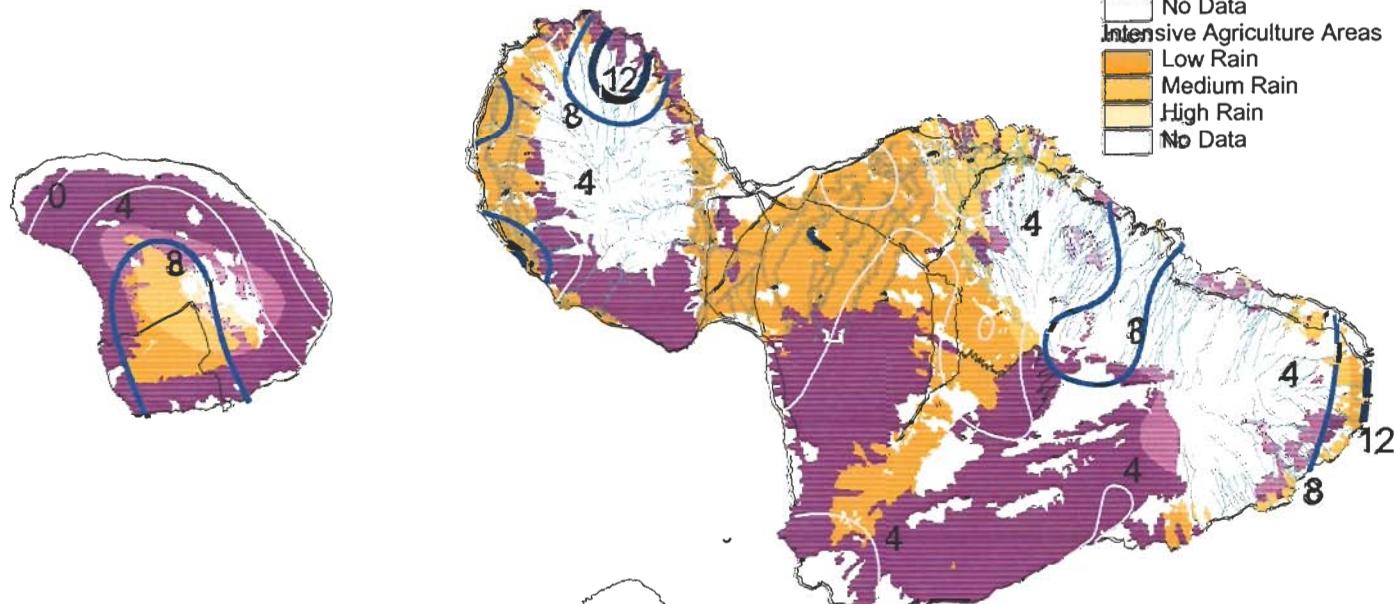
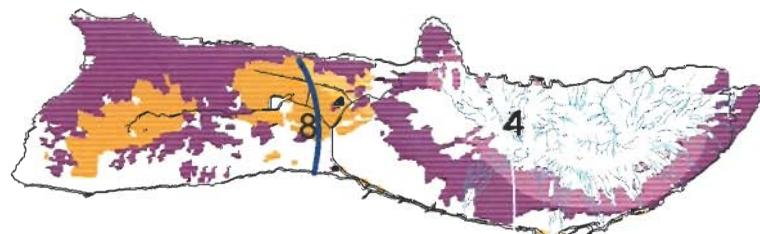
**Figure 5.14. Drought Risk Areas
Water Supply Sector, County of Maui
12-Month SPI, Severe Drought**



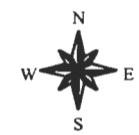
**Figure 5.15. Drought Risk Areas
Water Supply Sector, County of Maui
12-Month SPI, Extreme Drought**



**Figure 5.16. Drought Risk Areas
Agriculture Sector, County of Maui
3-Month SPI, Moderate Drought**



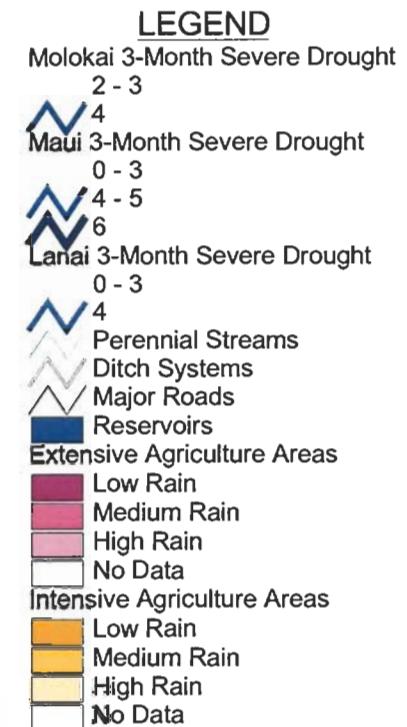
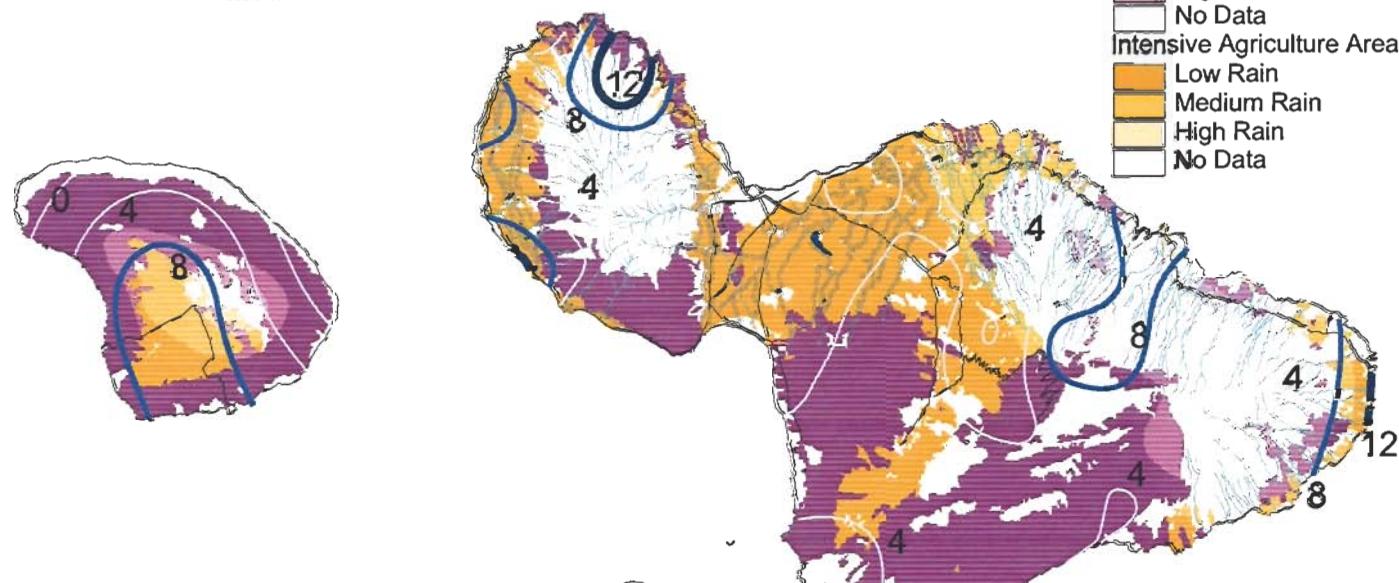
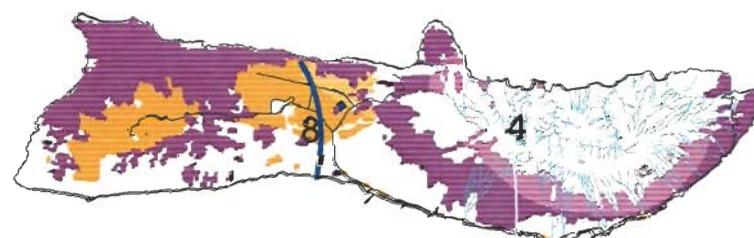
0 10 20 30 40 Miles



LEGEND

- Molokai 3-Month Moderate Drought
4 - 7
8
- Maui 3-Month Moderate Drought
0 - 7
8 - 9
10 - 12
- Lanai 3-Month Moderate Drought
0 - 7
8
- Perennial Streams
- Ditch Systems
- Major Roads
- Reservoirs
- Extensive Agriculture Areas
 - Low Rain
 - Medium Rain
 - High Rain
 - No Data
- Intensive Agriculture Areas
 - Low Rain
 - Medium Rain
 - High Rain
 - No Data

**Figure 5.17. Drought Risk Areas
Agriculture Sector, County of Maui
3-Month SPI, Severe Drought**



0 10 20 30 40 Miles



**Figure 5.18. Drought Risk Areas
Agriculture Sector, County of Maui
3-Month SPI, Extreme Drought**

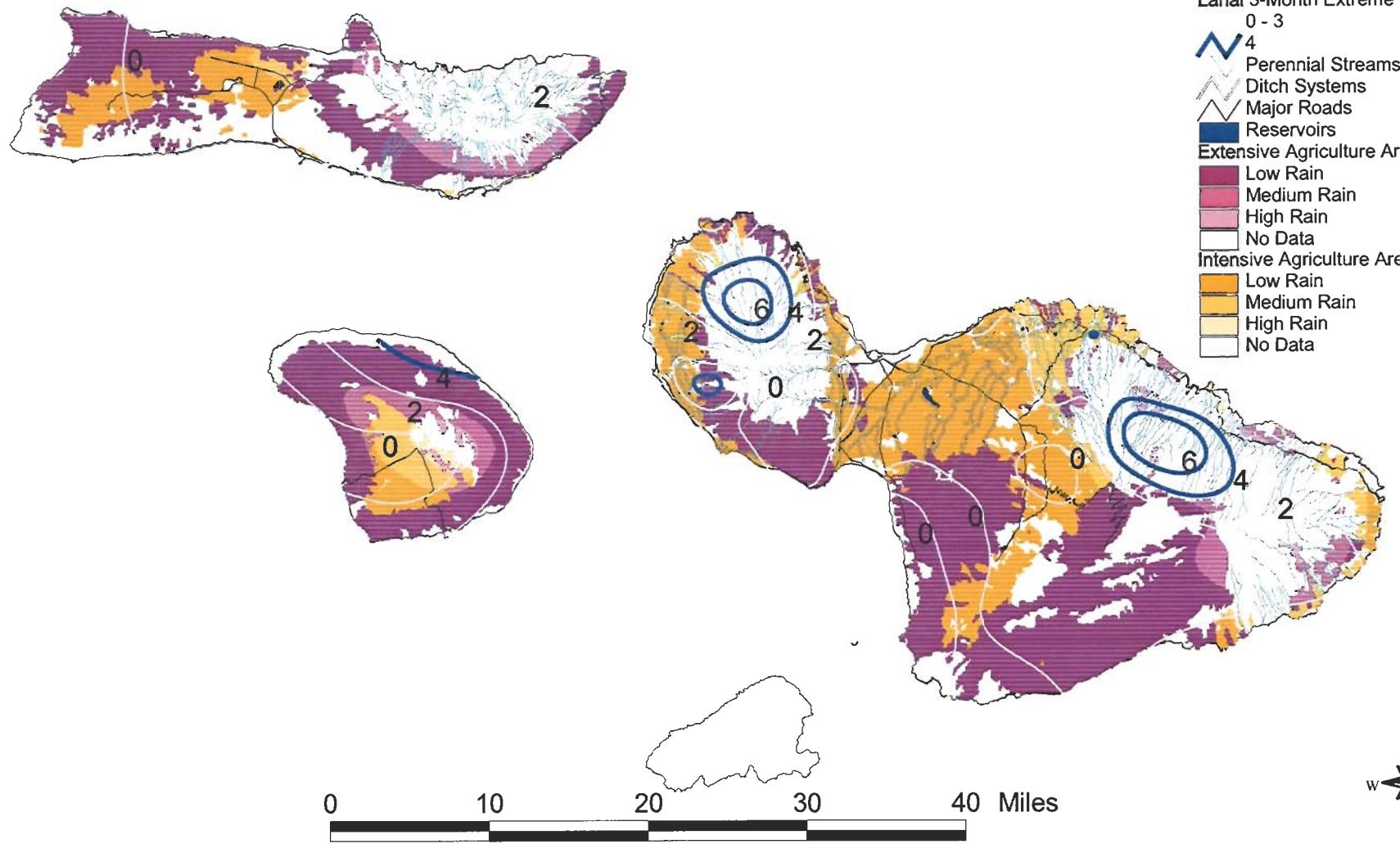


Figure 5.19. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Maui
3-Month SPI, Moderate Drought

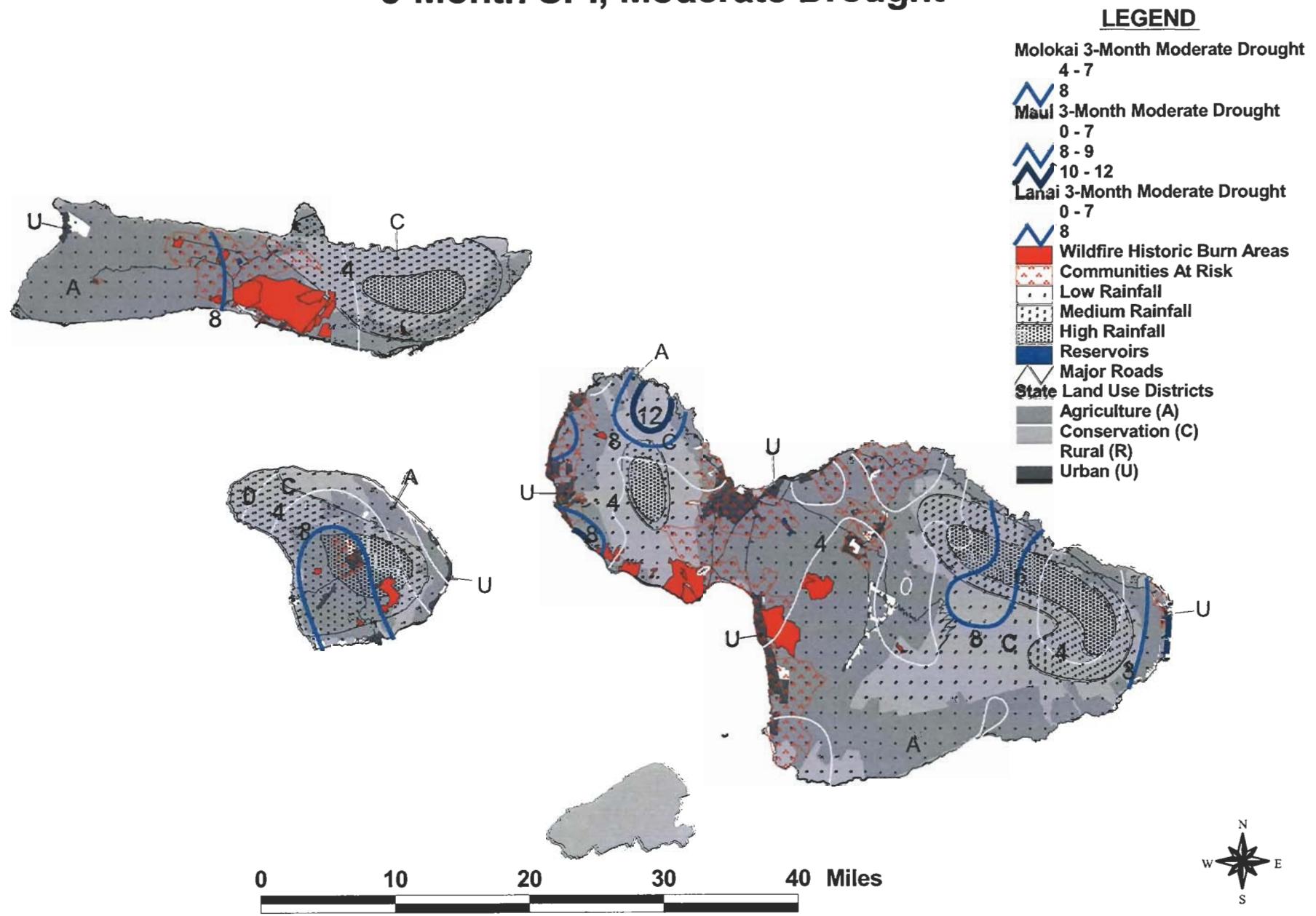


Figure 5.20. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Maui
3-Month SPI, Severe Drought

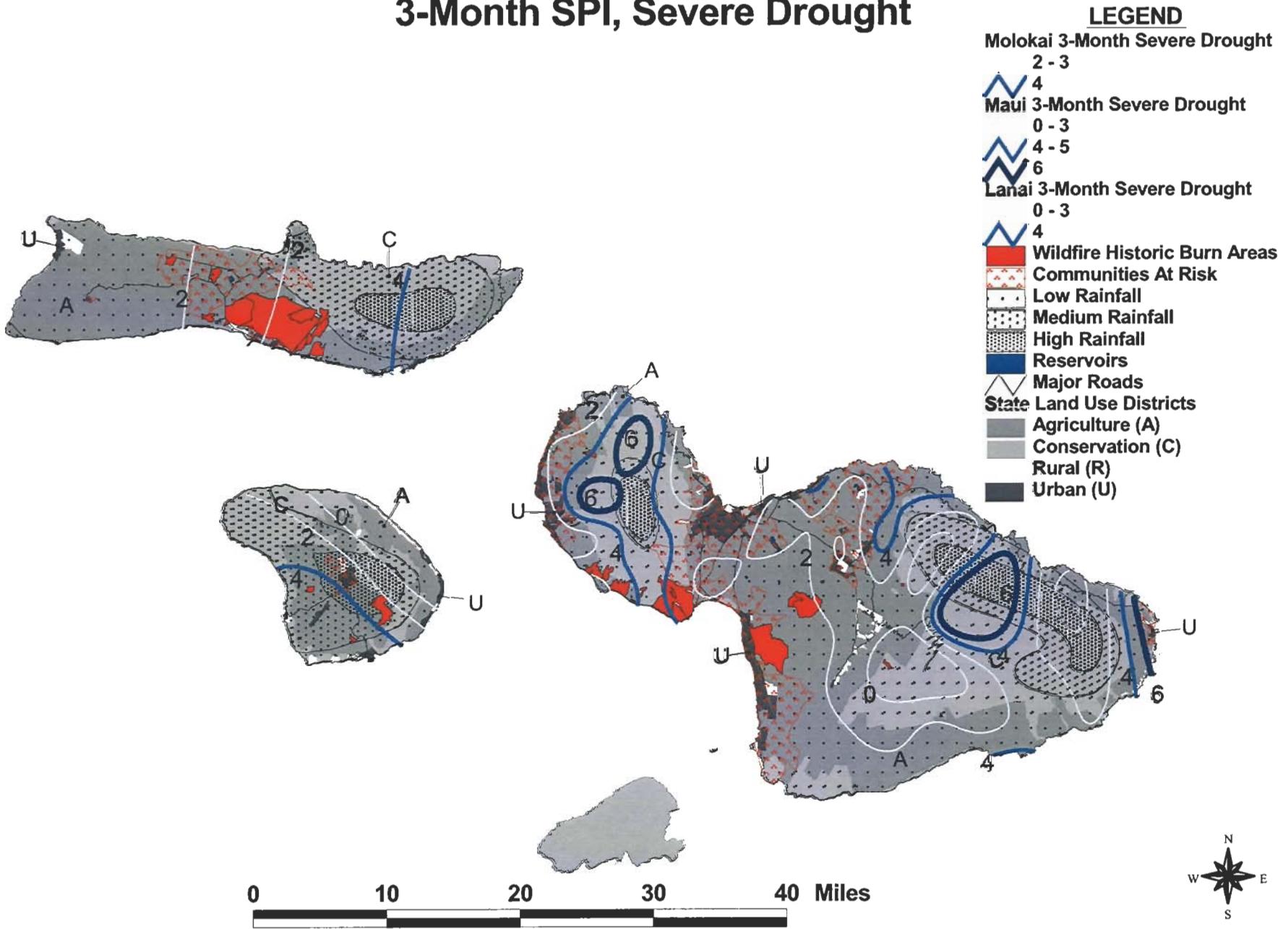


Figure 5.21. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Maui
3-Month SPI, Extreme Drought

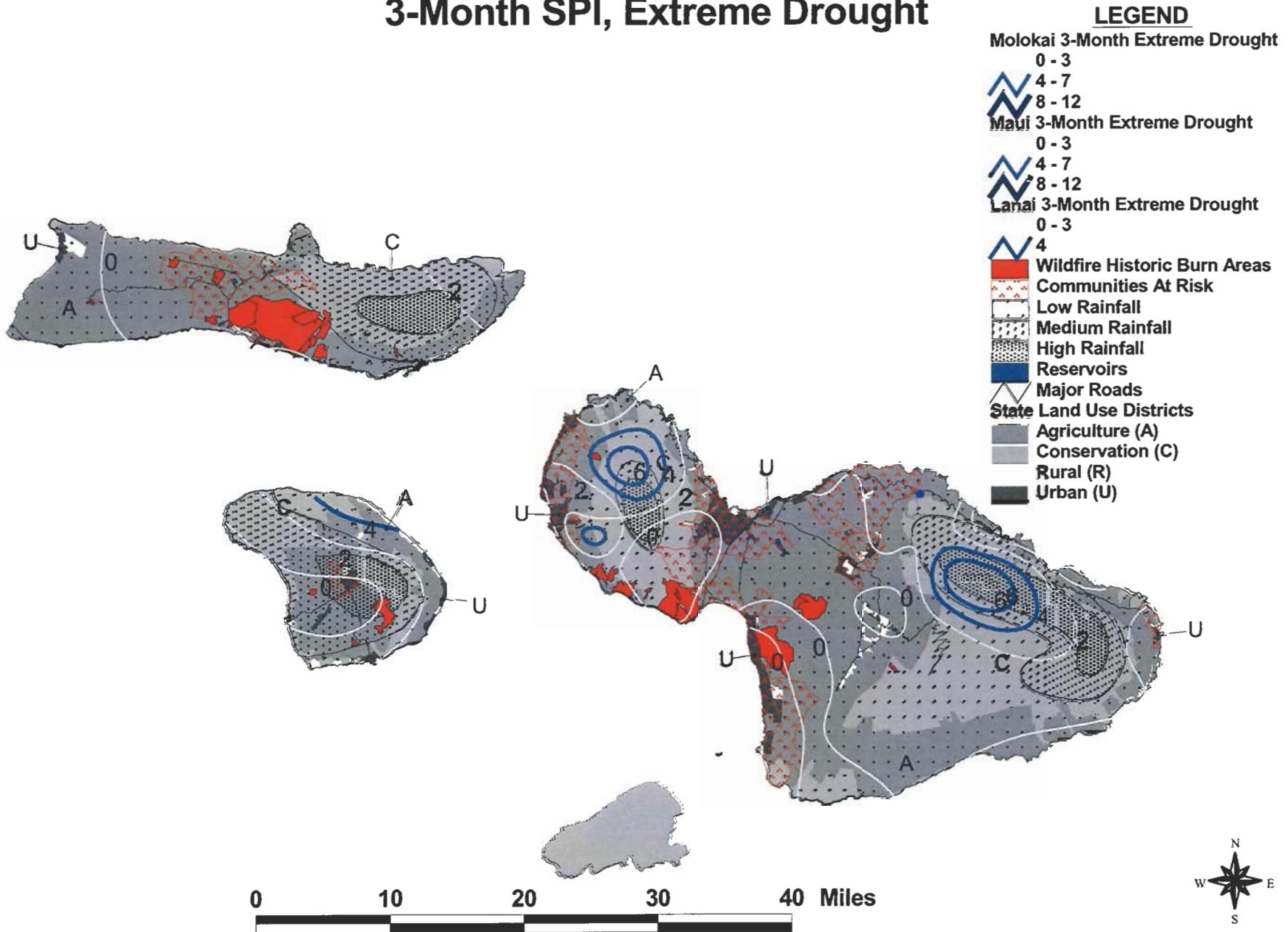


Figure 5.22. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Maui
12-Month SPI, Moderate Drought

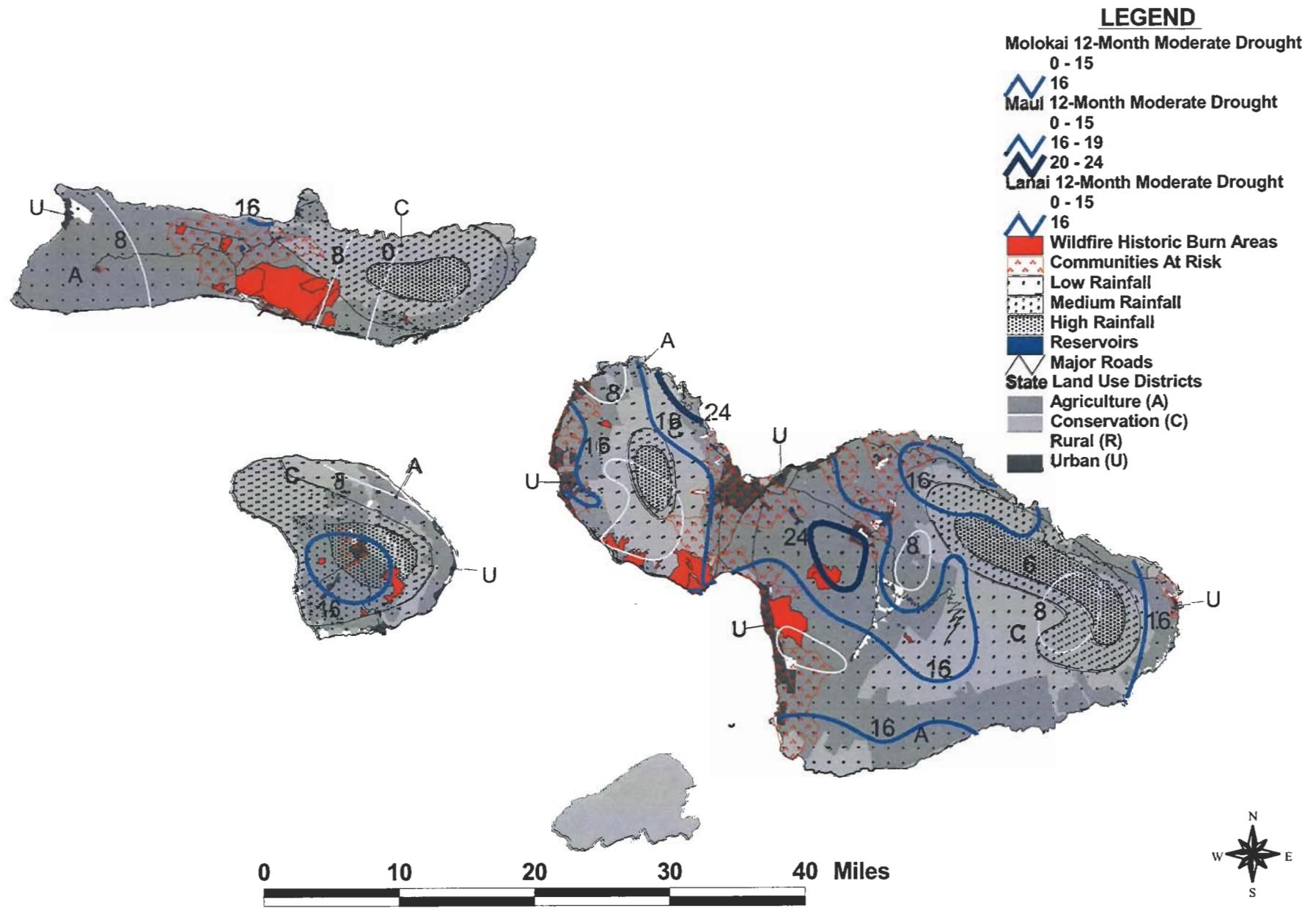
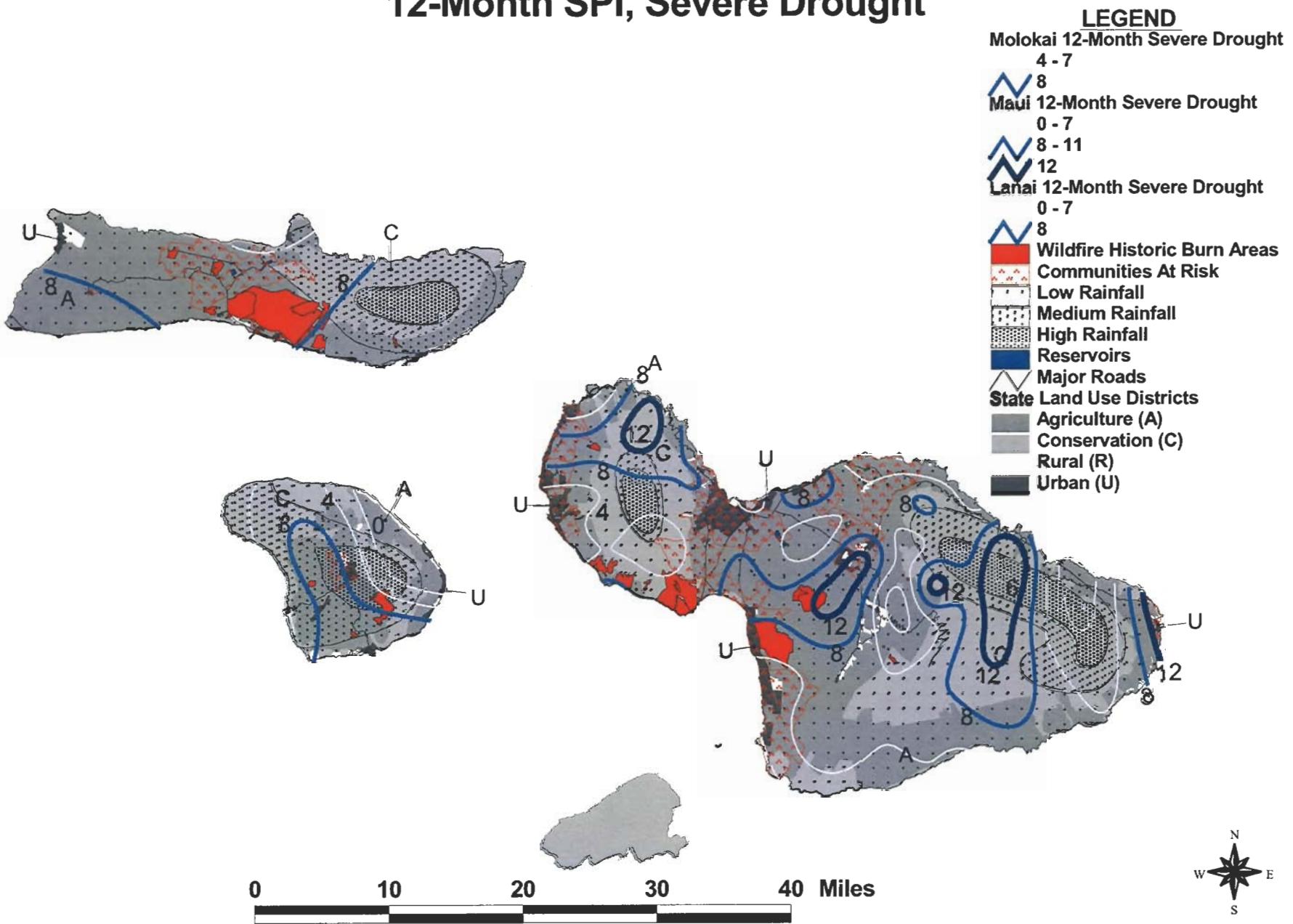


Figure 5.23. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Maui
12-Month SPI, Severe Drought



**Figure 5.24. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Maui
12-Month SPI, Extreme Drought**

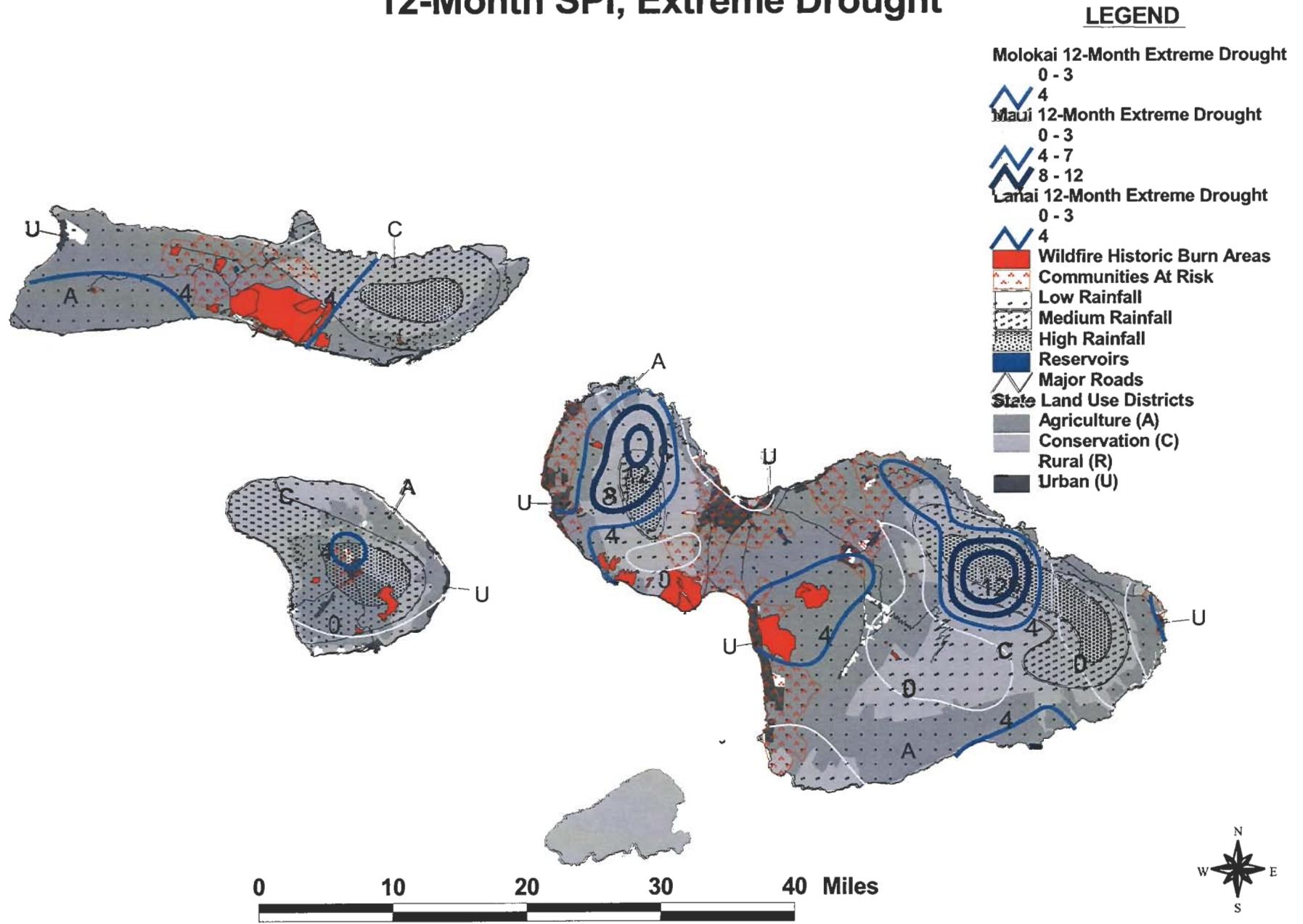


Figure 5.25. Drought Risk Areas
Water Supply Sector, City and County of Honolulu
12-Month SPI, Moderate Drought

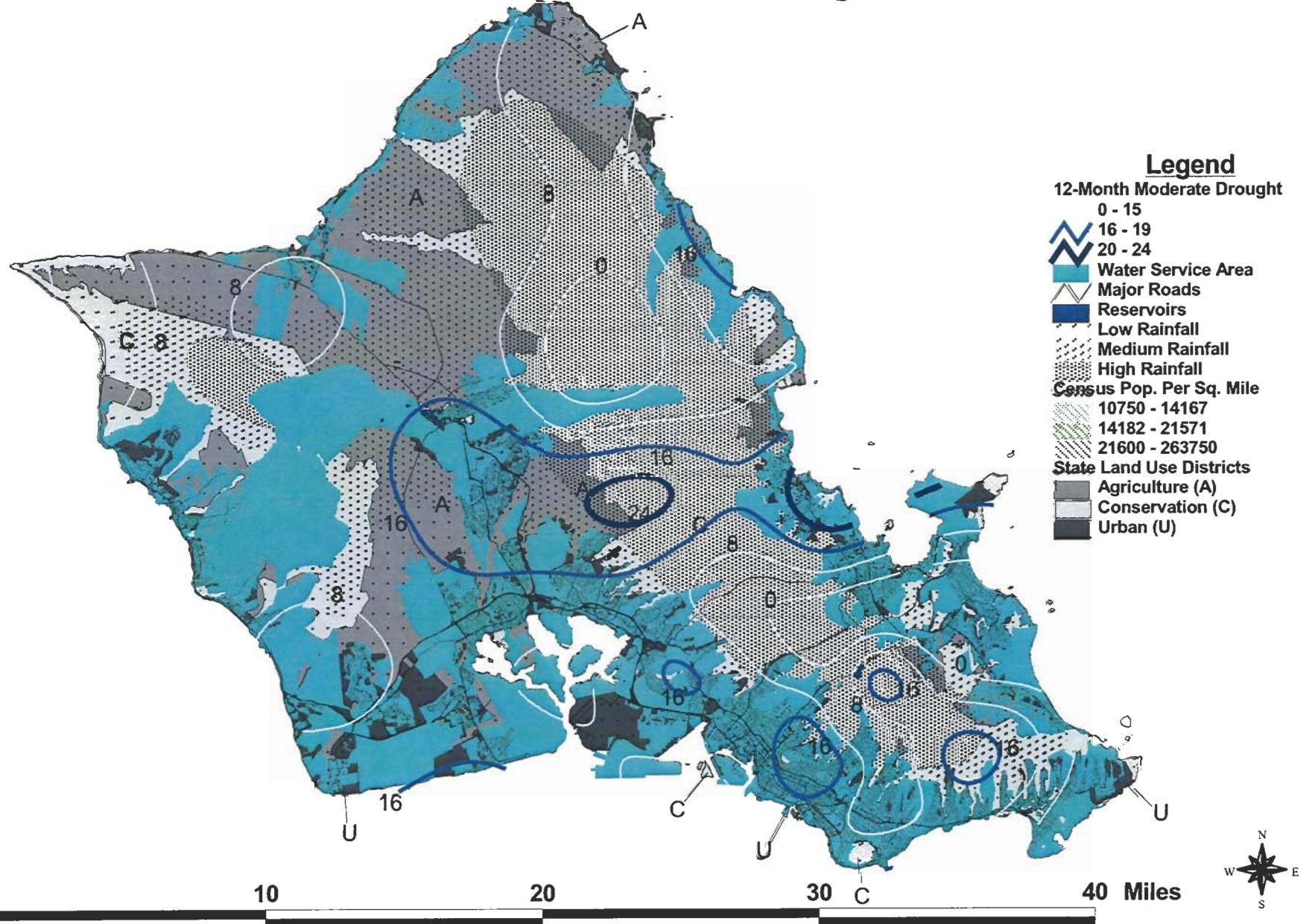


Figure 5.26. Drought Risk Areas
Water Supply Sector, City and County of Honolulu
12-Month SPI, Severe Drought

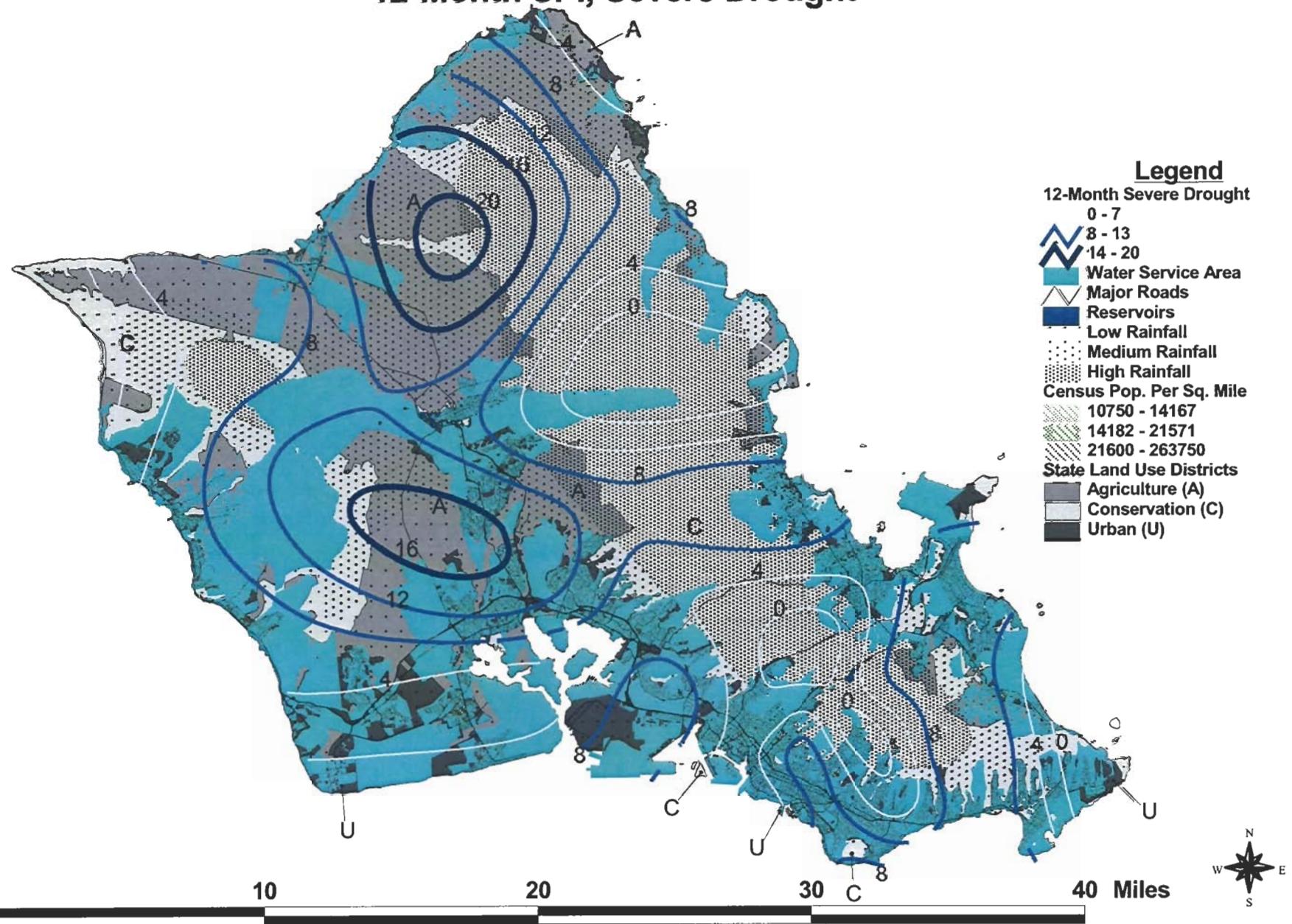


Figure 5.27. Drought Risk Areas
Water Supply Sector, City and County of Honolulu
12-Month SPI, Extreme Drought

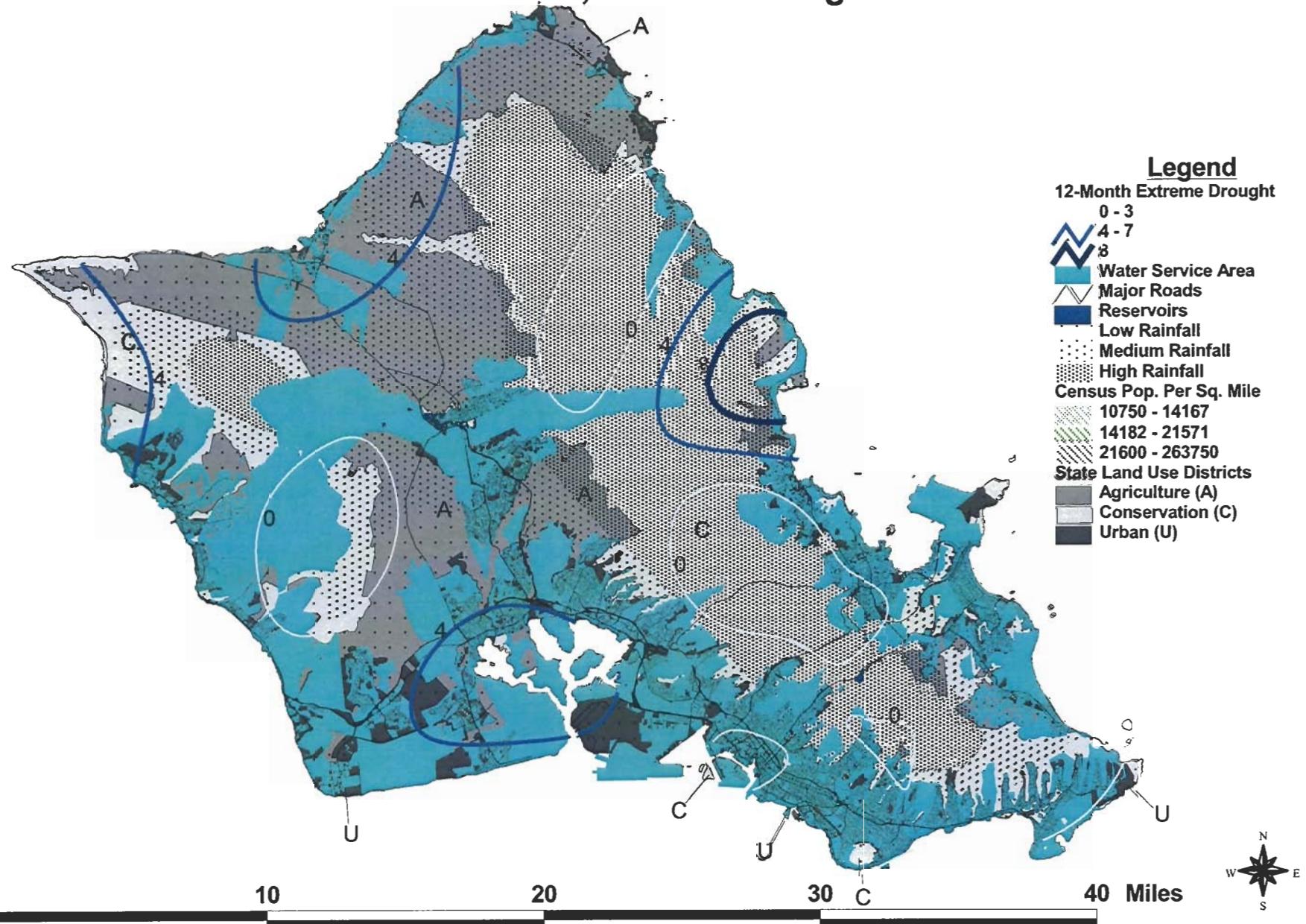


Figure 5.28. Drought Risk Areas
Agriculture Sector, City and County of Honolulu
3-Month SPI, Moderate Drought

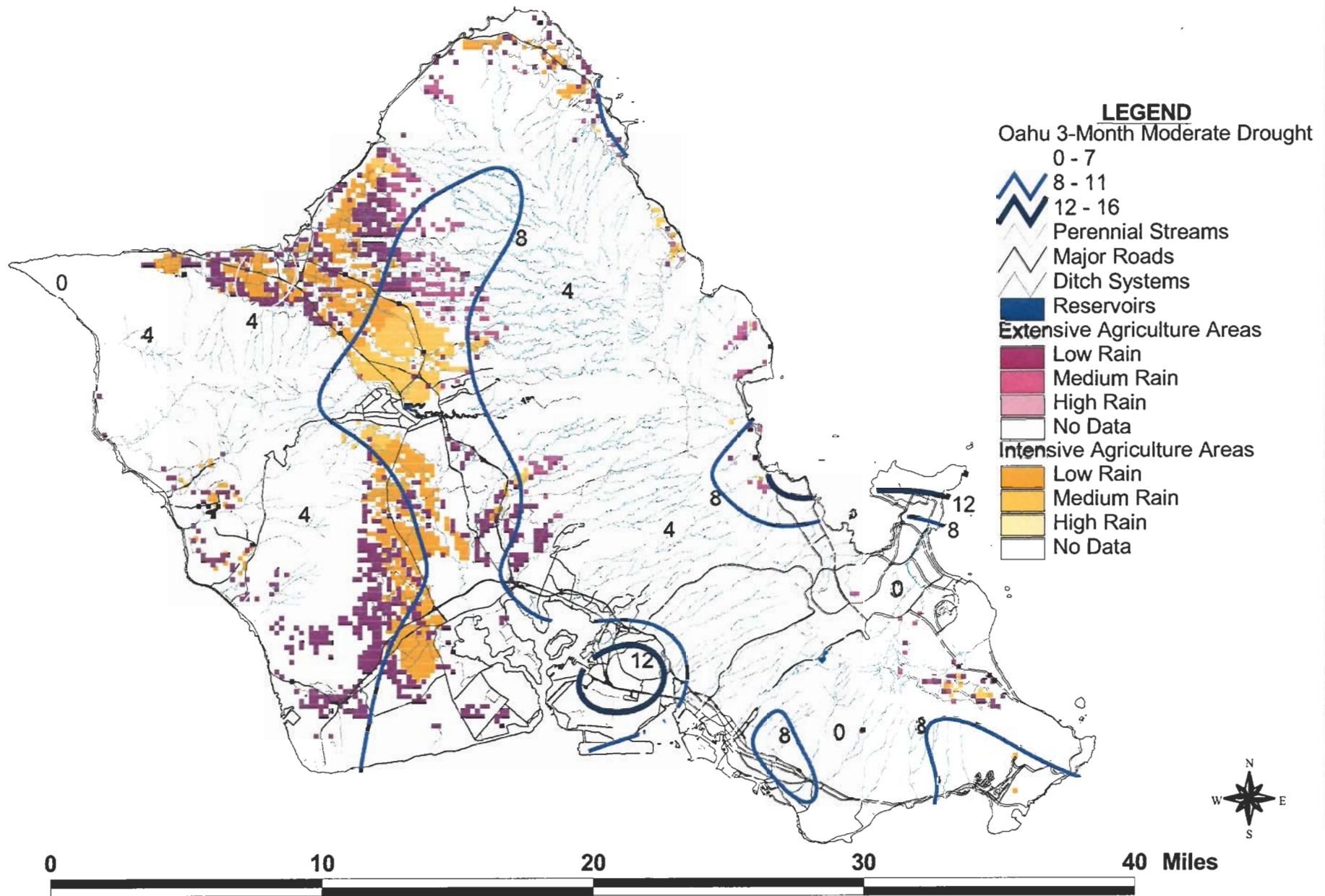


Figure 5.29. Drought Risk Areas
Agriculture Sector, City and County of Honolulu
3-Month SPI, Severe Drought

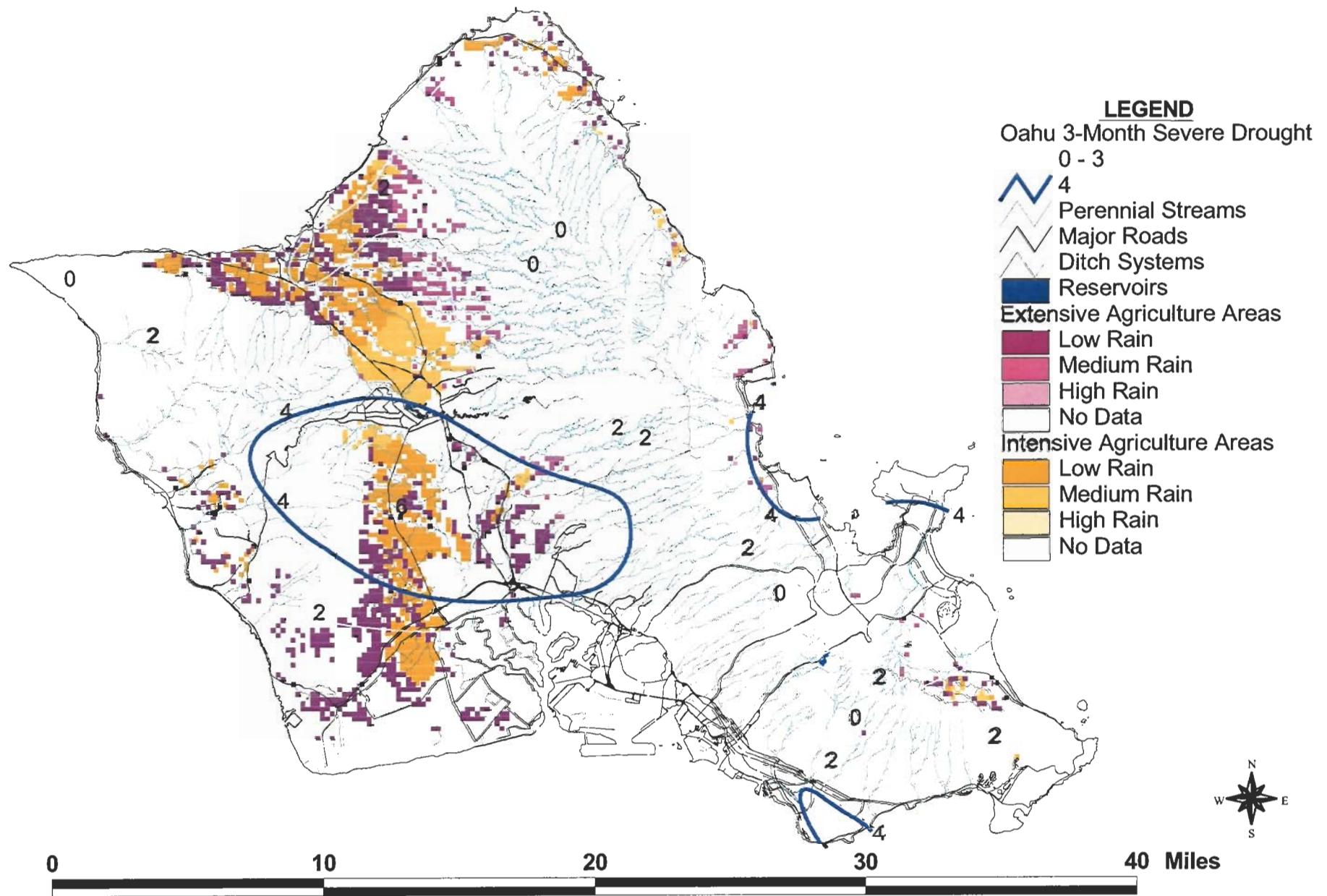


Figure 5.30. Drought Risk Areas
Agriculture Sector, City and County of Honolulu
3-Month SPI, Extreme Drought

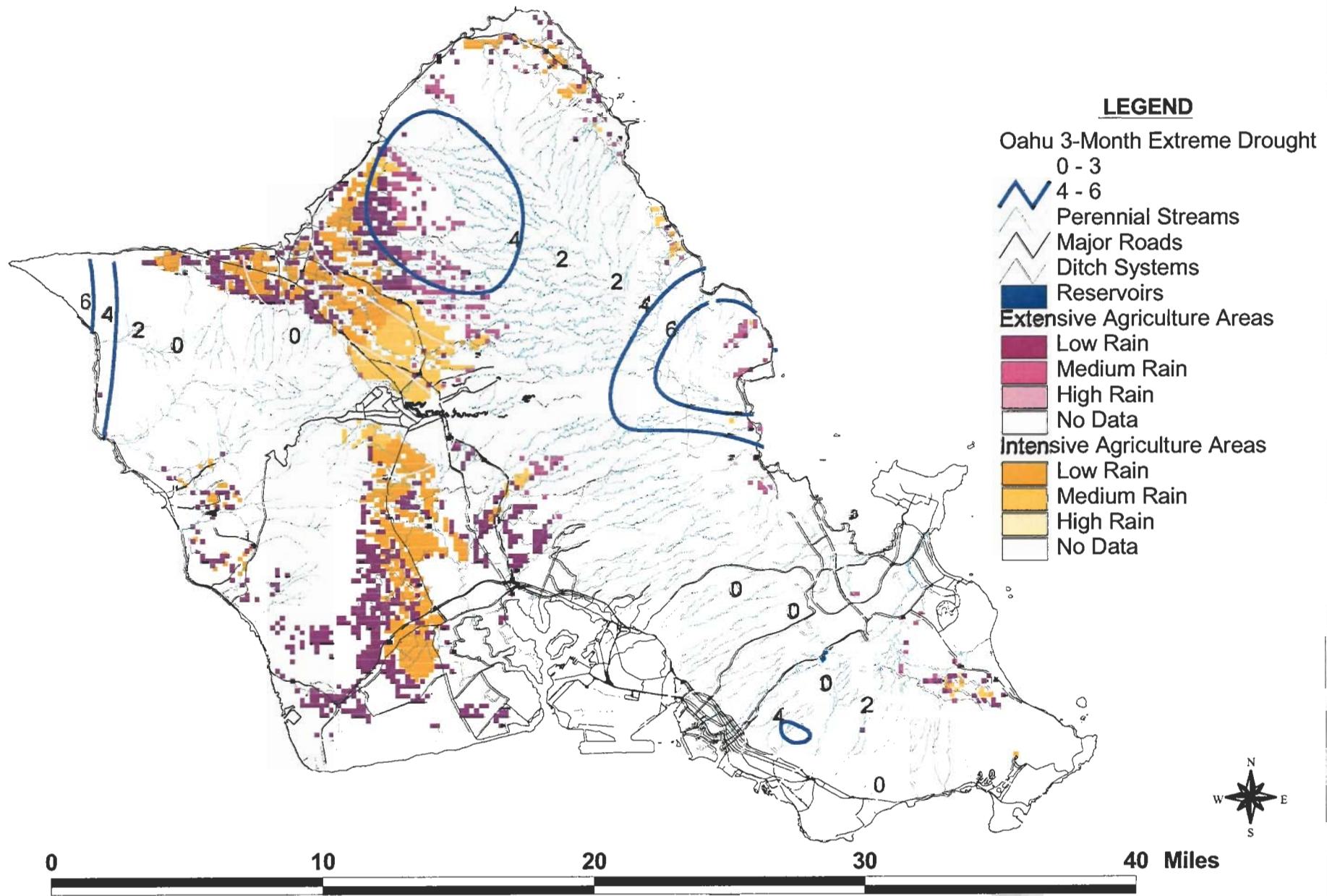


Figure 5.31. Drought Risk Areas
Environment, Public Health, and Safety Sector, City and County of Honolulu
3-Month SPI, Moderate Drought

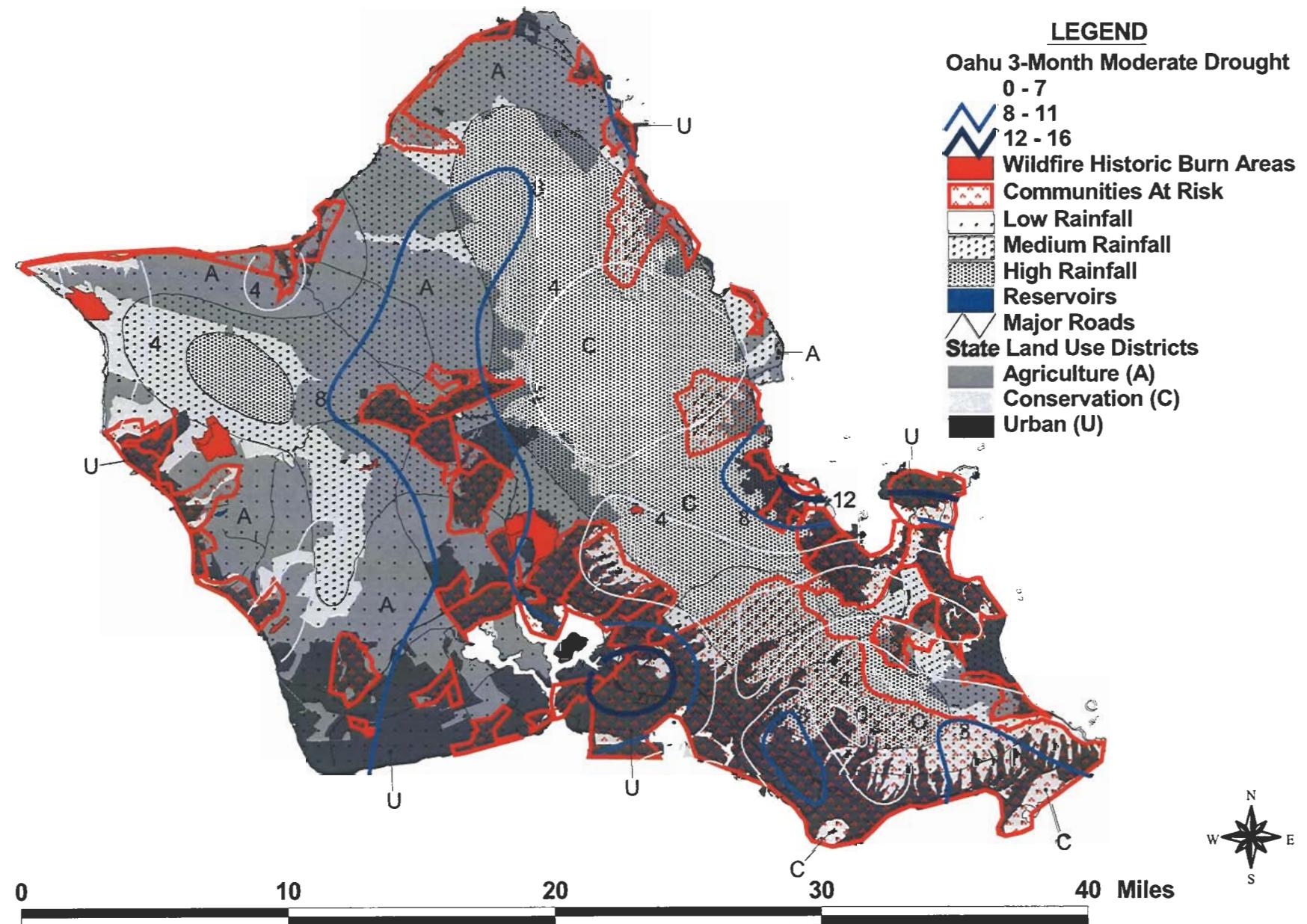


Figure 5.32. Drought Risk Areas
Environment, Public Health, and Safety Sector, City and County of Honolulu
3-Month SPI, Severe Drought

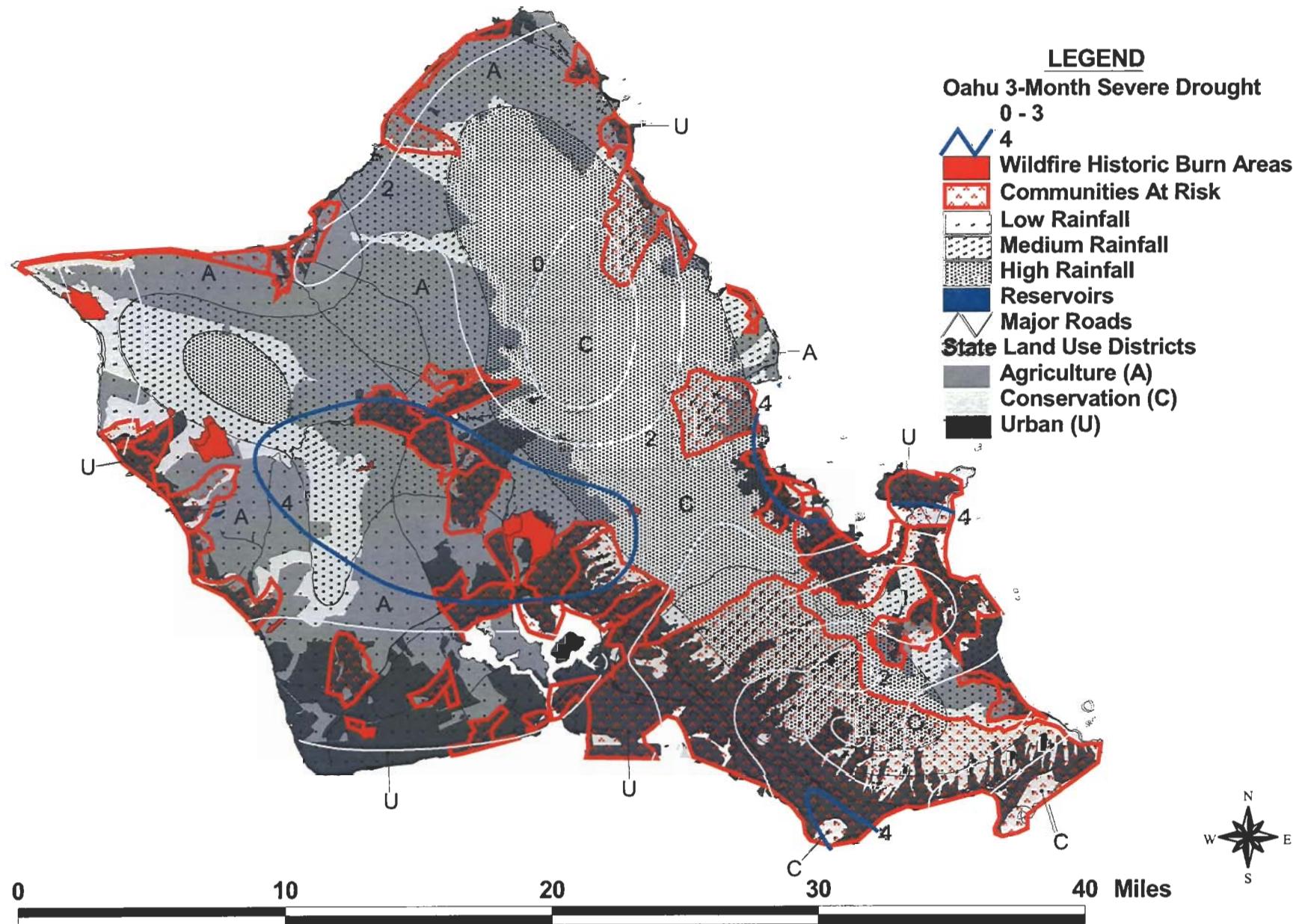


Figure 5.33. Drought Risk Areas
Environment, Public Health, and Safety Sector, City and County of Honolulu
3-Month SPI, Extreme Drought

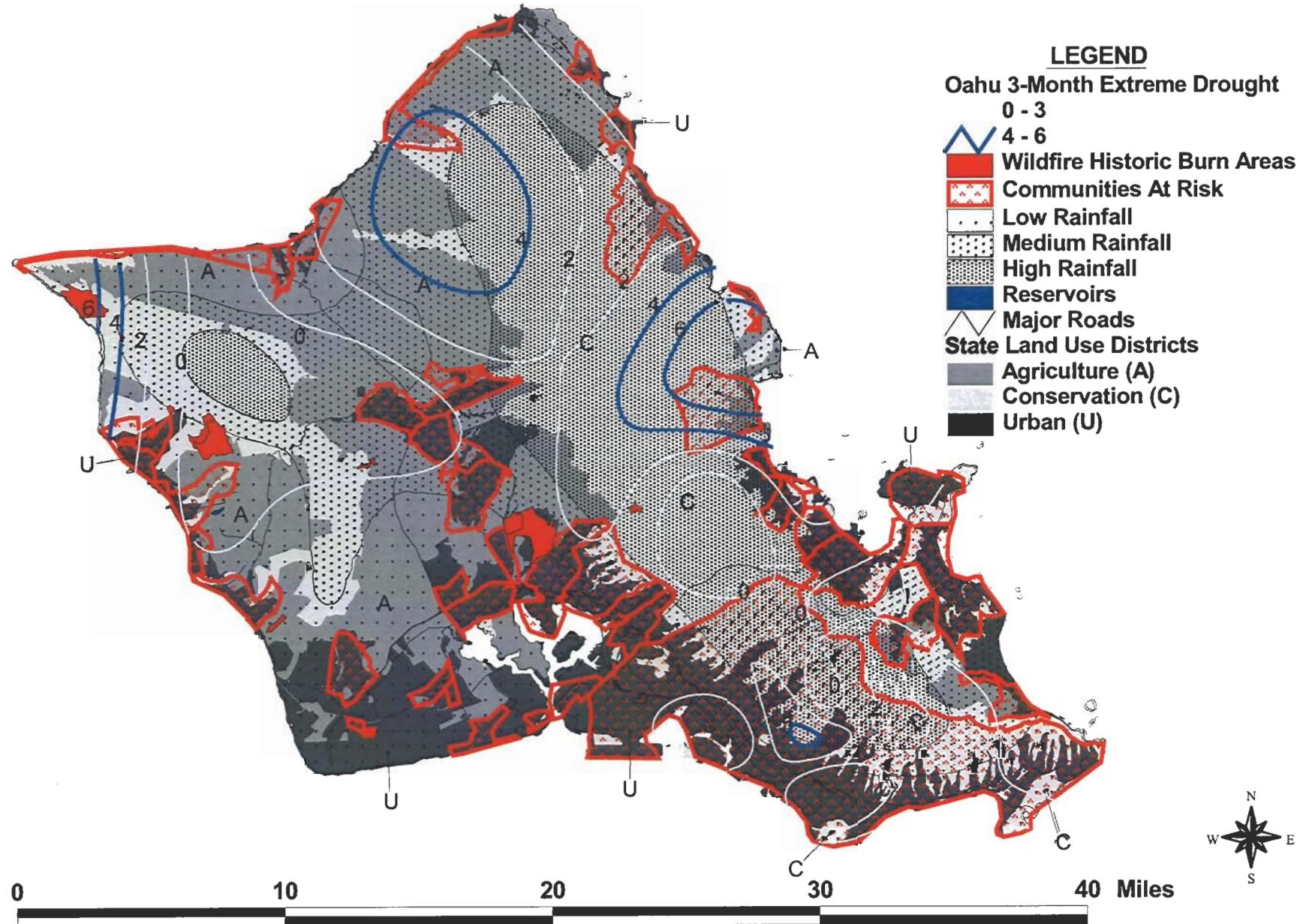


Figure 5.34. Drought Risk Areas
Environment, Public Health, and Safety Sector, City and County of Honolulu
12-Month SPI, Moderate Drought

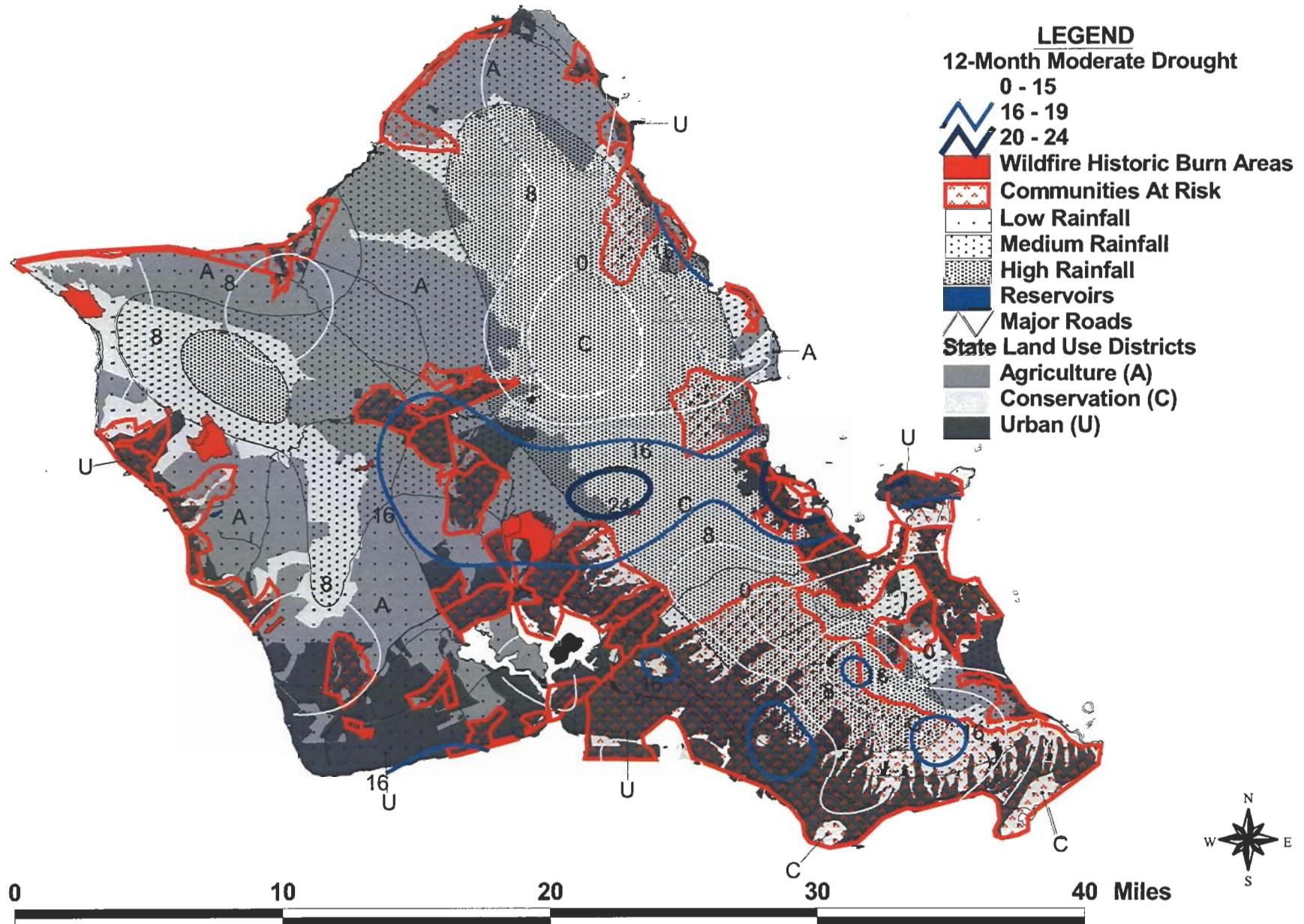


Figure 5.35. Drought Risk Areas
Environment, Public Health, and Safety Sector, City and County of Honolulu
12-Month SPI, Severe Drought

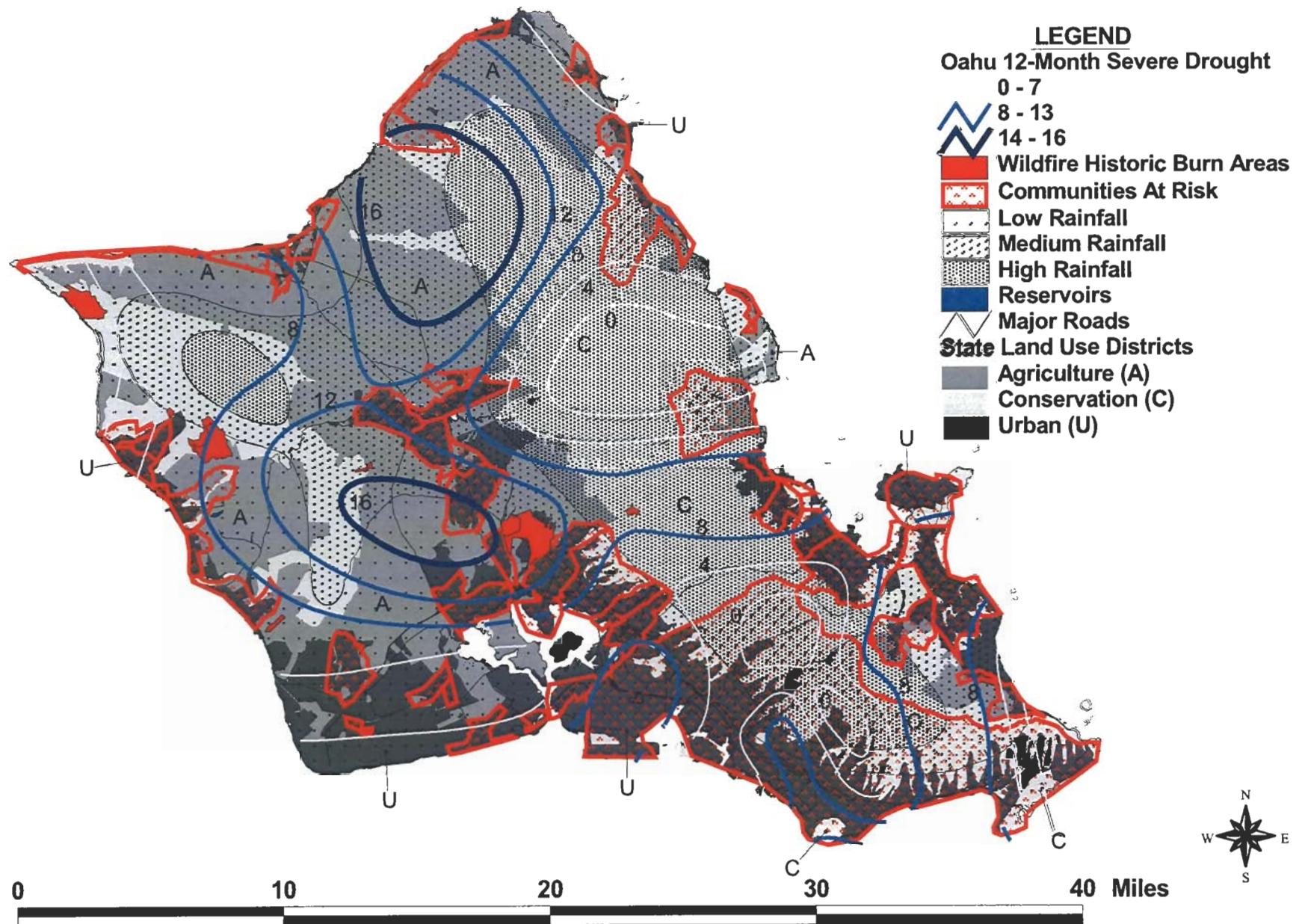
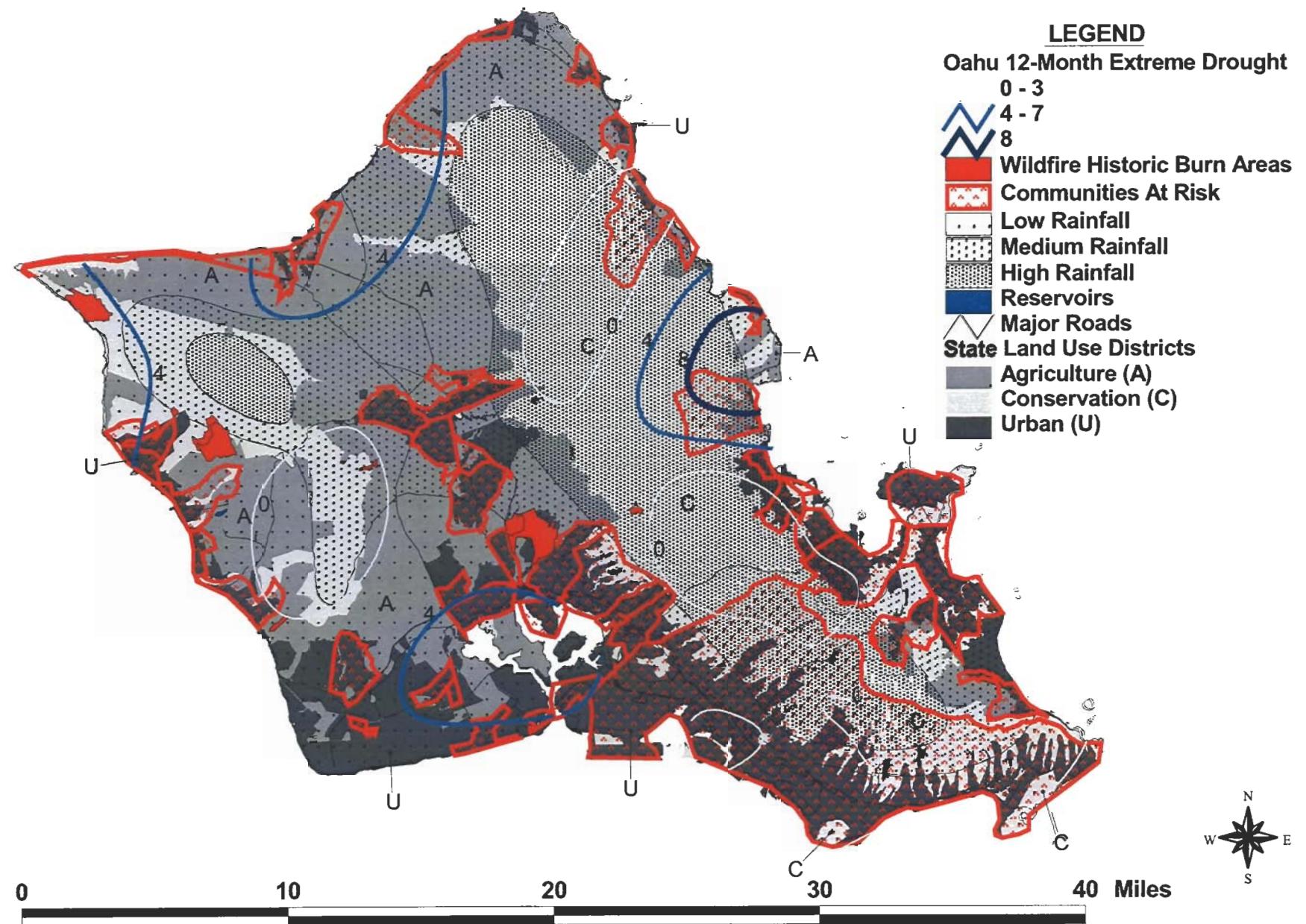
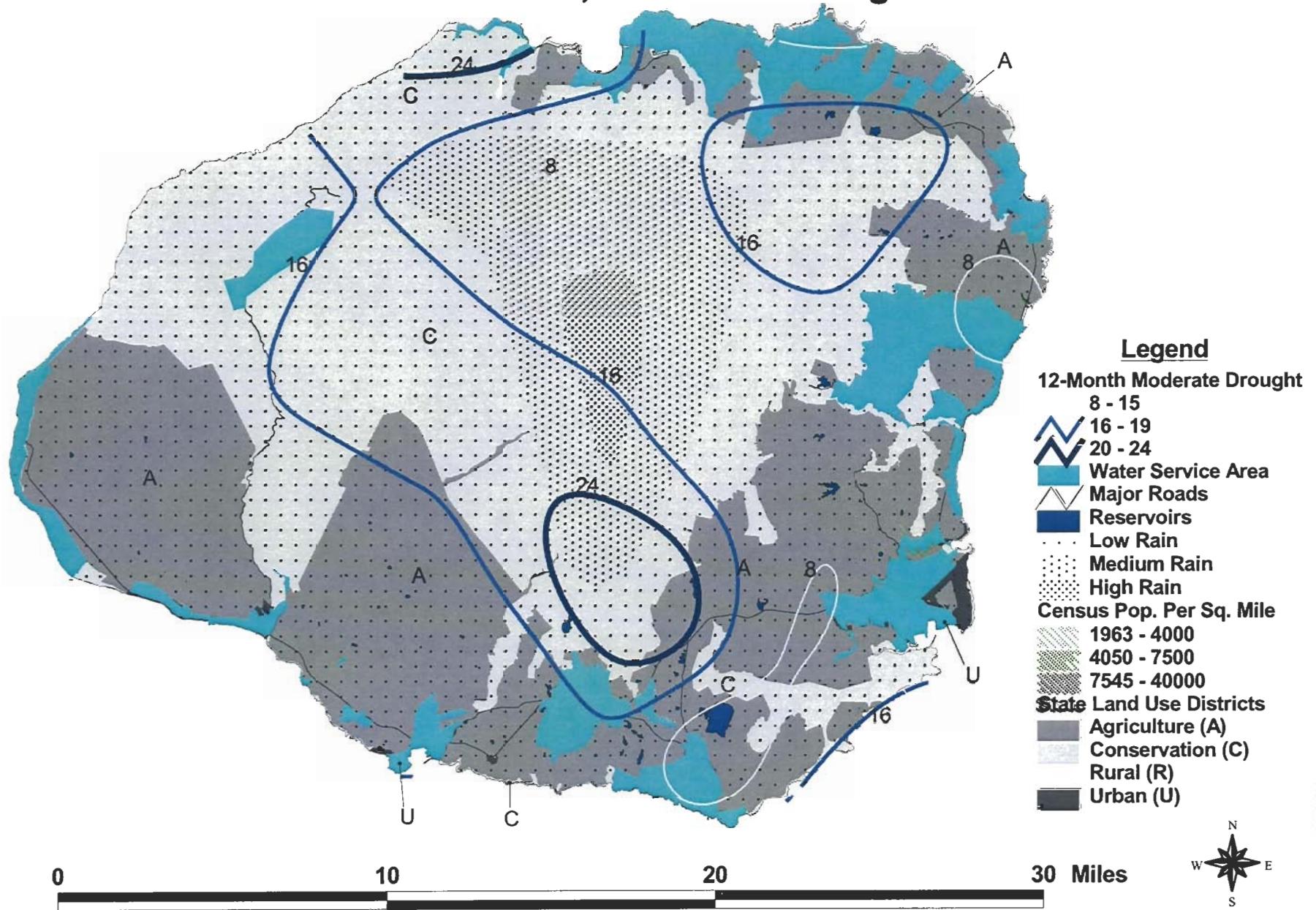


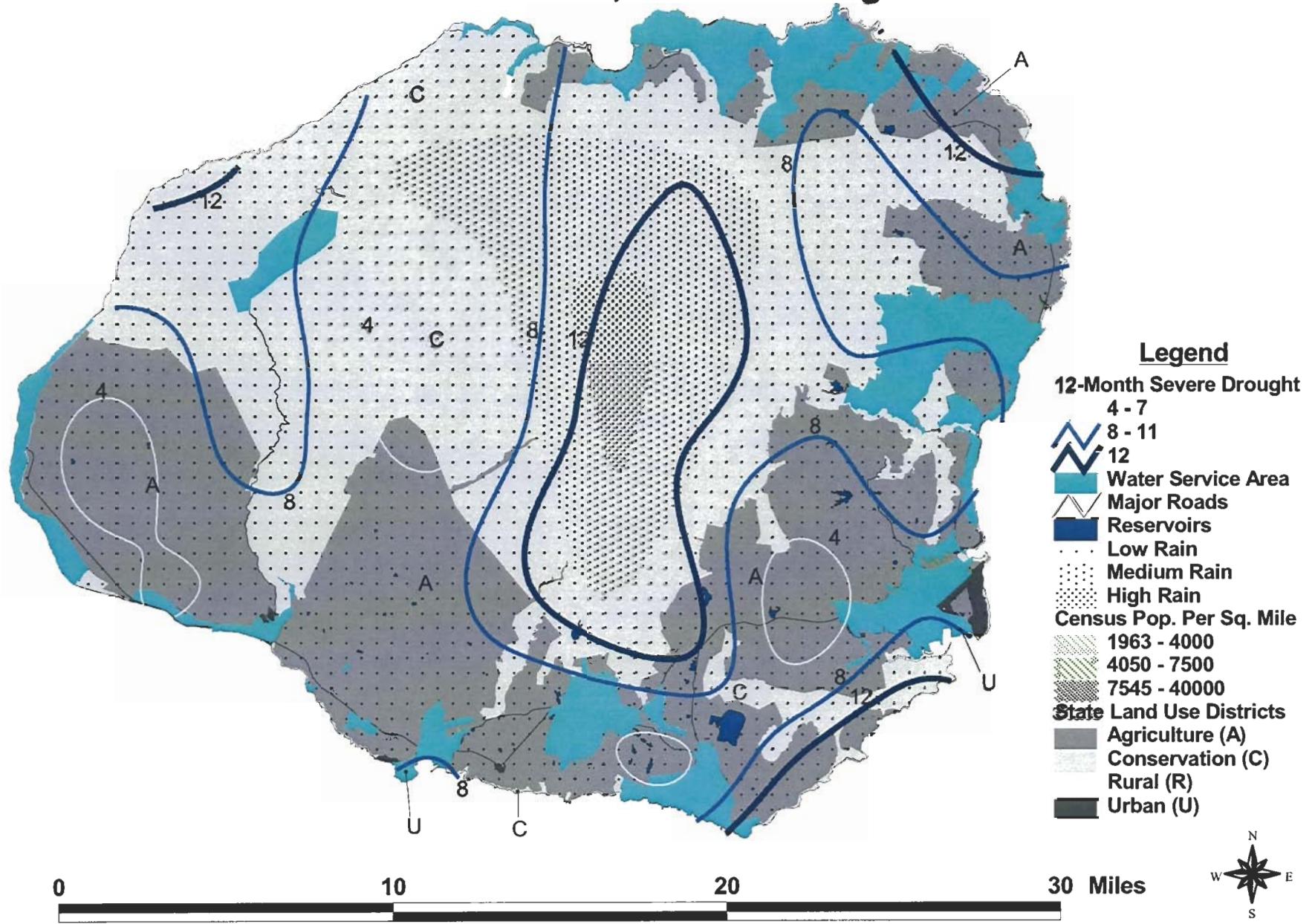
Figure 5.36. Drought Risk Areas
Environment, Public Health, and Safety Sector, City and County of Honolulu
12-Month SPI, Extreme Drought



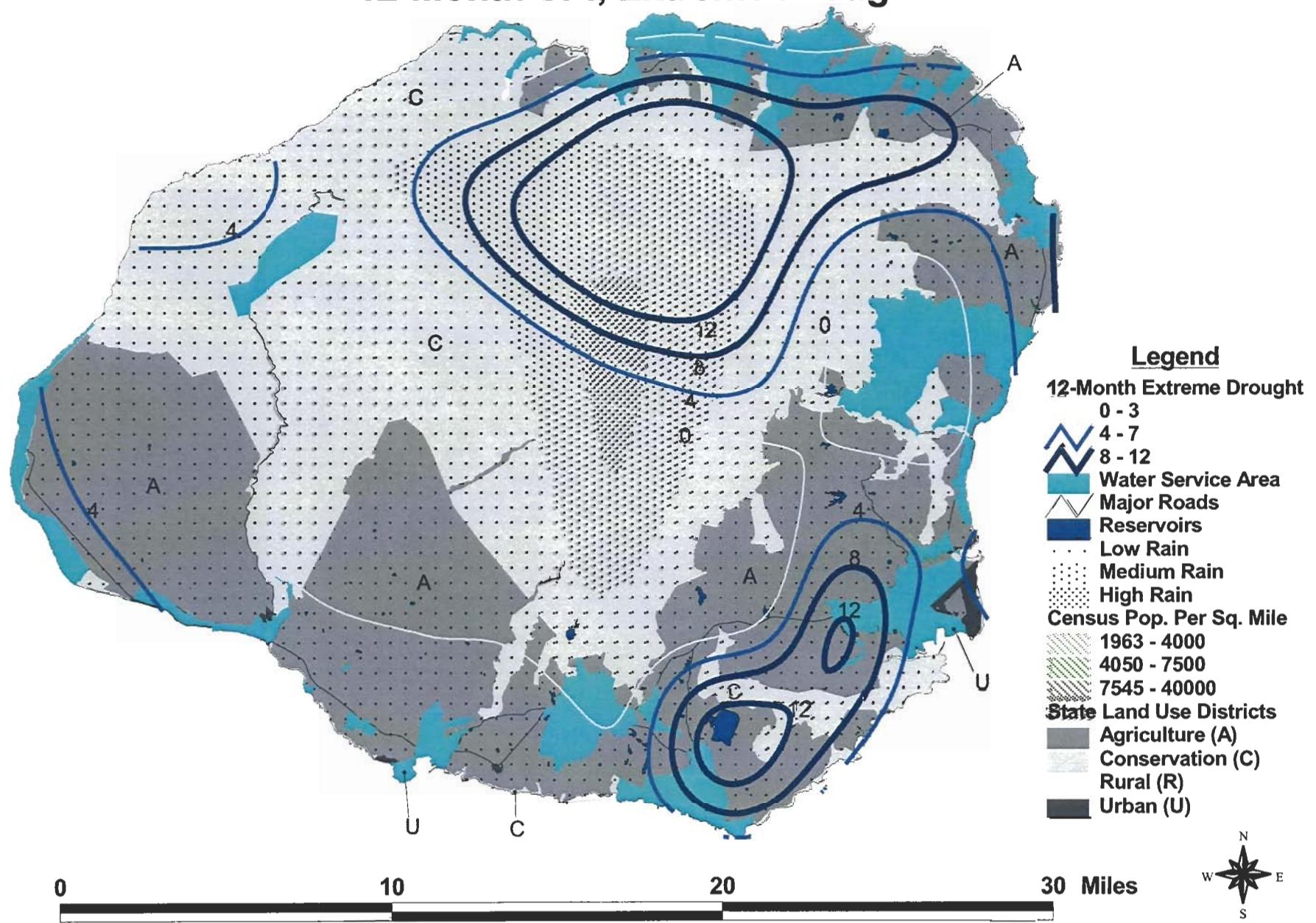
**Figure 5.37. Drought Risk Areas
Water Supply Sector, County Of Kauai
12-Month SPI, Moderate Drought**



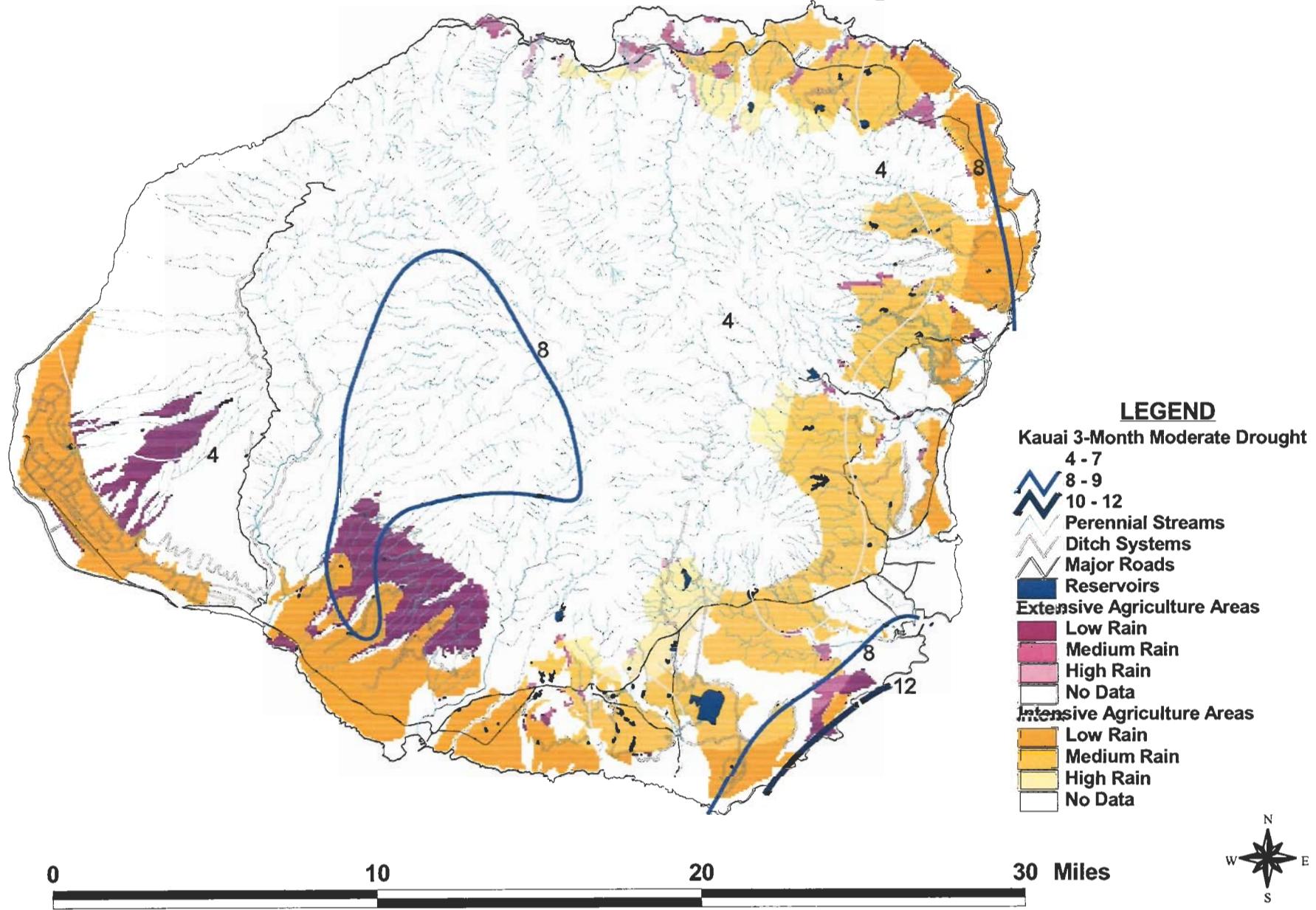
**Figure 5.38. Drought Risk Areas
Water Supply Sector, County Of Kauai
12-Month SPI, Severe Drought**



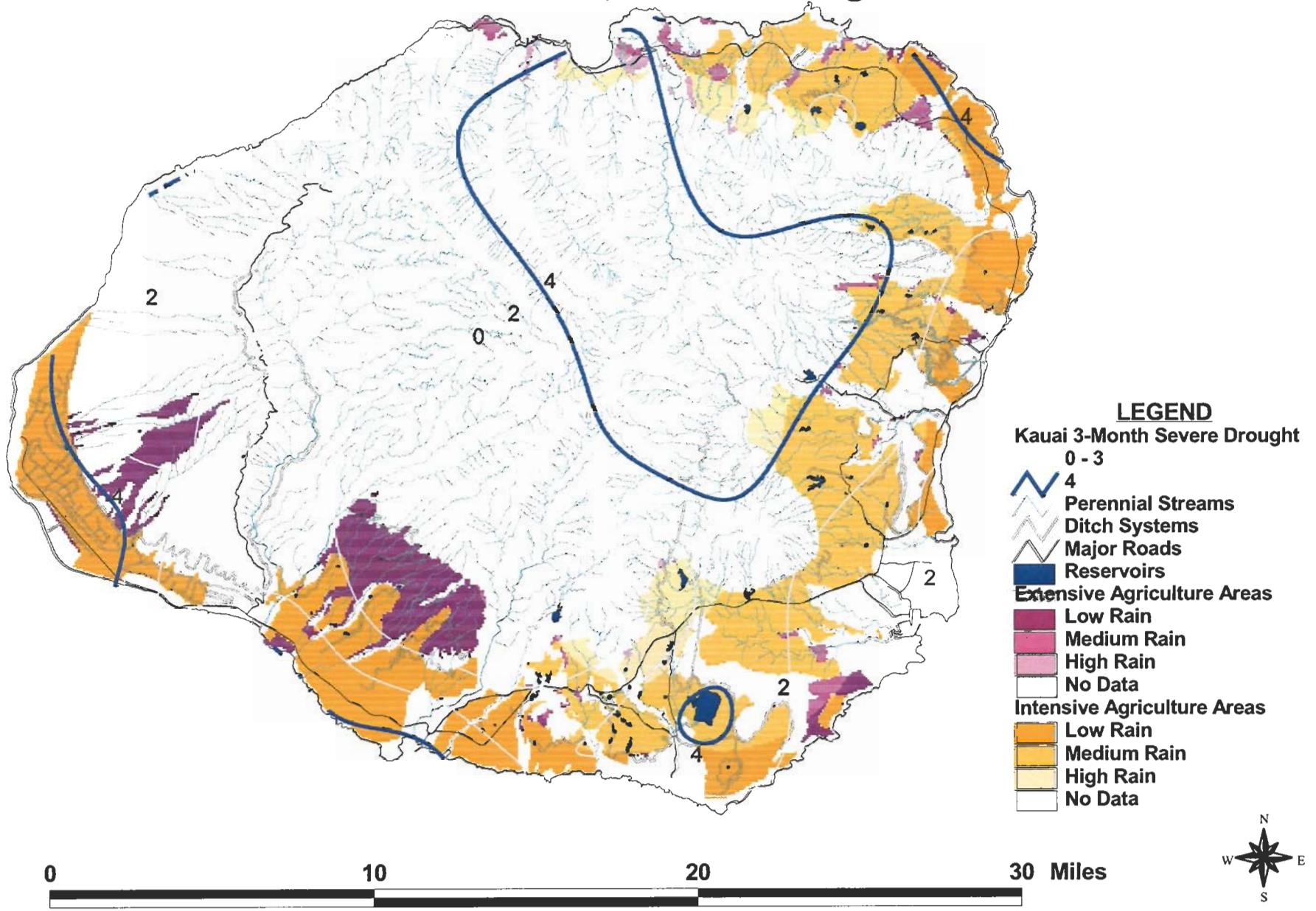
**Figure 5.39. Drought Risk Areas
Water Supply Sector, County Of Kauai
12-Month SPI, Extreme Drought**



**Figure 5.40. Drought Risk Areas
Agriculture Sector, City of Kauai
3-Month SPI, Moderate Drought**



**Figure 5.41. Drought Risk Areas
Agriculture Sector, City of Kauai
3-Month SPI, Severe Drought**



**Figure 5.42. Drought Risk Areas
Agriculture Sector, City of Kauai
3-Month SPI, Extreme Drought**

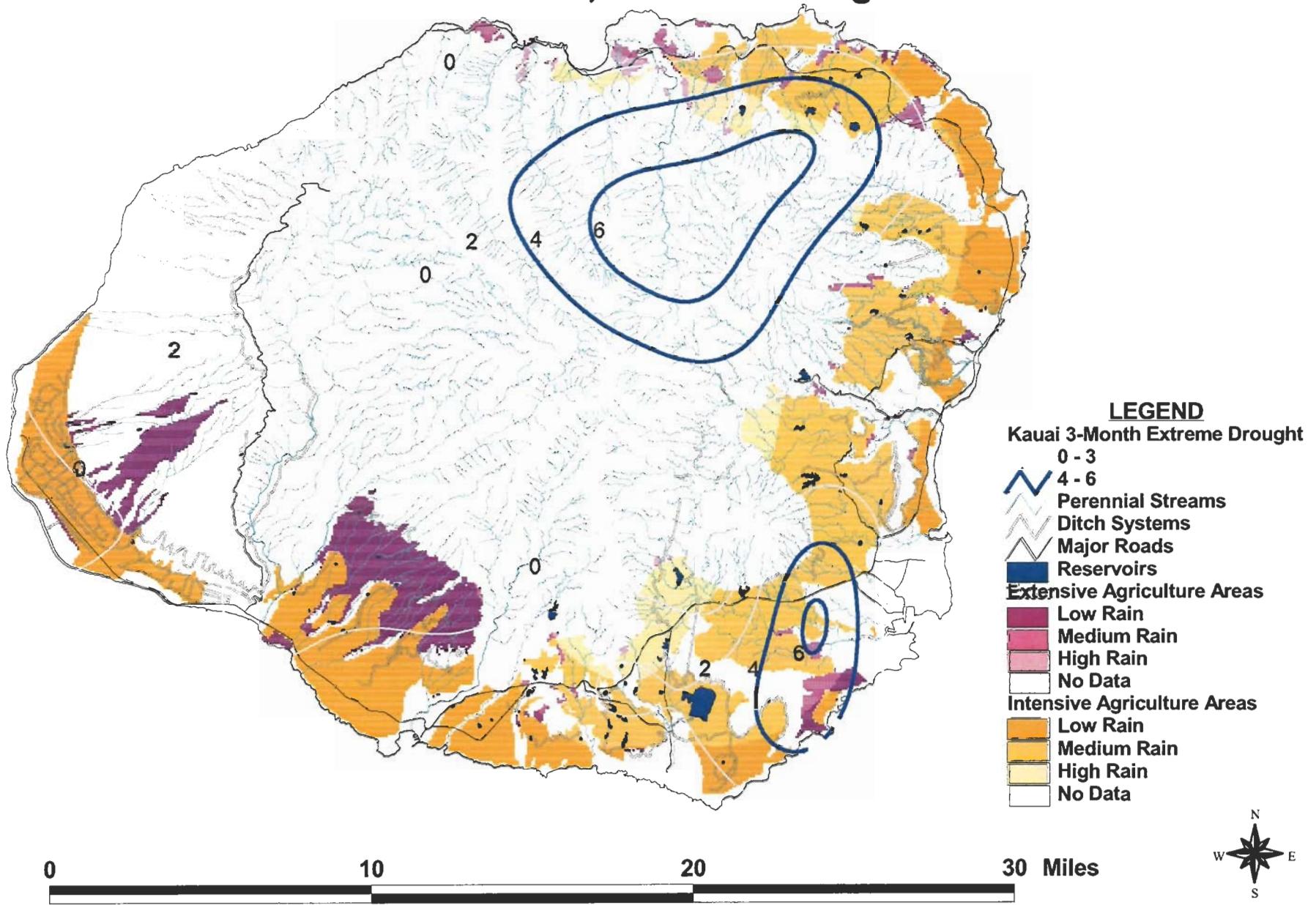


Figure 5.43. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Kauai
3-Month SPI, Moderate Drought

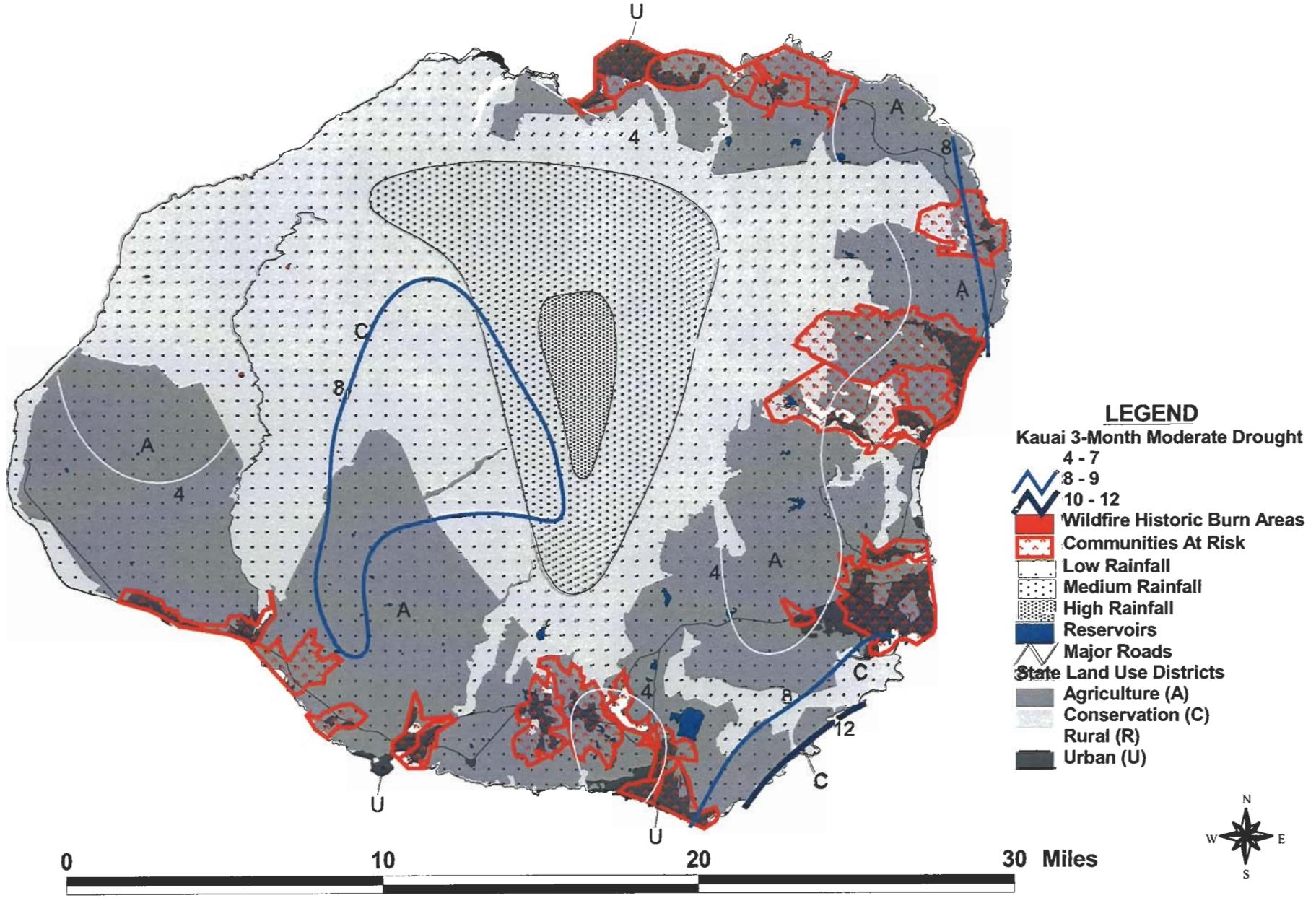


Figure 5.44. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Kauai
3-Month SPI, Severe Drought

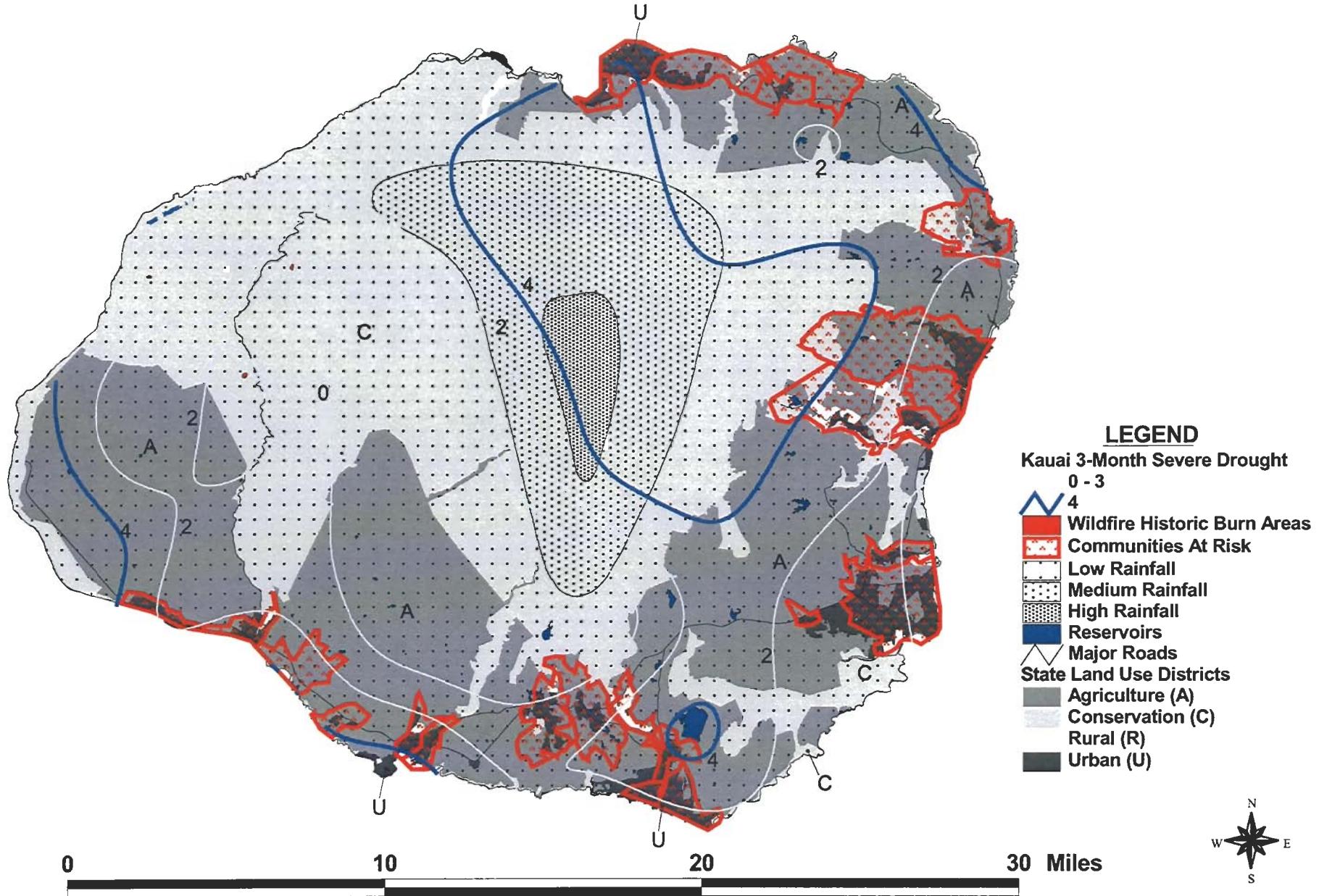


Figure 5.45. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Kauai
3-Month SPI, Extreme Drought

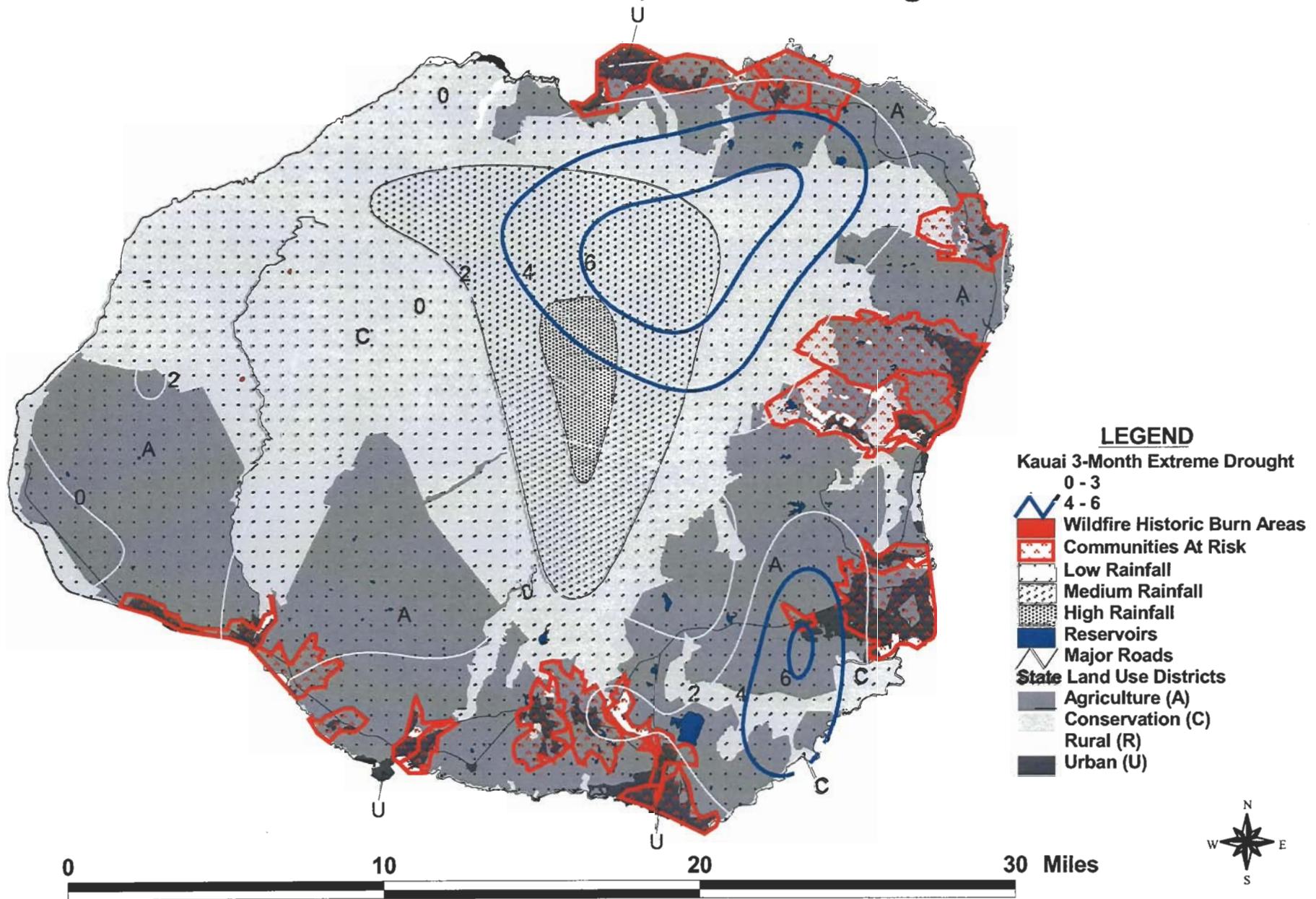


Figure 5.46. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Kauai
12-Month SPI, Moderate Drought

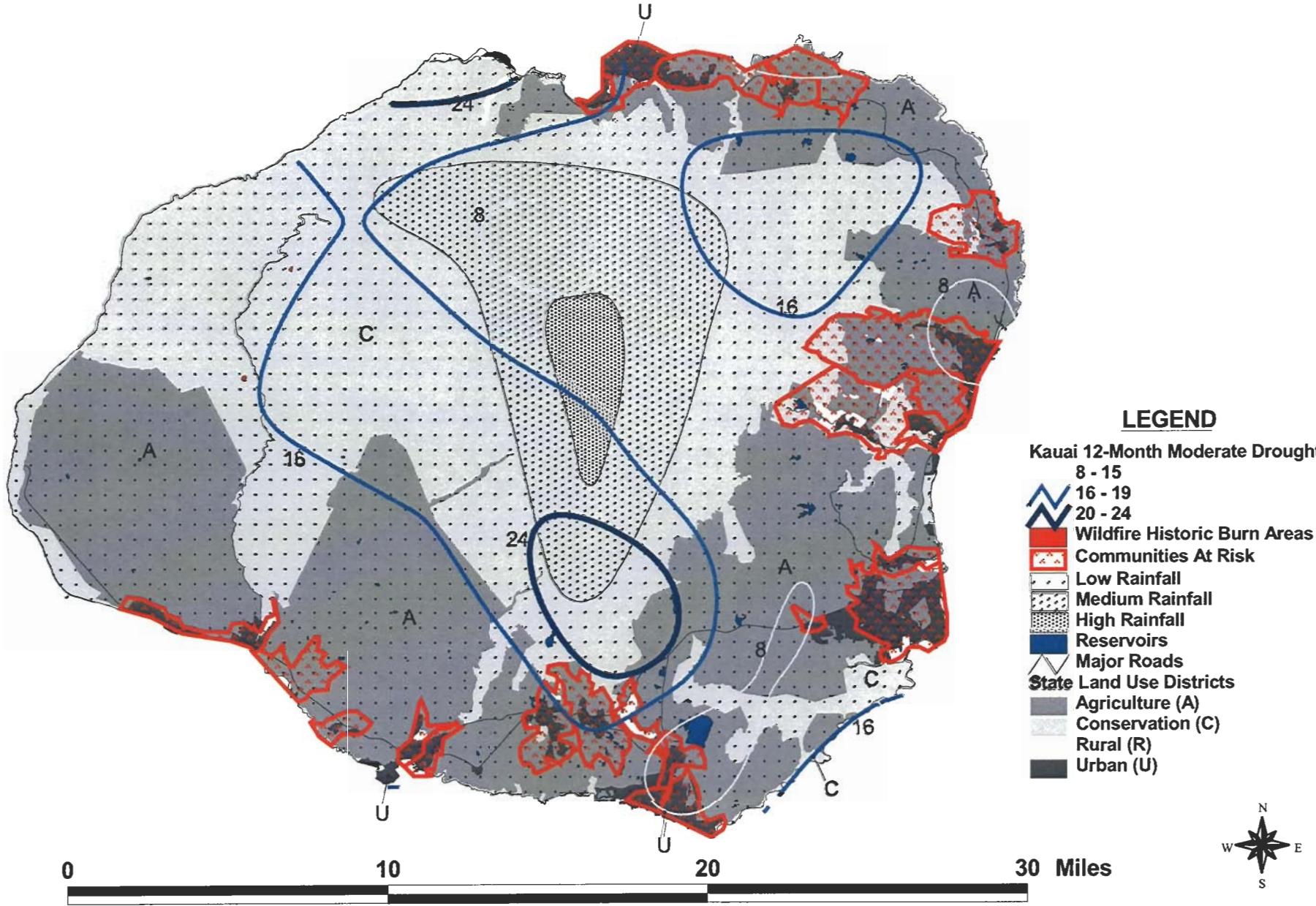


Figure 5.47. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Kauai
12-Month SPI, Severe Drought

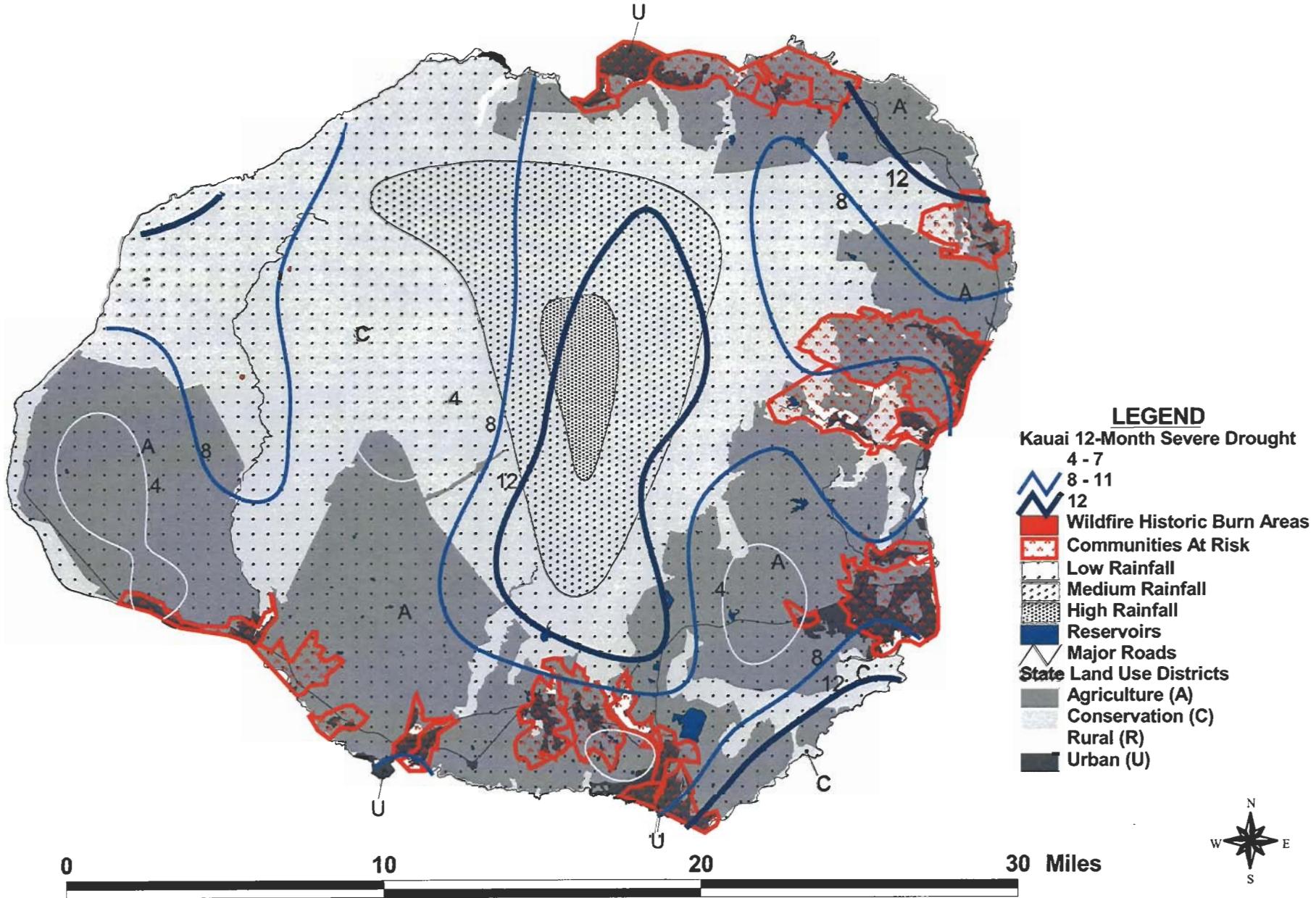
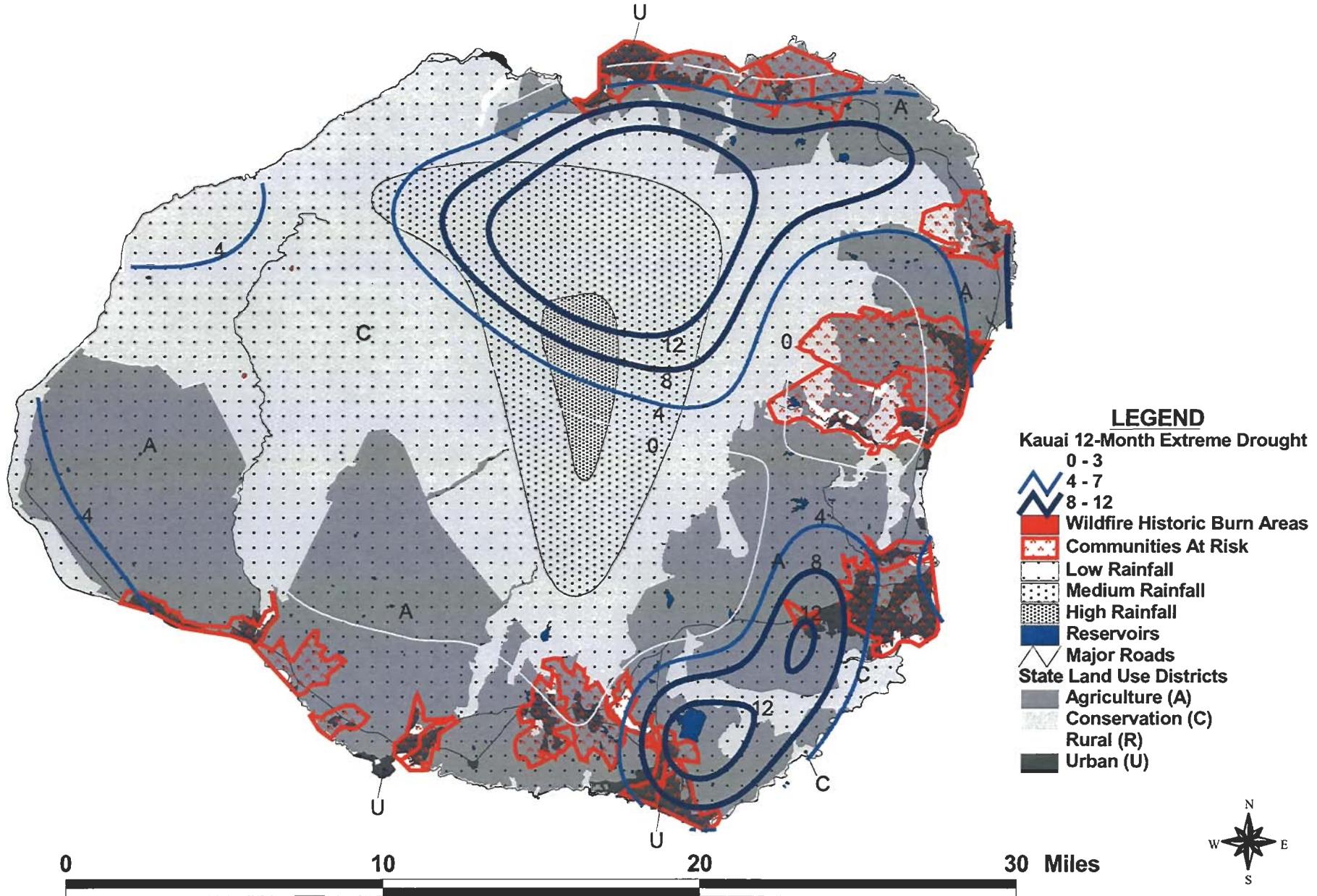


Figure 5.48. Drought Risk Areas
Environment, Public Health, and Safety Sector, County of Kauai
12-Month SPI, Extreme Drought



APPENDIX D
STATE AGENCY INDEX

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APPENDIX D STATE AGENCY INDEX

The following agencies/organizations of the State of Hawaii are responsible for specific response actions and for implementing certain recommended drought plan provisions during drought and non-drought periods.

DEPARTMENT OF AGRICULTURE

- **Chapter 141, HRS:** Department of Agriculture (DOA) powers: act to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency, and ensure availability of agriculturally suitable lands.
- **Chapter 152, HRS:** DOA duties: maintain constant vigilance for incipient infestation of specific noxious weeds...and shall use those procedures and methods to control or eradicate the infestations of noxious weeds.
- **Chapter 155, HRS:** DOA powers and duties provide relief to farmers in times of emergencies.

DEPARTMENT OF DEFENSE Civil Defense Division

Hawaii Revised Statutes (HRS), Chapter 26-21, establishes the Department of Defense who “shall be responsible for the defense of the State and its people from mass violence, originating from either human or natural causes.” Further, HRS, Chapter 128, delineates the functions and responsibilities of civil defense to include disasters and emergencies.

The Governor’s Memo 90-13, State of Hawaii Plan for Emergency Preparedness, Volume III, Disaster Response and Assistance, September 21, 1990, provides State and county governments a basis for disaster planning, preparedness, and training. Also, the plan establishes relationships among agencies, fixes responsibility and accountability, and sets forth the actions to be taken by departments and agencies of the State and each county government. Disaster is defined as “any destructive event resulting in significant physical loss or destruction and social disruption caused by natural or man-caused hazards or disaster agents. Natural disasters include storms, high winds, flash floods, high surf, hurricanes, tornadoes, droughts, earthquakes, tsunamis, volcanic eruptions, landslides, mudslides, and fires.” The mission of the State and counties are defined as follows:

- Prevent or minimize loss of life
- Alleviate suffering
- Reduce damage or destruction to property
- Provide for public safety, health and welfare
- Restore disrupted public systems and services
- Expedite recovery and rehabilitation

Specific responsibilities of the State Civil Defense Division include the following:

- Coordinate warning procedures and warning dissemination
- Collect, collate, evaluate, and disseminate damage assessment information and organize State Disaster Field Teams to assist with damage assessment
- Administer the State's Major Disaster Fund
- Coordinate requests for support of disaster operations
- Coordinate disaster assistance programs administered by the State, Federal, and private agencies

DEPARTMENT OF HEALTH

- **Chapter 11-19, HAR, Emergency Plan for Safe Drinking Water:** Identifies drought as a "Type B" emergency; authorizes the Dept. of Health to coordinate with other governmental agencies and the private section to provide water to affected areas; prescribe appropriate procedures to be undertaken by water suppliers and consumers to minimize health risks resulting from contamination of drinking water; notify customers regarding the seriousness of the emergency and measures to undertake to minimize health risks; determine whether alternative water supplies are safe and whether the means to transport or deliver the water may have adverse impact on the water quality

- **Chapter 11-20, HAR, Potable Water System:** Regulate all public water systems which provide water for human consumption through pipes or other constructed conveyances if the system has 15 or more service connections, or regularly serves an average of at least 25 persons daily at least 60 days out of the year.

DEPARTMENT OF LAND AND NATURAL RESOURCES Commission on Water Resource Management

The Commission on Water Resource Management is the state agency charged with the management of all water resources. The Commission's mandate is set forth in Chapter 174C, Hawaii Revised Statutes ("State Water Code"). The declaration of policy set forth in the State Water Code recognizes the "need for a program of comprehensive water resources planning to address the problems of supply and conservation of water." The policy further states that "the state water code shall be liberally interpreted to obtain the maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses."

Efforts to implement this policy have included preparation of a multi-component Hawaii Water Plan (HWP). The HWP consists of the following elements: 1) Water Resources Protection Plan; 2) Water Quality Plan; 3) State Water Projects Plan; 4) Agricultural Water Use and Development Plan; and 5) County Water Use and Development Plans prepared by each of the four counties. These plans which collectively form the basis of the HWP serve to protect against potential threats to water resources and are intended to formulate an integrated program for the protection, conservation, and management of the waters in each County. Accordingly, certain elements from each of these plans should be considered and, where appropriate, integrated during the development of any statewide drought mitigation plan.

The State Water Code (Section 174C-62, HRS) also requires that CWRM formulate a plan for implementation during periods of water shortage. As part of this plan, the CWRM shall adopt a reasonable system of permit classification according to source of water supply, method of extraction or diversion, use of water, or a combination thereof. The CWRM, by rule, may declare a water shortage when insufficient water is available to meet the requirements of the permit system or when conditions are such to require a temporary reduction in total water use to protect water resources from serious harm. However, such declaration of water shortages may only occur within designated water management areas.

If the CWRM finds that the restrictions imposed are not sufficient to protect public health, safety or welfare, or the health of animals, fish, or aquatic life, or a public

water supply, or recreational, municipal, agricultural, or other reasonable uses, the CWRM may declare the existence of a water emergency. Declaration of a water emergency shall be through the issuance of a CWRM order and may be instituted for any area, whether within or outside of a water management area. During such a water emergency, the CWRM may impose requirements including, but not limited to, apportioning, rotating, limiting, or prohibiting the use of water resources within a given area. Notwithstanding such provisions, appurtenant rights are preserved even during water shortages or designation of a water emergency.

It is further envisioned that elements (if not all) of the State Drought Plan should be incorporated within the Water Resources Protection Plan component of the HWP. Accordingly, the Statewide Framework for Updating the Hawaii Water Plan adopted by the CWRM includes provisions requiring the integration of the State Drought Plan upon its eventual completion. The purpose of this Drought Plan is to help identify and provide direction when drought-related water shortages and/or water emergencies arise so that the CWRM may base its orders on such criteria.

Division of Forestry and Wildlife

The DLNR Division of Forestry and Wildlife (DOFAW) is responsible for all wildfires on forest reserves, natural area reserves, wildlife and plant sanctuaries and public hunting areas. It also cooperates with established fire control agencies for the protection of other wildlands not within the department's protection areas to the extent needed to provide for public safety.

DOFAW cooperates with county fire control agencies and the federal government in developing plans and programs and mutual aid agreements for assistance in the prevention, control, and extinguishment of forest, grass, brush, and watershed fires not within the department's fire protection responsibilities described above.

During periods of high fire danger or drought, DOFAW has the statutory authority to restrict access to, or close any lands within its jurisdiction. It can also restrict outdoor burning. DOFAW has adopted a Fire Management Handbook, which specifies its standards for prevention, pre-suppression and suppression. The Document provides a structured approach in providing for public/firefighter safety and minimizing damage to Hawaii's environment. Funding for the fire management program is provided by the State's general fund and federal cost share programs through the USDA Forest Service. These include the State Fire Assistance (SFA) and Volunteer Fire Assistance (VFA) programs. Additionally, DOFAW is a key agency within the State who can trigger provisions of the Stafford Act (Fire Suppression Assistance) which provides for Federal Emergency Management Agency (FEMA) funding assistance in situations where forest and grass fires on public or private lands threaten a major disaster to communities and economies.

DOFAW has existing mutual aid agreements with all county fire departments statewide. These mutual aid agreements identify the responsibilities of each party as well as other fire management activities such as joint participation in prevention, training and equipment acquisition.

- **Chapter 185, Sec. 185-3(c3 & c4), HRS, Land Fire Protection Law:** Authorizes the administrator of the Division of Forestry and Wildlife to issue fire warning notices during dry periods; gives authority to the administrator to close forest reserves, public hunting areas, wildlife and plant sanctuaries, and natural area reserves to public access or restrict their use during dry periods when necessary, to reduce fire risk.

SOIL AND WATER CONSERVATION DISTRICTS

Hawaii has 16 Soil and Water Conservation Districts (SWCD) authorized under Chapter 180, Hawaii Revised Statutes. The SWCDs encourage soil and water conservation, ground and surface water protection, and soil erosion and sediment control through farm conservation practices and other means. The SWCD partners with the U.S. Department of Agriculture, Natural Resources Conservation Service and participates in NRCS conservation programs. The SWCDs are organized under the Hawaii Association of Conservation Districts.

- **Chapter 180, HRS:** Soil and Water Conservation Districts powers provide for and encourage demonstrations relative to control and prevention of erosions and conservation of soil and water resources; and develop plans for conservation of soil and water resources and control and prevention of erosion.
- **Chapter 180C, HRS:** County governments, in cooperation with SWCD, enact county ordinances for the purpose of controlling soil erosion and sediment.

UNIVERSITY OF HAWAII State Climatology Office

The Hawaii State Climatology Office (HSCO) at the University of Hawaii at Manoa provides climate data and information to the general public. The HSCO collects and archives historical climate (rainfall, temperature, wind, etc.) data for Hawaii and provides scientific advice regarding physical mechanisms leading to drought. Given available funding in the near future, the HSCO is working towards developing drought prediction models, taking into account both windward and leeward locations

and the Pacific Decadal Oscillation. An evaluation of the models' performance would be completed to assess the reliability of resulting long-lead drought forecasts expressed in a probabilistic manner.

STATE FIRE COUNCIL

The State Fire Council is comprised of the four county fire chiefs, and has been established within the State Department of Labor and Industrial Relations. The State Fire Council may advise and assist the county fire departments where appropriate. They may prescribe standard procedures and forms relating to inspections, investigations and reporting of fires. The Council may also approve plans for cooperation among the county fire departments and may advise the Governor and the Legislature with respect to fire prevention and protection, life safety, and other functions or activities for which the various county fire departments are generally responsible.

The State Fire Council also serves as a focal point through which all applications to the federal government for federal grant assistance for fire-related projects shall be made.

- **Chapter 132-16 State Fire Council; composition; functions.** (a) There is established a state fire council which shall be placed within the department of labor and industrial relations for administrative purposes. The state fire council shall consist of the fire chiefs of the counties. The state fire council may appoint an advisory committee to assist it in carrying out its functions under this chapter.

APPENDIX E
POTENTIAL RISK REDUCTION ACTIONS

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APPENDIX E POTENTIAL RISK REDUCTION ACTIONS

The following is a list of potential drought mitigation measures adapted from Appendix E of the handbook *“How to Reduce Drought Risk”* prepared by the Western Drought Coordination Council. This list is intended to provide government agencies and private entities with ideas that can be implemented to reduce drought risk.

Water Conservation Projects

- Establishing economic incentives for private investment in water conservation;
- Encouraging voluntary water conservation;
- Requiring water users to decrease reliance on ground water and implement conservation practices;
- Improving water use and conveyance efficiencies;
- Implementing water metering and leak detection programs;
- Modifying rate structures to influence consumer water use;
- Encouraging the use of water conserving plumbing fixtures;
- Encouraging xeriscaping and using drought-tolerant plants for landscaping;
- Conduct water conservation education at local schools;
- Line irrigation canals or install piping to control seepage;
- Use sprinkler and drip irrigation systems;
- Schedule irrigation by demand;
- Use soil-moisture monitoring;
- Improve tillage practices;
- Use evaporation suppressants;

- Use lower-quality groundwater for agricultural use; and
- Grow drought or salinity tolerant crops;

Water Storage Projects

- Implement programs to rehabilitate reservoirs to operate at design capacity;
- Construct new water reservoirs in areas at risk to drought;
- Inventory and review reservoir operational plans; and
- Use ground-water banking concepts to allocate and store surplus, inactive, or reclaimed water.

Source Development

- Develop potable groundwater wells where excess sustainable yields are available;
- Develop brackish water supply sources for uses that do not require potable water;
- Implement minor structural measures to obtain temporary water supplies from inactive or dead storage or from ground water sources;
- Undertake water supply vulnerability assessments;
- Undertake stream restoration projects that may improve stream flow and thereby increase available water supply;
- Inventory self-supplied water users for possible use of their supplies for emergency public water supplies; and
- Develop aquifer storage and recovery (ASR) projects in areas of seasonal water supply surplus.

Development of Alternative Sources

- Construct desalination plants to provide potable water;
- Clarify policies to allow the use of reclaimed water for irrigation, industrial and other non-potable uses;
- Develop projects to reclaim and reuse (store) storm water runoff in urban and undeveloped areas;
- Construct new wastewater treatment reclamation facilities;
- Construct distribution facilities for reclaimed water systems; and
- Establish policies to allow for the use of “gray” water for non-potable uses.

Public Education Awareness

- Establish a public advisory committee;
- Include public participation in drought planning;
- Organize drought information meetings for the public and the media;
- Implement water conservation awareness programs;
- Publish and distribute pamphlets on water conservation techniques and drought management strategies;
- Organize workshops on special drought-related topics;
- Prepare a sample ordinance on water conservation;
- Establish a drought information center;
- Set up a demonstration of on-site technology at a visitor center;
- Include the media in drought planning;
- Establish tuition assistance for farmers to enroll in farm management classes;
- Develop training material in several languages;

- Provide education on different cultural perspectives of water resources;
- Consult a marketing firm for strategies to draw public attention; and
- Employ public participation and public information specialists;

Land Use Planning

- Consider an area's vulnerability to drought when reviewing general and community plan and zoning amendments;
- Require developers to use non-potable water for landscape irrigation;
- Require developers to practice xeriscaping in landscaped common areas;
- Establish policy and guidelines to match the quality of water supply to an appropriate demand preventing potable uses where lower quality water would suffice (e.g., require only non-potable water for irrigation uses).
- Ensure that new developments have sufficient water storage facilities; and
- Initiate rezoning applications or amend existing ordinances to protect water recharge areas and encourage appropriate uses in areas at risk to drought;

Watershed Protection and Management

- Engage and coordinate with the Division of Forestry and Wildlife and watershed partnerships across the state to develop best management practices in the forested areas; and
- Implement watershed protection and management plans (e.g., construct fencing to keep out unwanted animals, control invasive species and weeds, prescribed burns, maintain fire roads and fire breaks, reforestation, etc.).

APPENDIX F
REFERENCES

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APPENDIX F REFERENCES

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