Final Report

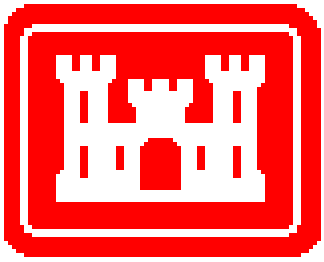
Hawaii Water Conservation Plan

Prepared for:

State of Hawaii

Department of Land and Natural Resources

Commission on Water Resource Management



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Acronyms and Abbreviations

AMA	Agricultural Management Assistance
AWEP	United States Department of Agriculture Natural Resources Conservation Service Agricultural Water Enhancement Program
AWUDP	Agricultural Water Use and Development Plan
BMP	Best Management Practice
BWS	City and County of Honolulu's Board of Water Supply
CWRM	State of Hawaii Department of Land and Natural Resources Commission on Water Resource Management
DLNR	State of Hawaii Department of Land and Natural Resources
DOE	U.S. Department of Energy
DOW	Kauai Department of Water
DWS	Department of Water Supply
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FEMP	Federal Energy Management Program
FTE	full-time employee
HDOA	State of Hawaii Department of Agriculture
HECT	High Efficiency Commercial Equipment
HET	High Efficiency Toilet
HGCSA	Hawaii Golf Course Superintendants Association
IA	Irrigation Association
IWA/AWWA	International Water Association/American Water Works Association
IWMP	Irrigation Water Management Plan
JBPHH	Joint Base Pearl Harbor-Hickam
LEED	Leadership in Energy and Environmental Design
LICH	Landscape Irrigation Council of Hawaii
mgd	Million Gallons per Day
NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
O&M	Operation and Maintenance
RC&D	Resource Conservation and Development Council
SCADA	Supervisory Control and Data Acquisition
SMART	Specific, Measurable, Attainable, Relevant, and Timely
SWOT	Strengths, Weaknesses, Opportunities, and Threats
UH	University of Hawaii

USACE	United States Army Corps of Engineers
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USGBC	U.S. Green Building Council
WCAG	Water Conservation Advisory Group
WUDPs	Water Use and Development Plans

Executive Summary

Need for a Water Conservation Plan

As an island state, Hawaii has limited access to natural fresh water supplies. Competition for fresh water, increasing population and development pressures, the rising awareness of environmental water needs, and the impacts of global climate change require that Hawaii become as efficient as possible in its uses of limited fresh water supplies. In some areas of the state, demand for water is approaching the sustainable limits of supply, and these demands are expected to increase in the future. In order to sustain and protect our water for future generations, we must strive to be as efficient as possible in all of our water uses.

The Commission on Water Resource Management (CWRM) is the primary steward of the water resources public trust and has broad powers and responsibilities to protect and manage Hawaii's water resources. This includes the authority and duty to develop plans and programs to conserve water across the State of Hawaii. While various state agencies and municipalities have developed and implemented individual programs to conserve water, there has been a lack of coordination and communication to collaborate those efforts toward a common goal.

Hawaii Water Conservation Plan Purpose

The purpose of the Hawaii Water Conservation Plan is to identify and implement water use and delivery efficiency measures to conserve the fresh water resources of the state. The plan is intended to be a guiding document for the CWRM as they develop and implement water efficiency measures that can be implemented across the state by various water user groups. In "owning" the Hawaii Water Conservation Plan, the CWRM serves as a coordinator, funding source, clearing house and offers technical assistance. Because the CWRM is not a water purveyor, it can lead by example, but otherwise cannot directly implement water efficiency programs. The CWRM depends on water users in Hawaii to participate and implement the measures outlined in this plan.

It is important to note that this Hawaii Water Conservation Plan focuses mainly on "demand side" measures of water use and delivery efficiency measures and programs to implement them. Although other types of "supply side" measures are commonly mentioned when discussing water conservation, such as reuse of recycled water or stormwater capture for groundwater recharge, these practices are not the emphasis of this plan. For the purposes of the Hawaii Water Conservation Plan, water conservation is defined as the reduction in fresh water use by improving the efficiency of water delivery and end water uses.

Principles and Planning Process

The CWRM began this process to develop a water conservation program with three overarching objectives:

1. Develop a coordinated statewide water conservation planning strategy and policy framework.
2. Develop a statewide water conservation program to implement the planning and policy framework.
3. Work collaboratively with water conservation stakeholders to achieve CWRM objectives.

The planning process for developing this water conservation plan involved forming an advisory group, defining a water use baseline, setting water conservation goals and strategies, developing recommended best management practices (BMP), defining and evaluating implementation approaches, and establishing an implementation and funding plan.

Water Conservation Advisory Group

There are numerous categories or sectors of water uses across the State of Hawaii. The uses range from municipal water supply to military to golf course and agriculture. Within the municipal and military sectors, there are also commercial, industrial, institutional, and other uses that are served. Realizing the need for collaboration and cooperation to succeed in a water conservation program, the CWRM sought to establish an advisory group of

stakeholders that would represent such a diverse water use spectrum. The Water Conservation Advisory Group (WCAG) is composed of water industry professionals and experts from across the state with knowledge or interest in water efficiency and conservation. Members represent all major water use sectors in the private industry as well as all levels of government.

During the development of this water conservation plan, the volunteer WCAG met six times over a period of 18 months to help create the statewide water conservation plan and program. During the six facilitated meetings, the WCAG contributed water use data, water conservation program information, participated in the development of sector-based BMPs, and established an initial prioritization of water conservation program elements. The CWRM believes that there should be a continuation of the WCAG or some derivative group of core members to support the implementation of water conservation programs in the state and to provide expert advice during the evolution of the State Water Conservation Program.

Water Use Characterization

The largest water use sectors by volume in Hawaii are the municipal and the agricultural sectors. The municipal (including military) water demand is approximately 205 million gallons per day. Water use data show that the residential sector is the largest municipal water use category, accounting for nearly two-thirds of all municipal water use. After that, the largest municipal water use categories are commercial, institutional, and hotel. Therefore, the categories in which municipal water conservation BMPs should be targeted include residential, commercial, institutional, and hotel use. The data also illustrate that there is a strong seasonal outdoor water use, and that outdoor water conservation BMPs should be considered.

Agricultural use is estimated at well over 350[1] million gallons per day (which represents both the reported and unreported uses), irrigating approximately 50,700 acres statewide. However, water use data are measured at different points within each irrigation system. Most data sets represented metered deliveries from main ditches and pipelines to water use at farm/field level diversion points, so do not represent total water diversions. Almost all of Hawaii's remaining large agricultural irrigation systems are legacy sugar plantation delivery systems. Many of these systems have fallen into disrepair, but some are undergoing rehabilitation through State-funded efforts. Rehabilitation, modernization, and improved maintenance of this system have the potential to improve water delivery efficiency while also improving the reliability of agricultural water supplies. It is important to note that some agricultural operations also have non-irrigation water uses for pest control and to meet regulatory requirements.

There are 104 golf courses in Hawaii with an estimated average water use of 53 million gallons per day in total across the golf course sector. The data indicate that the average 18-hole golf course in Hawaii covers 124 irrigated acres, has a peak month water use of 0.65 million gallons per day, and an average annual water use rate of 0.37 million gallons per day. Based on the data provided by water users and purveyors and on a per unit area basis, the average golf course irrigation water use was about half the average agricultural irrigation water use. However, the range in reported water use for individual agricultural and golf course sector sites was wide enough that a general comparison of water use across these two sectors is not possible.

[1] Agricultural water use based on the best available data at the time of printing which includes surface water and some brackish groundwater. This value does not include water supplied by municipal water utilities. Agriculture irrigation terminology have specific definitions described below:

Agricultural Water Use: Actual surface and ground water (fresh and brackish) used to grow crops and raise livestock. Where agricultural water systems are not available, farmers and ranchers obtain their water from municipal systems and is not included here.

Agricultural Water Demand: Replacement evapotranspiration for fields that are in production utilizing age crop coefficients. During droughts or system problems water use falls short of demand.

Deficit: The difference between agricultural water demand and use.

Water Conservation Measures and Prioritization

During the plan development process, the WCAG formulated a list of BMPs for the municipal, military, agricultural, and golf course sectors. The idea of establishing a landscape water use sector was considered, but since landscape use is common in all these sectors, the WCAG acknowledged the Landscape Industry Council of Hawaii (LICH), Landscape Irrigation Conservation Best Management Practices manual. Practices in the LICH manual can be applied within appropriate sector program elements.

A comprehensive list of sector-based BMPs was developed and the WCAG was led through a prioritization exercise to initially rank the BMPs based on specific criteria. The CWRM and the project team devised implementation approaches for each of the BMPs. These implementation approaches were then prioritized based on the following factors consistent with the CWRM's internal strengths and weaknesses as well as external threats and opportunities: ease of implementation, cost to CWRM, cost to "implementer," and whether the proposed BMP builds upon existing programs. The BMPs/implementation approaches were grouped into sector-based water conservation programs, and recommendations were made for program implementation and scheduling.

Implementation Plan

The Hawaii Water Conservation Plan implementation section describes prioritization, scheduling, and resources needed to implement recommended water conservation programs. There must be a balance of incentives and policy to elicit changes across the water use spectrum. The cost of implementation (both staffing and financial) is a major factor on whether a program can be implemented or not. Benefit-cost analysis is one factor to consider when choosing a project for implementation. Because staff and funding are both limited, implementation of the plan will occur over time and can be advanced as more staff and funding are available. This phased approach to implementation will require wise use of State funds and may necessitate new approaches to working together to implement the BMPs.

The CWRM's approach is to initially provide technical assistance and incentives where possible and to later establish or implement regulations and policies aimed at conserving and protecting our water resources. In this plan, there are a limited number of measures that are policy and/or regulation oriented and require certain actions by permitted water users over time. In most cases, however, the CWRM intends to establish a conservation framework and invite voluntary participation by different user groups for purposes of awareness, demonstration, documentation, or to receive dedicated funding for water conservation. The underlying premise of the plan is to build upon existing water conservation efforts where they exist and ones that have high stakeholder interests and opportunities for cost-sharing, establish partnerships to encourage voluntary participation in CWRM-sponsored water conservation programs, and to foster understanding and support for water efficiency. Any regulatory enforcement should give the affected parties reasonable time to comply without severe economic hardship. Over time, as data collection on water use and water savings evolves, additional programs may become viable and funding may be dedicated to support additional water conservation programs.

The implementation plan describes a 10 year planning horizon. As described in Section 7.1.2, two key implementation programs recommended for the first 2 years are: (1) procedure for conducting and requiring annual water loss audit for municipal, military, and other public water systems, and (2) irrigation metering demonstration projects for agriculture irrigation systems. Providing technical assistance and guidance will help affected stakeholders prepare for and begin to comply with policy and regulatory measures over some reasonable period of time. If funding is available, the CWRM will consider incentives to encourage the use of WaterSense/high efficiency plumbing fixtures and equipment as well as water efficient commercial equipment.

In addition to the recommended water conservation programs, the CWRM will continue to expand its role in coordinating new and existing water conservation programs, improving our water use data collection capacity, exploring policy actions, and pursuing funding opportunities to increase program effectiveness.

Commission Role and Vision

This Hawaii Water Conservation Plan establishes the Water Conservation Program in the CWRM. The CWRM anticipates taking a lead coordination role for water conservation across the State while partnering and collaborating with the WCAG and interested stakeholders. Water conservation programs should complement existing water conservation programs or measures within stakeholder agencies and organizations. Water conservation policies should be developed and enforced giving affected parties reasonable time to comply with rules and regulations. Program success will depend on coordinating water conservation program implementation, sharing resources, and building upon small achievements. The CWRM will pursue a sustainable funding strategy to implement the Hawaii Water Conservation Plan.

Regular water conservation plan updates or sectional revisions are necessary to evaluate program effectiveness, reflect changes happening in the community or in governmental regulations, and other factors such as new technologies. A 5-year update or revision to this plan is recommended.

The term "water conservation" means different things to different people. In Hawaii, a wide range of activities have been associated with the concept of water conservation, from watershed management to protect sensitive recharge areas to over-irrigation to promote aquifer storage and recovery to resource substitution which aims to use non-potable alternatives to preserve natural supplies. For the purposes of the Hawaii Water Conservation Plan, water conservation is defined as the reduction in fresh water use by improving the efficiency of water delivery and end uses.

SECTION 1

Introduction

1.1 Need for a Water Conservation Plan

As an island state, Hawaii has limited access to natural fresh water supplies. Competition for fresh water, increasing population and development pressures, the rising awareness of environmental water needs, and the impacts of global climate change require that Hawaii become as efficient as possible in its uses of limited fresh water supplies. Over 90 percent of the state's drinking water comes from groundwater sources, while much of the water used for agricultural irrigation comes from surface water sources. It is estimated that public water systems supply approximately 205 million gallons per day (mgd) of potable water across the state. Water used for agricultural irrigation is estimated to be well over 350[1] million gallons per day. In some areas of the state, demand for water is approaching the sustainable limits of supply, and these demands are expected to increase in the future. In order to sustain and protect our water for future generations, we must strive to be as efficient as possible in all of our water uses.

As the primary steward of the water resources public trust, the Commission on Water Resource Management (CWRM) has broad powers and responsibilities to protect and manage Hawaii's water resources, including the authority and duty to develop plans and programs to conserve water across the State of Hawaii. While various state agencies and municipalities have developed and implemented individual programs to conserve water, there has been a lack of coordination and communication to collaborate those efforts toward a common goal. In 2010, CWRM discovered an opportunity to cooperate with the U.S. Army Corps of Engineers (Planning Assistance to States Program) to develop a state water conservation plan and program to improve water use efficiencies in all water use sectors in the state.

1.2 Hawaii Water Conservation Plan Purpose

The purpose of the Hawaii Water Conservation Plan is to identify and implement water use and delivery efficiency measures to conserve the fresh[2] water resources of the state. While the plan is primarily intended to be a guidance document for the CWRM to direct agency activities and resources to promote water conservation, this plan also serves as an information resource that may be used by various water user groups to further their own water conservation efforts.

In "owning" the Hawaii Water Conservation Plan, the CWRM serves as a coordinator, funding source, clearing house, and resource for technical assistance and support. Because the CWRM is not a water purveyor, the CWRM can lead by example but otherwise cannot directly implement water efficiency programs. The CWRM will be dependent upon the participation of the water users in Hawaii to implement the measures outlined in this plan.

In this plan, some of the measures are policy- and/or regulation-oriented and require certain actions by water users over time. In most cases, however, the CWRM intends to establish a conservation framework and invite voluntary participation by different user groups for purposes of awareness, demonstration, documentation, or to receive dedicated funding for water conservation.

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Agricultural Water Use: Actual surface and ground water (fresh and brackish) used to grow crops and raise livestock. Where agricultural water systems are not available, farmers and ranchers obtain their water from municipal systems and is not included here.

Agricultural Water Demand: Replacement evapotranspiration for fields that are in production utilizing age crop coefficients. During droughts or system problems water use falls short of demand.

Deficit: The difference between agricultural water demand and use.

[2] Includes some brackish ground water for agricultural operations.

The underlying premise of the plan is to build upon existing water conservation efforts where they exist and to establish partnerships to encourage voluntary participation by public water suppliers, agricultural and other water users in CWRM-sponsored water conservation programs to foster understanding and support for water efficiency. Over time, as data collection on water use and water savings evolves, additional programs may become viable and funding dedicated to support additional water conservation programs.

Recognizing that some water users and sector groups are ahead of others in the implementation of water conservation measures, and in view of the current staffing and funding limitations of CWRM, this plan may also serve as a technical resource for water users to independently implement the prioritized BMPs identified in this plan. For each of the recommended BMPs, a brief description, qualitative estimates of water savings and costs, and possible implementation mechanisms are provided.

BMPs may also be considered and incorporated into long-range water use and development plans as a strategy for meeting future demands and promote sustainable water management. CWRM intends to fold the Hawaii Water Conservation Plan along with the recommended BMPs into the Water Resource Protection Plan component of the Hawaii Water Plan. The various other State and County agencies responsible for developing and updating other water use and development components of the Hawaii Water Plan will be encouraged to incorporate appropriate water conservation BMPs as part of their long-range plans.

1.3 Hawaii Water Conservation Plan Scope

This Hawaii Water Conservation Plan focuses mainly on water use and delivery efficiency measures and programs to implement them within four major water use sectors in Hawaii: municipal, military, agriculture, and golf course. Best available information was used to characterize sector water use and identify current and potential best management practices for industry implementation and to direct CWRM program development. While other types of practices are commonly mentioned when discussing water conservation, such as watershed protection or stormwater capture for groundwater recharge, these practices are not the emphasis of this plan. However, where appropriate, the Water Conservation Advisory Group identifies a limited number of best management practices that are not directly related to efficiency of water delivery and use but will serve to protect and conserve Hawaii's natural fresh water supplies.

The term "water conservation" means different things to different people. In Hawaii, a wide range of activities have been associated with the concept of water conservation, from watershed management to protect sensitive recharge areas to over-irrigation to promote aquifer storage and recovery to resource substitution which aims to use non-potable alternatives to preserve natural supplies. For the purposes of the Hawaii Water Conservation Plan, water conservation is defined as the reduction in fresh water use by improving the efficiency of water delivery and end uses.

Section 2
Background

2.1 Commission on Water Resources Management

The State of Hawaii Department of Land and Natural Resources (DLNR) Commission on Water Resource Management (CWRM) was created as the acting entity to fulfill the State of Hawaii's responsibility as the trustee of water resources to set policies, protect resources, define uses, and establish regulatory procedures. CWRM was established in 1987 through the adoption of the State Water Code (Chapter 174C, Hawaii Revised Statutes) and is governed by Chapters 13-167 to 13–171 of the Hawaii Administrative Rules.

CWRM consists of seven voluntary Commission members that have exclusive jurisdiction and final authority in all matters relating to implementation and administration of the State Water Code. Five of those members are appointed by the governor and confirmed by the State Senate; the remaining two are the Chairperson of the State Board of Land and Natural Resources, who serves as Chairperson of the Water Commission, and the Director of the State Department of Health.

CWRM is organized into three program areas: the Groundwater Regulation, Stream Protection and Management, and Planning Branches. Planning Branch personnel are responsible for coordination of all components of the Hawaii Water Plan and the development and implementation of a statewide water conservation plan and program, among other things. There are 22 employees of the CWRM, aligned to program areas outlined above. These staff members are responsible for carrying out the day to day responsibilities of the CWRM. Funding for the CWRM is through a variety of sources. These sources include appropriations by the legislature, fees/charges/fines/penalties, money from public and private sources to benefit water resource protection and management, and the sale of retail items by the DLNR related to water resources.

Several of the key powers and duties of CWRM are listed below.

- Designate water management areas for regulation.
- Establish an instream use protection program designed to protect, enhance, and reestablish beneficial instream uses of water.
- Cooperate and assist federal, state, county, or other local government agencies/organizations, and all other public and private agencies created for the purpose of utilizing and conserving State of Hawaii waters, in coordinating the use of their facilities, and participating in the exchange of ideas, knowledge, and data.
- Plan and coordinate programs for the development, conservation, protection, control, and regulation of water resources based upon the best available information in coordination with federal, state, county, or other local government agencies/organizations, and all other public and private agencies created for the purpose of utilizing and conserving State of Hawaii waters.
- Catalog and maintain an inventory of all water uses and water resources.
- Enforce its rules and orders.

Water resource management funding is established through the DLNR and can be used for the following activities.

- Monitoring programs and activities concerning water resource quality, protection, and management.
- Research programs and activities concerning water conservation and investigation of alternative sources of water.
- Data collection, development, and updating of long-range planning documents.
- Protection, management, operational, or maintenance functions including funding permanent or temporary staff positions.

2.2 Current State of Water Management and Conservation Planning, Regulation, and Implementation in Hawaii

2.2.1 Water Management and Conservation Planning

Conservation of water in the State of Hawaii is not a new idea. The three areas of water conservation (resource, water system, and consumer) have led to ongoing educational and outreach events spearheaded by the counties and industry groups for a number of years. Although each entity and water use sector has a mission to conserve water resources individually, there has been a lack of coordination and communication to collaborate those efforts toward a common goal. The current efforts from each sector are described below to allow for opportunities to build and combine measures helping to decrease inefficiencies and increase savings, as well as implement a successful statewide water conservation program.

Documents that have been written to explain current water usage, forecasts, and provide water conservation practices for specific events include: the *Hawaii Drought Plan* (Wilson Okamoto Corporation, 2005), county water use and development plans (Carl Freedman, Haiku Design and Analysis, 2007; Fukunaga & Associates, Inc., 2010; Group70 International, 2009; Townscape, 2009, RW Beck et al., 2001), *Agricultural Water Use and Development Plan* (Water Resource Associates, 2004), *Hawaii Water Resource Protection Plan* (Wilson Okamoto Corporation, 2008), and various Department of Defense mandates (e.g., U.S. Department of the Navy, 2010). Other than this document, there are none that link all counties and sectors together to support common water conservation goals.

In February 2000, CWRM published the Statewide Framework for Updating the Hawaii Water Plan (Framework), which included methods to integrate and update the Water Resource Protection Plan, Water Quality Plan, State Water Projects Plan, Agricultural Water Use and Development Plan, and county water use and development plans. This framework document discussed guidelines to update the plan, methods to integrate land use and water plans from the various entities, the roles and responsibilities of the different agencies, and potential critical resource areas that need more monitoring and data gathering. Importantly, the Framework recommends the specific consideration of water conservation as a resource option for meeting future demands.

Recent water management and conservation planning efforts are summarized by sector below.

2.2.1.1 State Departments

A number of documents have been published to encourage the adoption of water conservation measures at the state level. In response to Governor Lingle's Administrative Directive No. 06-01 (requiring all state agencies and programs to increase their commitment towards implementing innovative and resource efficient operation and management), the *Water Conservation Manual for State of Hawaii Facilities* (CWRM, 2007) provides detailed information on how to implement water efficient practices at state buildings and facilities.

Efforts to lead by example by the State of Hawaii on water conservation included the *Prototype Water Conservation Plan for the Department of Land and Natural Resources* (Fukunaga & Associates, 2005) which was a pilot project that examined five DLNR facilities to develop water conservation plans for other government facilities. The study concluded that to achieve the agency conservation goal of 10 percent and to save 3.1 million gallons per month, they needed to pursue additional follow-on studies/assessments of each facility. This would lead to the development of facility-specific water conservation plans aimed at achieving, or surpassing, their goal.

Another good example of government leading by example is the State of Hawaii Department of Accounting and General Services (DAGS) energy savings performance contracting (ESPC). Act 155, Session Laws of Hawaii 2009, authorized energy savings performance contracting in State-owned public buildings. During 2010 and 2011, DAGS entered into ESPC for 10 public buildings in the Capital District. These buildings covered over 1.3 million square feet. The purpose of the ESPC was to increase energy efficiency and building performance with the goal of reducing energy usage and demand. As part of the ESCP, the contractor also retrofitted building plumbing fixtures with better-than-code water efficient fixtures, installed weather-based irrigation systems, and made water efficiency improvements to air-conditioning cooling towers. These water efficient measures are expected to reduce potable water use by a total of 20 million gallons per year.

The Alliance for Water Efficiency completed a draft inventory in April 2012 of laws and policies on water conservation in place at all 50 states. In this document, the Alliance for Water Efficiency also assigned a grade to each state to reflect its level of water efficiency based on state-level laws and practices. Hawaii received a grade of "D" in this report, along with 18 other states receiving the lowest score. Two states received an "A;" there were ten "B's;" and 19 "C's." In order for Hawaii to move up in this scorecard grade, additional state-level policies, laws, and practices should be put into place and implemented.

2.2.1.2 Municipal

The municipal water providers for each county (City and County of Honolulu Board of Water Supply, Maui Department of Water Supply, Kauai Department of Water, and Hawaii Department of Water Supply) currently have their own programs for water management planning. The information below describes their efforts to support water conservation.

Honolulu Board of Water Supply

The Honolulu Board of Water Supply (BWS) has implemented a number of water conservation measures, becoming a role model for the rest of the state.

Stated in the Water Resource Protection Plan (Wilson Okamoto Corporation, 2008), BWS adopted a water conservation program using the following elements:

- Education and outreach (public, school, watershed, and community)
- Leak detection
- Repair and maintenance
- Large water user programs
- Regulation
- Alternative source development
- Recycling
- Conservation alternatives

In May 2011, BWS completed the Draft Water Conservation Program (WCP) Plan, which is the result of a multi-phased project spanning three years related to planning a comprehensive conservation program for the BWS service area. The WCP Plan includes results from a 2009 Market Penetration Study performed on Oahu to evaluate water conservation habits and saturation. The WCP Plan also includes results related to an evaluation of 15 water conservation programs/measures. BWS staff currently implements several of these conservation programs and are looking to phase in the launch of new conservation measures over the next several years.

Maui Department of Water Supply

The Maui Department of Water Supply (DWS) has implemented a water conservation program that includes a significant public outreach component (consumer conservation measures, waste prevention, general conservation information, free low-flow shower heads, faucet aerators, and leak detection dye tablets). The Maui DWS developed and expanded its conservation program to include both supply-side (leak detection, preventive and predictive maintenance, use of reclaimed water, use of alternate system backups, and resource protective measures) and demand-side measures (fixture distribution, audits/retrofits, landscaping, tiered rate structure, educational programs, regulations, and resource protection) (Wilson Okamoto Corp, 2008).

Kauai Department of Water

In the Kauai DOW *Water Plan 2020* (RW Beck et al., 2001), water conservation programs include:

- 100 percent customer metering
- Meter repair/replacement program
- Non-metered water analysis/report
- Leak detection
- Tank overflow controls/alarms
- Plumbing code water efficient fixture and pressure reducing valve requirement

- Voluntary water restriction notice
- Public outreach/education programs

The Kauai DOW also has a water conservation plan to meet the long-range water conservation goals of the BWS that include:

- Public outreach and education (community events, public presentations, display exhibits, publications/brochures, and school program)
- Demonstration conservation garden
- Pressure management
- Audits (system, residential, landscape)
- Ultra low flow toilet retrofit rebate
- Fixture distribution (low flow shower head and residential retrofit kit)
- Leak detection

Hawaii Department of Water Supply

The County of Hawaii Department of Water Supply (DWS) encourages conservation through the following (Wilson Okamoto Corporation, 2008):

- Inverted-block rate structure (charging higher unit costs for larger water users)
- Public outreach (brochures and handouts available to the public)
- During periods of drought or low rainfall, the department may issue notices asking for a 10 percent voluntary reduction in domestic use and restricting agricultural irrigation to the hours between 8 p.m. and 6 a.m.

Water conservation measures mentioned in the County of Hawaii DWS 20-year water master plan (Fukunaga & Associates, Inc., 2010) are separated into supply and demand-side. The supply-side measures include meter replacement and repair, non-revenue water analysis, leak detection program, and storage tank automatic level controls. The demand-side measures include meter replacement and repair, plumbing code regulation, voluntary water reduction, public outreach/education program, and xeriscape and efficient landscaping.

2.2.1.3 Military

The U.S. Department of Defense does not have a department-wide water conservation program, but each division follows the respective governmental requirements (Fukunaga & Associates, Inc., 2003). Military installations throughout Hawaii have been required to conserve water through various mandates including recent Executive Orders. Some examples are the installation of electric water meters and reductions of water usage by a specific amount each year. There currently is not a document adopted by all military branches that describes a water conservation plan.

Federal agencies must also improve their water efficiency and management by the following (U.S. Department of Energy, 2012):

- Reducing potable water consumption intensity 2 percent annually through fiscal year 2020, or 26 percent by the end of fiscal year 2020, relative to a fiscal year 2007 baseline.
- Reducing agency industrial, landscaping, and agricultural water consumption 2 percent annually, or 20 percent by the end of fiscal year 2020, relative to a fiscal year 2010 baseline.
- Identifying, promoting, and implementing water reuse strategies consistent with state law that reduce potable water consumption.

2.2.1.4 Agriculture

The sugar plantation industry's desire to increase water use efficiency in Hawaii spurred industry producers to become pioneers in the field of subsurface drip irrigation. Weather based irrigation scheduling using automated weather networks with radio telemetry is commonplace in plantation settings and large-scale agricultural operations. Farmers and ranchers regularly facing water deficits due to drought conditions are forced to quickly adopt water conservation measures. Additionally, establishment of instream flow standards and new regulatory conditions create additional challenges to water conservation efforts. The State of Hawaii Department of Agriculture (HDOA) created an *Agricultural Water Use and Development Plan* (AWUDP) published in 2004 (Water Resource Associates, 2004). Its purpose was to establish a rehabilitation program to maintain and repair various public and private systems and plan for a transition from mono-crops to diversified farming. The plan includes water conservation practices such as metering and monitoring individual farm connections and billings. HDOA plans to update the AWUDP within five years.

2.2.1.5 Golf Courses

Many golf courses are using advanced technology such as climate based irrigation scheduling and centralized control systems to efficiently manage their irrigation and conserve water. Several golf courses are also using recycled water, which reduces the demands on other freshwater supplies. The Hawaii golf course superintendents association provides a forum for connecting the golf course industry across Hawaii. However, there is no comprehensive guidance for water conservation on golf courses in Hawaii.

2.2.1.6 Landscape Industry

Landscape irrigation management is an important part of water conservation practices within both the municipal and military sectors. The Landscape Irrigation Council of Hawaii (LICH) has taken an active role in recent years to provide uniform guidance on irrigation water conservation practices that should be promoted within landscapes in Hawaii. The LICH recently took a water conservation survey of the industry and has published a handbook of recommended best management practices (BMPs) based on their feedback (LICH, 2011).

2.2.2 Regulation and Implementation

As authorized under the State Water Code, CWRM uses regulatory controls to implement its policies and relies on a permit system to apply and implement regulations concerning the diversion of surface waters and the development of ground water sources. This permit system helps to protect water resources and existing legal uses, ensure reasonable-beneficial uses, implement the counties' long-range plans, as well as promote hydrologic data gathering.

CWRM also has the authority to designate an area as a water management area if it is determined to be threatened by existing or proposed withdrawals and limit the amount of water withdrawn. This is done through a water use permitting process that is evaluated based on a number of criteria. The State Water Code does require that permitted uses be reasonable and reflect efficient water use as determined through actual metered use data in conjunction with established guidelines and standards. Adequacy of water conservation measures are analyzed as part of the reasonable-beneficial use test. Permit holders are required to submit water shortage plans, and other special conditions may be applied to these permits.

To protect instream uses, CWRM is authorized to establish instream flow standards (sometimes referred to as minimum flows) where necessary to protect the public interest in waters of the State. The setting of instream flow standards may affect the offstream water availability in affected stream systems.

In addition, the State Water Code requires the CWRM to catalog and maintain an inventory of all water uses. Hawaii Revised Statutes §174C-5(14). Hawaii Administrative Rules Title 13, Chapter 168, Section 7 (HAR 13-168-7) further requires the owners of well and stream diversion works to provide and maintain an approved meter or other appropriate device for measuring and reporting total water usage on a monthly basis to CWRM. In order to improve compliance with this rule, CWRM is in the process of setting up a database for well owners to input their monthly usages, thereby facilitating the reporting requirement for source owners while also allowing CWRM to more easily identify users who become delinquent by providing an automatic electronic notification to owners of their need to file the report.

As noted earlier, CWRM has limited authority to actually implement water conservation measures. Rather, its role is more of a coordinator and resource for technical support and funding. CWRM can use its regulatory tools to encourage water conservation in designated water management areas.

Each county is responsible for regulating water usage and implementing water conservation practices within its jurisdiction. As an example, a number of counties have executed water use restrictions during periods of drought. Counties have also provided high efficiency toilet rebates and free low-flow fixtures to promote water conservation.

Implementation of water conservation projects typically falls under the responsibility of county municipalities, military installations, private water purveyors, the HDOA in the case of state-run irrigation systems, and other water users with support from CWRM.

The State Water Code establishes the Hawaii Water Plan as the principal water resources planning guide for the State of Hawaii. The Hawaii Water Plan is comprised of the following five component parts (responsible agency in parentheses) : *Water Resource Protection Plan* (CWRM), *Water Quality Plan* (Hawaii Department of Health), *Agricultural Water Use and Development Plan* (Hawaii Department of Agriculture), *State Water Projects Plan* (DLNR Engineering Division), and *County Water Use and Development Plans* (one for each respective County). While it is NOT a component of the Hawaii Water Plan, the Hawaii Water Conservation Plan should be used as a guidance document and its principles incorporated into the Hawaii Water Plan component parts as appropriate. The next update of the *Water Resources Protection Plan* will incorporate elements of the Hawaii Water Conservation Plan. Future updates of the *Statewide Framework for Updating the Hawaii Water Plan* will include recommendations to integrate and incorporate the ideas and principles of the Hawaii Water Conservation Plan into the Hawaii Water Plan documents to the extent reasonable and appropriate.

Golf Courses

BMP Category	Specific BMPS	Comments	Priority
Use of Alternative Irrigation Water Sources			
	Reclaimed Water Use		
	Brackish Water Use		
Landscape and Golf Course Design			
	Drought Resistant and Low Water Use Turf Grass		
	Minimizing Close-Cut, Highly Maintained Turf Area		
	Lining of storage ponds and all water features		
	Stormwater and drainage capture and reuse		
Irrigation Systems Design and Devices			
	Use a qualified irrigation designer and installation contractor such as those certified by the Irrigation Association		
	Centralized irrigation control systems		
	Flow meter on main water sources		
	Multiple flow meters in distribution system for leak detection		
	Automatic rain shut-off devices		
	Automatic wind shut-off devices		
	Automatic drain valves to limit head drainage in low areas		
	Pressure regulators to ensure proper operating pressure		
	Drip systems for landscape plants		
Irrigation System and Golf Course Maintenance			
	Daily inspection and repairs		
	Regularly scheduled irrigation system audits		
	Aeration of high traffic areas for improved infiltration		
Irrigation Scheduling/Operation			
	On-site weather station for climate based irrigation scheduling		
	Soil moisture based irrigation scheduling		

BMP Definitions

Municipal

Water Loss Control

Water Loss Control is the calculation and reduction of water losses according to industry standard methodology. The industry standard is the IWA/AWWA Water Audit Methodology as outlined in the AWWA M36 Manual, Water Audits and Loss Control Programs.

Implementation mechanisms include requirement of water systems to perform annual water audits and submit to CWRM, and showing increase annually in the water audit data validity and/or reduction in water losses.

Rain Barrel Programs

Rain barrels, when installed at residential or large properties, collect rainwater from roof gutters to be used at a later time for non-potable outdoor purposes, such as hand watering or car washing.

Implementation mechanisms include public or targeted giveaway programs, do it yourself workshops, and sale at a reduced or subsidized price to water users.

Irrigation Upgrade Programs

Irrigation upgrade programs are the assessment and replacement of automatic irrigation components with more water-efficient technologies, such as controller systems that use real-time weather or soil moisture input or efficient applications such as rotary heads or drip irrigation. These are typically targeted to large irrigation systems (non-residential).

Implementation mechanisms include targeted or public rebates, water budgets to incentivize with financial penalties, or education/demonstration installations.

Gray Water Reuse

Water Reuse is the practice of using potable water for more than one end use before disposal and return to natural waters. Gray water reuse is from certain indoor end uses (shower, lavatory, washing machine) that can be reused with minimal treatment for non-potable uses such as irrigation or toilet flushing.

Individual gray water systems for buildings and residential uses can be rebated, required, or publicized.

Education and Outreach

Education and outreach is the development and dissemination of materials about ways to become more water efficient, and the value of water. This can also include highlighting new equipment and/or practices that increase water efficiency, as well as training and demonstrations.

Implementation mechanisms include requirement of water systems to develop education and outreach programs or coordination of regional education programs that individual water systems can participate in.

Efficient Commercial Equipment

Efficient commercial equipment is the identification and promotion of water using equipment for commercial users that are more water-efficient than those currently available or in use. These equipment can include toilet flush valves, urinals, kitchen pre-rinse spray valves, ice machines, and

cooling towers. Typically the water savings is very definable and payback can be calculated for these devices, based on their use.

Implementation mechanisms include education of the payback to promote retrofits, rebates for the installation to increase the payback for retrofits, and requirement of the use of efficient equipment in new commercial facilities.

Irrigation Technology

Irrigation technology is the promotion and installation of irrigation technology for automatic systems typically in residential or small landscape situations. These technologies can include inexpensive rain shutoffs switches that can be added to irrigation controllers and weather-based irrigation system controllers that are becoming more affordable for residential and small landscape uses.

Implementation mechanisms include education and rebates for the installation of rain shutoff switches on existing systems or replacement with weather-based irrigation controllers, and requirements for installation of rain shutoff switches on new irrigation systems.

Green Business Program

Green business programs are the development of new or promotion of existing green business programs. The intent is to highlight individual business that have implemented green business practices, such as energy and water efficiency above and beyond existing requirements, such as the USGBC LEED programs, and others.

Implementation mechanisms include education and promotion of selected promotions to targeted or public businesses. For those businesses that participate, there should be education to the public and other businesses about their resulting water and energy savings. Other implementation considerations include one-time or recurring rebates for certified businesses, or reduction in fees.

Water Use Surveys

Water use surveys include the development of water user assessment surveys to evaluate and benchmark opportunities for water efficiency improvements at individual customers. General surveys and materials can be developed for standardized users, while more customer specific audits must be performed for some commercial, Hotel/Motel/Resorts, and large landscape users.

Implementation mechanisms include free targeted or public surveys or audits, as well as a one-time financial credit for participating in a survey or audit.

WaterSense Certified/Labeled Equipment

WaterSense certified/labeled equipment is the promotion of the US EPA WaterSense program, which includes the certification and labeling of water using fixtures and appliances that use 20% less water than existing requirements, and are performance tested to receive certification.

Implementation mechanisms include joining the WaterSense Partner program to promote the availability and adoption of WaterSense labeled devices, or code changes to adopt WaterSense equipment such as toilets, urinals and faucets.

Military

Install meters at users/buildings

Install meters at users/buildings is the prioritization of on-base military users and/or buildings to install water use meters to better track water usage. There should also be a monthly meter reading program, and if applicable, a reporting mechanism to the users/building tenants.

Implementation mechanisms include requirements to meter a percent of buildings annually until completion.

Information and Education Programs

Information and education programs are the preparation and dissemination of materials about water conservation and efficiency and reducing water waste and loss. These materials could include existing material being used at other military installations.

Implementation mechanisms include signs, flyers, and education programs.

Distribution System Audits, Leak Detection, and Repair

Distribution system audits, leak detection and repair is the identification and reduction of leaks and other water losses and performing an audit according to industry standard methodology. The industry standard is the IWA/AWWA Water Audit Methodology as outlined in the AWWA M36 Manual, Water Audits and Loss Control Programs.

Implementation mechanisms include requirements for distribution system managers to perform system audits and develop a program for leak detection and repair. Also included could be the requirement to report on progress annually. Incentives could also be used to reward the reduction of leaks and other water losses, such as awards and recognition.

Water Efficient Fixtures

This BMP is the use of more water efficient fixtures in new buildings, and the retrofitting of equipment into existing buildings to reduce water use. These fixtures may include 1-pint urinals, WaterSense toilets, faucets, showerheads, efficient commercial toilet flush valves, and others. Another source of infromatio for this is the Federal Energy Management Program and SPiRiT to LEED transition program

Implementation mechanisms include the requirement to reduce water use intensity by 20% according to federal requirement, and implement LEED for new buildings according to the SPiRiT to LEED program. Annual reporting towards these requirements should be performed and publicized.

Look for opportunities to reuse or recycle water; Alternate Water Sources

This BMP is the practice of identifying opportunities to reuse or recycle water, or use alternate water sources for the original purpose. This could be identifying water uses that could be either substituted with reuse or alternate supplies, or where the water could be captured and reused for another water use.

Implementation mechanisms include the preparation of typical applications, and things to look for, as well as water use audits for installations. Then, an incentive to implement this could be developed, such as a reward and recognition program.

Water-Efficient Landscaping

Water-efficient landscaping is the use of landscaping practices that reduce irrigation water requirements. This includes the selection of plants and layout of the landscaping to reduce water requirements.

Implementation mechanisms include the requirement to perform an audit of existing landscapes to identify potential retrofit opportunities, and the development of landscape standards for new installations that minimize water use requirements.

Water-Efficient Irrigation

Water-efficient irrigation is the assessment and replacement of automatic irrigation components with more water-efficient technologies, such as controller systems that use real-time weather or soil moisture input or efficient applications such as rotary heads or drip irrigation.

Implementation mechanisms include the requirement to perform audits of currently irrigated areas to identify potential retrofits and calculate potential water savings, and the development of water-efficient irrigation standards for new installations.

Cooling Tower Management

Cooling tower management is the proactive maintenance and management of cooling towers to reduce leaks and water use. The water consumption of a cooling tower can be reduced by increasing the cycles of concentration, or amount of time the water is cycled through before being replaced with fresh water.

Implementation mechanisms include the requirement to perform regular maintenance and submit reports to prevent and repair leaks, as well as evaluate increasing the cycles of concentration. Another implementation mechanism could be to require a minimum cycles of concentration be set for all cooling towers.

Use a bucket and hose with spray nozzle when washing vehicles

This BMP is intended to promote the use of spray nozzles on hoses when washing vehicles, to prevent wasted water when not initially wetting or rinsing the vehicle during the wash process.

Implementation mechanisms include distribution of buckets and spray nozzles to all vehicle wash locations and educational materials describing the benefits of using spray nozzles, when washing vehicles.

Maintenance program to repair clogged line/valves/meters and check all valves, PRVs, and meters in the water system

This BMP is to perform maintenance on the water system to prevent leaks and interruptions in operation. The intent is to be proactive rather than reactive, and develop a maintenance program to systematically check the components of the water system.

Implementation mechanisms include a requirement to develop a maintenance plan, and submit regular reports on inspection and repairs.

Golf Courses

Use of qualified irrigation designers and contractors

Water efficient irrigation systems start with a proper design and installation. Use of qualified and experienced designers and contractors is the best way to ensure a water efficient irrigation system.

Implementation mechanisms involve developing a registry of qualified irrigation design and construction contractors with proven experience and certification by the Irrigation Association.

On-site weather station and climate based scheduling

Climate based scheduling is the use of real-time climate data to adjust irrigation schedules. Data from on-site weather stations that measure precipitation and evapotranspiration calculation variables (solar radiation, wind speed, air temperature, and relative humidity) are coupled with irrigation scheduling procedures to adjusting schedules in response to climatic demands. Use of an on-site weather station is especially important in Hawaii where precipitation gradients can be extreme over short distances.

Implementation mechanisms include the use of rebates or education/demonstration installations to encourage adoption and to educate potential users. Incentives, such as an awards and recognition program, could also be used to reward progressive golf courses for the adoption of advanced technology.

Daily inspection and repairs

Maintaining good operating conditions of an irrigation system through daily inspection and repairs is an important part of conserving water. This involves inspecting and repairing broken, malfunctioning, or leaking pipes, valves, fittings, and sprinklers. It also involves inspection and correction of over-irrigation in areas of poor drainage.

Implementation mechanisms include requirements for golf course managers to perform daily inspections and repairs to immediately correct any major leaks.

Regularly scheduled irrigation system audits

Irrigation systems often degrade in performance over time as equipment wears out, repairs are made with mismatched replacement components, and as landscape areas are changed. Regularly scheduled irrigation system audits are a good way to assess the performance of an irrigation system against industry benchmarks and design standards and to create a punch list of repairs or upgrades that may be needed to correct performance problems. Guidelines for performing irrigation audits on golf courses are available through the Irrigation Association. Certification for golf irrigation auditors is also available through the Irrigation Association.

Implementation mechanisms include requirements for golf course managers to perform regular system audits and develop a program for corrective actions. Also included could be the requirement to report on progress annually. Incentives could also be used to reward the reduction of leaks and other water losses, such as awards and recognition.

Aeration of high traffic areas for improved infiltration

In heavily trafficked areas of golf courses, surface soil compaction can reduce infiltration rates and can result in increased surface runoff and lower irrigation efficiency. Regular aeration programs can be used to improve alleviate surface compaction with the additional benefits of improving turf quality and playability.

Implementation mechanisms include requirements for golf course managers to develop a program for surface runoff control.

Centralized irrigation control system

Centralized irrigation system control provides greater flexibility in changing schedules to match demands and coordinating the rotation of irrigation run times around the system. With this control comes increased opportunity to conserve water.

Implementation mechanisms include the use of rebates or education/demonstration installations to encourage adoption and to educate potential users. Incentives, such as an awards and recognition program, could also be used to reward progressive golf course for the adoption of advanced technology.

Multiple flow meters in distribution system for leak detection

In addition to a main water source flow meter, installing flow meters on different zones or regions within an irrigation system can aid in the detection and repair of leaks. A methodology to estimate the scheduled and expected delivery volumes is also needed for comparison to metered flow records. These procedures can also be automated when coupled with a centralized irrigation control system.

Implementation mechanisms include the use of rebates to encourage more distributed metering and advanced leak detection.

Drip systems for trees/shrubs

In trees and shrub landscaping areas, sprinkler systems can be replaced with drip or micro irrigation systems to deliver the required amount of water directly to plant root systems without overwatering adjacent areas.

Implementation mechanisms include the use of rebates or education/demonstration installations to encourage adoption and to educate potential users.

Replacing non-play turf areas with xeriscaping

Water efficient landscape design and plant selection can significantly reduce irrigation water requirements in comparison to turf areas. Turf areas outside of normal play are good candidates for conversion to xeriscaping. Redesign and independent scheduling of irrigation systems serving these areas is also needed.

Implementation mechanisms include the use of rebates or education/demonstration installations to encourage adoption and to educate potential users.

Use of non-potable water sources

Use of non-potable water sources can help to reduce demand pressures on potable water supplies. However, efficient use of all water sources including non-potable water is still important for wise stewardship of Hawaii's water resources. In Hawaii, non-potable water sources might include reclaimed municipal or industrial wastewater or brackish groundwater. Specific requirements for use and public contact may depend upon the level of treatment provided. A salinity management plan is also advised for the use of brackish water sources.

Implementation mechanisms include master planning of treatment volumes and distribution locations for reclaimed municipal or industrial wastewater with targeted end users.

Agriculture

Climate and soil moisture based irrigation scheduling

Climate and soil moisture based scheduling is the use of real-time climate and soil moisture data to adjust irrigation schedules. Data from weather stations that measure precipitation and evapotranspiration calculation variables (solar radiation, wind speed, air temperature, and relative humidity) can be coupled with irrigation scheduling procedures to adjust schedules in response to climatic demands. Use of direct soil moisture monitoring, coupled with climate input for irrigation scheduling and forecasting is the most effective method for optimizing irrigation applications to satisfy crop water requirements without excess water delivery.

Implementation mechanisms include the use of incentive funding programs, outside technical assistance, and education/demonstration installations to encourage BMP adoption.

On-farm irrigation audits and water management plans

Irrigation systems often degrade in performance over time as equipment wears out, repairs are made with mismatched replacement components, and as crops or irrigation areas are changed. Irrigation operations that do not follow a plan for adjusting water applications to meet varying water demands also presents an opportunity for water conservation. Regularly scheduled irrigation system audits are a good way to assess the performance of an irrigation system against industry benchmarks and design standards and to create a punch list of repairs or upgrades that may be needed to correct performance problems. Development and adherence to an irrigation water management plan that considers climate, cropping, water supply and labor limitations is probably the single best way to improve irrigation water use efficiency at the farm scale.

Implementation mechanisms include the use of incentive funding programs, outside technical assistance, and education/demonstration installations to encourage BMP adoption.

Volumetric measurement of irrigation water use

Volumetric measurement of irrigation water use is the first step in providing data that can be used to assess water use efficiency. Volumetric measurement at main diversion and delivery points can provide the data needed to assess irrigation distribution efficiency and to identify potential irrigation water conservation projects. Volumetric measurement at all field diversions from the main delivery systems can be used further to assess water use efficiency at the field scale.

Implementation mechanisms include the use of incentive funding for installation of metering systems and increased regulation to require metering of all surface water diversions.

Lining and piping of irrigation canals

Leakage from unlined irrigation canals can be significantly reduced through projects to install liners that reduce canal seepage or projects that replace canals with enclosed conduits (piping). Piping of canals can have the added benefit of capturing energy that can be harnessed for hydro-electric projects or to reduce irrigation pumping energy requirements.

Implementation mechanisms include the requirement that all major irrigation systems to have current water conservation plans, the use of incentive funding programs, and education/demonstration installations to encourage BMP adoption.

Lining of earthen impoundment embankments

Lining of earthen impoundment embankments can be used to reduce the amount of seepage and water loss through those embankments. This measure can have the added benefit of increased safety and risk/liability reduction for water impoundments.

Implementation mechanisms include the requirement that all major irrigation systems to have current water conservation plans, the use of incentive funding programs, and education/demonstration installations to encourage BMP adoption.

Rehabilitation of aging and leaking pipes, flumes, gates, structures, impoundments

Many of the major irrigation systems in Hawaii were originally constructed more than 50 years ago. Repair and/or replacement of aging and leaking pipes, flumes, gates, structures, and impoundments can significantly reduce water losses. These measures can have the added benefit of increased safety and risk/liability reduction for irrigation distribution systems.

Implementation mechanisms include the requirement that all major irrigation systems to have current water conservation plans, the use of incentive funding programs, and education/demonstration installations to encourage BMP adoption.

Water control structure automation

Controlling and matching water deliveries to water demands through open channel conveyance systems is a difficult task. Reductions in water demands or increases in water levels at main diversions often results in operational spills from canal systems. Installing automated water control structures that respond to upstream or downstream water levels or respond to operational inputs from remote controls can significantly reduce operational spills.

Implementation mechanisms include the requirement that all major irrigation systems to have current water conservation plans, the use of incentive funding programs, and education/demonstration installations to encourage BMP adoption.

Centralized canal SCADA (supervisory control and data acquisition) systems

Many large irrigation systems in Hawaii span wide areas from main diversion points out to farm turnouts at the ends of the delivery system. Main water control points in the systems are also often in remote locations that can be time consuming to access. Use of centralized SCADA systems coordinated with remote communications (radio or satellite) can be a powerful tool in allowing an irrigation system manager to remotely monitor flows in various sections of the system and to adjust water control structures to match water deliveries to water demands. These systems provide the added benefit of increased safety and risk/liability reduction for irrigation distribution systems.

Implementation mechanisms include the requirement that all major irrigation systems to have current water conservation plans, the use of incentive funding programs, and education/demonstration installations to encourage BMP adoption.

Upgrade of on-farm systems to higher efficiency systems

Installation and operation of high efficiency on-farm systems (sprinkler, micro-spray, drip) can be effective in reducing irrigation water use in comparison to flood and older or low-technology sprinkler systems.

Implementation mechanisms include the use of incentive funding programs, outside technical assistance, and education/demonstration installations to encourage BMP adoption.

Crop residue management and conservation tillage for improved rainfall capture on irrigated lands

Surface soil compaction of grazing and crop lands can result in increase rainfall runoff and reduced effectiveness of rainfall in satisfying crop water demands. This results in the need for additional supplemental irrigation and/or reduced crop or rangeland production. Conservation tillage, crop residue management, and/or rotational grazing programs can be used to maintain proper surface infiltration and improve rainfall capture.

Implementation mechanisms include the use of incentive funding programs, outside technical assistance, and education/demonstration installations to encourage BMP adoption.

BMP GC10—Use of Non-Potable Water Sources

Category
Golf Course.
Description
Use of non-potable water sources can help to reduce demand pressures on potable water supplies. However, efficient use of all water sources including non-potable water is still important for wise stewardship of Hawaii's water resources. In Hawaii, non-potable water sources might include reclaimed municipal or industrial wastewater or brackish groundwater. Specific requirements for use and public contact may depend upon the level of treatment provided. A salinity management plan is also advised for the use of brackish water sources.
Water Savings
High – There may be no saving in total water use and sometimes there could be an increase in use to manage salinity. However, when considering the savings of otherwise potable quality water reserved for other uses and the utilization of non-potable water that would otherwise be discharged to the ocean, the savings are 1-for-1.
Cost
High – The primary costs are the treatment and distribution/conveyance of non-potable water to the place of use.
Schedule
Implementation of this BMP requires planning, permitting, design, and construction. Typical implementation time is at least 2 years from initial planning to project completion.