

APPENDIX **L**

Watershed Protection

Water Resource Protection Plan 2019 Update

L Watershed Protection

Table of Contents

L	Watershed Protection.....	3
L.1	Background on Watershed Management in Hawai‘i.....	5
L.2	Goals and Objectives	6
L.3	Hawai‘i Watershed Protection Programs	6
	L.3.1 The Hawai‘i Association of Watershed Partnerships	6
	L.3.2 The Division of Forestry and Wildlife’s Watershed Protection Initiatives..	10
	L.3.3 Honolulu Board of Water Supply Watershed Prioritization.....	11
	L.3.4 The Hawai‘i Coastal Zone Management Program	13
	L.3.5 Department of Health Water Quality Programs.....	15
	L.3.6 Other State Watershed Protection Programs.....	16
	L.3.7 Current CWRM Support of Watershed Protection and Management.....	18
L.4	Federal Watershed Protection and Management Programs	19
	L.4.1 Environmental Protection Agency (EPA) Programs.....	19
	L.4.2 U.S. Army Corps of Engineers (USACE) Permitting Programs.....	25
	L.4.3 USDA Natural Resource Conservation Service	26
	L.4.4 The West Maui Ridge to Reef Initiative.....	27
L.5	Gaps in Watershed Protection	29
	L.5.1 Understanding the Magnitude and Timing of Changes to Water Resources from Watershed Management Actions.....	29
	L.5.2 Identification of Priority Areas for Watershed Management.....	30
L.6	Recommendations	32

Figures

Figure L-1 Diagram of a Watershed.....	3
Figure L-2 Diagram of an Ahupua‘a.....	4
Figure L-3 Hawai‘i Association of Watershed Partnerships	7
Figure L-4 Rain Follows the Forest Priority Protection Areas	11
Figure L-5 BWS Priority Watersheds	12
Figure L-6 State Land Use Districts	16
Figure L-7 Watershed covered by the West Maui Ridge to Reef Initiative.....	28

L Watershed Protection

The USGS simply defines a watershed as the divide separating one drainage basin from another.¹ However, the watersheds of Hawai'i are an important part of our ecosystem. They function as an integral vehicle whereby water flows from the sky to the land and the ocean. Healthy watersheds provide Hawai'i communities with valuable water-related ecosystem services such as flood mitigation, adequate streamflow, healthy nearshore waters, and healthy ground water supplies. Watershed management seeks to maintain and restore the continuing functioning of these and other services.

Figure L-1 Diagram of a Watershed

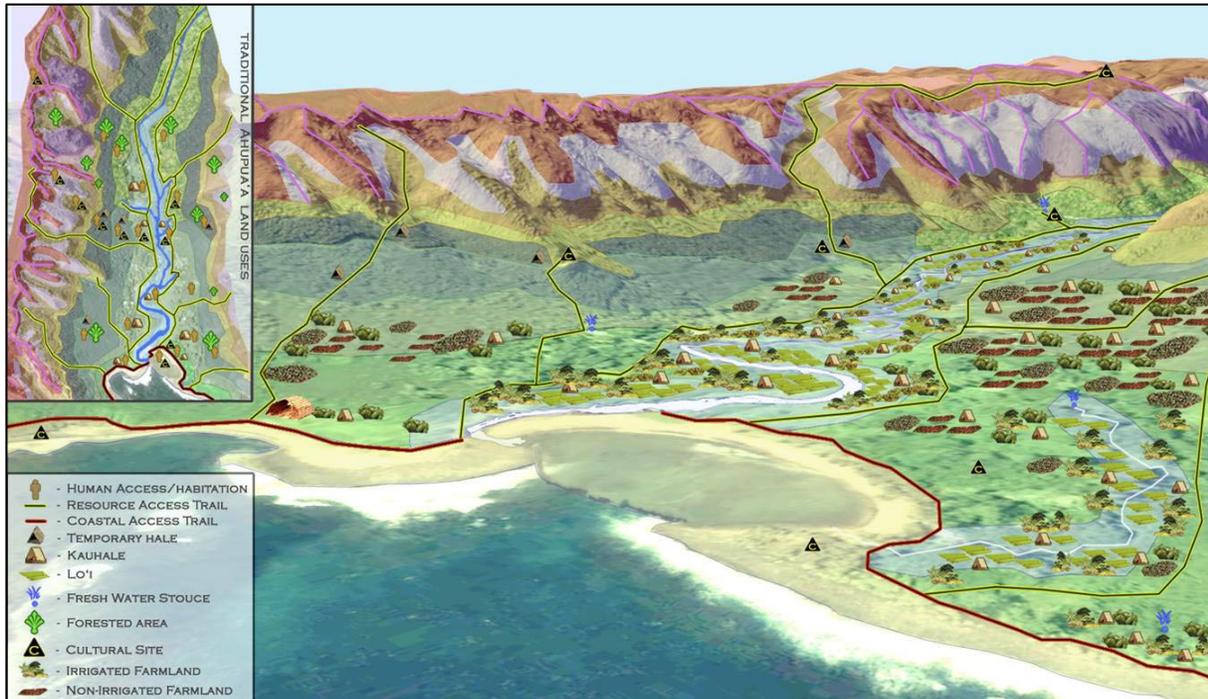


Source: http://fullspectrumbiology.blogspot.com/2013/06/watersheds-preservation-of-important_1180.html

The Hawaiian people recognized the benefit of a holistic land-management system through their establishment of the ahupua'a management system. Ahupua'a are traditional land divisions organized around water, as it was – and still is – the necessary resource for basic human needs such as drinking, bathing, and food production. According to traditional mo'olelo (stories), fresh water streams and springs were created throughout Hawai'i by the gods Kāne and Kanaloa. Therefore, water also has a spiritual meaning to Hawaiians and cannot be physically owned or commoditized.

¹ USGS Water Science Center <http://water.usgs.gov/wsc/glossary.html#W>

Figure L-2 Diagram of an Ahupua‘a



Drawing by Dr. Jonathan Ching

Ahupua‘a provided the necessary resources for survival, with typical ahupua‘a following watershed boundaries, running from the mountains out to the nearshore waters, with few exceptions. Hawaiians understood that every element within the ahupua‘a was related to one another and that the consequences of an action could directly affect the state of the environment, the people, and their way of life. Therefore, ahupua‘a resources were managed holistically to ensure the continued functioning of the system, much like modern watershed management principles prescribe.

The State of Hawai‘i has a long history of watershed protection and management programs, which were initiated specifically to ensure a sustainable water supply. Additionally, many modern watershed protection and management programs have sprung from the requirements of the Clean Water Act of 1977, subsequent supporting legislation, a resurgence in Hawaiian culture, and a newfound appreciation for traditional land and water management principles. In the face of a changing climate, these programs and principles have become even more critical as a means to ensure the sustainability of clean and plentiful water resources for our island communities.

This section of the WRPP describes CWRM’s role to support watershed protection efforts, as well as the identification of other entities that share in the responsibility to protect and manage one of our most valuable resources.

L.1 Background on Watershed Management in Hawai'i

Article XI, Section 7 of the Hawai'i State Constitution says that:

“The State has an obligation to protect, control and regulate the use of Hawai'i's water resources for the benefit of its people.

The legislature shall provide for a water resources agency which, as provided by law, shall set overall water conservation, quality and use policies; define beneficial and reasonable uses; protect ground and surface water resources, watersheds and natural stream environments; establish criteria for water use priorities while assuring appurtenant rights and existing correlative and riparian uses and establish procedures for regulating all uses of Hawai'i's water resources.”

The definition of a “watershed” can be found in the enabling statutes for the Division of Forestry and Wildlife (DOFAW). HRS § 183-31 states:

“The department of land and natural resources shall determine, after public hearing held in the same manner as provided in section 91-3, areas which are watersheds.

The term "watershed" as used in this part means (1) an area from which the domestic water supply of any city, town or community is or may be obtained, or (2) an area where water infiltrates into artesian or other ground-water areas from which the domestic water supply of any city, town or community is or may be obtained.”

HRS § 183-1.5(4) also states that DLNR shall “devise ways and means of protecting, extending, increasing, and utilizing the forests and forest reserves, more particularly for protecting and developing the springs, streams, and sources of water supply to increase and make that water supply available for use.”

DOFAW implements the statutes identified above through programs such as the Natural Area Reserves System (NARS) Program, Natural Area Partnership Program, and the Watershed Partnership Program.

L.2 Goals and Objectives

Watershed protection is not only reliant upon collaboration across all levels of government, but must also include communities, which are a key component of successfully implementing any watershed protection goals. The following are CWRM's goals and objectives to support State efforts to protect and manage Hawai'i's watersheds:

- Encourage integrated programs at the watershed level that currently exist between mauka- and makai-area interests, urban issues and conservation priorities, and economic goals and pollution prevention.
- Encourage the research necessary to link management activities in the watershed (e.g. fencing, invasive species removal, non-point source pollution mitigation, etc.) with changes to the hydrologic products from the watershed (e.g. increased water supplies, healthy coral reefs, water quality improvement, etc.).
- Encourage collaboration and coordination amongst agencies, local communities, and other stakeholders in the development and implementation of watershed protection programs.

L.3 Hawai'i Watershed Protection Programs

In 1903, the Governor of the Territory of Hawai'i approved Act 44, enacted by the territorial legislature, to designate forest reserves and extend the reserve system to protect ground water supplies. Extensive cattle grazing in native forests during the 1800s had resulted in significant deforestation. Public and private concerns about water supply and quality were the impetus for placing the forests into reserves and undertaking massive reforestation projects at the turn of the century. Through Act 44, the Territory of Hawai'i established one of the first forestry agencies in the nation, with the authority to establish forest reserves for the protection of springs, streams, and other water supply sources. The State's long-standing policy of watershed protection resulted in dramatic improvements from the degraded conditions due to overgrazing that prevailed at the turn of the century. Management activities such as protective zoning, fencing, removal or control of feral animals, reforestation, and fire protection have laid some groundwork for reducing excessive erosion and loss of vegetative cover.

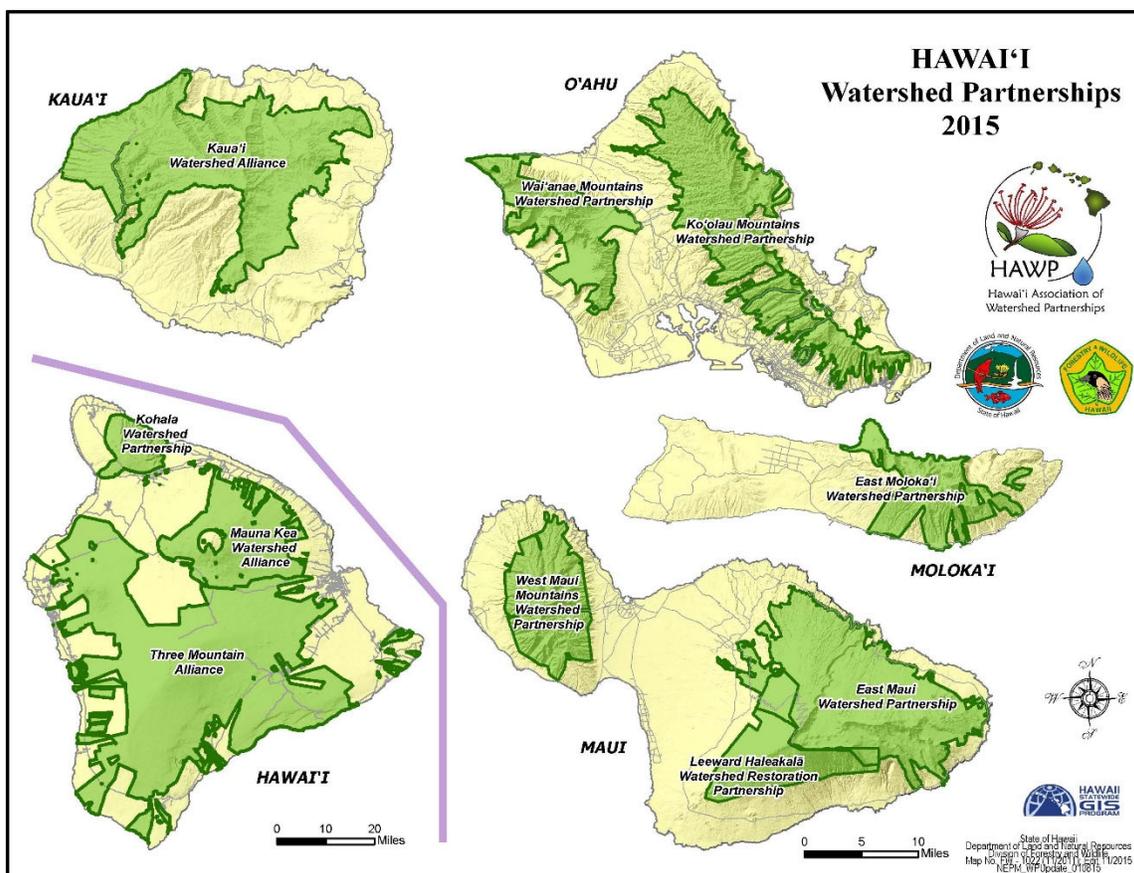
L.3.1 The Hawai'i Association of Watershed Partnerships

The modern form of watershed management through public/private partnerships emerged in the early 1990s, with voluntary alliances between landowners committed to the common value of protecting large areas of forested watersheds for water recharge and other shared interests. The first Watershed Partnership was formed in 1991 on East Maui when several public and private landowners realized the benefits of working together to ensure the conservation of a shared watershed that provided billions of gallons of fresh water to the area.

The successful creation of the East Maui Watershed Partnership reinvigorated the historic cooperative partnership of public and private sectors in working together to protect essential, forested watershed recharge areas in Hawai'i. In the following years, more watershed partnerships formed including Ko'olau Mountains Watershed Partnership, East Moloka'i Watershed Partnership, West Maui Mountains Watershed Partnership, The Kaua'i Watershed Alliance, and Kohala Watershed Partnership. The success of these partnerships highlighted the need to address watershed issues statewide.²

In 2003, the Hawai'i Association of Watershed Partnerships (HAWP) was established through the signing of a Memorandum of Understanding (MOU) between the seven existing watershed partnerships. The State of Hawai'i also signed the MOU as an individual partner. The parties, through the MOU, established principles and agreed to participate in cooperative fundraising, building public and political support, and capacity building for island-based mauka watershed partnerships.

Figure L-3 Hawai'i Association of Watershed Partnerships



² Hawai'i Association of Watershed Partnerships Webpage. Accessed 2013. <http://hawp.org/about-us/history/>

Today there are 10 active watershed partnerships, collaborating with approximately 75 public and private partners representing 2.2 million acres of vital watershed lands across the State (Figure L-3 Hawai'i Association of Watershed Partnerships).

Island of Kaua'i

- **Kaua'i Watershed Alliance (144,004 acres)**
Kamehameha Schools; Princeville Corporation; County of Kaua'i Department of Water; Kaua'i Ranch, LLC; Lihue Land Company; McBryde Sugar Company, Ltd.; DLNR; Grove Farm Company, Inc.; Ben A. Dyre Family Limited Partnership

Island of O'ahu

- **Wai'anae Mountains Watershed Partnership (46,000 acres)**
Honolulu BWS; DLNR; Gil-Olson Joint Venture; MA'O Organic Farms; U.S. Army; U.S. Navy; Ka'ala Farms Inc.
- **Ko'olau Mountain Watershed Partnership (100,484 acres)**
Kamehameha Schools; Honolulu BWS; DLNR; Bishop Museum; DHHL; Agribusiness Development Corp.; U.S. Army; Queen Emma Land Company; Manana Valley Farm, LLC; Tiana Partners; Dole Food Co., Inc.; U.S. Fish and Wildlife Service; Hawai'i Reserves, Inc.; Kualoa Ranch; O'ahu Country Club; The Nature Conservancy; DOH; EPA; U.S. Forest Service; NRCS; USGS; 'Ohulehule Forest Conservancy LLC; Lyon Arboretum; Hi'ipaka LLC dba Waimea Valley

Island of Moloka'i

- **East Molokai Watershed Partnership (32,983)**
Kamehameha Schools; Kapualei Ranch; Ke Aupuni Lokahi Enterprise Community Governance Board; DOH; DLNR; Kalaupapa National Historical Park; Maui County; Maui Board of Water Supply; Moloka'i-Lāna'i Soil and Water Conservation District; NRCS; US Fish and Wildlife Service; USGS; EPA; The Nature Conservancy; Kawela Plantation Homeowners Association, Kawela Ahupua'a;

Island of Maui

- **East Maui Watershed Partnership (100,000 acres)**
DLNR; The Nature Conservancy; Maui County Board of Water Supply; Haleakala Ranch Co.; East Maui Irrigation Co., Ltd.; Haleakala National Park; Hana Ranch; County of Maui
- **Mālama Kahalawai Watershed Partnership (48,000 acres)**
Maui County Board of Water Supply; Kamehameha Schools; C. Brewer and Co., Ltd.; Amfac/JMB Hawai'i, LLC; The Nature Conservancy; Maui Land and Pineapple Co., Inc.; DLNR; County of Maui
- **Leeward Haleakalā Watershed Restoration Partnership (43,000 acres)**
Department of Hawaiian Home Lands (DHHL); Estate of James Campbell; Haleakalā National Park; Haleakalā Ranch; Ka'ono'ulu Ranch; Nu'u Mauka Ranch; DLNR; 'Ulupalakua Ranch; John Zwaanstra

Island of Hawai'i

- **Three Mountain Alliance (1,116,300 acres)**
Kamehameha Schools; DLNR; Department of Public Safety, Kulani Correctional Facility; U.S. Fish and Wildlife Service; USGS Biological Resources Division; U.S. Forest Service; The Nature Conservancy; National Park Service, Hawai'i Volcanoes National Park
- **Mauna Kea Watershed Alliance (484,000 acres)**
DLNR; DHHL; Kamehameha Schools; Hakalau Forest National Wildlife Refuge; Kūka'iau Ranch
- **Kohala Mountain Watershed Partnership (68,000 acres)**
Parker Ranch, Inc.; Kahua Ranch, Ltd.; Pono'holo Ranch, Ltd.; The Queen Emma Foundation; Kamehameha Schools; Laupāhoehoe Nui, LLC; DLNR; DHHL; Hawai'i County Department of Water Supply; The Nature Conservancy

L.3.2 The Division of Forestry and Wildlife’s Watershed Protection Initiatives

In addition to being a member of all of the above watershed partnerships, DOFAW supports the implementation of management plans developed by the partnerships through their administration of the Watershed Partnerships Program Grant (WPPG).

As the watershed partnership program is a means through which DOFAW implements the charge given to them in HRS183-31, they recognized the need to develop a new plan to support this program. The importance of watershed protection was also recognized by Governor Abercrombie through his *New Day in Hawai’i* plan when he called on DLNR to “*Ensure that our mauka watersheds are fully functioning so that our fresh water resources can be utilized and enjoyed by the people of Hawai’i in perpetuity.*”

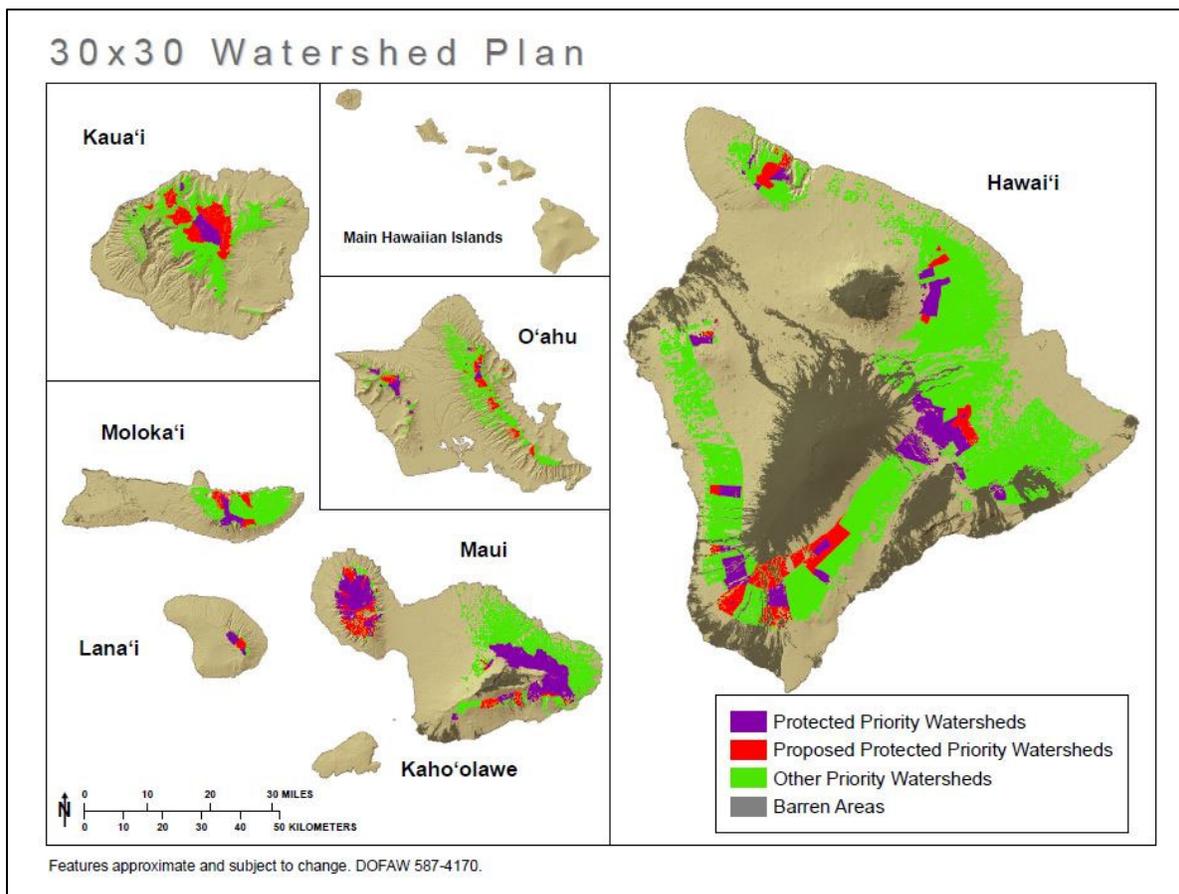
The cost to upkeep our watersheds is difficult to define, but the State's "Watershed Initiative" (Rain Follows the Forest) estimated approximately \$11 million per year. At the time (2011), the goal was to double the acres protected (20%). However, in light of the advancing threats facing Hawaii's watersheds, Governor David Ige launched his Sustainable Hawaii Initiative in Sept 2016, which increased the goal to protect 30% (253,000 acres) of Hawaii’s highest priority watershed forests by 2030 (30x30 Watershed Plan Figure L-4). Of the 843,000 acres identified as priority watershed across the state, 140,000 (17%) are currently protected. In order to reach the 30% goal, more funding is needed to build protective fences, which will enclose priority areas that are critical to water recharge and safeguarding biodiversity. In FY19, the Legislature allocated over \$7 million for fence construction that will protect an additional 18,000 acres of priority watersheds. The status of watershed protection can be tracked via an online dashboard at <https://dashboard.hawaii.gov/stat/goals/5xhf-begq/4s33-f5iv/wtjm-96jt>



*Before (1998)
and after
(2005)
watershed
management
efforts*

*Source:
Hawaii
Alliance of
Watershed
Partnerships*

Figure L-4 30x30 Watershed Plan



L.3.3 Honolulu Board of Water Supply Watershed Prioritization

The Honolulu Board of Water Supply (BWS) is the largest municipal water supplier for the island of O'ahu. Officially created in 1929 by the Territorial Legislature, BWS' mission is to provide safe, dependable and affordable water now and into the future. A key component of accomplishing this mission involves proper management of the watersheds, which directly affect ground water supply.

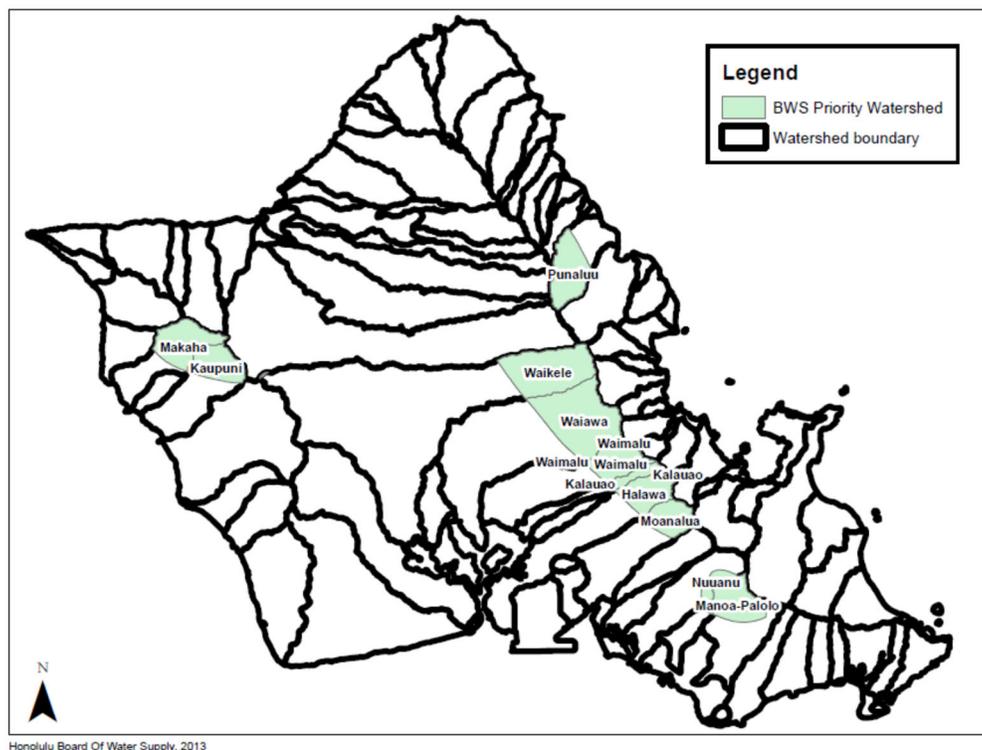
Accordingly, BWS' Water Resources Division is responsible for preparing Watershed Management Plans covering O'ahu, which meets the requirement for a County Water Use and Development Plan per the State Water Code and City and County of Honolulu ordinance. To date, the Wai'anae, Ko'olauloa, Ko'olaupoko, and North Shore Watershed Management Plans have been completed. The Central, 'Ewa, and Primary Urban Center Watershed Management Plans are currently in progress and the East Honolulu Plan has yet to be started.

The BWS Water Resources Division, Hydrology-Geology Branch also plays a primary role in proper management of watersheds on O'ahu. Through its Watershed Program, the Branch has leveraged partnerships with other Federal, State, and local agencies and organizations to help

maximize the effectiveness of countless watershed conservation and restoration projects. Examples of such projects include fencing of native forests, ungulate (pig and goat) removal, invasive plant removal, replanting of native species, and establishing vegetative firebreaks.

The Branch also completed a Watershed Prioritization Report, which prioritized watersheds on O’ahu from its water supply perspective, to meet two objectives. First, as a member of both the Ko’olau and Wai’anae Mountains Watershed Partnerships (KMWP and WMWP), BWS prioritization results serve as input for prioritizing watersheds for cooperative conservation and restoration work. Second, BWS prioritization results serve as guidance for its own watershed management projects, to focus funding and implementation efforts. In order to prioritize watersheds from a water supply perspective, basic concepts of water budgeting were considered: ground water recharge and ground water production from the watersheds. Ground water recharge parameters included general soil/rock/vegetation type in each watershed, and relative rainfall amounts across watersheds. Ground water production parameters included production amounts compared to the sustainable yields defined for watershed regions, as well as relative chloride concentrations. In addition to these parameters, the demand from major agricultural irrigation systems was considered and incorporated into the prioritization scheme. The identified priority watersheds for the Wai’anae and Ko’olau mountain ranges (**Figure L-5 BWS Priority Watersheds**) were organized into a tiered strategy, and have since been utilized to focus funding and labor efforts on numerous watershed conservation and restoration projects. More information about the BWS prioritization can be found at <http://www.boardofwatersupply.com/bws/media/files/publication-watershedprioritization-poster-2013-07.pdf>.

Figure L-5 BWS Priority Watersheds



L.3.4 The Hawai'i Coastal Zone Management Program

Coastal Zone Management, or CZM, is about balancing the needs of economic development and conservation of resources in a sustainable manner. The federal Coastal Zone Management Act (CZMA) of 1972 established the voluntary program with a broad framework in order to allow flexibility among the State programs. In 1977, the Hawai'i State Legislature enacted the State CZM law (codified in HRS Chapter 205A) to provide a common focus for State and County actions dealing with land and water uses and activities. The Hawai'i CZM Program was officially approved in 1978. The Office of Planning (OP) within the State Department of Business, Economic Development and Tourism is responsible for the overall administration of the Hawai'i CZM Program.

The Hawai'i Coastal Zone Management Act recognized this link between terrestrial activities in the watershed and the health of coastal and marine resources. It defines watershed management areas as the uppermost reaches of the mountains out into the sea.³ The Hawai'i CZM Program was established through this Act to coordinate land use practices, and the entities that influence those practices, towards a common goal of improving the quality of the coastal zone and nearshore waters.

As the State's coastal zone resource management policy umbrella, the Hawai'i CZM Program is the guiding perspective for the design and implementation of allowable uses and activities within the coastal zone. The Hawai'i State Legislature charged the CZM Program with the responsibility of encouraging agencies to look at resources from a broader ecosystem perspective.

The Hawai'i CZM Program is undertaking many important initiatives including, but not limited to, the following:

- Coordinate the implementation of the Hawai'i Ocean Resources Management Plan (ORMP), which was last updated in 2013. The ORMP is a primary means for achieving the objectives of the CZM Act of 1977 across jurisdictions, disciplines, and communities. Eleven management priorities over the next five years are identified to meet the challenges of increasing land use and ocean resource development, competing human uses, the impacts from climate change, and environmental health.

³ Hawai'i Office of Planning Coastal Zone Management Program, "Hawai'i Watershed Guidance". Date accessed 01/2013. Available at: http://www.refresilience.org/pdf/HI_Watershed_Guidance.pdf

- Assess, consider, and control cumulative and secondary impacts of coastal growth and development, including integrated planning that builds on and better supports the stewardship efforts of community groups and organizations. The goal is to move the State towards place-, cultural-, and community-based approaches to natural and cultural resource management.
- Reduce hazards to life and property from coastal hazards, including tsunamis, storm waves, stream-flooding erosion, and subsidence.
- Implement CZM Program compliance through Special Management Area (SMA) and Shoreline Setback Areas (SSA), which are designated for more intensive management by the Counties.

The Hawai'i CZM Program focuses on complex multi-functional resource management problems, issues, concerns, and opportunities. HRS Section 205A-2, enumerates the CZM objectives and policies which address recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, managing development, public participation, beach protection, and marine resources. Compliance with HRS Chapter 205A, CZM objectives and policies ensure that appropriately designed developments along coastal areas respect economic, biological, environmental, and cultural values.

Within a network of State and County agencies, the program employs a wide variety of regulatory and non-regulatory techniques to address coastal issues and uphold environmental law. Much of CZM's work is characterized by stewardship, planning, permit administration, education and outreach, multi-functional coordination, policy development and implementation, identification of emerging issues and exploration of solutions, technical assistance to local governments and permit applicants, and assuring State and County compliance with the statutory requirements.

L.3.5 Department of Health Water Quality Programs

The goals and objectives of the national Clean Water Act and Safe Drinking Water Act, among other federal laws, are embodied in the EPA's management, regulatory, and permitting programs that are carried out in Hawai'i by the State DOH.

The DOH Clean Water Branch (CWB) administers National Pollutant Discharge Elimination System (NPDES) permits to minimize discharge of pollutants to State waters. The CWB also administers the Surface Water Quality Management Program, which includes the Total Maximum Daily Load (TMDL) and Polluted Runoff Control programs. The DOH Safe Drinking Water Branch (SWDB) is responsible for protecting drinking water sources (surface water and ground water) from contamination and regulates owners and operators of public water systems. The DOH Wastewater Branch administers water pollution control programs and regulates municipal and private wastewater treatment works, as well as individual wastewater systems. More information on the DOH and water quality management is provided in the WRPP **Appendix M Water Quality**.

Most of the DOH's programs are federally funded. These programs must meet federal Clean Water Act requirements, obtain EPA approval, and employ a watershed-based approach to water quality management.

Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990 requires each federally-approved CZM program to develop and implement a Coastal Nonpoint Pollution Control Program. The Hawai'i Watershed Guidance⁴ was developed by the CZM Program and DOH in a joint effort to coordinate the protection of the resources that are impacted by the quality of water from Hawai'i's watersheds (e.g., healthy and productive marine ecosystems). The guidance is meant to help managers and others working in the watershed to develop effective watershed plans to achieve water quality goals. This document is a component of the Ocean Resources Management Plan.

Through the ORMP, the CZM Program and DOH are the primary State agencies responsible for coordinating watershed management activities with the goal of protecting the quality of our water resources. Through the Rain Follows the Forest Plan, DOFAW is leading the effort to coordinate watershed activities to protect the quantity of our water resources. Holistic watershed management requires that CWRM support both of the above endeavors.

⁴ Hawai'i Office of Planning Coastal Zone Management Program, "Hawai'i Watershed Guidance." Date accessed 01/2013. Available at: http://www.refresilience.org/pdf/HI_Watershed_Guidance.pdf

L.3.6 Other State Watershed Protection Programs

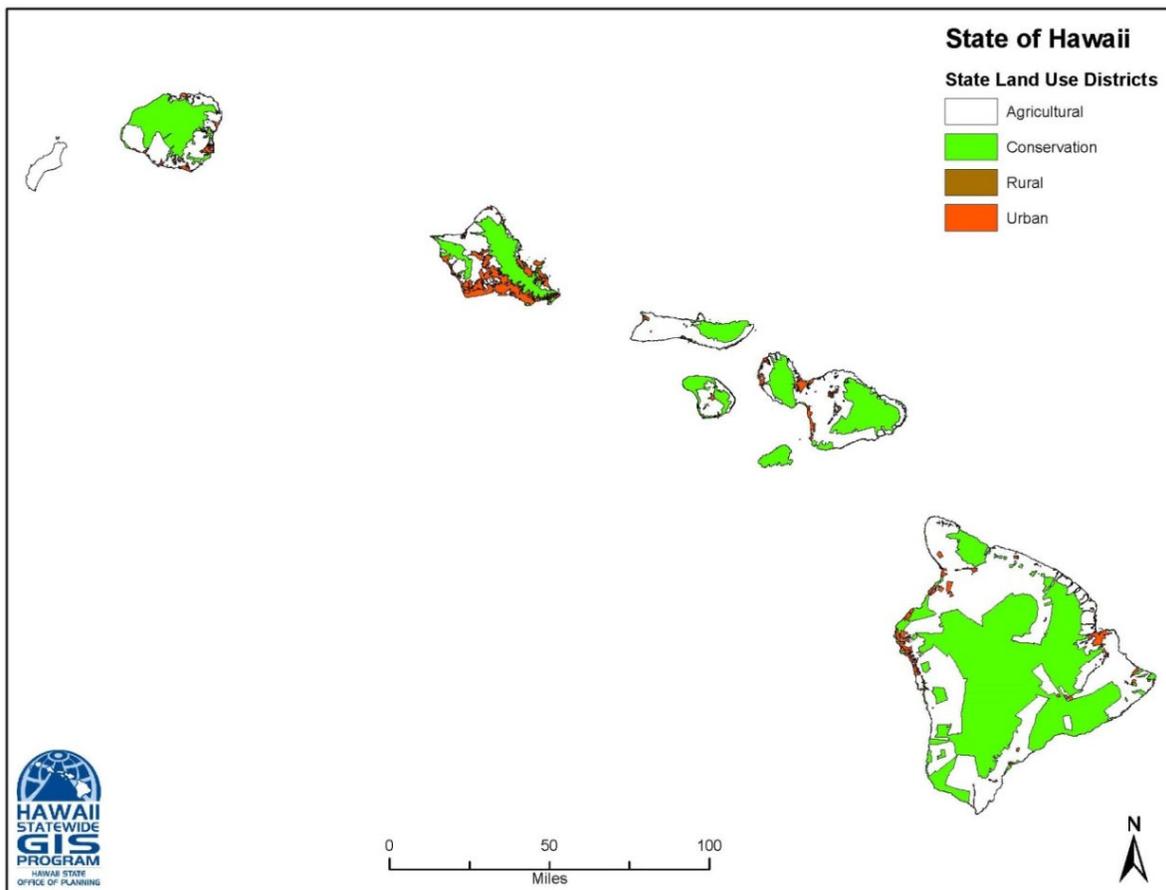
In addition to the State programs that involve active management activities, the DLNR Office of Conservation and Coastal Lands (OCCL) and the DBEDT Land Use Commission (LUC) prevent degradation of the watershed through land use designations and regulation of land use activities. Similarly, the Hawai'i Soil and Water Conservation District Program assists agricultural producers in the watershed in reducing erosion and sediments that may result from on-farm activities.

L.3.6.1 DBEDT Land Use Commission

The LUC's primary role is to ensure that areas of state concern are addressed and considered in the land use decision-making process. The LUC is administratively attached to DBEDT and has established four land use districts: Urban District, Rural District, Agricultural District, and Conservation District.

The LUC acts on petitions for land use district boundary changes submitted by private landowners, developers and State and county agencies. Decisions on boundary change petitions are guided by a specific set of criteria, which includes preservation or maintenance of important natural systems or habitats. Such values are generally associated with Conservation District lands.

Figure L-6 State Land Use Districts



Act 187 defined Conservation as meaning the protection of watersheds and water supplies; preserving scenic areas; providing park lands, wilderness and beach reserves; conserving endemic plants, fish, and wildlife; preventing floods and soil erosion; forestry; and other related activities. The Conservation District is comprised primarily of lands in existing forest and water reserve zones and includes areas necessary for protecting watersheds and water sources; scenic and historic areas; parks; wilderness; open space; recreational areas; habitats of endemic plants, fish and wildlife; and all submerged lands seaward of the shoreline. The Conservation District also includes some lands that are subject to flooding and soil erosion. Since 1964, the Board of Land and Natural Resources has adopted and administered land use regulations for the Conservation District pursuant to the State Land Use Law (Act 187) of 1961.

L.3.6.2 DLNR Office of Conservation and Coastal Lands

The Office of Conservation and Coastal Lands (OCCL) is responsible for overseeing approximately two million acres of private and public lands that lie within the State Land Use Conservation District. In addition to privately and publicly owned Conservation District lands, OCCL is responsible for overseeing beach and marine lands to the seaward extent of the State's jurisdiction.

The OCCL has multiple functions in addition to overseeing activities in the mauka to makai Conservation District. These include permit processing, prosecution of land use violations, resolution of shoreline encroachments, enactment of beach restoration projects, administration of contested cases involving Conservation District Use Permits and shoreline certifications. The OCCL provides direction and guidance to coastal landowners, concerned citizens and resource agencies on current best practices for shoreline use and management through the development, implementation, and monitoring of Coastal Management Policy and Procedures. It is a goal of OCCL to balance the conservation of our State's unique and fragile natural resources from Mauka to Makai with development of these resources for the good of the State.

L.3.6.3 State Soil and Water Conservation Districts

Separate and distinct from the State land use Conservation District are "Soil and Water Conservation Districts" or "Resource Conservation Districts," which originated during the Dust Bowl era of the 1930s, after President Roosevelt urged state governors to recommend legislation that would allow the establishment of local soil Conservation Districts. There are approximately 3,000 Conservation Districts nationwide. Their mission is to coordinate assistance from public and private local, state, and federal sources to develop locally driven solutions to natural resource concerns.

According to the National Association of Conservation Districts, the nonprofit organization that represents the 3,000 local Conservation Districts, local residents should make conservation decisions, with technical and funding assistance from federal, state, and local governments and the private sector. Conservation Districts help accomplish the following actions:

- Implement farm conservation practices to keep soil in the fields and out of waterways;
- Conserve and restore wetlands, which purify water and provide habitat for birds, fish and numerous other animals;
- Protect ground water resources;
- Plant trees and other land cover to hold soil in place, clean the air, provide cover for wildlife, and beautify neighborhoods;
- Help developers and homeowners manage the land in an environmentally sensitive manner; and
- Reach out to communities and schools to teach the value of natural resources and encourage conservation efforts.

In Hawai'i there are 16 Conservation Districts. They strive to assist partners and government agencies with identifying and implementing culturally sensitive projects and practices, to assure the protection of Hawai'i's environment.

Current challenges facing Conservation Districts include managing manure and fertilizer to prevent water pollution, restoring wetlands, improving irrigation efficiency and flood protection measures, and addressing urban expansion issues, including the protection of plant and animal habitats and water quality. These challenges are not unique to farmers and ranchers. Although specifics may vary, municipal, state, and federal agencies and conservation groups also deal with the same issues, albeit the specific aspects of the issues vary.

L.3.7 Current CWRM Support of Watershed Protection and Management

Although CWRM does not have a formal watershed protection and management program, there are several ongoing initiatives that support the missions of watershed management organizations. The first is the cooperative hydrologic monitoring program between CWRM and the USGS. This is a long-term monitoring program that collects rainfall, ground water, and surface water data from monitoring stations throughout the State. The data from this program allows managers to observe trends in Hawai'i's water resources that are associated with land use change, seasonal climate variability, and climate change. This program currently funds monitoring stations in several watersheds on O'ahu as a means to observe hydrologic responses to watershed management activities. For more information on the cooperative monitoring program please refer to WRPP **Appendix G Monitoring of Water Resources**.

CWRM also funds research that is vital to understanding the impacts of watershed management on water supplies. These include the regular updates of ground water recharge estimates by the USGS, a recent update of the Rainfall Atlas of Hawai'i (2013) by the University of Hawai'i, a statewide estimate of evapotranspiration rates by the University of Hawai'i, and numerical ground water models by the USGS.

CWRM has recently partnered with the USGS and the Maui Department of Water Supply to study the impacts of native and nonnative vegetation on the hydrology of selected watersheds on Maui. The findings of the first phase of this study is scheduled to be published sometime in 2018 and will help water resource managers begin to understand how freshwater availability is affected by watershed restoration activities.

Despite these ongoing efforts, gaps in the understanding of the hydrologic processes that occur in the watershed still exist. The high cost of protecting mauka watershed areas⁵ underscores the importance of the need to support research that helps water resource managers determine how watershed protection efforts impact the sustainability of fresh water supplies. Research recommendations for CWRM to support watershed management are identified later in this section.

L.4 Federal Watershed Protection and Management Programs

At the national level there exists Federal watershed protection and management programs to support and compliment State watershed protection efforts. However, a key difference to note is that the focus of these Federal programs is water quality.

Federal protection and management activities are primarily executed through certain programs administered by the EPA, the USACE, and the USDA. These programs are described below.

L.4.1 Environmental Protection Agency (EPA) Programs

Over the past 20 years, the EPA has found that the discharge of pollutants into the nation's lakes, streams, rivers, wetlands, estuaries, coastal waters, and ground water has been substantially reduced. This was achieved primarily by controlling point sources of pollution and, in the case of ground water, preventing contamination from hazardous-waste sites under the provisions of the Clean Water Act and the Safe Drinking Water Act. Environmental threats to water resources still exist, and the potential causes of pollution vary with human activities in the watershed. In addition to discharges from industrial or municipal sources, water resources may be threatened by urban, agricultural, or other forms of polluted runoff; landscape modification; depleted or contaminated ground water; changes in flow; over-harvesting of fish and other organisms; introduction of exotic species; bioaccumulation of toxics; and deposition or recycling of pollutants between air, land, and water.

⁵ <http://www.civilbeat.org/2017/01/money-sought-to-protect-watersheds-and-grow-more-food/>

Through program evaluation, the EPA has found that the federal laws addressing water resource problems have tended to focus on particular sources, pollutants, or water uses. Such laws have not enabled an integrated environmental management approach. Consequently, significant gaps exist in efforts to protect watersheds from the cumulative impacts resulting from the combination of all human activities in the watershed. However, the existing water pollution prevention and control programs, waste- and pesticide-management programs, and other related natural resource programs are excellent foundations on which to build an integrated watershed management approach.

The U.S. Environmental Protection Agency Office of Water (Office of Water) is responsible for preventing pollution wherever possible and reducing risk to people and ecosystems through implementation of the Clean Water Act and Safe Drinking Water Act; portions of the Coastal Zone Act Reauthorization Amendments of 1990; Resource Conservation and Recovery Act; Ocean Dumping Ban Act; Marine Protection, Research and Sanctuaries Act; Shore Protection Act; Marine Plastics Pollution Research and Control Act; London Dumping Convention; International Convention for the Prevention of Pollution from Ships; and several other statutes. Several organizations make up the Office of Water: Office of Wetlands, Oceans and Watersheds; Office of Science and Technology; Office of Wastewater Management; and the Office of Ground Water and Drinking Water. In addition, Water Divisions in all ten regional offices work with stakeholders to implement all programs.

Other federal agencies, state and local governments, Indian tribes, the regulated community, organized professional and interest groups, landowners and managers, and the public-at-large assist in program implementation. The Office of Water provides guidance, specifies scientific methods and data collection requirements, performs oversight, and facilitates communication among involved parties.

Through experience gained over the past several decades, the Office of Water has gained valuable insight to resource regulation and management. The Office of Water notes on its website a central theme that summarizes the difficulties faced by government agencies involved in resource management:

“...[W]e are still working with laws and regulations that treat land, air, water and living resources as separate entities instead of as interrelated systems. This regulatory pattern makes comprehensive solutions and their implementation problematic, and complicates protection of ecosystems and habitat. The traditional command and control approach, combined with single media laws, precludes flexibility and deflects attention from developing and applying alternative solutions that include market mechanisms, economic incentives, voluntary approaches, alternative enforcement penalties, prevention, negotiation, education and land use planning.”

U.S. EPA Office of Water⁶

⁶ U. S. EPA. 2006. *Overview of the National Water Program*. Internet, Available at: <http://www.epa.gov/water/programs/owintro.html>.

To remedy the existing jurisdictional and regulatory issues intrinsic in the structure of government, the Office of Water advocates supplementing the “command and control approach” with alternative techniques to allow program implementation on an integrated watershed basis, including air, land, and ecosystem relationships and related regulatory tools in water initiatives. The Office of Water seeks to apply a broad and balanced approach, utilizing regulatory enforcement, education outreach, voluntary compliance, and volunteer initiatives, particularly initiatives that prevent rather than remedy pollution. Thus, the Office of Water developed a Watershed Protection Strategy to protect water resources and public health at the overreaching watershed scale. The following sections provide information on the strategy development and the framework for implementation.

EPA’s Watershed Protection Approach

The Office of Water describes its Watershed Protection Approach as “a strategy for effectively protecting and restoring aquatic ecosystems and protecting human health.” The approach is based on the premise that many water quality and ecosystem problems are best solved at the watershed level, rather than at the individual body of water or discharger level.

The Watershed Protection Approach includes the following actions:

- Targeting priority problems;
- Promoting a high level of stakeholder involvement;
- Using integrated solutions that employ the expertise and authority of multiple agencies; and
- Measuring success through monitoring and other data gathering.

In 1996, the EPA published its *Watershed Approach Framework*⁷ to build upon the Office of Water’s Watershed Protection Approach, which was endorsed by senior EPA managers in 1991. The *Watershed Approach Framework* emphasizes the role EPA envisions for states and tribes. According to the Office of Water, the Watershed Protection Approach Framework also reflects the high priority that individual Office of Water programs have put on developing and supporting comprehensive state and tribal watershed approach strategies that actively involve public and private interests at all levels to achieve environmental protection.

Increased public awareness and concern over environmental issues has invigorated community-volunteer initiatives for watershed protection nationwide. The creation of multidisciplinary and multi-jurisdictional partnerships between public and private organizations facilitates community actions to address local problems within their watershed. The Office of

⁷ U. S. EPA.. 1996. ***Watershed Approach Framework***. EPA 840-S-96-001, Office of Water (4501T), U.S. EPA, Washington, DC. Available online at: <http://www.epa.gov/owow/watershed/framework.html>.

Water supports and encourages such partnerships for watershed restoration, maintenance, and protection. The Watershed Protection Approach Framework provides a coordinating structure for environmental management that focuses public- and private-sector efforts on the highest-priority problems within hydrologically defined geographic areas, or watersheds. The hydrologic boundaries consider both ground and surface water flow.

Guiding Principles and Benefits

The Watershed Protection Approach focuses on achieving pollution prevention, sustainable environmental improvements, and meeting community goals. The Watershed Protection Approach is flexible and its application may vary in terms of specific project objectives, priorities, elements, timing, and resources. However, the EPA recommends that projects apply the following guiding principles:

- **Partnerships:** The people most affected by management decisions are involved throughout and shape key decisions. This ensures that environmental objectives are well integrated with those for economic stability and other social and cultural goals. It also provides that the people who depend upon the natural resources within the watersheds are well informed of, and participate in, planning and implementation activities.
- **Geographic Focus:** Activities are directed within specific geographic areas, typically areas that drain to surface water bodies, or that recharge or overlay ground water, or a combination of both.
- **Sound Management Techniques based on Strong Science and Data:** Collectively, watershed stakeholders employ sound scientific data, tools, and techniques in an iterative decision-making process. This includes:
 - Assessing and characterizing natural resources and the communities that depend upon them;
 - Goal setting and identifying of environmental objectives, based on the condition or vulnerability of resources, and the needs of the aquatic ecosystem and the people within the community;
 - Identifying priority problems;
 - Developing specific management options and action plans;
 - Implementing plans; and
 - Evaluating effectiveness and revising plans, as needed.

All stakeholders and involved parties provide input on the roles, priorities, and responsibilities. Collective actions are based upon shared information and a common understanding. The Office of Water notes that the iterative nature of the Watershed Protection Approach encourages partners to set goals and targets and to make maximum progress based on available information, while continuing analysis and verification in areas where information is incomplete. This is of particular importance in Hawai'i, where data is lacking in many areas. The Watershed Protection Approach also accommodates concerns about environmental justice and promotes the adoption of pollution prevention techniques.

There are numerous benefits that are derived from utilizing the EPA's Watershed Protection Approach. Active and broad involvement of citizens, agencies, and private interests fosters a sense of community, reduces conflicts, increases individual and group commitment to follow through with action items, and improves the likelihood of sustaining long-term environmental improvements. Other specific benefits include:

- Operating and coordinating programs on a watershed basis makes good sense for environmental, financial, social, and administrative reasons.
- Joint review of environmental studies and assessments (for drinking water protection, pollution control, fish and wildlife habitat protection, and other aquatic resource protection programs) allows managers from all levels of government to understand the cumulative impacts of various human activities and determine the most critical problems within each watershed.
- Shared use of environmental studies and assessments allows public and private managers to allocate limited financial and human resources to set priorities for action and address the most critical needs.
- Establishing and monitoring environmental indicators helps guide activities toward solving high-priority problems and measuring success in real-world improvements, rather than simply fulfilling programmatic requirements.
- The emphasis on broad community involvement provides those people who depend on the aquatic resources for their health, livelihood, or quality of life a meaningful role in the management of resources.
- A cooperative approach can result in cost savings by leveraging and building upon financial resources and the willingness of individuals and concerned parties to take action.
- Improved communication and coordination reduce costly duplication of efforts and conflicting actions.

- Regarding actions that require permits, specific actions taken within a watershed context (for example, establishing of pollutant-trading schemes or wetlands mitigation banks and related streamlined permit review) enhance predictability that future actions will be permitted, and reduces costs for the private sector.
- Through resource leveraging and cost savings, the Watershed Protection Approach can help enhance local and regional economic viability in ways that are environmentally sound and consistent with watershed objectives.
- The Watershed Protection Approach strengthens teamwork between the public and private sectors at the federal, state, tribal, and local levels to achieve the greatest environmental improvements with the available resources.

Implementation through State and Local Watershed Approaches

“The [EPA] has both a national interest in and responsibility for supporting watershed approaches. The interest stems from the belief that the diverse sources of aquatic ecosystem impacts will best be brought under control through a combination of cooperative and mandatory measures tailored to the needs in specific watersheds with wholehearted support from watershed stakeholders. EPA’s responsibility includes definition and ensured compliance with basic water programs; development of national standards and tools; funding; and national assessment of status and progress.”

– EPA Office of Water, Watershed Protection Approach Framework, 1996⁸

State and local government agencies implement existing water and natural resource protection programs and are well situated to coordinate among other levels of government (e.g., local, regional, and federal). Therefore, the EPA places special emphasis on supporting state and tribal partners in developing and implementing comprehensive watershed approaches. However, this emphasis should not be construed as a lack of support for other parties who may want to be involved in watershed management, especially local stakeholders.

The EPA recognizes that each state or tribe may approach watershed management differently. The EPA supports watershed approaches that are specifically tailored to the needs of the jurisdictions, and therefore, the agency will not prescribe implementation actions. EPA envisions locally driven, watershed-based activities embedded in comprehensive state and tribal watershed approaches all over the United States.

⁸ U. S. EPA.. 1996. **Watershed Approach Framework**. EPA 840-S-96-001, Office of Water (4501T), U.S. EPA, Washington, DC. Available online at: <http://www.epa.gov/owow/watershed/framework.html>.

The Office of Water provides assistance to public and private water quality managers and staff in the development and implementation of watershed approaches. In 2008 the EPA published the Handbook for Developing Watershed Plans to Restore and Protect our Waters.⁹ This handbook provides guidance on how to incorporate the minimum elements of the Clean Water Act to meet water quality standards and protect water resources. The Hawai'i Watershed Guidance developed by the CZM Program and DOH complements the EPA guidance and links Federal recommendations to local level actions.

L.4.2 U.S. Army Corps of Engineers (USACE) Permitting Programs

The Water Resources Development Act of 1986 (§729) authorizes the USACE to assess the water resource needs of river basins and watersheds, including needs related to watershed protection and ecosystem protection and restoration. The West Maui Ridge to Reef Initiative is an example of a watershed project undertaken in Hawai'i pursuant to this authority.

Upon receipt of a request for assistance and formal assurance of local cooperation by a non-federal sponsoring agency, and subject to the availability of federal funds, an initial watershed assessment is conducted. This reconnaissance phase is 100% federally funded and limited to \$100,000 per project. After approval of the watershed assessment, the project enters a watershed study phase which will lead to the development of a watershed plan that recommends tools and strategies for achieving the desired conditions in the watershed. The cost of this phase is shared 75% Federal and 25% non-Federal.

The USACE also has jurisdiction over activities in waters of the United States and administers a regulatory program to protect aquatic resources. Waters of the United States consist of, essentially, all surface waters including all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. The USACE permit review process is intended to prevent adverse impacts to surface water resources and wetland environments, through the evaluation of proposed actions with respect to applicable laws, regulations, and policies.

The USACE derives its regulatory authority over waters of the United States from two Federal laws: Section 10 of the Rivers and Harbors Act of 1899 applies to all navigable waters of the United States and Section 404 of the Clean Water Act applies to all waters, including wetlands that have sufficient nexus to interstate commerce.

⁹ U. S. EPA.. 2008. **Handbook for Developing Watershed Plans to Restore and Protect our Waters**. EPA 841-B-08-002, Office of Water (4501T), U.S. EPA, Washington, DC. Available online at: http://water.epa.gov/polwaste/nps/upload/2008_04_18_NPS_watershed_handbook_handbook.pdf

L.4.3 USDA Natural Resource Conservation Service

In 1935, the USDA created the Natural Resource Conservation Service (NRCS), a federal-private partnership program with landowners and managers, to conserve soil, water, and other natural resources. The objectives of NRCS's natural resources conservation programs include the reduction of soil erosion, enhancement of water supplies, improvement of water quality, increase of wildlife habitat, and reduction of damages caused by floods and other natural disasters. Enhanced natural resources contribute to agricultural productivity and environmental quality, while supporting continued economic development, recreation, and scenic beauty.

The NRCS has six mission goals:

- High quality, productive soils;
- Clean and abundant water;
- Healthy plant and animal communities;
- Clean air;
- Adequate energy supply; and
- Working farms and ranchlands.

To achieve these goals, NRCS implements three strategies:

- **Cooperative conservation:** seeking and promoting cooperative efforts to achieve conservation goals.
- **Watershed approach:** providing information and assistance to encourage and enable locally led, watershed-scale conservation.
- **Market-based approach:** facilitating the growth of market-based opportunities that encourage the private sector to invest in conservation on private lands.

NRCS conservation activities include farmland protection, upstream flood prevention, emergency watershed protection, urban conservation, and local community projects designed to improve social, economic, and environmental conditions. Soil surveys, conservation needs assessments, and National Resources Inventory assessments provide the basis for resource conservation planning activities and an accurate evaluation of the condition of private lands. Local NRCS offices provide technical and financial conservation assistance to farmers and ranchers to develop conservation plans and to advise on design, layout, construction, management, operation, maintenance, and evaluation of the recommended, voluntary conservation practices.

The NRCS also provides conservation assistance through a nationwide network of conservation districts. The agency implements its “watershed approach strategy” through relationships with conservation districts and with local farmers and landowners.

L.4.4 The West Maui Ridge to Reef Initiative

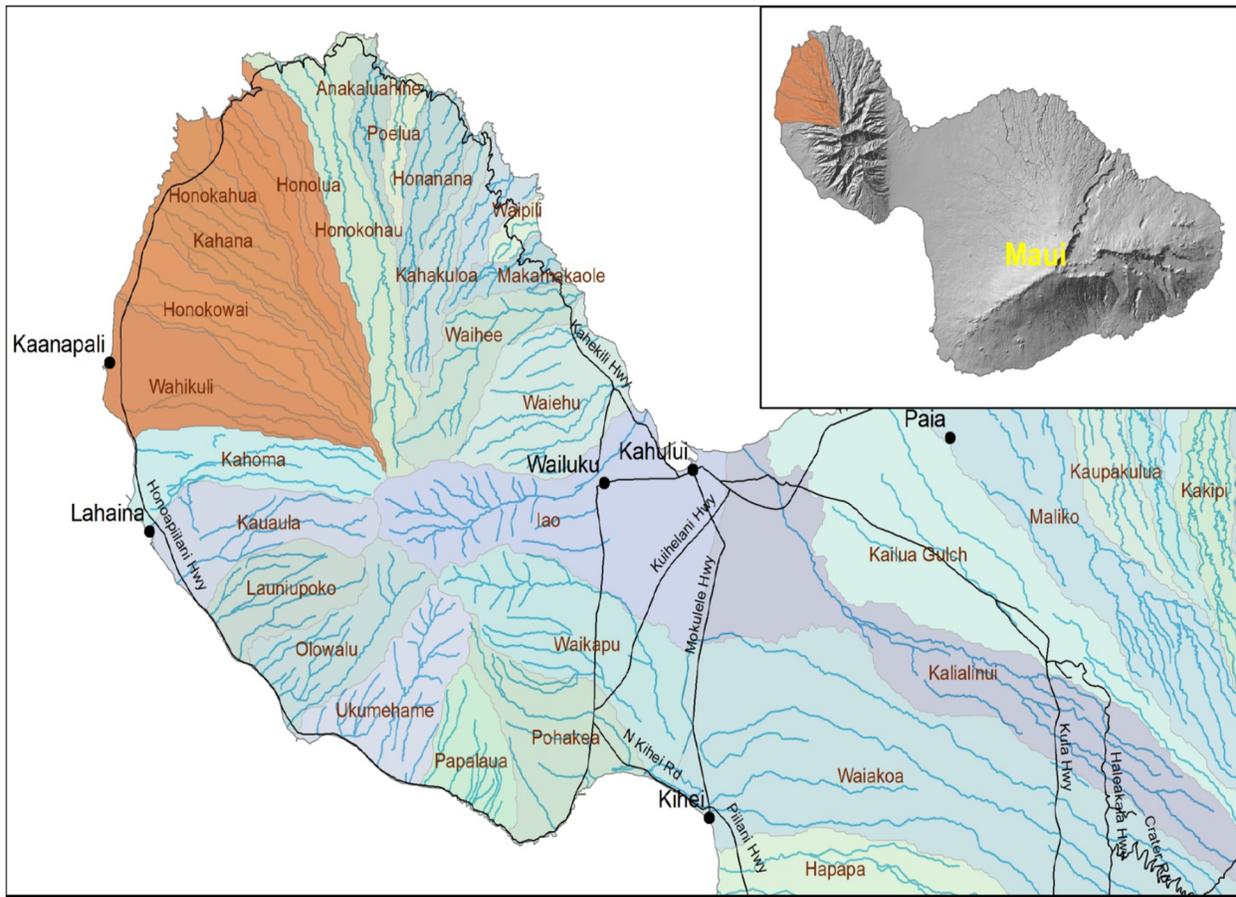
In 2011, the U.S. Coral Reef Task Force identified the Wahikuli and Honokōwai watersheds as priority management areas to protect the coral reef ecosystem along the West Maui coast. A Watershed Management Plan funded by the National Oceanic and Atmospheric Administration (NOAA) for these watersheds, which qualified under the EPA’s Clean Water Act (CWA) §319 funds were previously developed. The priority area was expanded to also include the watersheds of Kahana, Honokahua, and Honolua to the north (**Figure L-7 Watershed covered by the West Maui Ridge to Reef Initiative**).¹⁰ The goal of the initiative is to “restore and enhance the health and resiliency of West Maui coral reefs and nearshore waters through the reduction of land-based pollution threats from the summit of Pu’u Kukui to the outer reef.”

Federal partners include EPA, USACE, NOAA, USGS, USFW, and NRCS. State partners include DAR, DOFAW, CWRM, and DOH. Non-profits and community-based organizations are also contributing to the effort. The planning process will initiate a watershed planning process focusing on the Kahana, Honokahua, and Honolua watersheds in the short-term and complete the USACE’s Water Resources Development Act of 1986 §729 watershed assessment process for all five watersheds over the longer-term. It is hoped that the short-term watershed planning process will also qualify the northern three watersheds for additional EPA’s CWA §319 funds for implementation.

¹⁰ West Maui Ridge to Reef Initiative. Date accessed 4/1/13. Available online at: <http://www.westmauir2r.com/>

The steps in the planning process include identify problems and opportunities, inventory and forecast resources, formulate measures and strategies, evaluate alternative strategies, compare alternative strategies, and identify a recommended strategy. Throughout the three-year planning process, implementation of measures previously identified through the watershed planning process for the Wahikuli and Honokōwai watersheds will proceed and inform the larger planning effort. Identified data gaps will also be filled through additional studies and data collection to the extent possible.

Figure L-7 Watershed covered by the West Maui Ridge to Reef Initiative



L.5 Gaps in Watershed Protection

Although current watershed management efforts favor a comprehensive approach, watershed management in Hawai'i tends to have either a water quality or water quantity improvement focus. CWRM, BWS, the Watershed Partnerships, and DOFAW's *Healthy Forest, Healthy People* Plan are focused primarily on water quantity improvements, while DOH, EPA, and the CZM Program are responsible for coordinating watershed protection efforts to improve water quality and protect coastal resources. NRCS and the Soil and Water Conservation Districts address both water quality and quantity, and entities such as OCCL, LUC, and USACE address water as part of a system, but do not have water resource protection as a main focus.

CWRM supports DOFAW's role as the lead entity coordinating watershed management activities to improve ground water resources. As briefly described earlier, CWRM regularly collaborates with researchers to study precipitation changes, ground water recharge rates, and water resource impacts from climate change. CWRM efforts are focused on the following two fundamental issues to support the Division's goals:

1. Determination of the magnitude and timing of the change to water resources that result from watershed protection actions; and
2. Identification of priority areas to focus watershed management in response to current and projected increased competition for water resources.

L.5.1 Understanding the Magnitude and Timing of Changes to Water Resources from Watershed Management Actions

In order to understand the benefit of watershed management, we must measure the magnitude and timing of changes that result from watershed management actions. The basic premise of the watershed management referred to HRS § 183-31 and *The Rain Follows the Forest* Plan is that protecting native flora and fauna from nonnative species will result in increased drinking water supplies. However, the change in ground water supplies as a result of these native forest protections is not well understood. This makes it difficult to justify funding for watershed management, as there is no data that demonstrates this link to drinking water supplies or the magnitude of the benefit.

Work by Giambelluca¹¹ and Kagawa¹² have shown that stands of native forest on the Island of Hawai'i use water more efficiently than those dominated by studied non-native species. When the USGS recently estimated the recharge to the island's ground water, they incorporated this data into their analysis and observed a 10 to 12 percent increase in recharge.¹³ However, recent work by Rosa on Moloka'i found that recharge decreased along with runoff in a watershed reforested by native species.¹⁴ Brauman also found evidence to support this in her analysis of land cover effects on ground water recharge in the tropics. She suggests that in a precipitation scenario consistent with climate change predictions, differences in vegetation will have little effect on water quantity, instead impacting changes in water quality and runoff.¹⁵ The differing information from these studies has made it difficult for CWRM to understand the impact of watershed management efforts on water resources and to connect them to resource sustainability estimates. More research is needed to synthesize information on individual hydrologic components in a variety of vegetative regimes to provide a better understanding of how water resources are affected by watershed management actions.

L.5.2 Identification of Priority Areas for Watershed Management

The approach pioneered by the Honolulu BWS watershed prioritization program should be applied throughout the State. This will allow watershed managers and funding partners to better prioritize and focus actions, allowing for management to respond to areas where water resources may be under threat from natural or anthropogenic pressures.

CWRM currently uses the Hawai'i Water Plan process, hydrologic studies, and stakeholder input to identify areas of the State where there are or will be increased competition for water resources. CWRM should delineate these areas in a format that can easily integrate with DoFAW's watershed priority areas, thereby providing additional data to prioritize watershed management activities.

¹¹ Giambelluca, T.W., Delay, J.K., Asner, G.P., Martin, R.E., Nullet, M.A., Huang, M., Mudd, R.G., Takashi, M. 2008. *Stand Structural Controls on Evapotranspiration IN Native and Invaded Tropical Montane Cloud Forest in Hawai'i*. American Geophysical Union, Fall Meeting 2008, abstract #B43A-0422.

¹² Kagawa, A., Sack, L., Duarte, K., and James, Shelley, 2009, *Hawai'ian native forest conserves water relative to timber plantation; species and stand traits influence water use*: Ecological Applications, v. 19, no. 6, p. 1429–1443.

¹³ Engott, J.A., 2011, *A water-budget model and assessment of groundwater recharge for the Island of Hawai'i*: U.S. Geological Survey Scientific Investigations Report 2011 5078, 53 p.

¹⁴ Rosa S.N. 2013. *Evaluating Land-Cover Change Effects on Runoff and Recharge in Kawela, Molokai, Hawai'i*. M.S. Thesis, University of Hawai'i at Mānoa, 102p

¹⁵ Brauman, K.A., D.L. Freyber, G.C. Daily. 2011. *Land Cover Effects on Groundwater Recharge in the Tropics: Ecohydrologic Mechanisms*. DOI:10.1002/eco.236

To complement prioritization efforts that focus on the recharge potential of upper forested lands, impacts from makai land uses and activities need to be taken into account. High water use activities may elevate the importance of a watershed area because we rely heavily on it for potable water. Additionally, threats to water sources from potential contamination may also influence a watershed's prioritization.

Only a few tools currently exist to account for competition for water and threats to recharge and water quality, particularly as they relate to makai areas. The first are the County Water Use and Development Plans (WUDPs) that set forth the allocation of water to land use in each county. The WUDPs inventory existing water uses as well as future land uses, and related water needs for each county. Strategies for meeting water demands over a minimum twenty-year planning horizon must consider alternative water sources, including conservation, in addition to ground and surface water resources, and may also incorporate land use controls, such as downzoning. The statutory requirement to utilize the ground and surface water hydrologic units designated by CWRM for the presentation of data and analysis allows CWRM to identify the hydrologic units that may experience increased competition for water in the future and focus management efforts accordingly. Please refer to the WRPP **Appendix H Existing and Future Demands** for a more detailed discussion of the WUDPs.

The second tool available to refine the priority area maps are the ground water Capture Zone Delineation (CZD) maps¹⁶ that were developed by the DOH for their source water assessment program. These maps were developed to identify areas that would directly impact drinking water sources should any type of ground water contamination occur in that area. The zones created by this analysis can be interpreted as areas where recharge directly feeds a particular drinking water source. However, as CZD maps were created to protect individual wells from contamination and not to enhance ground water recharge to the larger aquifer, some of the capture zones identified through the program may be too small to address watershed management concerns for the benefit of water supply. To increase the usefulness of this product for *The Rain Follows the Forest Plan*, GIS analysis could be refined to extend ground water capture zones into the mauka forested areas where much of the recharge to ground water aquifers occur.

A third tool available to refine the priority area maps are the USGS ground water recharge estimations for the Hawaiian Islands. These studies provide a primary input for CWRM to determine the sustainability of Hawai'i's ground water resources. They would also allow for the identification of high recharge areas that may be negatively impacted by changes in vegetation and/or land use. Unfortunately, some of the limitations in using this data results from the lack of detailed vegetation and land cover maps. More data on plant water usage in various ecosystems is also needed to quantify the changes in recharge rates. CWRM should engage the research community to identify the studies and data needed to overcome these limitations.

¹⁶ Hawaii DOH Source Water Protection Program: <http://health.hawaii.gov/sdwb/swap/>

L.6 Recommendations

The State Water Code states that CWRM, through the WRPP, shall coordinate programs to conserve, augment, and protect the resource and cooperate with other agencies and entities.¹⁷ In the face of a changing climate, CWRM has an important role to play in supporting the watershed management efforts of DOFAW, DOH, and the CZM Program. Therefore, CWRM should directly pursue, or support and cooperate in the implementation of the following recommendations:

- Continue to provide the hydrologic data needed to support DOFAW's watershed management activities and the division's leadership role in watershed management.
- Improve the facilitation of data sharing amongst agencies on hydrologic and biological resources.
- Continue to support the CZM Program and DOH's role to coordinate watershed management activities to protect coastal resources.
- Support efforts to synthesize and summarize current watershed research efforts in the context of eco-hydrologic services.
- Continue to attend and support watershed partnership group meetings.
- Support research on the effects of climate change on water resources in Hawai'i and products from the watershed.
- Support research that improves the understanding of how landscape changes in the watershed affect ground and surface water resources, such as paired catchment studies.
- Work with partners and support research to identify and refine priority watershed areas meant to enhance ground and surface water quantity.
- Study existing government and community efforts in watershed management and protection and encourage sharing of information and experiences.
- Encourage stakeholders to support long-term hydrologic monitoring programs to understand changes in watershed hydrology that results from watershed management activities.

¹⁷ HRS §174C-31(d)(4) and §174C-5(12).