



Hawai`i
Watershed Guidance



A report prepared for the Hawai'i Office of Planning
Coastal Zone Management

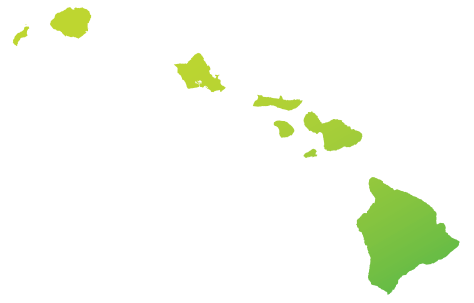
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Hawai`i Watershed Guidance





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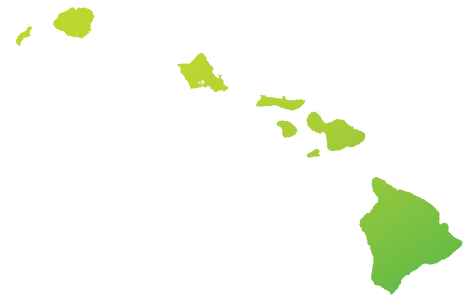
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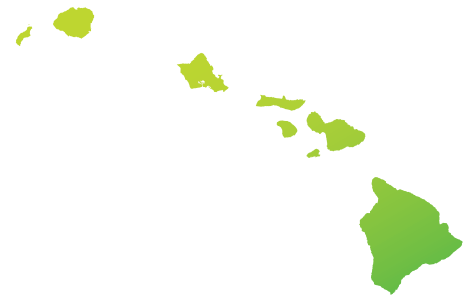
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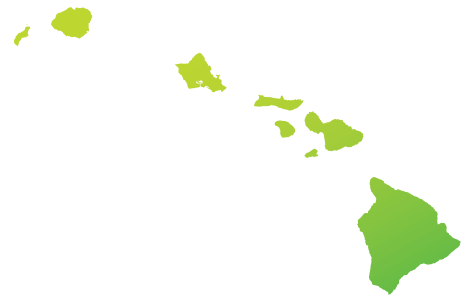
Acronyms

BASINS	Better Assessment Science Integrating Nonpoint and Point Sources
BLNR	Board of Land and Natural Resources
BMP	Best Management Practice
BOD	Biological oxygen demand
BWS	Honolulu Board of Water Supply
C&C	City and County of Honolulu
C&C BWS	City and County of Honolulu Board of Water Supply
CDUA	Conservation District Use Application (permit process)
CDUP	Conservation District Use Permit
CED	Covered Electronic Device
CES	University of Hawai'i Cooperative Extension Service
CFU	Colony forming units
CIP	Capital Improvement Programs
COEMAP	Hawaii Coastal Erosion Management Plan
CNPCP	Coastal Nonpoint Pollution Control Program
CTAHR	University of Hawai'i College of Tropical Agriculture and Human Resources
CWA	Clean Water Act
CWDA	Critical Wastewater Disposal Area
CWRM	Hawai'i Commission on Water Resource Management
CZARA	Coastal Zone Act Reauthorization Amendments of 1990
CZM	Hawai'i Coastal Zone Management
DBEDT	Department of Business, Economic Development, and Tourism
DES	City and County of Honolulu Department of Environmental Services
DLNR	Department of Land and Natural Resources
DLNR-DAR	DLNR Division of Aquatic Resources
DLNR-DOBOR	DLNR Division of Boating and Ocean Recreation
DLNR-DOCARE	DLNR Division of Conservation and Resources Enforcement
DLNR-DOFAW	DLNR Division of Forestry and Wildlife
DOA	Hawaii Department of Agriculture
DOBOR	DLNR's Division of Boating and Ocean Recreation
DOFAW	Division of Forestry and Wildlife
DOH	Hawaii Department of Health
DOH-CWB	Department of Health - Clean Water Branch
DOH-SDWB	Department of Health Safe Drinking Water Branch
DOH-UIC	Department of Health Underground Injection Control

DOT	Department of Transportation
DPW	Department of Public Works
EA	Environmental Assessment
eFOTG	NRCS's electronic <i>Hawaii Field Office Technical Guide</i>
EIS	Environmental Impact Statement
EFDC	Environmental Fluid Dynamics Code
EPA	U.S. Environmental Protection Agency
EPA Handbook	EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters
EPO	Environmental Planning Office
FOTG	NRCS's <i>Field Office Technical Guide</i>
FSP	Hawaii's Forest Stewardship Program
GIS	Geographic Information System
GSSHA	Gridded Surface Subsurface Hydrologic Analysis
HACD	Hawai'i Association of Conservation Districts
HAPPI	University of Hawaii CES Hawaii Pollution Prevention Information Project
HAR	Hawai'i Administrative Rules
HCC	Hawaii County Code
HDOH	Hawai'i Department of Health
HRS	Hawai'i Revised Statutes
HSPF	Hydrologic Simulation Program Fortran
I/E	Information and Education
Integrated Report	2006 State of Hawai'i Water Quality Monitoring and Assessment Report
KCC	Kauai County Code
LA	Load Allocation
LAS	Hawaii's Local Action Strategy (to address land-based pollution threats)
LCC	Large Capacity Cesspool
LSPC	Loading Simulation Program in C++
LUC	Land Use Commission
LUPAG	Land Use Pattern Allocation Guide (Hawaii County)
MCC	Maui County Code
mL	Milliliters
MOS	Margin of Safety
MP	Management Plan
MSD	Marine Sanitation Device
NARS	Hawaii's Natural Area Reserve System
NOAA	U.S. National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point Source (pollution)
NRCS	USDA Natural Resources Conservation Service
NSPECT	Nonpoint-Source Pollution and Erosion Comparison Tool
NWS	National Weather Service
NWIS	National Water Information System



OCCL	Office of Conservation and Coastal Lands
ORMP	Hawai'i Ocean Resources Management Plan
OSDS	On-Site Disposal System
OSWM	DOH's Office of Solid Waste Management
PRC	Polluted Runoff Control
PRISM	Parameter-elevation Regressions on Independent Slopes Model
ROH	Revised Ordinances of Honolulu
SCAP	DLNR's Stream Channel Alteration Permit
SMA	Special Management Area
SMART	Specific, Measurable, Achievable, Relevant, and Time-sensitive
SMZ	Streamside Management Zone
SWCD	Soil and Water Conservation District
SWMM	Storm Water Management Model
SWMP	DOT's Storm Water Management Program
TMDL	Total Maximum Daily Load
TR-55	Technical Release 55
TSS	Total suspended solids
UIC	Underground Injection Control (line or program)
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGA	U.S. Golfing Association
USGS	U.S. Geological Survey
USGS NWIS	U.S. Geological Survey National Water Information System
USGS PIWSC	U.S. Geological Survey Pacific Islands Water Science Center
VFS	Vegetated Filter Strips
VTs	Vegetated Treatment Systems
WARMF	Watershed Analysis Risk Management Framework
WASP7	The Water Quality Analysis Simulation Program
WAMView	Watershed Assessment Model
WLA	Waste Load Allocation
WRDB	Water Resources Database
WRPP	Water Resource Protection Plan



1.0 Introduction

Water, running through Hawai`i's watersheds from the top of the mountain to the sea, is exposed to a range of human activities. Our activities on land, such as agriculture and residential development, and on the sea, such as marinas and recreational boating, cause a range of pollutants to enter our streams and coastal waters. These pollutants impair water quality and degrade the beneficial uses that must be maintained to support Hawai`i's sensitive aquatic and coastal ecosystems and the range of ecosystem services that benefit us all. Watershed management efforts are designed to achieve a variety of goals, such as ensuring sustainable supply of drinking water, improving water quality, restoring native plants and animals, protecting healthy ecosystem, and perpetuating Native Hawaiian culture. The Hawai`i Coastal Zone Management (CZM) Program and Hawai`i Department of Health (HDOH) have developed this Hawai`i Watershed Guidance to emphasize the six steps in watershed management, the nine minimum elements of a watershed plan, and the management measures needed to demonstrate results.

1.1 What is the purpose of this guidance?

This guidance is intended to help those involved in managing Hawai`i's watersheds develop and implement watershed plans that have the greatest potential for achieving water quality goals. A watershed plan is merely a road map to guide the implementation of practices and activities to achieve results, including the improvement of water quality. Oftentimes, watershed plans include a laundry list of practices that could be implemented in the watershed, without careful consideration for selecting the most appropriate practice for the conditions or implementing the practice in the appropriate geographic area to reduce the pollutant sources. This guidance emphasizes selecting, implementing, and monitoring appropriate management measures to reduce pollutant loads. Watershed management is a collaborative multi-stakeholder process informed by sound information and data, defined through management measures to achieve goals, and implemented to achieve results.

Vast resources are available to help stakeholders develop effective watershed plans, but often it is difficult to find these materials and to know which tools are most appropriate for Hawai`i's unique environment. This guidance focuses on the practices and strategies that are common to all watershed planning and implementation efforts and highlights information and data sources developed specifically for Hawai`i under various programs. Two of the most relevant programs that will be highlighted repeatedly

throughout this document include Hawai'i's Coastal Nonpoint Pollution Control Program (CNPCP) and Hawai'i's Polluted Runoff Control (PRC) Program.

1.2 Who will use this document?

This guidance is intended for use by agencies and organizations that are primarily interested in the protection or restoration of surface water quality through the development or implementation of watershed plans. If your watershed issues are technically complex, you might have to enlist the support of experienced professionals such as engineers, hydrologists, statisticians, biologists, and database managers who have a variety of skills and can provide specific information for your watershed plan. The primary audiences that will benefit from this guidance are the following:

- **Community stewardship groups and watershed organizations** that are developing new plans, updating existing plans to meet funding requirements, or are considering other watershed issues.
- **Private landowners, farmers, ranchers, operators of marinas, and other private-sector partners** working to develop sustainable land and sea use practices.
- **Local agencies** developing or updating watershed plans or managing nonpoint source pollution through permits or other planning or regulatory means.
- **State agencies** developing and reviewing watershed plans, participating as stakeholders on watershed planning committees, or providing guidance to watershed associations.
- **Federal environmental agencies** with similar planning programs to help identify overlapping activities, provide sources of data, and offer other kinds of financial and technical assistance.

1.3 What's inside?

This guidance emphasizes the application of tested and proven methods to protect or restore water quality through management measures. This guidance walks the reader through a six-step watershed planning and implementation process:

Step 1 – Build Partnerships

Step 2 – Characterize the Watershed

Step 3 – Set Goals and Identify Solutions

Step 4 – Design Implementation Program

Step 5 – Implement Watershed Plan

Step 6 – Measure Progress and Make Adjustments



Information and guidance specific to Hawai'i are integrated within this process as well as lessons from the many ongoing efforts. The foundation of this guidance is based on the U.S. Environmental Protection Agency's (EPA's) *Handbook for Developing Watershed Plans to Restore and Protect our Waters*. The reader is referred to the EPA handbook for more in-depth coverage of the process and technical requirements for watershed planning and implementation.

This guidance is divided into five chapters that cover the watershed planning and implementation process. Each chapter includes information and references to resources that can help move through this process in Hawai'i.

- **Chapter 1: Introduction** includes the purpose of the guidance, the intended audiences, and guidelines on how to use the information provided.
- **Chapter 2: Connecting Land and Sea** introduces the overarching framework for watershed management and features of Hawai'i's watersheds.
- **Chapter 3: Selecting and Implementing Management Measures to Restore and Protect Water Quality** outlines the six steps for developing and implementing watershed plans and the nine minimum elements of watershed plans. The selection and implementation of the management measures from Hawai'i's CNPCP as part of the planning process are emphasized as a requirement for achieving water quality goals.
- **Chapter 4: Staying Focused on Achieving Results** reinforces key messages needed to achieve water quality goals.
- **Chapter 5: Hawaii Management Measures.**
- **Appendix A: Glossary** provides definitions of key terms used in the guidance.
- **Appendix B: List of Government Agencies with Watershed Responsibilities** identifies federal, state, and local agencies with watershed responsibilities.
- **Appendix C: Data Sources Useful in Characterizing the Watershed** highlights data types and sources of information.
- **Appendix D: Additional Watershed Planning Resources and References** highlights useful guides and other resources for watershed management.

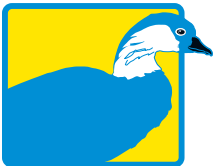
1.4 Helpful tips for using the guidance

The guidance is designed to help users understand the overall planning and implementation process and locate other needed that may be needed. The guidance uses the planning and implementation framework provided in the EPA handbook. The reader is referred to the EPA handbook as well as other resources for more in-depth discussion

of the planning and implementation process. Information and resources specific to Hawai`i are highlighted throughout the guidance. The following icons are used to help the reader.



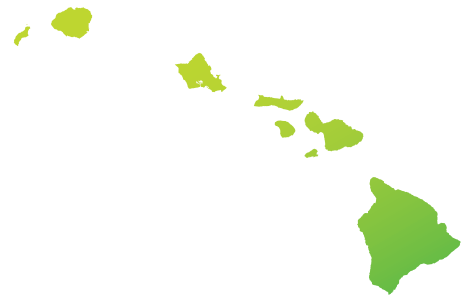
Important information specific to Hawai`i



Tips and lessons from Hawai`i's watershed efforts



Links to resources with more in-depth discussion of the topic



2.0 Connecting Land and Sea

Traditional Hawaiian management adopted a holistic approach that recognized the interconnectedness of land and sea, the interactions among species, the rhythms of the seasons, and the impacts of overuse on resources. Today, our use of the land and water has impaired water quality and beneficial uses of streams and coastal waters. Hawaiʻi's watersheds support a diversity of biota and provide a range of services, including water, food, and recreation. More effective watershed management is needed to restore, protect, and maintain the structure, function, and services of Hawaiʻi's marine and terrestrial ecosystems.

Hawaiʻi's Coastal Zone Management Area is defined in Chapter 205A, Hawaiʻi Revised Statutes (HRS), as "all lands of the State and the area extending seaward to the limit of the State's police power and management authority, including the U.S. territorial sea."

(See [Hawaiʻi Coastal Zone Management Act](#))

Hawaiʻi's watersheds are characteristically small, with steep terrains, flashy streams, and small drainage basins. As a result, there is a strong link between the health of the watershed and of the coastal and marine resources. This connection is recognized in Hawaiʻi's Coastal Zone Management Act, where watershed management areas are defined from the uppermost reaches of the mountains out into the sea. The [Hawaiʻi Ocean Resources Management Plan](#) serves as an overarching framework for watershed management by highlighting three perspectives for natural and cultural resources management: connecting land and sea, preserving our ocean heritage, and promoting collaboration and stewardship. The watershed planning



Perspective 1: Connecting Land and Sea

Careful and appropriate use of the land is required to maintain the diverse array of ecological, social, cultural, and economic benefits we derive from sea.

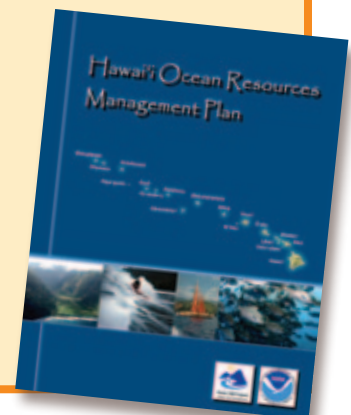
Perspective 2: Preserving Our Ocean Heritage

A vibrant and healthy ocean environment is the foundation for the quality of life valued in Hawaiʻi and the well-being of its people, now and for generations to come.

Perspective 3: Promoting Collaboration and Stewardship

Working together and sharing knowledge, experience, and resources will improve and sustain our efforts to care for the land and sea.

See [Hawaiʻi Ocean Resources Management Plan](#)

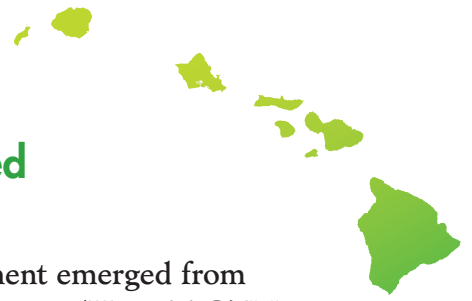


process and management measures and practices described in this guidance provide the tools to implement many of the strategic actions under each perspective of the Hawaiʻi Ocean Resources Management Plan (Table 1).

Table 1. Elements of the Watershed Planning Process and Management Measure Implementation to support Hawaiʻi's Ocean Resources Management Plan Goals and Strategic Actions

Elements of the Hawaiʻi Ocean Resources Management Plan	Related Step of the Watershed Planning Process or Applicable Management Measure(s)
Perspective 1: Connecting Land and Sea	
<i>Goal: Improve coastal water quality by reducing land-based sources of pollution and restoring natural habitats</i>	
Strategic Action: Reduce soil erosion from upland forest ecosystems and conservation lands	<ul style="list-style-type: none"> • Forestry Management Measure
Strategic Action: Reduce pollutant loads from residential, agricultural, and commercial land uses in priority watersheds	<ul style="list-style-type: none"> • Agriculture Management Measure • Urban Areas Management Measure
Strategic Action: Restore and protect wetlands, streams and estuaries	<ul style="list-style-type: none"> • Wetlands, Riparian Areas, and Vegetated Treatment Systems Management Measure
Strategic Action: Protect beaches, wetlands, and coastal communities from shoreline erosion and other coastal hazards	<ul style="list-style-type: none"> • Hydromodification Management Measure
Perspective 2: Preserving Our Ocean Heritage	
<i>Goal: Improve coastal water quality by reducing marine sources of pollution</i>	
Strategic Action: Provide appropriate waste management infrastructure to support commercial and recreational marine facilities	<ul style="list-style-type: none"> • Marinas and Recreational Boating Management Measure
<i>Goal: Improve the health of coastal and ocean resources for sustainable traditional, subsistence, recreational, and commercial uses</i>	
Strategic Action: Establish and institutionalize approaches for restoring, operating, and preserving ancient Hawaiian coastal fishponds and salt ponds for the benefit of coastal communities around the State	<ul style="list-style-type: none"> • Wetlands, Riparian Areas, and Vegetated Treatment Systems Management Measure
Perspective 3: Promoting Collaboration and Stewardship	
<i>Goal: Apply integrated and place-based approaches to the management of natural and cultural resources</i>	
Strategic Action: Develop integrated natural and cultural resources planning process and standardized tools	<ul style="list-style-type: none"> • Planning and Implementation Steps 1 – 6
Strategic Action: Build capacity for community participation in natural and cultural resources management	<ul style="list-style-type: none"> • Step 1 – Build Partnerships

Note: Planning and implementation steps 1–6 are detailed in Chapter 3.0. A summary of the management measures is provided in Chapter 3.0, Step 3—Set Goals and Identify Solutions. A complete listing and description of Hawaiʻi's Management Measures for the Coastal Nonpoint Pollution Control Program can be found at [Hawaiʻi's Management Measures](#).



2.1 What are guiding principles for watershed management in Hawai'i?

Guiding principles for natural and cultural resource management emerged from consultations with community stewardship groups across the state (Hawai'i CZM Program 2008). These principles emphasize risk-based, community-based, place-based, integrated, culture-based, and collaborative approaches for developing and implementing watershed plans to restore and protect water quality.

Natural hazards, such as flooding, drought, and hurricanes, pose additional stress on watersheds. Climate change exacerbates the impacts of these hazards. Hawai'i's climate is changing in ways that are consistent with the influence of global climate change including rapid rise in air temperature over the past 30 years with a stronger warming at higher elevations. Along with an increase in surface air temperature, documented climate change impacts in Hawai'i include: decreased rainfall and stream flows, increased rain intensity, sea-level rise, rising sea surface temperatures, and ocean acidification.

Watershed management strategies and actions should integrate risk reduction measures to address natural hazards and climate impacts (see *Hawai'i Statewide Assessment of Forest Conditions (2010)*). Watershed plans should consider the risk from natural hazards and climate change to ensure that investments made in watershed management are not lost through single or repeated hazard events. Watershed protection and restoration measures may be needed to ensure watersheds are not further degraded during response or recovery from a disaster. In addition, risk-based actions will increase the range of technical and financial resources available for implementing planned



Guiding Principles for Watershed Management

- **Risk Based:** integrate risk reduction measures based on existing hazards and projected future impacts of climate change
- **Community-based:** engage communities in plan development and implementation
- **Place-based:** consider unique social, economic, and environmental characteristics of the watershed
- **Integrated:** consider connections between land and sea as well as cumulative impacts of planned actions and other planning efforts
- **Culture-based:** build on Native Hawaiian knowledge, principles, and practices
- **Collaborative:** promote collaboration among stakeholders at all stages

Adapted from the *Hawai'i Community Stewardship Report (2008)*

actions. The Hawaiʻi Coastal Hazards Atlas provides place-based information that can be considering in developing watershed plans to address risks from natural hazards (see *Hawaiʻi Coastal Hazards Atlas*).

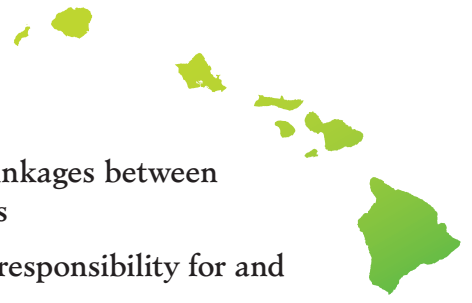
Watershed planning and implementation is a community-based process. Research has shown that the greatest chance for a watershed plan's success is when stakeholders are brought into the process at the beginning of the planning effort. Implementation of watershed plans is ultimately the primary responsibility of government agencies, but community support and action are vital beyond the plan development. People are more likely to take action if they support the plan and feel that their concerns are being addressed.

Watershed plans should be place-based, focusing on a geographic area that is defined by a drainage basin or watershed. A watershed plan should address unique ecological, social, and economic characteristics of the area such as endemic species, demographics, and land ownership. The area covered by the watershed plan should be large enough to ensure that implementing the plan will address the major sources and causes of impairments and threats in an efficient and economical manner. Focus should not be on a single waterbody segment or narrowly defined areas that do not provide an opportunity for addressing watershed stressors. On the other hand, the scale should not be so large that it hampers the ability to conduct detailed analysis or minimizes the probability of involvement by key stakeholders and successful implementation. Watershed plans that bundle adjacent watersheds with similar sets of problems or address a common stressor across multiple related watersheds can be particularly useful for planning, cost, and implementation efficiency.

Watershed plans should be developed and implemented in an integrated and holistic manner that incorporates all of the beneficial uses of a waterbody, the criteria needed to protect the uses, and the strategies required to restore water quality or prevent degradation. This approach usually provides the most technically sound and economically efficient means of addressing water quality problems. In addition, watershed plans should address the major sources of pollution to protect the watershed's long-term health.

Watershed plans, where applicable, can build on Native Hawaiian principles and practices. There is no separation of culture and place for Native Hawaiians. Culture flows from those connected to the ʻāina, shaped by everyday actions. Native Hawaiian traditional practices incorporate an extensive knowledge of the natural world, gathered over centuries when survival depended on sustaining the bounty of the land and sea for current and future generations. Use or consideration of these practices will help modern watershed planning. Traditional Hawaiian approaches that can be applied to watershed management today include:

- Management systems at multiple levels: ahupuaʻa, moku, and moku puni



- Integrated and place-based approaches that highlight linkages between land and sea and unique features of specific ecosystems
- Recognition that resource use is integrally linked with responsibility for and care of the environment
- Ahupua`a-based organization, such as `aha councils, that advise management decision-making employing traditional and local knowledge as well as science-based information and data
- Kapu system (prohibitions) and best management practices developed at appropriate scales of management and consistent with natural processes



Ahupua`a, the traditional Native Hawaiian political division of land that encompasses various elements of the `āina, which often (but not always) ranged from mauka to makai, from the tops of the mountains to the sea. Although the term ahupua`a is often used interchangeably with watershed, they are not the same. Ahupua`a is a political land division, whose boundaries often do not coincide with watersheds. However, this does not mean that we cannot garner important knowledge from the relationships that developed within and among ahupua`a. For example, those sharing resources with each other learn the value of integrating care for natural resources with cultural, human, and spiritual resources. Traditional Native Hawaiian principles and practices are being applied by community stewardship alongside contemporary watershed management efforts throughout Hawai`i. Lessons from these efforts are providing valuable insights for improved management of Hawai`i's watersheds.

(See [Hawai`i Community Stewardship Report \(2008\)](#))

Today, the ahupua`a as a management concept can represent a diversity of human, cultural, socioeconomic, environmental, and natural resource conditions. This diversity needs to be recognized such that institutional arrangements and processes for management are adapted to provide relevant modes of interaction and input by the community, together with government and nongovernmental organizations and the public. While ahupua`a were the traditional management unit, solutions to natural resource management problems must be defined at the appropriate scale whether that be at the ahupua`a, moku, or moku puni (island) level.

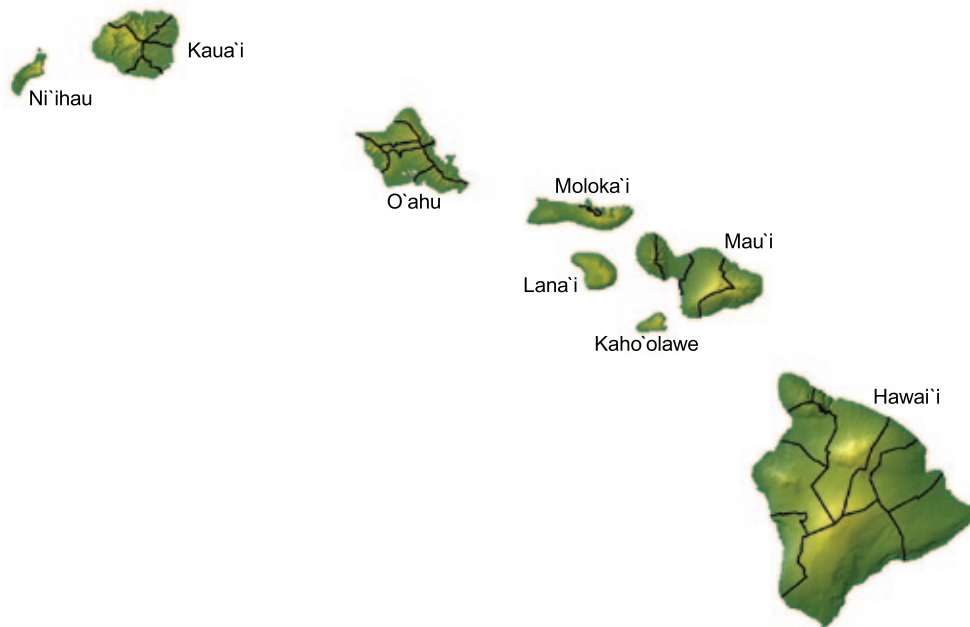


Figure 1. Map of Main Hawaiian Islands Showing Moku Based on Judicial Land Boundary Data

2.2 What are watershed management programs in Hawai`i?

Watershed management is collaborative multi-stakeholder process informed by sound information and data, defined through management measures to achieve goals, and implemented to achieve results. Hawai`i's PRC Program and CNPCP are the two primary state government programs responsible for addressing nonpoint source pollution. These programs, established through 1987 Water Quality Act amendments to the Clean Water Act (CWA) and Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, are designed to provide technical guidance and financial support to reduce nonpoint source pollution that results in impaired water quality in Hawai`i's streams and coastal waters. This section provides an overview of these programs and other watershed management efforts in Hawai`i.

Hawai`i's Coastal Nonpoint Pollution Control Program. The CNPCP was established by Congress in 1990 under Section 6217 of the CZARA and is jointly administered by the National Oceanic and Atmospheric Administration (NOAA) and EPA. Hawai`i's CNPCP, developed jointly by the Hawai`i CZM Program and the HDOH, is responsible for ensuring that the management measures are implemented and for providing accountability through a variety of tools, including rules, ordinances, voluntary approaches, educational campaigns, and financial incentives, all backed by enforceable policies and mechanisms. These measures are monitored and tracked to assess implementation across the state.



Hawai`i's CNPCP represents a comprehensive approach to polluted runoff, recognizing that all land-use activities in coastal watersheds can have impacts on estuaries, beaches, marine resources, and the ocean. The program works to improve coordination among agencies, promote pollution prevention, and build partnerships and networks that facilitate implementation of appropriate methods to limit polluted runoff before problems occur.

Hawai`i's CNPCP builds on existing state coastal zone management and water quality programs. The primary focus is on pollution prevention, minimizing creation of polluted runoff rather than cleaning up already contaminated water—which can be a difficult and expensive process. To this end, the CNPCP establishes management measures to address nonpoint source pollution from a variety of sources. Management measures are the best available, economically achievable practices or combinations of practices that can be used to address nonpoint source pollution. *Hawai`i's Management Measures* are designed to control runoff from six main sources:

- Forestry
- Agriculture
- Urban areas
- Marinas and Recreational Boating
- Hydromodification
- Wetlands, Riparian Areas, and Vegetated Treatment Systems



What Are Management Measures and Practices?

A management measure is a group of cost-effective practices designed to control runoff from six main sources. These management measures are implemented cooperatively to achieve more comprehensive goals.

Management practices are effective and practical methods used to achieve the management measure. Management practices are the building blocks of management measures.

Hawai`i's Updated Management Measures provide cost-effective solutions to achieve water quality protection and improvement in Hawai`i's watersheds in six categories of sources. These management measures should be incorporated where relevant in watershed management plans and necessary practices should be implemented to address water quality problems. In addition, the reader should also consult management measures described in EPA's guidance.

For a detailed description of Hawai`i's management measures see: *Hawai`i's Management Measures*. For additional guidance consult *EPA's National Management Measures to Control Nonpoint Pollution - Nonpoint Source Categories*.

The implementation of these management measures is the responsibility of State and local agencies throughout Hawai`i. These agencies are listed in Appendix B. In addition, many agencies have programs, projects, and funding opportunities that support ahupua`a, watershed, and ecosystem-based management in Hawai`i (see [Hawai`i Programs, Projects, and Funding Opportunities](#)).

Hawai`i's CNPCP seeks to strengthen links between federal, state, and county coastal zone management and water quality programs in order to protect coastal water quality from NPS pollution.

Hawai`i's Polluted Runoff Control Program. In 1987, Congress amended the federal CWA to place new emphasis on controlling polluted runoff. Section 319 of CWA requires states to develop nonpoint source pollution control programs and submit assessment and management plans. Section 303(d) of CWA requires each state to identify waterbodies not achieving water quality standards, develop categories and subcategories of nonpoint source pollutants, and develop and implement state water pollution control programs responsible for addressing impairments. Section 305(b) of CWA requires states to monitor water quality. EPA's integrated report guidance combines the requirements of Section 303 (d) and Section 305(b) into one Integrated Water Quality Report.

Hawai`i's PRC Program, administered by HDOH, receives funding from the EPA through Section 319(h) of the CWA to address nonpoint source pollution. Since 2004, the focus of Hawai`i's Polluted Runoff Control Program has been on development and implementation of watershed plans to reduce nonpoint source pollution in priority watersheds. The PRC Program provides funding through an annual competitive process to address watershed priorities (see [Hawai`i's Polluted Runoff Control Program](#) for more information).



Section 319 Funding from Hawai`i Department of Health

Hawai`i's Department of Health, Clean Water Branch Polluted Runoff Control Program, administers grant money it receives from Section 319 of the Clean Water Act to address Hawai`i's polluted runoff. Proposed projects should implement a component of an existing watershed management plan, TMDL, or other work or action plan to address water quality issues. Projects should have a reasonable expectation of delivering water quality improvements. A list of priority watersheds for Section 319 funding is provided on PRC's Website for Hawai`i's Section 319 Nonpoint Source Control Grant Program.

[HDOH 319 Program](#)





The Hawai'i Coral Reef Strategy. The State of Hawai'i Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) is the primary agency responsible for coordinating Hawai'i's reef management efforts in the Main Hawaiian Islands. The Coral Reef Working Group, made up of key state and federal partners involved in coral reef management, was established to help provide guidance for the State of Hawai'i's coral program. The Hawai'i Coral Reef Strategy integrates previously separate local action strategies to address priority threats to coral reefs, such as land-based pollution, into a single strategy with specific place-based priorities. These priority areas for the next 10 years (2010–2020) are:

1. Kaanapali-Kahekili
2. Pelekane Bay-Puako-Anaeho'omalu Bay
3. Maunalua Bay
4. Kāne'ohe Bay
5. Olowalu
6. Hā'ena-Hanalei
7. Kealahou
8. Wai'anae
9. South Shore Molokai

Hawai'i Association of Conservation Districts. The Hawai'i Association of Conservation Districts (HACD) encompasses 16 soil and water conservation districts (SWCDs) throughout the State of Hawai'i. Since its inception in 1954, HACD has worked to coordinate and facilitate local partners and governmental agencies in identifying and implementing projects and practices with cultural sensitivity to assure the protection of Hawai'i's environment. HDOH currently funds four conservation specialist positions (Oahu, Maui, Kauai, and Big Island) to assist HACD in providing technical assistance and conservation planning to their cooperators as well as specific watershed planning and implementation activities (See [Hawai'i Association of Conservation Districts](#) for more information).

County Plans. County governments are engaging communities in development of management plans to meet the requirements of preparing county water use and development plans under the State of Hawai'i Water Code as well as community development plans to guide sustainable development.

The Honolulu Board of Water Supply (BWS) is developing watershed management plans for each of Oahu's eight planning districts. The overall goal of the planning effort is to formulate environmentally holistic, community-based, and economically viable watershed management plans that provide a balance between: (1) the preservation and management of Oahu's watersheds, and (2) sustainable groundwater and surface water use and development to serve present users and future generations. The plan has five objectives: (1) Promote sustainable watersheds (2) Protect and enhance water quality

and quantity (3) Protect Native Hawaiian rights and traditional customary practices (4) Facilitate public participation, education, and project implementation and (5) Meet future water demands at reasonable costs. The plans will provide short-, mid-, and long-range guidance for the sustainable management and use of Oahu's surface and ground water resources. Plans have been developed for Wai'anae, Ko'olaupoko, and Ko'olaupoko (See the [Honolulu Board of Water Supply](#) for more information).

The current Hawai'i County General Plan, approved in 2005 by the County Council, is the overall planning document for Hawai'i Island. The general plan mandates districts within the county to plan for the future through community development plans. Community development plans translate broad general plan goals, policies, and standards into implementation actions as they apply to specific geographical regions around the Island (See the [Hawai'i County Resource Center](#) for more information).

Ecosystem Restoration Program. The U.S. Army Corps of Engineers (USACE) has undertaken a number of watershed studies and restoration projects in partnership with state and county agencies (see [USACE Projects](#)).

- West Honolulu Watershed Study – The objective of this study was to provide a holistic, comprehensive analysis of watershed data, problems, and issues and to conceptualize and describe potential watershed restoration projects and actions.
- Pelekane Bay Ecosystem Restoration Project – The purpose of the project is to reverse degradation to the coral reef ecosystem and improve water quality in Pelekane Bay to conditions that prevailed before the Kawaihae Deep Draft Harbor and area were developed. The project is at the reconnaissance stage.
- Central Oahu Watershed Study – This study provided an overview of watershed information pertinent to the area; identified resource problems and issues; and investigated potential projects and programs to remediate these issues. The study was conducted to inventory and address water-related issues associated with development and other land uses to protect and restore critical environmental resources.
- Ala Wai Canal Project – This project, conducted with DLNR, is in the feasibility phase. It includes identification of alternatives, environmental documentation, and a preliminary design related to flood hazard reduction and ecosystem restoration for the Ala Wai watershed.
- West Maui Watershed Project – This reconnaissance study, conducted with DLNR, was completed in 2010. Its objective is to use the Hawai'i Ahupua'a concept of resource management to identify measures recommended to solve West Maui's watershed problems, including aquatic, marine, and terrestrial ecosystem degradation, threats to water supply quantity and quality, and storm damage.

Hawai'i Association of Watershed Partnerships. Watersheds made up of a community with a few large landowners, as is the case with the nine watershed partnerships or those composed mainly of large-scale agricultural companies, have a smaller and more uniform group of constituents. These watersheds have large portions zoned as conservation and agricultural lands. Watershed plans for these locations have the ability to address large areas while requiring a small number of dedicated people. There are rarely opposing views in overall goals and objectives—only differing priorities. These few interests can be represented as a single voice.

Watershed partnerships are voluntary alliances of landowners and other partners working collaboratively to protect forested watersheds for water recharge, conservation, and other ecosystem services. There are nine watershed partnerships on six islands (Figure 2). In addition to these nine watershed partnerships, the Wai'anae Watershed Partnership has been added to included selected watersheds on the western side of Oahu. Most management actions are habitat-based and revolve around combating the main threats of feral ungulates and invasive species. These management actions make a critical difference by benefitting native forests, watersheds, and coastal and coral reef areas by reducing erosion and sedimentation runoff into streams. Through these partnerships, plans have been developed and are being implemented to protect forested watersheds on all main Hawaiian Islands.

Community-Based Organizations. Community stewardship groups, nongovernmental organizations, and private land owners play a vital role in watershed management in Hawai'i. In addition to supporting the efforts of government agencies, community-based organizations are instrumental in promoting and teaching traditional knowledge

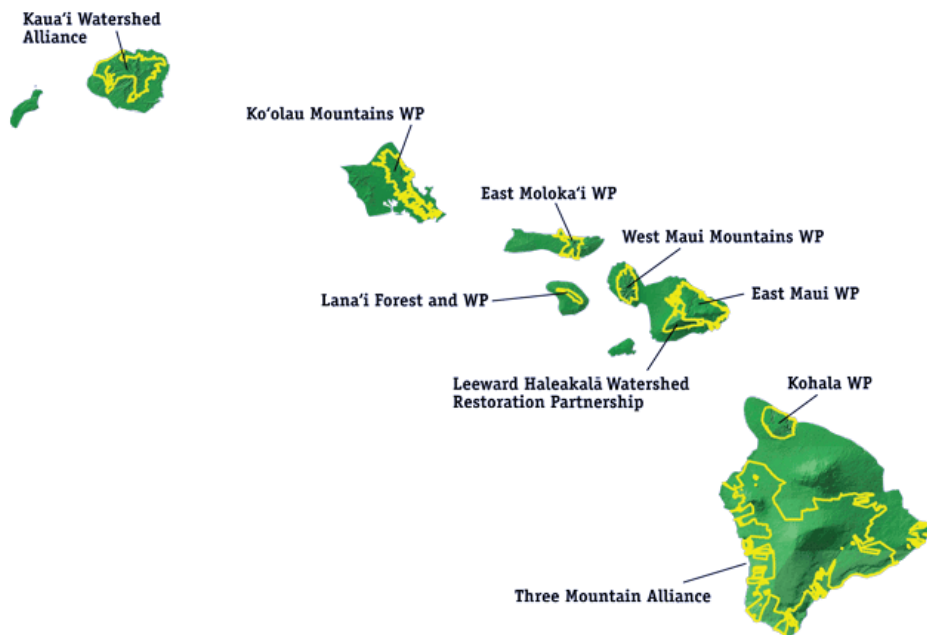


Figure 2. Watershed Partnerships in Hawai'i



Hawai'i Association of Watershed Partnerships are voluntary alliances of both public and private landowners committed to the common value of protecting forested watersheds for water recharge, conservation, and other ecosystem services through collaborative management. There are nine statewide Watershed Partnerships on six major islands -Kaua'i (1), O'ahu (1), Lāna'i (1), Moloka'i (1), Maui (3), and Hawai'i (2). Together, these partnerships involve more than 45 private landowners and 24 public agencies that cover 1.6 million acres of land in the state

(See [Hawai'i Association of Watershed Partnerships](#))



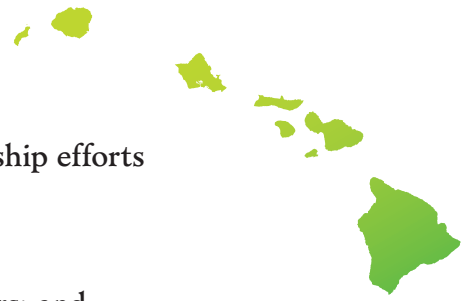
and practices, acquiring community involvement and support, and developing new approaches. The Hawai'i Community Stewardship Directory provides highlights of the efforts of more than 100 community stewardship groups (see [Hawai'i Community Stewardship Directory](#)).

A number of factors present challenges to community-based programs and projects (Hawai'i CZM Program 2008). Difficulty in recruiting volunteers, working with the government, lack of time, and diverse interests have been identified by community-based groups as frequent barriers to success. Community members who are not participating in the process but who raise objections during implementation is another common obstacle to success. Changing demographics, which often involves integrating new participants who do not know the specific, place-based issues can slow the process and drain momentum. Educating these newcomers consumes precious time of volunteer-based community organizations and initiatives. In addition, reaching consensus is often difficult and can water down final actions.

Achieving success relies on a number of factors. Networking with other community groups is critical to strengthening community stewardship efforts. Using culturally appropriate approaches promotes open communication, trust, and greater understanding and must occur within and among groups on multiple levels, including adults, children, community members, government, and *kupuna*.

Early and strong support from government can be the foundation for success. Seed money and agency support help programs get on the right track. Many government agencies and partners are recognizing how a "targeted watershed" approach pools resources to focus long-term efforts on specific aims provides an opportunity to produce measurable successes. Rather than thinly supporting scattered projects here and there, a targeted approach helps ensure that enough fiscal, human, technical, and other resources are available in a few targeted areas to encourage success.

Community stewardship groups and organizations have identified a number of changes that would better support their efforts (Hawai'i CZM Program 2008). Top strategies



that the state could pursue in support of community stewardship efforts include the following:

- Promote accomplishments and share lessons learned;
- Develop collaborative arrangements among stakeholders; and
- Sustain funding to successful community stewardship efforts on each island.

The resurgence of traditional Hawaiian approaches and the development of western-based watershed management techniques in recent years are being applied by communities and in partnership with government agencies. These resource management approaches have similar overarching philosophies, including an integrated holistic approach, long-term sustainability, and greater public understanding of, appreciation for, and connection with the natural resources we rely on.

Government agencies, communities, and the private sector must foster partnerships to solve problems that cross multiple jurisdictional and geographic boundaries to address complex environmental and natural resource management problems. Government agencies must resolve jurisdictional issues where they inhibit an integrated approach. Statewide policy and planning goals must include communities as equal partners, and locally organized advisory bodies must receive some level of responsibility and funding to improve the condition of the environment in their local areas. All available tools, knowledge, partnerships, and community involvement techniques must be employed and strengthened to accomplish an integrated approach.

Community stewardship of natural, cultural, and community resources occurs for small and large projects across the state. The right leadership is critical to the success of each project. Motivation to address the unique financial, political, and technical challenges, and the dedication to keep the community motivated through the setbacks that always occur, are key characteristics of successful leadership. All of the general concerns related to community stewardship of natural and cultural resources discussed above become more complex as the scope of an effort widens to encompass an entire watershed. Difficulties associated with development and implementation of a watershed plan — including fostering community involvement, determining goals, prioritizing efforts, and assessing the progress made — can be addressed in a variety of ways, and differences in opinion often arise. Nevertheless, generating stewardship for watershed resources can be a powerfully uplifting achievement for a unified community.

2.3 Why are watershed plans important?

A watershed plan provides a context and a road map for how the watershed will be managed. You want to provide enough information in the plan so that it clearly shows how you developed your goals and how you intend to achieve them. Many watershed plans are broad, exhaustive documents with much historical information, but no clear, concrete plan of action that links back to the major problems and sources of pollution

in the watershed. In addition, many plans do not quantify the pollutants, so that it is almost impossible to identify the reductions needed to achieve goals. Watershed plans must provide a careful analysis of the sources of water quality problems, their relative contributions to the problems, and management measures to solve the problems.

Significant environmental results are more likely where watershed plans provide detailed information to ensure that priority activities are being undertaken to achieve water quality objectives and beneficial uses within a specific time frame. Such plans help:

- Ensure that limited resources address significant pollutant sources
- Accelerate the pace of restoration
- Provide information to leverage related resources, and
- Establish feedback mechanisms for adjustments to ensure ongoing progress



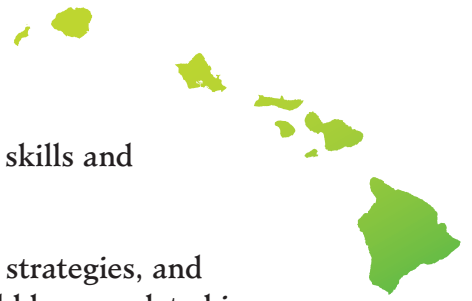
The watershed planning process requires the participation of a variety of people with diverse skills and knowledge.

Although watershed plans are often focused on identifying solutions to water quality impairments, they can also be used to identify areas for protection and conservation. Proactive watershed planning and implementation can ensure that best management practices are implemented before the water quality becomes degraded.

2.4 What is the watershed planning and implementation process?

The *watershed planning and implementation process* restores and protects watersheds through a series of iterative steps to characterize existing conditions, identify and prioritize problems, define management objectives, develop protection or restoration measures, and implement and adapt selected actions. Using a watershed approach to restore impaired waterbodies is beneficial because it addresses problems in a holistic manner (considering all parts of the watershed system such as biological, chemical, social, and other components).

A *watershed plan* is the document that is created during the watershed planning process. It provides information on assessment and management for a watershed, including analysis, actions, participants, and resources related to developing and implementing the plan. The development of a watershed plan requires a certain level of technical



expertise and participation of a variety of people with diverse skills and knowledge.

Although each watershed plan will emphasize different goals, strategies, and pollutant-related issues, the watershed planning process should be completed in an iterative and adaptive manner, allowing for adjustments and modifications in the future when new or better information becomes available. There may be limitations to the information available during the planning stages of a watershed plan. Information and load estimates may need to be updated in the future, resulting in the need to adjust the plan. Furthermore, several years of implementation will likely be needed before the project goals are met.

2.5 What are characteristic features of Hawaiʻi's watersheds?

Hawaiʻi's watersheds are distinguished by diverse social, economic, environmental, and resource management issues. Diverse interests, political inertia, complex permitting issues, and community organization are challenges in urban watersheds, where commercial, residential, small-scale agricultural, and conservation land use are interconnected over short distances. Moreover, the majority of watersheds in Hawaiʻi are not in close proximity to urban centers where the necessary expertise is often located. Watershed plans require a high level of detail, and a lack of expertise can appear insurmountable. Characterization of the watershed, and specifically calculating pollutant load and estimating the appropriate location and level of load reduction requires specialized technical expertise.

Of the approximately 580 watersheds in the state, most are small, less than 3 square miles (2,000 acres) in area. The geology of the islands is part of a partially exposed volcanic mountain range; soils are mostly of volcanic origin, but some are of coralline origin or a mixture of both. Typical watersheds are steep with highly permeable volcanic rocks and soils, and short, flashy streams.

Hawaiʻi has a subtropical climate, and rainfall varies tremendously by location (fewer than 20 inches per year to more than 400 inches per year). The hydrology of each island is a discrete system of streams and related drainage areas. There are no major river basins. The majority of streams are active only during heavy rainfall. The state's flashy and perennial streams flow directly into the sea or into small drainage basins. Water quality at the head of the stream is often very good, but significantly decreases as it travels toward the ocean.

Located in the most isolated archipelago in the world, Hawaiʻi's watersheds exhibit a high degree of endemism, and many species are critically endangered. Invasive species and development threaten native species by causing increased erosion and reduced water retention in the watershed.

2.6 What are impaired waterbodies in Hawai'i?

Streams or coastal waters are considered impaired waterbodies if they do not meet Hawai'i's water quality standards that support its designated use. State Water Quality Standards are a requirement under the CWA, which aims to keep waters safe for plants and animals to live and people to wade, swim, and fish. Water quality standards are used to evaluate the physical, chemical, and biological health of their waters. In other words, they are used to understand when and where pollution from our daily activities is polluting our waters to a point that might hurt people, plants, or animals. The HDOH, Environmental Planning Office, revises water quality standards every 3 years as a requirement of the CWA. Any amendments needed to reflect current knowledge and new federal regulations are adopted through the public hearing process.

The HDOH, Water Quality Management Program, is responsible for setting the state's water quality standards, monitoring and assessing our achievement of these goals, listing impaired waterbodies that do not meet the state's water quality standards, and engaging in long-range planning for surface water quality improvement and protection through the total maximum daily load (TMDL) process.

CWA Section 305(b) requires states to describe the overall status of water quality statewide and the extent to which water quality provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water. CWA Section 303(d) requires states to submit a list of Water Quality-Limited Segments, waters that do not meet state water quality standards, plus a priority ranking of listed waters based on the severity of pollution and the uses of the waters. The 2006 State of Hawai'i Water Quality Monitoring and Assessment Report (known as the Integrated Report) is the first effort by HDOH to integrate both reporting requirements of the CWA Section 305(b) and Section 303(d) (See [2006 State of Hawai'i Integrated Report](#)). This Integrated Report



Hawai'i State Water Quality Standards

Hawai'i's Water Quality Standards define:

- The classification system for state surface waters, which assigns different protected uses to different water classes,
- The specific numeric or narrative water quality criteria needed to achieve that use, and
- A general antidegradation policy that maintains and protects water quality for the uses defined for a class.

Hawai'i's water quality standards were amended on May 27, 2009. See [Chapter 11-54 Administrative Rules](#)



describes impaired waters and priority pollutants in Hawai'i's streams and marine waters.

HDOH's 2006 Section 303(d) list of impaired waters contains a total of 209 marine areas. The breakdowns for the individual islands (number of listed waters per island and total number of listed waters) are: Kauai 28 (13 percent of total), Oahu 71 (34 percent of total), Molokai 3 (1 percent of total), Lanai 6 (3 percent of total), Maui 72 (34 percent of total), and Hawai'i 31 (15 percent of total). Of the 209 marine areas, 39 new waterbodies were added, a total of four waterbodies were de-listed (no category 5 listing present): Analani Pond (Puala'a), Ala Moana Beach (Diamond Head), Lanikai Beach, and Waimanalo Bay station [Waimanalo Beach County Park North]), all for *enterococci*. Seven previously listed waterbodies were listed for new pollutants.

Of the 209 listed marine waters, 56 were because of high *Enterococcus* indicator bacteria test results. In general, HDOH does not consider these waters to represent a threat to human health, despite the results, because *Enterococcus* in tropical waters may result from animal waste or soils, instead of human sewage, which the indicator bacteria was intended to signal. *Enterococcus* reproduces in biofilm and is found in drainage pipes, concrete channels, river rocks, and in beach sand. For these reasons, Hawai'i uses a secondary indicator, *Clostridium perfringens*, to evaluate whether human fecal contamination is involved. Hawai'i's revised bacterial water quality standard is 35 CFU/100 mL. During rain events, *Enterococcus* levels in the marine waters increase because of storm water runoff from streams and storm drains. For these reasons, HDOH intends to raise the Hawai'i standard to 35 CFU/100mL to match the national standard. Nonetheless, when *Enterococcus* levels rise during non-storm related events, a sanitary survey is conducted to isolate the cause of the rise.

The 43 new marine areas were listed for one or a combination of pollutants that include *Enterococcus*, total nitrogen, nitrate + nitrite, total phosphorus, turbidity, chlorophyll *a*, and ammonium nitrogen. Similar to the existing listings, turbidity was the most common pollutant to trigger a marine water listing, with 24 occurrences.

Primary pollutants in Hawai'i's impaired waters are turbidity, nutrients, and bacteria (Table 2). Within the 93 listed inland freshwater perennial streams, there were a total of 296 individual pollutant/waterbody combinations. The most common listing was turbidity, where the standard was exceeded in 101 of the waterbodies. The next most common listings are nitrite/nitrates (75 instances), total nitrogen (67 instances), and total phosphorus (41 instances). There were five instances of Dieldrin listings, two for chlordane, two for total suspended solids, and one listing for metals/lead.

As stated in the Integrated Report, turbidity in these impaired marine waters is caused by polluted runoff, and HDOH is focusing its polluted runoff control program on selected watersheds to make measurable improvements.

Table 2. Priority Pollutants and Sources in Hawai'i's Watersheds

Primary Pollutants	Pollutant Sources	
<ul style="list-style-type: none"> • Turbidity • Nutrients • Bacteria 	<ul style="list-style-type: none"> • Cesspools • Septic systems • Animal wastes • Fertilizer • Exotic species 	<ul style="list-style-type: none"> • Algae blooms • Roadside erosion • Streambank erosion • Impacts of feral animals • Natural flood events

See [2006 State of Hawai'i Integrated Report](#) for more information on priority pollutants and sources in Hawai'i's watersheds.

2.7 What watersheds are current priorities for restoration and protection in Hawai'i?

Priority watersheds in Hawai'i are areas where opportunities to achieve water quality improvements have been identified. These areas may have a watershed plan that meets EPA requirements, an approved TMDL or TMDL implementation plan, and substantial partnerships. Priority watersheds may also include areas with waters not currently impaired and require efforts to ensure these waters remain unimpaired by nonpoint source pollution. Funding from Section 319 grants emphasizes implementing activities in priority watersheds but also allows for the support of watershed plan development. Current priority watersheds in Hawai'i are listed below.



Current Priority Watersheds in Hawai'i for Section 319

- Nawiliwili Bay watersheds – includes Puali, Huleai, and Nawiliwili stream watersheds
- Hanalei Bay watersheds – includes Hanalei, Waikoko, Waipa, and Waioli watersheds
- Ala Wai watersheds – includes Manoa-Palolo, Makiki, Ala Wai watersheds
- Ko'olaupoko watersheds – includes Windward Oahu watersheds from Kualoa to Makapuu
- Kapakahi Stream watershed
- South Moloka'i watersheds – includes watersheds from Kaluaapeelua to Ohia
- Pelekane Bay watershed
- Hilo Bay watersheds – includes Wailuku, Honolii, Paukaa, Maili, Pukihae, Wainaku, and Wailoa watersheds
- West Maui – includes watersheds from Launiupoko to Honolulu

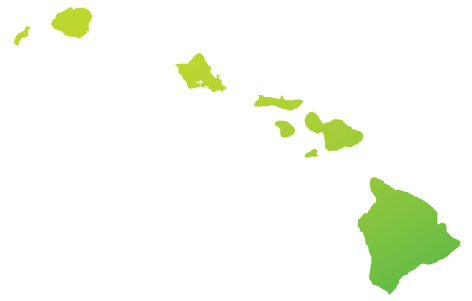
See [HDOH Polluted Runoff Control Program](#) for more information on [Priority Watersheds in Hawai'i](#).



In addition, a Hawai'i watershed prioritization process was completed in 2009 (for report, see [Hawai'i Watershed Prioritization Process](#)). This process used a geographic information system (GIS) database to conduct a quantitative assessment of watershed priorities in Hawai'i. Four broad classes of criteria were used to quantify priority watersheds: stressors, sensitive areas, assets, and indicators. Stressors fell into three main categories: urban, agriculture, and soil. Sensitive areas were areas likely to be harmed by impaired watershed discharge, such as Marine Life Conservation Districts, recreational areas, and coral reefs susceptible to watershed disturbance. Watershed Assets included properties that would serve to protect a watershed from disturbance, such as conservation areas that promote watershed health by managing land for conservation and restricting development. Indicators used in the prioritization process focused on watersheds already recognized in need of restoration such as those with Section 303(d) listed streams. This prioritization process will be used in the future to inform identification of additional priority watersheds where application of this watershed guidance will be targeted.

2.8 What about protecting healthy watersheds?

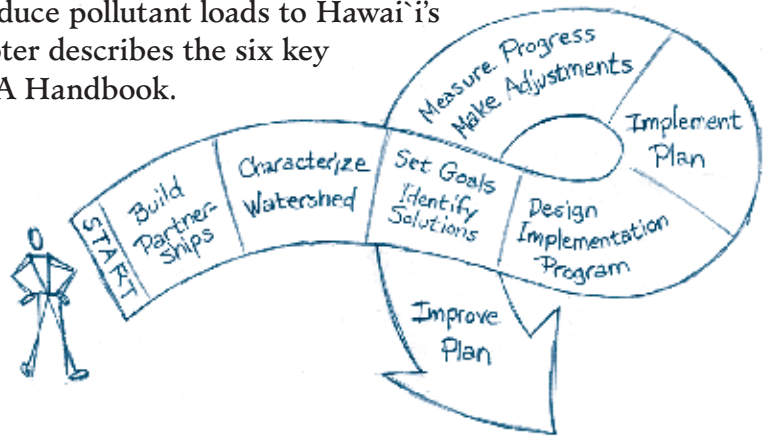
In some cases, stakeholders might want to protect waters that are affected by nonpoint source pollution but that are not included on the Section 303(d) list. Preventative, risk-based management is needed to protect healthy watersheds. Of particular concern are high-quality waters threatened by changing land uses when unique and valuable aquatic resources are at serious risk of irreparable harm. In healthy watersheds, the focus of planning and implementation is not only to address known sources of pollution, but also to assess potential risks from a variety of threats. Threats to healthy watersheds may be local, such as new development or changes in land use with a watershed. Regional threats may include the introduction and spread of new invasive species. Global threats may include extreme drought and flooding as result of climate change. The severity and likelihood of these threats need to be identified and assessed as a basis for planning. Monitoring may need to incorporate control sites to demonstrate that management efforts are protecting conditions in the watershed. This guidance can be used to develop watershed plans for waters that are not impaired by nonpoint source pollution to ensure that they remain unimpaired.



3.0 Planning and Implementing Management Measures to Restore and Protect Water Quality

Watershed planning and implementation is a process that depends on building and maintaining partnerships needed to characterize the watershed, set goals and identify solutions, implement actions, and make necessary adjustments. The overall goal of this process is to improve or protect water quality by planning and implementing a set of management measures designed to reduce pollutant loads to Hawai'i's streams and marine waters. This chapter describes the six key steps in this process following the EPA Handbook.

Six Steps. The six-step planning and implementation process is summarized in Table 3. Each step includes several substeps that further clarify what should be accomplished before planning moves on to the next step. It is helpful to review the steps and identify where you stand in the process. This section also discusses key elements of watershed plans. These elements are bold, italicized, and highlighted with an asterisk in Table 3.



EPA has developed a number of tools to help agencies and organizations work through this six step process.

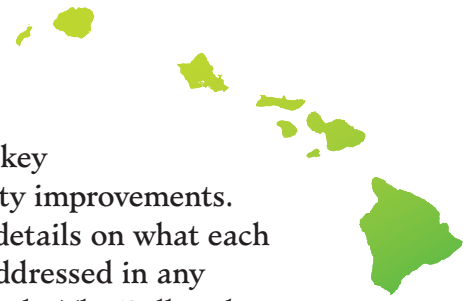
- EPA's Watershed Plan Builder is a tool designed for users who are just beginning to develop a watershed plan, are in the process of developing a watershed plan, or updating an existing plan. It will help get you started on developing a watershed plan by guiding you through a series of questions designed to collect information about your watershed. The information you provide will be used to produce a customized watershed plan outline. The outline will include recommended content to be included in the various sections of your watershed plan, as well as related data links and contact information. You can then use this outline to begin working through the watershed planning process with your stakeholders to create a comprehensive watershed plan (See [Watershed Plan Builder](#)).

- EPA's Watershed Planning website is designed to walk you through each step of the watershed planning process. You may wish to use this information after you have used the Watershed Plan Builder to create a customized watershed plan outline (See [On-Line Watershed Planning Process](#)).
- The Watershed Academy is a focal point in EPA's Office of Water for providing training and information on implementing watershed approaches. The Academy's self-paced training modules, webcast seminars and live training courses provide current information from national experts across a broad range of watershed topics (See [Watershed Academy](#)).
- EPA's Watershed Central Wiki is an excellent online resource of user-generated information related to watershed planning. Since going live in March 2009, the website's number of registered users, pages of content, and audience have grown substantially (See [Watershed Central Wiki](#)).

Table 3. Six Steps of Watershed Planning and Implementation Process

Steps	Substeps
Step 1 – Build Partnerships	<ul style="list-style-type: none"> • Identify key stakeholders • Identify issues of concern • Develop preliminary goals • Initiate outreach activities
Step 2 – Characterize the Watershed	<ul style="list-style-type: none"> • Gather existing data and create a watershed inventory • Identify data gaps and collect additional data if needed • Analyze data • <i>Identify causes of water quality impairment and pollutant sources*</i> • Estimate pollutant loads
Step 3 – Set Goals and Identify Solutions	<ul style="list-style-type: none"> • Set overall goals and management objectives • Develop indicators and targets • <i>Estimate load reductions expected of management measures*</i> • Identify critical areas • <i>Describe management measures needed to achieve load reductions*</i>
Step 4 – Design an Implementation Program	<ul style="list-style-type: none"> • <i>Develop an implementation schedule*</i> • <i>Develop interim milestones to track implementation of management measures*</i> • <i>Develop criteria to measure progress toward meeting watershed goals*</i> • <i>Develop monitoring component*</i> • <i>Develop information/education component*</i> • Develop evaluation process • <i>Identify technical and financial assistance needed to implement plan*</i> • Assign responsibility
Step 5 – Implement the Watershed Plan	<ul style="list-style-type: none"> • Prepare work plans • Implement management strategies • Conduct monitoring • Conduct information and education activities • Share results
Step 6 – Measure Progress and Make Adjustments	<ul style="list-style-type: none"> • Track progress • Make adjustments

* One of the nine key elements for watershed management plans as defined by EPA. The nine key elements are presented in a shorter form and in the order that a watershed planner would likely address them. See Table 4 for order and exact wording as found in the Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003.



Nine Key Elements of Watershed Plans. EPA has identified nine key elements of successful watershed plans to achieve water quality improvements. Table 4 provides a checklist of the nine elements, along with details on what each element includes. EPA requires that these nine elements be addressed in any watershed plans funded with Clean Water Act Section 319 funds. The Polluted Runoff Control Program provides funding to assist with development and updates of watershed plans that address all of the nine key elements. The PRC Program also provides financial assistance to implement these plans. On-the-ground restoration identified in complete watershed plans is eligible for Section 319 funding assistance.

Keep in mind that the nine key elements required by EPA are already included within the six step planning and implementation process that are described in this guidance (see Table 3). Therefore, if a watershed plan is developed following the six-step process, all the key elements should be addressed by default. However, the checklist in Table 4 is provided to help ensure that watershed plan developers meet all EPA's requirements if they plan to receive Section 319 funding.

Table 4. Checklist of the Nine Key Elements for Watershed Plans

Nine Key Elements of Watershed Plans	
a.	<p>Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions and any other goals identified in the watershed plan. Sources that need to be controlled should be identified at the significant subcategory level along with estimates of the extent to which they are present in the watershed (such as X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).</p> <ul style="list-style-type: none"> <input type="checkbox"/> Map of the watershed or planning area that locates the major causes and sources of impairment <input type="checkbox"/> Information on natural background levels <input type="checkbox"/> Accounting of significant point and nonpoint sources TMDL or similar analysis to estimate pollutant load <p>(See also Step 2 – Characterize the Watershed)</p>
b.	<p>An estimate of the load reductions expected from management measures.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Load reductions are estimated at the same level as required in the scale and scope of the watershed or planning area <p>(See also Step 3 – Finalize Goals and Identify Solutions)</p>
c.	<p>A description of the nonpoint source management measures that will need to be implemented to achieve load reductions and a description of the critical areas where those measures will be needed to implement this plan.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Management measures are identified and described based on the Management Measures for CNPCPM and national guidance found in CZARA Section 6217(g) <input type="checkbox"/> Best practices identified to prevent or minimize future problems as well as measures needed to maintain existing high-quality conditions <p>(See also Step 3 – Finalize Goals and Identify Solutions)</p>

Table 4. Checklist of the Nine Key Elements for Watershed Plans

Nine Key Elements of Watershed Plans	
d.	<p>Estimate of the amounts of technical and financial assistance needed, associated costs, and the sources and authorities that will be relied on to implement this plan.</p> <ul style="list-style-type: none"> □ <i>Detailed assessment of technical expertise needed and cost to implement the management measures</i> □ <i>Identification of roles and responsibilities of authorities relied upon to implement the plan</i> <p>(See also Step 4 – Design and Implementation Program)</p>
e.	<p>An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.</p> <ul style="list-style-type: none"> □ <i>Outreach and education activities needed to enhance public understanding of the project and engage early and continued participation in selecting, designing, and implementing the nonpoint source management measures</i> <p>(See also Step 4 – Design and Implementation Program)</p>
f.	<p>Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.</p> <ul style="list-style-type: none"> □ <i>Schedule for implementing management measures in the watershed plan with start and end dates for each phase of implementation</i> <p>(See also Step 3 – Finalize Goals and Identify Solutions)</p>
g.	<p>A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.</p> <ul style="list-style-type: none"> □ <i>Measurable milestones that track progress in implementing management measures.</i> <p>(See also Step 4 – Design and Implementation Program)</p>
h.	<p>A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.</p> <ul style="list-style-type: none"> □ <i>Measurable interim targets to determine the effectiveness of implementing management measures</i> <p>(See also Step 4 – Design and Implementation Program)</p>
i.	<p>A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item h immediately above.</p> <ul style="list-style-type: none"> □ <i>Monitoring program designed to determine whether load reductions are being achieved over time to meet water quality standards by implementing the management measures</i> □ <i>A process for making revisions or adjustments by reviewing the effectiveness of the management measures</i> <p>(See also Step 4 – Design and Implementation Program)</p>

Step 1 – Build Partnerships

Bringing together people, policies, priorities, and resources through a watershed approach blends science and regulatory responsibilities with social and economic considerations.

It is critical to build partnerships with key interested parties at the outset of the watershed planning effort.

People and organizations that have a stake in the outcome of the watershed plan are called *stakeholders* (Figure 3).

Stakeholders make and implement decisions, are affected by the decisions made, and have the ability to assist or impede implementation of the decisions. It is essential that all of the stakeholder groups are identified and included, and not just those that volunteer to participate.



Step 1 Activities

- Identify Key Stakeholders
- Identify Issues of Concern
- Develop Preliminary Goals
- Initiate Outreach Activities
- Results and Next Steps

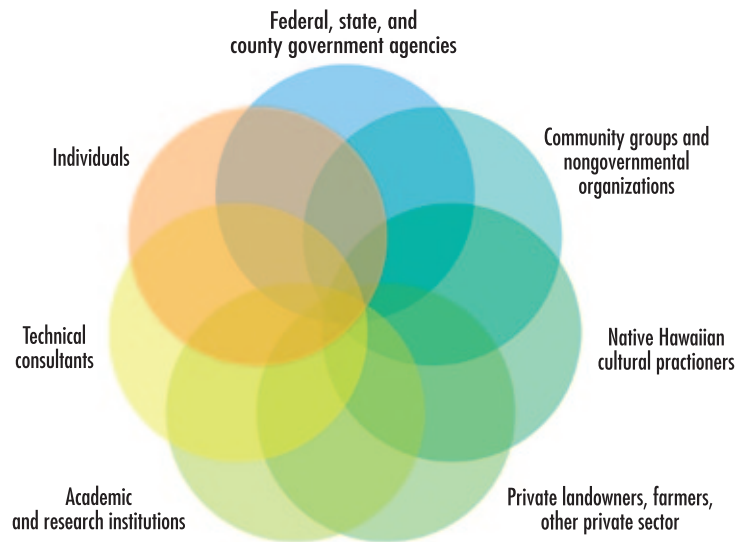


Figure 3. Range of Potential Stakeholders in Watershed Planning and Implementation


Identify Key Stakeholders. At a minimum, one partner is engaged to create and implement the watershed plan, but ideally many more are involved. Weaving partners into the process strengthens the end result by incorporating new ideas and input, increasing public understanding of the problems, and encouraging public commitment to the solutions. Partnerships can identify and coordinate existing and planned efforts, and help avoid



duplicated efforts and wasting time and money. Federal, state, and local government agencies have a significant role in watershed management in Hawai'i. Early and regular communication with relevant government agencies will provide information and data, technical support, and potential funding for all steps in the planning and implementation process.

Identify Issues of Concern. Talk to stakeholders in the watershed to identify their issues of concern. These issues will help shape the goals and determine the types of data needed. It is important to identify what is already known about problems in the watershed. Some questions to help focus community input include:

- What are the known or perceived impairments and problems in the watershed?
- Do we already know the causes and sources of any water quality impairments in the watershed? If so, what are they?
- What information is already available and what analyses have been performed to support quantifying pollutant loads?
- Have the relative contributions from the major types of sources of the pollutant or stressor causing impairment been estimated?
- Are there any historical or ongoing management efforts aimed at controlling the problem pollutant or stressors?
- Are there any threats to future conditions, such as accelerated development patterns, natural hazards, or climate change?
- Have any additional concerns or goals been identified by the stakeholders?



The prospect of creating a watershed plan can be an intimidating task. Many groups have found that tackling smaller projects and tasks early in the planning process can help to engage stakeholders, demonstrate progress, and create a sense of momentum.

Develop Preliminary Goals. Develop preliminary goals that transform the many issues identified through stakeholder consultation and review of historical or ongoing

management efforts into a set of broad goal statements. As you move through the planning process, you should build on these goals by developing indicators to measure progress toward achieving your goal, developing specific objectives to show how you will achieve the goal, and finally developing measurable targets to decide when you have achieved your goal.

Initiate Outreach Activities. Information and education are key to building support for the watershed planning effort and implementation. These activities are needed at the very beginning of a watershed planning effort to make



Examples of Preliminary Goals

- Reduce sediment runoff into streams and marine waters
- Restore coral reef habitat for recreational use
- Protect native forests
- Protect open space



potential partners and stakeholders aware of the issues, recruit them to participate, and educate them on the watershed planning process.

One of the first activities in developing a watershed management plan is to talk to stakeholders in the watershed to identify issues of concern. These issues will help to shape the goals and determine what types of data are needed. An initial meeting with stakeholders is valuable to gather their input on what they believe are the major concerns in the watershed. Questions to guide stakeholder input include:

- What are known or perceived impairments and problems in the watershed?
- Do we already know the causes and sources of any water quality impairments in the watershed? If so, what are they?
- What information is already available, and what analyses have been performed to support development of a TMDL, watershed plan, or other document?
- Have the relative contributions from major types of sources of the pollutant or stressor causing the impairment been estimated?
- Are there any historical or ongoing management efforts aimed at controlling the problem pollutants or stressors?
- Are there any threats to future conditions, such as accelerated development patterns or impacts of climate change?
- Have any additional concerns or goals been identified by the stakeholders?

It is often useful to develop a conceptual model of the watershed that links causes and impacts of water quality concerns in the watershed (Figure 4). A conceptual model links sources, stressors, impacts, and water quality impairment in “if-then” statements. The benefits of developing a conceptual model with stakeholders include the following:

- Illustrates a simplified understanding of the situation at a project site or watershed
- Provides a framework for strategic planning
- Illustrates assumed linkages among factors
- Reflects the group's collective understanding of the causes and impacts

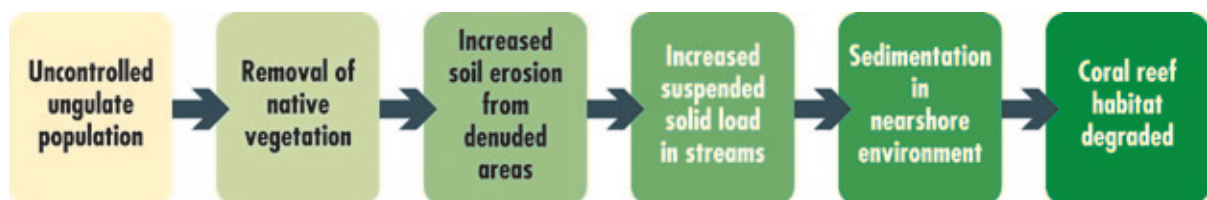


Figure 4. Example of a Simplified Conceptual Model

- Reflects the most relevant factors
- Helps to identify data needs
- Is based on sound information

Results and Next Steps. At the end of this step, you should have completed the following:

- ✓ Identified a preliminary list of stakeholders who you think should be involved in the watershed planning effort.
- ✓ Outlined some initial goals for the watershed planning effort that you can refer to and refine throughout the planning process.
- ✓ Developed a set of indicators that you will use to measure the current health of the watershed and can then be used to measure progress once you implement the watershed plan.
- ✓ Conducted initial public outreach to make the community aware of the watershed planning effort and to help you recruit partners.



Chapters 3 and 4 within the *EPA Handbook* address Step 1 – Build Partnerships.

■ Chapter 3 - Build Partnerships:

www.epa.gov/owow/nps/watershed_handbook/pdf/ch03.pdf

■ Chapter 4 - Define Scope of Watershed Planning Effort:

www.epa.gov/owow/nps/watershed_handbook/pdf/ch04.pdf

- Use Worksheet 3-1 in the *EPA Handbook* as a guide to catalog stakeholder skills and resources.

EPA's Watershed Planning Process Website also provides information for this step at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=41&navId=34&rightNavId=34>.

The publication *Getting in Step: Engaging and Involving Stakeholders in Your Watershed* presents tools to engage stakeholders to restore and maintain healthy environmental conditions through community support and cooperative action. The guide is intended primarily for federal, state, tribal, and local agency personnel involved in watershed management activities.

www.epa.gov/nps/toolbox/guide.htm

Step 2 – Characterize the Watershed

Characterizing the watershed develops an understanding of the impacts seen in the watershed, identifies possible causes and sources of the impacts, and subsequently quantifies the pollutant loads. Characterizing the watershed, its problems, and pollutant sources provides the basis for developing effective management strategies to meet watershed goals.

Create a Watershed Inventory. A watershed inventory is a comprehensive approach for consistently gathering, analyzing, synthesizing, presenting, and archiving watershed information that will best serve planning objectives. Key steps in the watershed inventory process include:

- Delineate watershed boundaries based on hydrologic units or, where applicable, ahupua'a boundaries. Construct a network diagram or schematic that illustrates how water flows within these boundaries.
- Locate potential sources of point and nonpoint source pollution within the watershed.
- Compile data about the transport, fate, management, and regulation of pollutants from these sources.
- Identify interested parties for the watershed including those who (1) own, operate, manage, or regulate pollutant sources and receiving waters, and (2) use receiving waters or otherwise represent public participation in associated conservation, planning, management, or regulation.



Step 2 Activities

- Gather Existing Data and Create a Watershed Inventory
- Identify Data Gaps and Collect Additional Data if Required
- Analyze Data
- Identify Causes and Sources of Pollution that Need to be Controlled*
- Estimate Pollutant Loads
- Define Results and Next Steps

** One of nine key elements needed in a watershed plan*



What Is the Geographic Scale of My Watershed Plan?

Defining the geographic scale is an important aspect of the watershed planning process. Watersheds should be small enough to manage, but also large enough to address water quality concerns. Watershed projects are more successful when conducted on smaller scales (from 2 to 15 square miles or 1,280 to 9,600 acres). Practical considerations include the capacity of groups to effectively address and implement measures over the spatial extent of the watershed.

Existing information is gathered and a data inventory is created to complete the watershed characterization step. There are five minimum categories of data needed:

- Physical and natural features
- Land use and population characteristics
- Waterbody conditions
- Pollutant sources
- Waterbody monitoring data

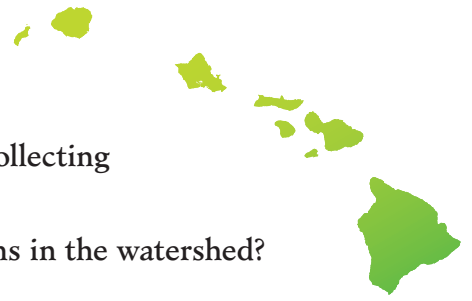
It is important to decide which data are essential. If the data needs are not carefully assessed based on the water quality impairments, stakeholder concerns and watershed goals, the data collection process can become an expensive and endless task. There are always more data that could be collected, but the question “Does the plan require it?” should be asked.

Data can come from a variety of sources, including volunteer organizations, local and state agencies, and the federal government, such as the U.S. Geological Survey's National Water Information System Website (NWISWeb – <http://waterdata.usgs.gov/nwis>). Appendix C provides a list of web addresses for sources of various data used in watershed characterization that can help build the watershed inventory.

Identify Data Gaps and Collect Additional Data as Needed. A review of the data inventory will help identify data gaps. When data gaps exist, it is important to recognize the type. An *information data gap* occurs when a specific category of data is missing – waterbody conditions, monitoring data, pollutant sources, or related information. A *temporal data gap* occurs when the missing data are from a specific period of time and do not cover the range of seasonal variations. A *spatial data gap* occurs when the missing data are from a specific location. Data gaps may also occur in reviewing the acceptability of the data sources. In many cases, existing data were collected to address questions other than those being asked in the watershed assessment.

When you rely on data sets from other sources, it is important to evaluate the acceptability of the data. Data acceptability is assessed by comparing the types and quality of data with the minimum criteria needed to address the monitoring questions of interest. The data quality and measurement quality should be reviewed for each source. Data quality relates to the purpose of the monitoring activity, the types of data collected, and the methods and conditions under which the data were collected. Measurement quality describes data characteristics such as accuracy, precision, sensitivity, and detection limit.

After you have reviewed the existing data sources, assessed the quality and relevance of the data, and identified data gaps and available resources, consider the need to



collect additional data. Before you invest finite resources in collecting additional data, consider the following questions:

- Can we identify and quantify the water quality problems in the watershed?
- Can we quantify pollutant loads?
- Can we link the water quality impairments to specific sources and source areas in the watershed?
- Have we identified critical habitat including buffers for conservation, protection, and restoration?
- Do we know enough to select and target management measures to reduce pollutant loads and address water quality improvements?

If the existing data sources allow you to answer these questions, reconsider whether the data gaps are relevant and require collection of new data. Should you decide that additional data collection is critical, develop a sampling plan to ensure you are collecting the relevant data in a manner that can pass both the data quality and measurement quality criteria used to evaluate existing data. Further guidance on developing a sampling and analysis plan is provided in Chapter 6 of EPA's handbook.

Analyze Data to Characterize the Watershed and Pollutant Sources. Gathering and organizing data are major components of developing a successful watershed plan. Several iterations of gathering data, identifying gaps, and analyzing data might be needed. When the time comes to analyze the data, a variety of techniques will likely be needed. Generally, the analysis begins with a broad assessment of averages, maximums and minimums of pollutant loads, and seasonal rainfall. Then, the analysis is refined to build a better understanding of the pollutants, their behavior and watershed impacts, and their sources. Source load estimates are critical to successfully control pollutant sources, target efforts effectively, restore watershed health, and meet watershed and water quality goals. Many watershed models are available to help estimate pollutant loads. (See box highlighting Watershed Assessment and Modeling Tools.)

Identify Causes and Sources of Pollution that Need to be Controlled. Watershed plans should include a map or conceptual model (or both; see Figure 4) of the watershed that identifies the major causes and sources of impairment. The development of a conceptual model begins with identifying the causes of water quality impairment and the sources of pollutants (Figure 5). To address these impairments, goals need to be set that will meet the appropriate water quality standards for pollutants that threaten or impair the physical, chemical, or biological integrity of the watershed. Significant point and nonpoint pollutant sources and natural baseline pollutant load levels should be known. If a TMDL exists, this element may have already been adequately addressed.

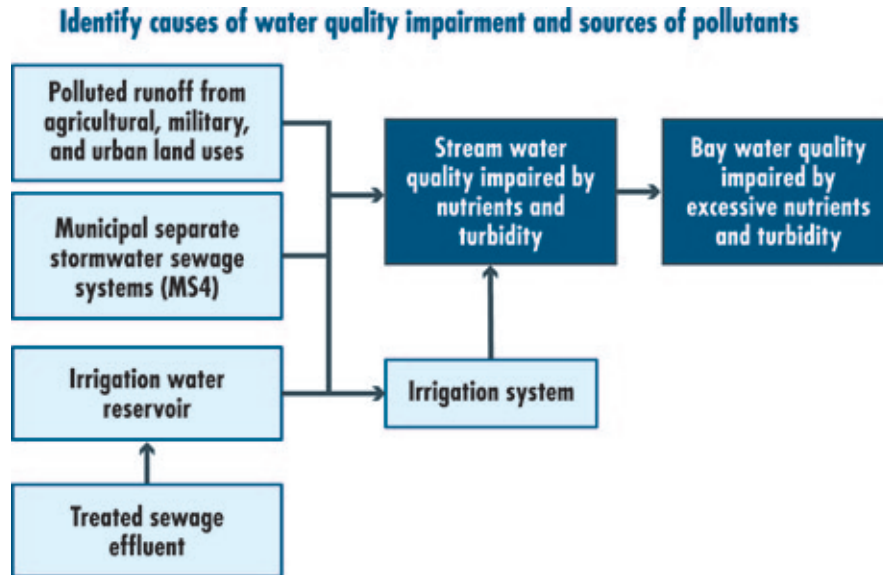


Figure 5. Causes and Sources of Pollutants identified in a Hawai'i Watershed

Estimate Pollutant Loads. The watershed characterization step is used as a basis for selecting the appropriate method for quantifying the pollutant loads in the watershed. Various approaches can be used. Some loading analyses focus on “how much” load is acceptable, whereas others focus on “source loads.” A variety of models have been used in Hawai'i to estimate pollutant loads. Specialized technical expertise may be required to use these models, however. For watershed planning, source load estimates are



What Is a Total Maximum Daily Load (TMDL)?

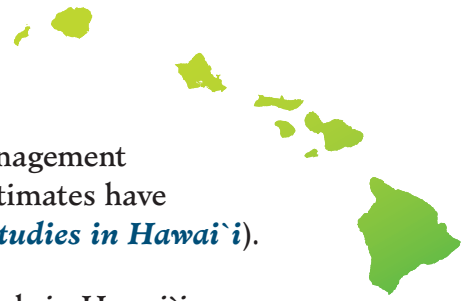
A TMDL calculates the maximum amount of a pollutant allowed to enter a waterbody, so that the waterbody will meet and continue to meet water quality standards for the particular pollutant. The TMDL allocates the maximum allowable pollutant load to point sources and nonpoint sources, which include both anthropogenic and natural pollutant sources. The TMDL includes three components as follows:

$$\text{TMDL} = \text{LA} + \text{WLA} + \text{MOS}$$

Where:

- TMDL = Total Maximum Daily Load, or load capacity
- LA = Load Allocation for nonpoint sources
- WLA = Waste Load Allocation for point sources
- MOS = Margin of Safety

EPA's TMDL Website: www.epa.gov/owow/tmdl



desirable because the information can be used to support management planning and focus resources on restoration. Some loading estimates have already been developed for Hawai'i watersheds (see *TMDL Studies in Hawai'i*).

TMDL studies have been conducted for a number of watersheds in Hawai'i. TMDLs are required for pollutant-impaired waterbodies on the state's CWA Section 303(d) list. The main objectives of the proposed TMDLs are to stimulate and guide action that will control sources of excessive nutrients and sediment and to improve stream water quality so that the designated and existing uses of the waterbodies throughout the watershed will be protected and sustained. These uses include protection of native breeding stock, support and propagation of aquatic life, recreation, aesthetic enjoyment, agricultural and industrial water supplies, and support for traditional and customary native Hawaiian beliefs, values, and practices.

TMDLs are a tool for implementing water quality standards, based on the relationship between point and nonpoint sources of pollutants and receiving water quality. The TMDLs must consider critical conditions, seasonal variations, future growth, and a margin of safety that accounts for uncertainty in the pollutant load calculations. EPA approval of TMDLs is based on a checklist of elements that must be satisfactorily addressed in the state's TMDL decision. HDOH uses these same elements as an organizing framework for responding to public review of the proposed decision.

In watersheds where a TMDL for affected waters has already been developed and approved (or is being developed), the watershed plan should be written to achieve the load reductions called for in the TMDL. Implementation of management measures should result in pollutant load reductions that will help achieve the TMDL. To estimate the expected pollutant load reductions, the cause-and-effect relationship between pollutant loads and the waterbody response needs to be understood.

EPA's Modeling Toolbox is a collection of models, modeling tools, and databases that have been used over the past decade in development of TMDLs. The toolbox contains assessment tools, watershed models, and receiving modeling approaches for TMDL development. The toolbox takes these proven technologies and provides the capability to more readily apply the models, analyze the results, and integrate watershed loading models with receiving water applications. The design of the toolbox is such that each of the models is a stand-alone application. The toolbox provides an exchange of information through common linkages. Because of its modular design, additional models can be added easily to integrate with the other tools. In addition, the toolbox



Under Section 303(d) of the Clean Water Act, monitoring data as well as other information must be used by the states to develop a list of "water quality limited segments," waters that do not meet water quality standards for a particular pollutant. States must develop Total Maximum Daily Loads, or TMDLs, for every waterbody and pollutant combination on the Section 303(d) list.

EPA's TMDL Website:
www.epa.gov/owow/tmdl



Watershed Assessment and Modeling Tools

EPA Toolbox

Watershed Models

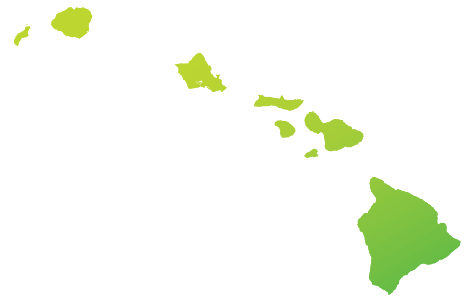
- Basins – Better Assessment Science Integrating Nonpoint and Point Sources (Basins) is an open source, freely distributable geographic information system (GIS) tool for watershed analysis and monitoring.
- LSPC* – Loading Simulation Program in C++ (LSPC) is a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms for simulating hydrology, sediment, and general water quality on land as well as a simplified stream transport model.
- WAMView – Watershed Assessment Model (WAMView) is a tool that has been shown to be useful in the assessment of watershed-related properties. WAM was developed to allow engineers and planners to assess the water quality of both surface water and groundwater based on land use, soils, climate, and other factors. The model simulates the primary physical processes important for watershed hydrologic and pollutant transport.
- SWMM – Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single-event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas.
- WARMF – Watershed Analysis Risk Management Framework is a decision support system for watershed management. The system provides a road map to calculate TMDLs for most conventional pollutants (coliform, total suspended solids [TSS], biological oxygen demand [BOD], and nutrients). It also provides a roadmap to guide stakeholders to reach consensus on an implementation plan.

Water Quality Models

- WASP7 – The Water Quality Analysis Simulation Program (WASP7) helps users interpret and predict water quality responses to natural phenomena and manmade pollution for various pollution management decisions.
- QUAL2K – QUAL2K (or Q2K) is a river and stream water quality model.
- Aquatox is a simulation model for aquatic systems. AQUATOX predicts the fate of various pollutants, such as nutrients and organic chemicals, and their effects on the ecosystem, including fish, invertebrates, and aquatic plants.

Hydrodynamic Models

- EFDC* – The Environmental Fluid Dynamics Code (EFDC Hydro) is a state-of-the-art hydrodynamic model that can be used to simulate aquatic systems in one, two, and three dimensions.
- EPD-RIV1 – EPD-RIV1 is a system of programs to perform one-dimensional dynamic hydraulic and water quality simulations.



Water Resources Database

- The Water Resources Database (WRDB) is a comprehensive data storage system capable of handling a vast amount of data, accommodating a wide variety of data types and diverse information, and presenting data conveniently and efficiently.

Natural Resources Conservation Service and Other Models

- Technical Release 55* – Technical Release 55 (TR-55) presents simplified procedures to calculate storm runoff volume, peak rate of discharge, hydrographs, and storage volumes required for floodwater reservoirs. These procedures are applicable in small watersheds, especially urbanizing watersheds
- PRISM* – Parameter-elevation regressions on independent slopes model (PRISM) is an analytical tool that uses point data, a digital elevation model, and other spatial data sets to generate gridded estimates of monthly, yearly, and event-based climatic parameters, such as precipitation, temperature, degree days, and dew point.
- N-SPECT – Nonpoint-Source Pollution and Erosion Comparison Tool (NSPECT) is used to establish relative loadings and load reductions within specific watersheds.
- ALAWAT* – The ALAWAT model uses a version of the Soil Conservation Service rainfall-runoff model to provide daily estimates of pollutant loadings from various land uses based on estimates of runoff, stream flow, sediment loads and pollutant loads.
- GSSHA* – Gridded Surface Subsurface Hydrologic Analysis (GSSHA) is a grid-based two-dimensional hydrologic model that can be used to predict stream flow, sediment transport, and runoff for small lakes, detention basins, and wetlands.

** Models used in Hawai'i TMDL Studies*

For information on tools and training, see:

EPA Ecosystem Research Division, EPA Toolbox, www.epa.gov/athens/wwqtsc/html/tools.html

U.S. Department of Agriculture – Natural Resource Conservation Service, for

- TR55 – www.wsi.nrcs.usda.gov/products/w2q/h&h/tools_models/other/TR55.html
- PRISM – www.wcc.nrcs.usda.gov/climate/prism.html



Total Maximum Daily Load Studies (Completed or in Progress) in Hawai'i

Kauai

- Nawiliwili Bay Watersheds (Puali, Huleia, Nawiliwili)
- Hanalei Bay Watershed (Waikoko, Waipa, Waioli, Hanalei), Kauai

Oahu

- Kaneohe Stream
- Kapa'a Stream
- North and South Forks of Kaukonahua Stream
- Kawa Stream
- Waimanalo Stream
- Ala Wai (Manoa-Pololo, Makiki, Ala Wai)
- Kaelepulu Inland Waters
- Pearl Harbor Watershed (Kapakahi, Waiawa, Waimano, Waimalu, Aiea, Kalauao, Halawa)

Hawai'i

- Hilo Bay Watershed (Waiakea and Alenaio Streams)

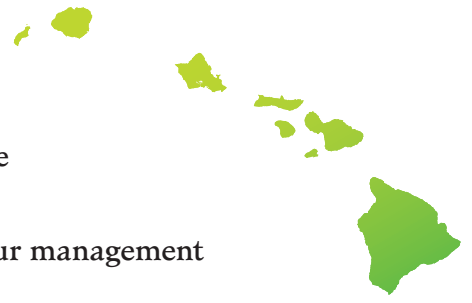
See [TMDL Studies in Hawai'i](#)

provides the capability to visualize model results, a linkage to GIS and non-geographic databases (including monitoring data for calibration), and the functionality to perform data assessments.

EPA concluded that it is necessary to establish a level of consistency and defensibility for TMDL modeling tools. The toolbox is therefore designed to address a broad range of waterbody types and pollutants. EPA actively supports the components of the TMDL Modeling Toolbox and is committed to enhancing and improving components of the toolbox to meet the technical demands of the TMDL program and watershed protection. This commitment will ensure defensibility when TMDLs are faced with legal challenges.

Results and Next Steps. At the end of this step, you should have completed the following:

- ✓ Identified existing reports and data sets that exist within your watershed.
- ✓ Created an inventory for the data.
- ✓ Identified any data gaps and decided if new data need to be collected.
- ✓ Developed a collection plan and collected new data if necessary.



- ✓ Analyzed the data to identify the major problems in the watershed and the sources of pollutants.
- ✓ Initiated the identification of critical areas to target your management efforts.
- ✓ Estimated the loadings of the various pollutants.

Based on the problems identified in the watershed in the next step, you will identify targets and the load reductions that are needed to meet these targets. You will also identify what types of management strategies you will use to reduce the pollutant loads and where you will implement those strategies to control the sources.



Chapters 5, 6, 7 and 8 within the *EPA Handbook* address Step 2 – Characterize the Watershed.

- Chapter 5 – Gather Existing Data and Create an Inventory:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch05.pdf
- Chapter 6 – Identify Data Gaps and Collect Additional Data:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch06.pdf
- Chapter 7 – Analyze Data:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch07.pdf
- Chapter 8 – Estimate Pollutant Loads:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch08.pdf

Step 2 includes one of EPA's nine key elements – Identify causes and sources of pollution that need to be controlled. See Section 3.4 for more information on this key element. EPA's Watershed Planning Process site provides information for this step at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=69&navId=92&rightNavId=92>.

EPA's Plan Builder provides information and tools developed by EPA to assist with development and implementation of effective watershed management plans. It is designed for people who are involved in watershed management. These activities include development and implementation of watershed plans, analysis of data, and implementation of management practices. Each piece of this website provides specific information or helps you perform a task. <http://iaspub.epa.gov/watershedplan/watershedPlanning.do?pagelId=48&navId=35>



Step 3 Activities

- Set Overall Goals and Objectives
- Develop Indicators and Targets
- Estimate Load Reductions Needed*
- Describe Management Measures to Achieve Load Reductions*

* One of nine key elements needed in a watershed plan

Step 3 – Set Goals and Identify Solutions

The watershed plan's goals are refined to create management objectives based on the data analysis conducted in Step 2. Once you have identified the problem in the watershed and isolated and quantified the sources that need to be managed, the goals and management objectives of the watershed plan can be developed.

Set Overall Goals and Objectives. In Step 1, watershed partners and stakeholders identified the preliminary vision or goals for the watershed that they would like to see addressed in the watershed plan. Often, stakeholders will recommend very broad goals, such as “restore lake water quality,” “protect wetlands,” or “manage growth to protect

our water resources.” These goals might start out broad, but they will be refined as you move through the watershed characterization process, starting here in Step 3. Goals from other watershed planning activities might also be incorporated. For example, if a TMDL has already been developed in your watershed, you can include the goals outlined in the TMDL, such as the required loading targets to be achieved. These goals are specific.

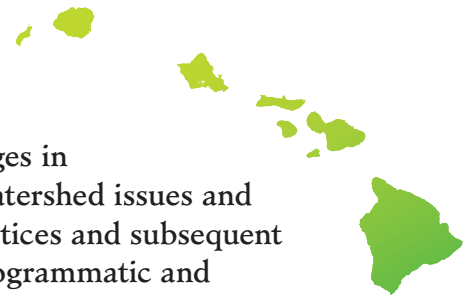
Specific management objectives should be developed for each goal identified. A management objective is more detailed than a goal and explains how the goal will be achieved. Associated indicators measure progress toward meeting the objectives and goals. *Indicators* are direct or indirect measurements of a valued component or quality in a system. An indicator does not include the cause of the problem. An example of the relationship between a broad watershed goal and the management objective and indicators is provided in Table 5.

Table 5. Example Goal, Management Objective, and Indicators

Goal	Management Objective	Indicators/Targets
Restore coral reef habitat	Reduce sediment loads from new and existing urban development	<ul style="list-style-type: none"> • Decrease in total suspended solids • 20% increase in living coral cover

Develop Indicators and Targets. Establish indicators and targets specific to the management objectives to enable you to quantitatively evaluate whether the objectives are being met. A specific value for each indicator represents a desired outcome or condition that will meet the watershed goals and management objectives.

Indicators can be categorized as environmental, programmatic, or social. Environmental indicators are a direct measure of the environmental conditions that a watershed plan seeks to achieve. Programmatic indicators are indirect measures of resource protection or restoration (for example, the number of management practices or the number of



point source permits issued). Social indicators measure changes in social or cultural practices (such as increased awareness of watershed issues and behavior changes that lead to implemented management practices and subsequent water quality improvements). Examples of environmental, programmatic and social indicators are found in Table 6.

Table 6. Example Environmental, Programmatic, and Social Indicators

Goal	Management Objective	Indicators/Targets
Environmental (baseline conditions)	Dissolved oxygen, flow rate, temperature	Direct water quality measurements
Environmental (measure implementation progress)	Dissolved oxygen, flow rate, temperature	Direct water quality measurements
Programmatic	Number of participants at management practice workshop	Sign-in sheets
Programmatic	Number of management practices installed	Tracking database
Social	Number of landowners requesting assistance to install management practices	Phone and e-mail log
Social	Number of landowners aware of technical and financial assistance to install management practices	Pre- and post-surveys

Estimate Load Reductions Needed. To estimate the load reductions needed, the links between pollutant loads and the waterbody response need to be understood. The options for establishing these links include the following:

- Qualitative or theoretical evaluations based on local knowledge or historical conditions — generally used when data are limited or the causes and sources are not well characterized
- Mass balance approach — tallying all inputs and outputs to a waterbody to evaluate the resulting conditions
- Empirical relationships based on observed data — described as mathematical expressions
- Statistical or mathematical relationships — generally with a load duration curve
- Reference watershed approach — comparing the impaired watershed with a “healthy” watershed
- Receiving water computer models — generally used in watersheds with unique conditions or complicated chemical and biological features.

Selecting the appropriate approach will depend on several factors, including data availability, pollutants, waterbody type, source types, time frame, and spatial scale. Most important, the approach must be compatible with the method used to quantify loads and must be able to predict the necessary load reductions to meet targets. Chapter 9 of the *EPA Handbook* provides details on each of the load reduction estimation techniques listed above.

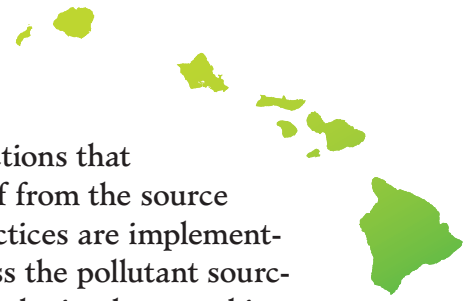
If there is an existing TMDL, the watershed plan should identify and incorporate the load reductions established in the TMDL. Loads for downstream waters should also be included in this element to ensure that downstream segments also meet water quality standards. The estimate should account for reductions in pollutant loads from point and nonpoint sources identified in the TMDL.

Developing TMDLs requires a combination of technical analysis, practical understanding of important watershed processes, and interpretation of watershed loadings and receiving water responses to these loadings. An essential component of TMDL development is establishing a relationship between source loads and numeric indicators intended to measure if water quality standards are attained. The linkage analysis examines connections between the potential pollutant sources (indicators), available data, numeric water quality targets (TMDL endpoints), and estimated loadings. This linkage can be used to calculate the total capacity of the waterbody to assimilate or dilute the pollutant loads while still meeting water quality criteria and supporting its designated uses. The allowable loads are then allocated among the various sources.

Describe Management Measures and Practices to Achieve Load Reductions. Watershed plans must identify all appropriate management measures and practices needed to address priority problems and achieve pollutant load reductions. A management measure is a group of cost-effective practices designed to control polluted runoff. *Hawai'i's Management Measures for the CNPCP* are defined for six main sources of pollutants:

- Agriculture
- Forestry
- Urban Areas
- Marinas and Recreational Boating
- Hydromodifications
- Wetlands, Riparian Areas and Vegetated Treatment Systems

Watersheds generally accommodate uses from multiple categories, and all relevant measures will be considered for each watershed plan. Management measures typically will be implemented by applying one or more management practices appropriate to the source, location, and climate. Figure 6 presents an example demonstrating the linkages that should be made between causes and sources of pollution, goals and management objectives, load reductions, and management measures.



Watershed plans will include best management practices or actions that implement these management measures where polluted runoff from the source has been identified as a concern. In general, management practices are implemented immediately adjacent to the waterbody or upland to address the pollutant sources. It is important to identify which management practices can be implemented in the critical areas identified. Potential practices should be screened for a variety of factors to narrow the options down to those that are the most promising and acceptable (such as pollutant reduction efficiencies, legal requirements, cost, and physical constraints). Once the management practices are identified and screened, you should select the final management practices that will be the most effective in achieving the load reductions needed to meet the watershed goals. Those practices will include structural controls, nonstructural controls or a mix of both. *Structural controls* are built facilities that typically capture runoff, treat it through chemical, physical or biological means, and discharge the treated effluent to receiving waters, groundwater, or conveyance systems. *Nonstructural practices* usually involve changes in activities or behavior and focus on controlling pollutants at their source.

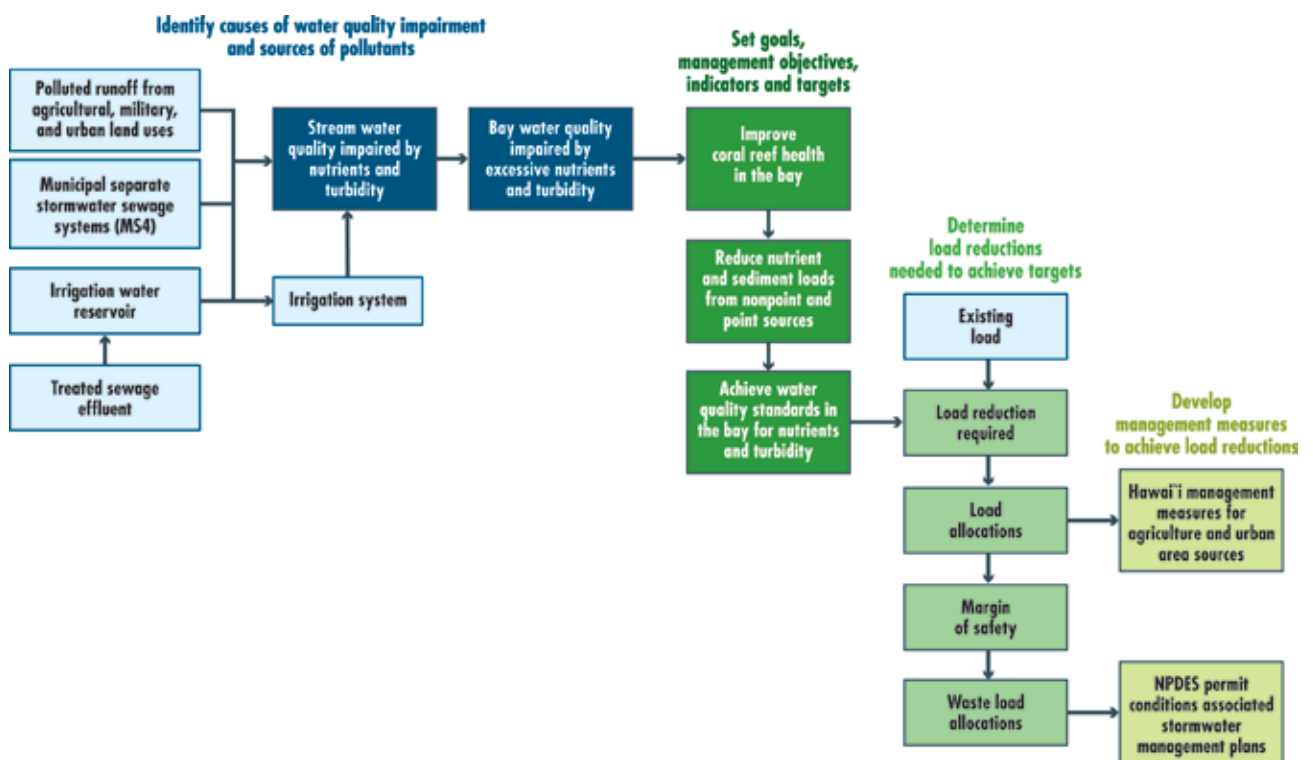


Figure 6. Linkages between Watershed Goals and Management Measures to Achieve Load Reductions



For more guidance on management measures, the reader is referred to:
EPA's Guidance for Specifying Management Measures www.epa.gov/owow/wtr1/nps/MMGI/

Management Measures for Agricultural Sources. Agricultural lands include croplands (such as corn, soy, and cane), orchards (for example, papaya and banana), as well as cattle pastures and nursery crop production. Because it is such an important aspect of watershed management, involving those practicing agriculture is critical to understand the ongoing efforts, as well as the value and feasibility of implementing best management practices in your watershed. The goals of management measures for agricultural sources of nonpoint source pollutants are summarized in Table 7.

The primary agricultural nonpoint source pollutants are nutrients (particularly nitrogen and phosphorus), sediment, animal wastes, pesticides, and salts. Agricultural nonpoint sources enter surface water through direct surface runoff or through seepage to groundwater that discharges to a surface water outlet. Various farming activities result in the erosion of soil particles. The sediment produced by erosion can damage fish habitat and wetlands and, in addition, often transports excess agricultural chemicals, resulting in contaminated runoff. This runoff in turn effects changes to aquatic habitat such as increased temperature and decreased oxygen. The most common sources of excess nutrients in surface water from nonpoint sources are chemical fertilizers and manure from animal facilities. These nutrients cause eutrophication in surface water. Pesticides used for pest control in agricultural operations can also contaminate surface- as well as groundwater resources. Return flows, runoff, and leachate from irrigated lands may transport sediment, nutrients, salts, and other materials. Finally, improper grazing practices in riparian, as well as upland areas, can also cause water quality degradation.

The Hawai'i Association of Conservation Districts encompasses 16 SWCDs across the state, which in turn provide free technical assistance to the agricultural community aimed at improving water efficiency, decreasing soil erosion, and minimizing the environmental impact of farming. The SWCD board members are volunteers and rely heavily on their U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) partners. The association hosts a website to assist those interested in developing their individual conservation plans (www.hacdhawaii.org/index.html). The NRCS has offices across the state and publishes the *Hawai'i Field Office Technical Guide*, providing technical resources to private landowners in their efforts to conserve natural resources (www.nrcs.usda.gov). The University of Hawai'i Cooperative Extension Service (CES) and College of Tropical Agriculture and Human Resources (CTAHR) publish useful pamphlets and manuals addressing specific issues related to Hawaiian agriculture (www.ctahr.hawaii.edu/site).

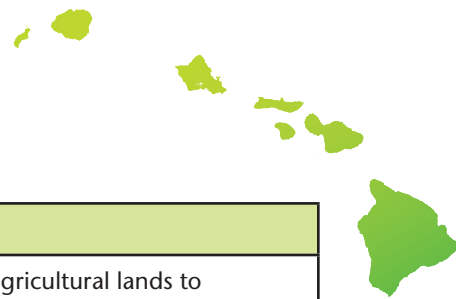


Table 7. Management Measures for Agricultural Sources

Management Measures for Agriculture
Erosion and Sediment Control — minimizes delivery of sediment from agricultural lands to receiving waters by apply the erosion component of the U.S. Department of Agriculture’s Conservation Management System through such practices as conservation tillage, strip cropping, contour farming, and terracing or designing and installing a combination of practices to remove settleable solids and associated pollutants in runoff for all but the larger storms.
Wastewater and Runoff Control from Confined Animal Facility — limits discharges from confined animal facilities by storing wastewater and runoff caused by all storms.
Nutrient Management — calls for development and implementation of comprehensive nutrient management plans that include a nutrient budget for the crop, identification of the types and amounts of nutrients necessary to produce a crop based on realistic crop yield expectations, and identification of the environmental hazards of the site.
Pesticide Management — minimizes water quality problems by reducing pesticide use, improving the timing and efficiency of application, preventing backflow of pesticides into water supplies, and improving calibration of pesticide spray equipment. A key component of this measure is use of integrated pest management strategies.
Livestock Grazing — protects sensitive areas including streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones by reducing the physical distance and direct loading of animal waste and sediment caused by livestock by restricting livestock access to sensitive areas through a range of options.
Irrigation — promotes an effective irrigation system that delivers necessary quantities of water, yet reduces nonpoint pollution to surface waters and groundwater through a uniform application of water based on an accurate measurement of cropwater needs and the volume of irrigation water.

Source: [Agriculture Chapter Factsheet](#)

See details in: [Hawaiʻi Management Measures for Agriculture](#)

Management Measures for Forestry. Forestry is a limited activity in Hawaiʻi, with most of the operations occurring on agricultural lands or on conservation lands designated for commercial forest use. Hawaiʻi’s forestry activities occurring on public lands are required to have a Conservation District Use Permit (CDUP) and implement an approved management plan. On private lands, the DLNR’s Division of Forestry and Wildlife (DOFAW) administers the Forest Stewardship Program, which provides technical and financial assistance for those intending to actively manage their land for forestry. DLNR’s [Forest Stewardship Handbook](#) describes the program. The goals of management measures for forestry sources of nonpoint source pollutants are summarized in Table 8.

Sediment, nutrients, pesticides, and temperature are pollutants commonly associated with forestry activities. Sediment concentrations can increase because of the accelerated erosion; water temperatures can increase through removal of overstory riparian shade; slash and other organic debris can accumulate in waterbodies, depleting dissolved oxygen; and organic and inorganic chemical concentrations can increase as a result of

harvesting and applications of fertilizers and pesticides. These potential increases in water quality contaminants are usually proportional to the severity of site disturbance (Riekerk 1983, 1985; Riekerk and others 1989). The impacts of silvicultural nonpoint source pollution depend on site characteristics, climatic conditions, and the forest practices employed.

Table 8. Management Measures for Forestry

Management Measures for Forestry
Preharvest Planning — designed to ensure that silvicultural activities, including timber harvesting, site preparation, and associated road construction, are conducted in a way that takes into account potential nonpoint source pollutant delivery to surface waters. Components of this measure address include the timing, location, and design of harvesting and road construction, the identification of sensitive areas or high-erosion-hazard areas; and the potential for additional cumulative contributions to existing water quality impairments.
Streamside Management Zones — establishes areas along surface waters that are managed to protect the water quality of the adjacent waterbody. Streamside Management Zones (SMZ) protect against soil disturbance and reduce the delivery of sediment and nutrients from upslope activities to waterbodies. Canopy species in SMZs shade waterbodies, which moderates water temperature, and provide the detritus that often serves as an energy source for stream ecosystems. Trees in the SZA also provide a source of large, woody debris to waterbodies.
Road Construction/Reconstruction — intended to reduce generation and delivery of sediment from road construction or reconstruction. This reduction is to be accomplished by following the preharvest plan layouts and designs for the road system, incorporating adequate drainage structures, and properly installing stream crossings. Other components of this measure include avoiding constructing roads in SMAs, removing debris from streams, and stabilizing areas of disturbed soil such as road fills.
Road Management — intended to prevent sedimentation and pollution from runoff-transported materials on existing roads. Components of this measure include the use of inspections and maintenance to prevent erosion of road surfaces and ensure the continued effectiveness of stream crossing structures. The measure also addresses appropriate actions for closing roads that are no longer in use.
Timber Harvesting — intended to reduce NPS pollution resulting from timber harvesting operations. The measure includes components for the location of landings, for the operation of groundskidding and cable yarding equipment, and for the prevention of pollution from petroleum products. Harvesting practices that protect water quality and soil productivity can also reduce total mileage of roads and skid trails, lower equipment maintenance costs, and provide better road protection and reduce road maintenance.
Site Preparation and Forest Regeneration — intended to reduce the impacts of mechanical site preparation and regeneration operations and to confine on-site potential nonpoint source pollution. Components of this measure address keeping slash materials out of drainages, operating machinery on the contour, and protecting the ground cover in ephemeral drainages and SMAs.
Fire Management — intended to reduce the potential nonpoint source pollution and erosion resulting from prescribed fire for site preparation and from methods for suppression of wildfire.

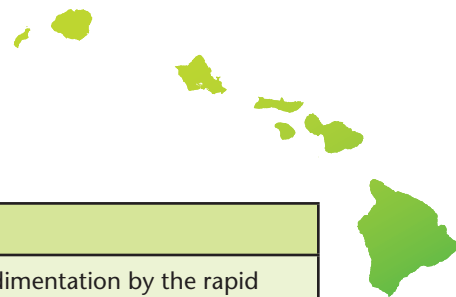


Table 8. Management Measures for Forestry

Management Measures for Forestry
Revegetation of Disturbed Areas — intended to reduce erosion and sedimentation by the rapid revegetation of areas of soil disturbance from harvesting and road construction.
Forest Chemical Management — intended to ensure that the application of pesticides and fertilizers does not lead to contamination of surface waters. Components of this measure include applications by skilled workers according to label instructions, careful prescription of the type and amount of chemical to be applied, and the use of buffer areas for surface waters to prevent direct application or deposition.
Wetland Forest Management — intended to protect the aquatic functions of forested wetlands.

Source: [Forestry Chapter Factsheet](#)

See details in: [Hawai'i Management Measures for Forestry](#)

Management Measures for Urban Areas. During urbanization, pervious spaces — including vegetated and open forested areas — are converted to land uses that usually involve increased areas of impervious surface, resulting in increased runoff volumes and pollutant loadings. Changes to the natural hydrology are inevitable as urbanization occurs. As population density increases, there is a corresponding increase in pollutant loadings generated from human activities. Primary nonpoint source pollutants in urban areas include oil, chemicals, and fertilizer. Stormwater runoff carries pollutants directly to streams and rivers, where they seriously harm water quality. The goals of management measures for urban areas are summarized in Table 9.

Watersheds with large urban areas often require novel approaches in designing watershed plans, in part because of the large number of stakeholders, most of whom do not interact directly with the land or water resources of their ahupua'a and so do not understand their impact on the resources. In addition, the financial investment already expended often makes retrofitting facilities to improve watershed health a major roadblock. Development must conform to all policies outlined in each of the counties' general plans, while state agencies, including the Department of Transportation (DOT), Department of Health, and Coastal Zone Management Program, provide topic-specific guidance to minimize the environmental impacts of urban development on watersheds. Examples include DOT's *Storm Water Permanent Best Management Practices (BMP) Manual* and *Construction Best Management Practices Field Manual*, the State Water Commission's *Water Resource Protection Plan*, and the Department of Health's *The Hawai'i Guide to Alternatives and Disposal of Household Hazardous Waste*.

Table 9. Management Measures for Urban Areas

Management Measures for Urban Areas
<p>New Development — intended to mitigate the effects of new development on water quality. This measure specifies that runoff from new development be managed so as to meet two conditions:</p> <ul style="list-style-type: none"> • Average annual total suspended solid (TSS) loadings after construction is completed are reduced by 80 percent or no greater than predevelopment loadings; and • Post-development peak runoff rate and average volume are maintained at levels that are similar to predevelopment levels (New developments required to obtain NPDES permits are not subject to this management measure)
<p>Watershed Protection — encourages comprehensive planning for development on a watershed scale and for small-scale site development as well, including planning and designing to protect sensitive ecological areas, minimize land disturbances and retain natural drainage and vegetation whenever possible.</p>
<p>Site Development — reduce erosion and transport of sediment from construction sites to surface water through the development of sediment and erosion control plans.</p>
<p>Existing Development — addresses reduction of pollution loadings from already developed areas. Watershed management programs should be developed that identify the sources, specify appropriate controls such as retrofitting or the establishment of buffer strips, and provide a schedule by which these controls are to be implemented.</p>
<p>New On-site Disposal Systems — addresses nutrient/pathogen loadings to surface water from new on-site disposal systems. The measure specifies that new on-site disposal systems (OSDS) are to be designed, installed, and operated properly and to be situated away from open waterbodies and sensitive resources such as wetlands, and floodplains. Protective separation between the OSDS and the groundwater table is to be established. The OSDS unit should be designed to reduce nitrogen loadings in areas where surface waters may be adversely affected.</p>
<p>Operating On-site Disposal Systems — calls for policies and systems to operate and maintain OSDS so as to prevent surface water discharge and reduce pollutant loadings to ground water. It also calls for inspection at regular time intervals and repair or replacement of faulty systems.</p>
<p>Pollution Prevention — includes techniques and activities to prevent nonpoint source pollutants from entering surface waters. Primary emphasis is placed on public education to promote methods for proper disposal and/or recycling of hazardous chemicals, pet waste management strategies, management practices for lawns and gardens, OSDSs, and commercial enterprises such as service stations and parking lots.</p>
<p>Golf Course Management — calls for site preparation and grading plans and nutrient and irrigation management to minimize impacts runoff and impacts to sensitive environments.</p>
<p>Planning, Siting, and Developing Roads, Highways, and Bridges — calls for roads and highways to be situated away from areas that are sensitive ecosystems and susceptible to erosion and sediment loss and for the development and implementation of an approved erosion and sediment control plan prior to construction, which would reduce erosion and improve retention of sediments onsite during and after construction.</p>
<p>Operation and Maintenance of Roads, Highways, and Bridges — provides an operation and maintenance approach designed to reduce pollutant loadings to receiving waters during operation and maintenance of roads, highways, and bridges.</p>
<p>Road, Highway, and Bridge Runoff Systems — specifies development of runoff management systems to reduce pollutant concentrations in runoff from existing roads, highways, and bridges. Runoff management systems should identify priority pollutant reduction opportunities and schedule implementation of retrofit projects to protect impacted areas and threatened surface waters.</p>

Source: [Urban Area Chapter Factsheet](#); See details in: [Hawai'i Management Measures for Urban Areas](#)



Management Measures for Marinas and Recreational Boating. Marinas and other recreational boating facilities, including boat ramps, piers, and mooring fields, occur at the terminus of a watershed. Based on their location, there is a strong potential for marina waters to become contaminated with pollutants generated from the various activities. Marinas themselves affect only ocean waters, which is also unique aspect of watershed planning. Thus, mitigation efforts in and around marinas can be appropriate for upland as well as marina pollutant sources, protecting the nearshore waters of the state.

The goals of management measures for marinas and recreational boating are summarized in Table 10.

Potential pollutants include the following:

- Nutrients and pathogens from pet waste and overboard sewage discharge
- Sediments from parking lot runoff and shoreline erosion
- Fish waste from dockside fish cleaning
- Petroleum hydrocarbons from fuel and oil drippings and spills and from solvents
- Toxic metals from antifoulants and hull and boat maintenance debris
- Liquid and solid wastes from engine and hull maintenance and general marina activities

Any proposed public or private marina construction project requires a Conservation District Use Application (CDUA) permit, administered by DLNR's Office of Conservation and Coastal Lands (OCCL). The approval of a CDUA permit rests on the project's compliance with EPA's *National Management Measures Guidance to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (November 2001). In addition, special management area (SMA) permits are required by the counties, and NPDES permits are required by EPA.

Table 10. Management Measures for Marinas and Recreational Boating

Management Measures for Marinas and Recreational Boating
Marina Flushing — requires that marina siting and design allow for maximum flushing of the water supply for the site. Adequate flushing reduces the potential for the stagnation of water in a marina and helps to maintain the biological productivity and reduce the potential for toxic accumulation in bottom sediment.
Water Quality Assessment — specifies that water quality be considered in the siting and design of both new and expanding marinas.
Habitat Assessment — protects against adverse impacts on shellfish resources, wetlands, submerged aquatic vegetation, and other important habitat areas as designated by local, state, or federal governments.

Table 10. Management Measures for Marinas and Recreational Boating

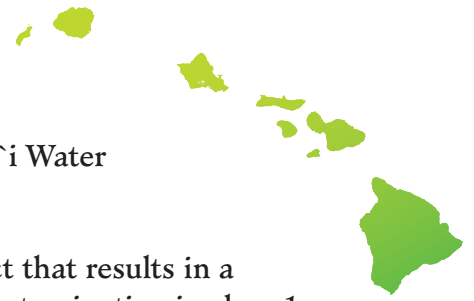
Management Measures for Marinas and Recreational Boating
Shoreline Stabilization — calls for shorelines to be stabilized by vegetative methods unless structural methods are cost-effective.
Stormwater Runoff — specifies implementation of runoff control strategies which include the use of pollution prevention activities and the proper design of hull maintenance areas.
Fueling Station Design — specifies that fueling stations should be located and designed so that, in the case of an accident, spill contaminants can be contained in a limited area. Fueling stations should have fuel containment equipment as well as a spill contingency plan.
Sewage Facilities — intended to prevent the discharge of sewage directly to coastal waters, new and expanding marinas are to install pumpout, pump station, and restroom facilities where needed.
Solid Waste — specifies that solid wastes produced by the operation, cleaning, maintenance, and repair of boats should be properly disposed of to limit their entry to surface waters.
Fish Waste — requires that sound fish waste management be promoted through a combination of fish cleaning restrictions, public education, and proper disposal.
Liquid Material — provides for appropriate storage, transfer, containment, and disposal facilities for liquid materials commonly used in boat maintenance and encourages recycling these materials.
Petroleum Control — addresses the problem of fuel and oil leaks, which often occur during the refueling and operation of boats. The amount of fuel and oil leakage from fuel tank air vents should be reduced.
Boat Cleaning — minimizes the use of potentially harmful hull cleaners and bottom paints and their release to marinas and coastal waters.
Public Education — instituted for boaters, as well as marina operators, to prevent improper disposal of polluting materials.
Maintenance of Sewage Facilities — specifies that pumpout facilities be maintained in operational condition and that their use be encouraged to reduce untreated sewage discharges to surface waters.
Boat Operation — is designed to prevent increased turbidity and physical destruction of shallow-water habitat resulting from boating activities outside marinas.

Source: *Marinas and Recreational Boating Chapter Factsheet*

See details in: *Hawai'i Management Measures for Marinas and Recreational Boating*

Management Measures for Hydromodifications. Hydromodification is the alteration of streams and coastal waters, including creation or modification of diversions, dams, channels, and levees, which could degrade water resources. Hydromodification occurs in conjunction with agriculture, forestry, urban areas, and marinas, and thus management measures here occur in conjunction with those described above. The goals of management measures for hydromodification are summarized in Table 11.

The Hawai'i Commission on Water Resource Management (Hawai'i Water Commission) sets policies, approves water allocations, and issues permits to regulate water use. Policies, program directives, and recommendations of the Water Commission



are described in the [Water Resource Protection Plan](#) (Hawai'i Water Commission 2008).

The HDOH enforces water quality standards and any conduct that results in a demonstrable increase in levels of point or nonpoint source contamination in class 1 waters is prohibited. The U.S. Army Corps of Engineers regulates activities within wetlands and some streams and requires a permit, through Section 404 of the CWA, for any project that includes dredging or placing dredged or fill material into U.S. waters.

Table 11. Management Measures for Hydromodification

Management Measures for Hydromodification
Physical and Chemical Characteristics of Surface Waters — ensures that the planning process for new channelization projects includes an evaluation of the potential effects on the physical and chemical characteristics of surface waters that may occur as a result of the proposed work and encourages planning and design of new projects to reduce undesirable impacts.
Instream and Riparian Habitat Restoration — ensures that the planning process for new channelization projects includes an evaluation of the potential effects on instream and riparian habitat that may occur as a result of the proposed work. The measure encourages planning and design of new projects to reduce undesirable impacts. The operation and maintenance programs for existing modified channels should identify opportunities to restore instream and riparian habitat in those channels.
Erosion and Sediment Control — provides for reducing erosion and retaining sediment onsite, to the extent practicable, during and after construction of dams. An approved erosion and sediment control plan, or similar administrative document that contains erosion and sediment control provisions, should be prepared and implemented prior to land disturbance.
Protection of Surface Water Quality and Instream and Riparian Habitat — ensures that the operation of dams will be assessed for impacts to surface water quality and instream and riparian habitat, and that the potential for improvement will be evaluated.
Streambank and Shoreline Erosion — calls for stabilization of eroding streambanks and shorelines using vegetative methods such as marsh creation and vegetative bank stabilization ("bioengineering") are the preferred methods.

Source: [Hydromodification Chapter Factsheet](#)

See details in: [Hawai'i Management Measures for Hydromodification](#)

Management Measures for Wetlands, Riparian Areas, and Vegetated Treatment Systems.

Wetlands and riparian areas are natural habitats that can reduce polluted runoff and prevent the entry of pollutants into receiving waters by intercepting surface runoff, subsurface flow, and certain groundwater flows. They can further enhance water quality by processing, removing, transforming, and storing sediment, nitrogen, phosphorus, and certain heavy metals. The goals of wetland, riparian, and vegetated treatment system management measures are summarized in Table 12.

The Hawai'i CZM Program together with the Department of Geography at the University of Hawai'i at Manoa has prepared the draft *Hawai'i Coastal and*

Estuarine Land Conservation Plan (see [Hawai'i Coastal and Estuarine Land Conservation Plan](#)). This plan is intended to identify priority conservation needs and provide clear guidance for the process of nominating local coastal land conservation projects to the national competition. The preparation of an approved state *Coastal and Estuarine Land Conservation Plan* is the initial action that must take place in order to qualify for competitive funding under the *Coastal and Estuarine Land Conservation Program*. In addition, the Primary Urban Center Development Plan (2004), East Honolulu Sustainable Communities Plan (April 1999), Koolau Loa Sustainable Communities Plan (October 1999), and the Waianae Sustainable Communities Plan (July 2000) all recommend the establishment or enhancement of riparian zones along all streams to protect water quality, reduce erosion, and improve the aesthetics of the urban area.

Table 12. Management Measures for Wetlands, Riparian Areas, and Vegetated Treatment Systems

Management Measures for Wetlands, Riparian Areas, and Vegetated Treatment Systems
Protection of Wetlands and Riparian Areas — maintain the water quality benefits of wetlands and riparian areas and to ensure that they do not in turn become a source of nonpoint pollution due to degradation.
Restoration of Wetlands and Riparian Areas — promotes the restoration of preexisting wetland and riparian areas where the restoration of such systems will have a significant nonpoint source pollution abatement function.
Vegetated Treatment Systems — promotes the use of artificial wetlands or vegetated treatment systems to remove sediment and other pollutants from runoff and wastewater by filtration, deposition, infiltration, absorption, adsorption, decomposition, and volatilization, thereby reducing the amount of pollution entering adjacent waterbodies.

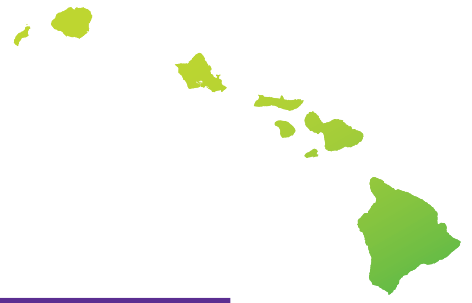
Source: [Riparian and Wetlands Chapter Factsheet](#)

See details in: [Hawai'i Management Measures for Wetlands, Riparian Areas, and Vegetated Treatment Systems](#)

Results and Next Steps. At the end of this step, you will have completed the following:

- ✓ Finalized your goals and identified management objectives.
- ✓ Developed numeric targets and indicators.
- ✓ Identified load reductions needed to achieve goals.
- ✓ Developed management strategies to implement in the watershed.

In the next step, you will develop an implementation program that outlines the major activities to be conducted, a schedule with well-defined milestones, criteria to measure progress, an information and education component, an estimate of financial and technical resources needed, a monitoring component, and an evaluation framework.



Chapters 9, 10 and 11 within the EPA handbook address Step 3 – Set Goals and Identify Solutions.

- Chapter 9 – Set Goals and Identify Load Reductions:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch09.pdf
 - See Worksheet 4-4 in the EPA handbook for template to create a table like Table 8.
- Chapter 10 – Identify Possible Management Strategies:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch10.pdf
- Chapter 11 – Evaluate Options and Select Final Strategies:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch11.pdf

Step 3 includes two of EPA's identified nine key elements:

- Determine load reductions needed
- Develop management measures to achieve goals

See Section 3.4 for more information on these key elements.

EPA's Watershed Planning Process site provides information for this step at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=34&navId=52&rightNavId=52>.



Step 4 Activities

- Develop an Implementation Schedule*
- Develop Interim Milestones to Track Implementation of Management Measures*
- Develop Criteria to Measure Progress toward Meeting Watershed Goals*
- Develop Monitoring Component*
- Develop Information/education Component*
- Develop an Evaluation Process
- Identify Technical and Financial Assistance Needed to Implement Plan*
- Assign Responsibility
- Define Results and Next Steps

* One of nine key elements needed in a watershed plan

Step 4 – Design an Implementation Program

Step 4 generates several of the basic elements needed for effective watershed plans. All of the information generated in the previous steps is incorporated to produce a roadmap to implement the program. The implementation program should include the following.

Develop an Implementation Schedule. An implementation schedule includes a timeline and identifies the responsible organization or person to implement the actions related to the management objectives. The actions in the schedule should be discrete and contain adequate detail to make tracking and reviewing their progress reasonable. A greater level of detail may appear in the annual work plan of those implementing the individual actions.

A schedule should be created to implement the management measures outlined in the watershed plan. The schedule should include a timeline for implementation of each activity as well as specify who is responsible for implementation. Each activity listed in the watershed plan should be at a reasonable scale so that it can be easily tracked and reviewed.

Develop Interim Milestones. Interim, measurable milestones are small, discrete tasks that track implementation of management measures and demonstrate the level of implementation progress. It is helpful to think of milestones as specific subtasks to be accomplished over a specific period of time that are needed to accomplish the management measures. Milestones should be regularly reviewed and evaluated. Contingency plans should also be in place if milestones are not met or are met in a shorter time frame. Keep in mind that milestones measure the progress of management measure implementation and do not measure the effectiveness of the management measure implemented to preserve or improve water quality.



Milestones should be **S**pecific, **M**easurable, **A**chievable, **R**elevant to a nonpoint source management measure, and **T**ime-sensitive (SMART). You should consider economic, social, and environmental factors in selecting milestones. Given the selected practices and available funds, estimate what can be accomplished within a specific timeframe (such as 1 year, 5 years, or 10 years) and set short-, mid-, and long-term milestones. The availability of staff, funding, and resources will help determine which category they fall



in. It is also important to assign responsibility for specific tasks. The implementation program should also include information on how a milestone's progress will be measured, such as monitoring, spot-checking, participation, adoption of management practices, or some other method.

Develop Criteria. Criteria measure the effectiveness of the implemented milestones to improve water quality. They are interim targets that measure selected indicators. The indicators will address a water quality condition or measurable, action-oriented activity. Table 13 provides an example of the suite of indicators that may be necessary for a specific water quality issue.

Table 13. Example Issue and Suite of Possible Indicators

Water Quality Concern	Possible Indicators
Suspended Solids	<ul style="list-style-type: none"> • Total suspended solids • Sediment load • Transparency of waterbody or secchi depth • Living coral cover

Throughout the watershed planning process, indicators are used to measure progress toward achieving goals and meeting objectives. The list of indicators is refined and modified throughout the planning and implementation process (Table 14). Early in the watershed planning process, indicators are used to measure the current watershed conditions. Later in the process, they are used to measure the progress of implementation. Stakeholders should provide input when indicators are developed to ensure that their concerns are addressed and that the indicators are easily understood by non-technical audiences.

Table 14. Planning Step and Corresponding Indicator Description

Planning Step	Description of How Indicators are Used
Step 2 – Characterize the Watershed	Indicators are used to measure current environmental conditions, such as water quality, habitat, aquatic resources, land use patterns.
Step 3 – Set Goals and Identify Solutions	Indicators are used to determine when the goal will be achieved, for example, reducing nutrient loads to meet water quality standards; Indicators are used to measure the targets for load reductions, for example, phosphorus concentration.
Step 4 – Design an Implementation Program	Indicators are used to track the implementation of the management measures, such as the number of management practices installed. The monitoring program measures the indicators that have been developed as part of the management measures and information and education program.
Step 5 – Implement the Watershed Plan	Indicators are used to measure implementation of the watershed plan, tracking dollars spent, resources expended, management practices implemented, and improvements in water quality.

Indicators should be quantitative and consider the impacts, impairments, or issues of concern in the watershed and the types and pathways of watershed stressor sources that contribute to those impacts. Indicators should be linked to water quality restoration or protection goals or other parameters (such as channel instability, eroding banks, channel flow, or flow cycles). Completed TMDLs already have defined indicators that should be incorporated into the watershed plan.

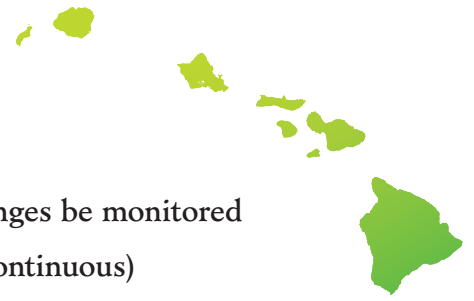
Criteria expressed as indicators can be direct measurements or indirect indicators of load reductions. Indicators might measure a water quality condition that can be measured (examples include dissolved oxygen, nitrogen, and total suspended solids) or action-related achievement that can be measured (pounds of trash removed, number of volunteers at the stream cleanup, or length of stream corridor revegetated). Indicators should provide quantitative measurements of progress toward meeting the goals and should be easily communicated to various audiences. The indicators and interim criteria selected should reflect the performance of the management measures, the concerns identified by stakeholders, and the refined goals and management objectives. Other factors that should be considered in developing these interim targets or criteria include the implementation schedule for the management measures, the nature of the pollutants, and the time frame for applying the criteria.

Also included with this component should be a discussion of how it will be determined if the watershed plan needs to be revised if the criteria are not met, which supports an adaptive management approach by providing a mechanism to evaluate implementation plans and evaluate whether substantial progress is being made.

Develop a Monitoring Component. The watershed plan needs to have a monitoring component to evaluate whether progress is being made toward attaining or maintaining water quality standards. The monitoring schedule should be integrated with the criteria and milestone components as discussed previously. The monitoring component should determine if loads are being reduced and water quality improved.

There are many decisions that need to be made when developing a monitoring program. USDA's *National Handbook of Water Quality Monitoring* provides an overview of decisions that need to be made in developing a comprehensive monitoring component for a watershed planning effort. EPA recommends that watershed practitioners refer to the USDA guidance; its recommendations as listed below for developing a program:

- Identify problem
- Form objectives — both management objectives and monitoring objectives need to be linked
- Design experiment — designs can range from paired watershed; upstream-downstream monitored before, during, and after BMP installation; and multiple-watershed monitoring



- Select scale (point, plot, field, or watershed)
- Select variables — which aspect of the system will changes be monitored
- Choose sample type (grab, composite, integrated, or continuous)
- Locate stations (near critical areas, near BMPs)
- Determine frequency (weekly, monthly, seasonal)
- Design stations to measure discharge volume, chemical concentrations, or precipitation
- Define collection/analysis methods – includes quality assurance/quality control methods
- Define land use monitoring (direction observation, log books, interviews, agency reporting)
- Design data management for acquisition, storage, and reporting

Monitoring can be very expensive. It is important to have a close link between the selected monitoring methods and the plan's implemented management practices. While auxiliary data may be interesting, they deplete valuable resources that could be applied to other important elements of the implementation plan. In addition, statistical analysis is critical to interpreting monitoring results, and input from a statistician should be gathered when designing the monitoring component.

Develop an Evaluation Process. Evaluation measures progress and facilitates adaptation of the watershed plan over time. By understanding the amount of progress that is being made, programs can continuously improve their efficiency and quality. An evaluation framework or logic model provides a picture or visual representation of your program, showing the inputs needed to implement your program, the expected outputs, and the anticipated outcomes from implementing the activities. Using a logic model can help you to better document the outcomes, discover what works and why, and continuously make changes to your program based on your evaluation results.

Inputs are processes that are used to implement the program (resources and stakeholder participation) (Figure 7). *Outputs* are tasks that are conducted and products that are developed (implemented activities and practices, brochures). *Outcomes* result from the implementation effort (such as changes in awareness, behavior, or water quality). There are several evaluation options such as surveys, interviews, and macroinvertebrate and water quality sampling. Evaluation methods should be selected based on the type of results they provide, the budget available, and the timeframe. Evaluation should occur at four points: before implementation begins, during implementation, after implementation, and long term (after considerable time has passed after implementation).

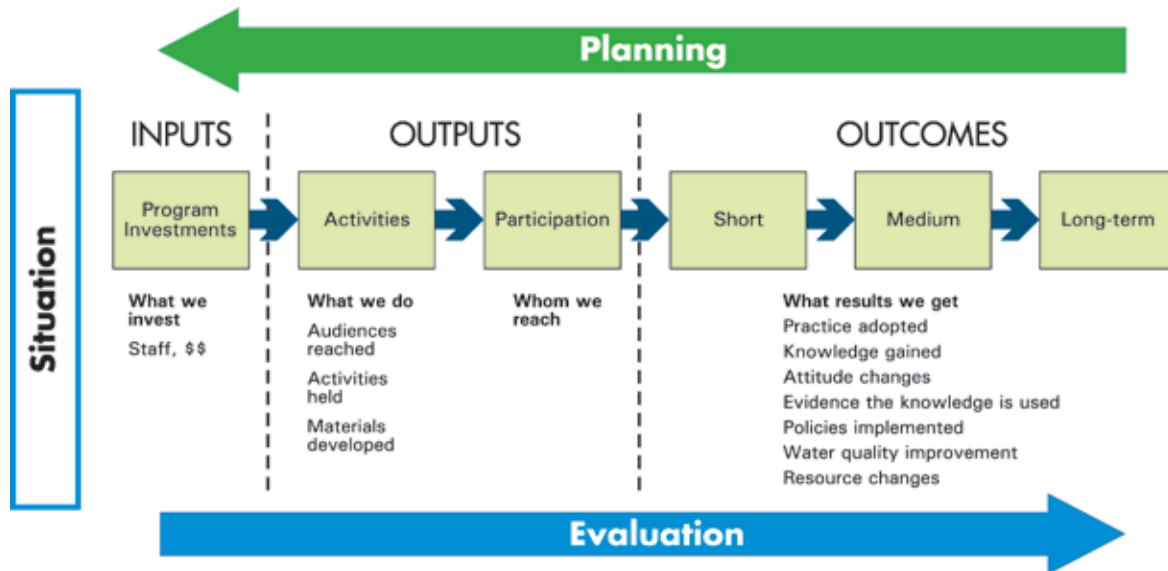


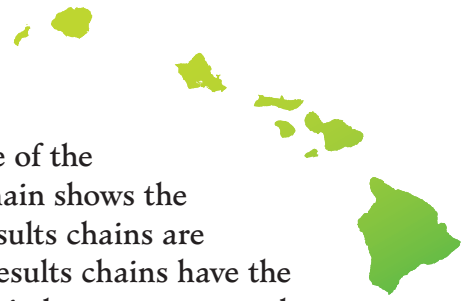
Figure 7. Logic Model Components

A results chain is another evaluation tool that clarifies assumptions about how management activities contribute to desired outcomes (Figure 8). This tool is being used as part of the conservation planning cycle to visually depict the causal links between direct and indirect threats on threatened and endangered species, habitats, and other components of an ecosystem of interest (FOS 2009).

Results chains map out a series of causal statements that link factors in an “if...then” fashion—for example, “if a threat is reduced, then a biodiversity target is enhanced,” or “if an opportunity is taken, then a thematic target might be improved.” Results chains focus on the achievement of results to define how you think project activities will contribute to your goal. The basis for the chain comes from your conceptual model, but you will build on the model to make it more specific and to make the boxes results-oriented. Results chains are composed of an activity or strategy (a group of activities), desired outcomes, and the ultimate impact that these results will have on the biodiversity target. A “goal” is a formal statement of a desired impact on a target, and an “objective” is a formal statement of a desired outcome.



Figure 8. Example of a Simplified Results Chain



Results chains differ in that conceptual models show the state of the world before a particular action takes place, while a results chain shows the state of the world as it results from the proposed strategy. Results chains are similar to the logic models used by many organizations, but results chains have the added benefit of showing more detail and the direct relationship between one result and another.

Develop an Information and Education (I/E) Component. I/E activities should be developed and implemented in close coordination with the watershed plan. I/E activities should be organized as a cohesive campaign with identified target audiences (people who need to be educated, adopt new behaviors, or install practices to help meet watershed goals). The messages and formats should address the target audience's knowledge level and methods of receiving information. I/E should be evaluated, and the method of evaluation should be planned *before* the I/E activities are implemented. I/E often receives only a form of *process evaluation* (cost/budget analysis, number of people reached, or number of materials and meetings); however, *impact evaluation* (changes in the audience's behavior and water quality improvements) and *context evaluation* (societal ramifications) need to be evaluated as well. EPA's *Getting in Step Outreach Guide* provides further detail for I/E campaigns and their evaluation (See [*Getting in Step - A Guide for Conducting Watershed Outreach Campaigns*](#)).

A watershed plan should identify I/E activities that will be used to implement the watershed plan. This element should identify the target audiences, information needed from those target audiences, formats and distribution mechanisms for materials, and evaluation methods. A description of how the results from the watershed plan will be shared with stakeholders and the community should also be included. Costs, responsible persons, schedule, and interim milestones for I/E activities should also be incorporated into the appropriate, corresponding elements.

Prepare a List of Technical and Financial Resources. Without funding and resources, a watershed plan cannot be implemented. You should therefore identify existing and new funding sources and develop a detailed estimate of annual costs associated with implementing the watershed plan. Cost associated with monitoring, equipment, laboratory analysis, data management-related costs, staff, and I/E need to be included with the annual costs.

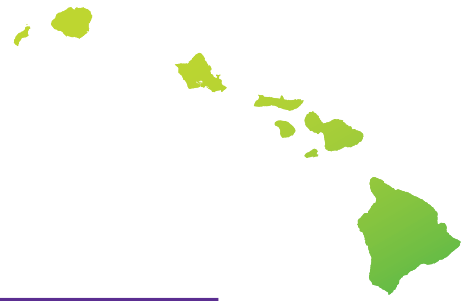
The financial and technical assistance needed to implement the entire plan—including implementation, long-term operation and maintenance of management measures, information and education activities, monitoring, and evaluation activities—should be estimated. The relevant authorities that might play a role with the plan implementation should also be identified. Use of federal, state, local, and private funds or resources that may be available to implement the plan also should be considered. Gaps between the watershed plan's needs and the available funds and resources should also be addressed in this element.

Assign Responsibility. Responsibilities for implementing, reviewing, and revising (if needed) the watershed plan must be defined and accepted. The role of each partner or stakeholder (organization or individual) should be articulated and documented. Tasks can be subdivided if necessary to better assign responsibility given skills, knowledge, and availability. When tasks are assigned, consider whether staff are permanent or part-time, whether there is long-term funding available for the task, and whether there is broad public or local government (or both) support for the task.

Results and Next Steps. At the end of this step, you will have completed the following:

- ✓ Developed an implementation schedule.
- ✓ Set milestones to evaluate whether management practices are being effectively implemented.
- ✓ Established criteria to determine if you are achieving load reductions and making progress toward your watershed goals.
- ✓ Have established monitoring programs that are designed to track progress in meeting load reduction goals and attaining water quality standards.
- ✓ Created an I/E component to involve stakeholders and the local community.
- ✓ Set up an evaluation process to demonstrate the success of the program.
- ✓ Identified and estimated financial and technical assistance.
- ✓ Assigned stakeholders and the community responsibility in the plan's implementation and kept them involved in the project.
- ✓ Developed management strategies to implement in the watershed.

Assembling the watershed plan and supporting documents is the final part of this step. EPA's on-line watershed planning process includes sample outlines for each step of the process.



Chapter 12 in the EPA handbook addresses Step 4 – Design an Implementation Program.

- Chapter 12 – Design Implementation Program and Assemble Watershed Plan:

www.epa.gov/owow/nps/watershed_handbook/pdf/ch12.pdf

Step 4 includes six of EPA's identified nine key elements.

- Develop implementation schedule
- Develop interim milestones to track implementation of management measures
- Develop criteria to measure progress toward meeting watershed goals
- Develop monitoring component
- Develop information/education component
- Identify technical and financial assistance needed to implement plan

A sample implementation plan matrix is in the EPA handbook, Worksheet 12-1.

EPA's Watershed Planning Process site provides information for this step at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=76&navId=73&rightNavId=73>.

EPA's *Getting in Step: A Guide for Conducting Watershed Outreach Campaigns* provides steps and examples to produce an effective, cohesive outreach campaign. The guide is a valuable resource to those implementing information and education programs. www.epa.gov/nps/toolbox/guide.htm



Step 5 Activities

- Prepare Work Plans
- Implement Activities
- Conduct Monitoring
- Conduct Information/Education Activities
- Share Results
- Define Results and Next Steps

Step 5 – Implement the Watershed Plan

The creation of the watershed plan is just the beginning—the plan needs to be implemented! With the plan completed, the dynamics of the watershed group may change. Some members may reduce their level of involvement, and there may be a need to engage others to fill new skill and resource requirements. Project management, technical expertise, group facilitation, data analysis, communication and public relations are a few of the skill sets that are needed to implement a watershed plan. It may be helpful to create a watershed plan implementation team with formal positions to ensure that responsibilities are clearly assigned and that the plan will be successfully implemented in the years to come.

Prepare Work Plans. The watershed plan will serve as the foundation for preparing work plans that outline the implementation activities in 2- to 3-year timeframes. Work plans are an important tool for preparing grant applications to fund implementation activities and for reporting on progress. A work plan should provide a description and summary matrix of the following key parameters:

- Period (6 months, 1 year, 5 years)
- Geographic scope (size of watershed covered in the plan)
- Critical areas (a list or description of the amount and type of areas that need to especially protected such as wetlands, drinking water sources, habitat for endangered species)
- Goal statement
- Management measures and practices
- Implementation activities
- Costs (broken down among different activity or practice)
- Schedule (including interim milestones)
- Monitoring (considering environmental, administrative, and social indicators)

Implement Activities. The management measures selected, schedules and milestones, financial resources, and information and education programs developed during the course of assembling the plan provide a road map for implementation. Follow it! Key implementation activities include the following:

- Ensuring technical assistance in the design and installation of management measures



- Providing training and follow-up support to landowners and other responsible parties in operating and maintaining the management measures
- Managing the funding mechanisms and tracking expenditures for each action and for the project as a whole
- Conducting the land treatment and water quality monitoring activities and interpreting and reporting the data
- Measuring progress against schedules and milestones
- Communicating status and results to stakeholders and the public
- Coordinating implementation activities among stakeholders, among multiple jurisdictions, and within the implementation team.

To keep the implementation team energized, consider periodic field trips and site visits to document implementation in addition to the necessary regular team meetings.

Conduct Monitoring. Implementation can begin with an I/E component or with on-the-ground management measures. As the plan is implemented, do not forget to share the incremental results with the watershed stakeholders and the community. Transparency of the process and accountability among watershed partners is vital to keep the process moving forward with support.

Conduct Information/Education Activities. In Step 4, appropriate information/education activities were identified and included in the implementation plan. Now in Step 5, the activities selected should be implemented. Tasks associated with conducting meetings, creating education materials, and interacting with stakeholders and the public should be carried out.

Share Results. Continuous communication is essential to building the credibility of and support for the watershed implementation process. This communication is especially critical if you are using a stakeholder-driven process. Regular communication, through e-mails, press releases, ads in local papers, newsletters, or meetings also helps to strengthen accountability among watershed partners by keeping them actively engaged. Communication might also stimulate more stakeholders to get involved in the effort and offer new ideas or suggestions. Sharing results can also help to ensure more consistent watershed approaches across subwatersheds.

Remember to publicize accomplishments to commissioners, elected local and state officials, watershed residents, and other major stakeholders. Consider issuing a watershed “report card” or develop a fact sheet, brochure, or annual report to highlight progress, successes, and future activities.



Chapter 13 within the *EPA Handbook* addresses Step 5 – Implement the Watershed Plan.

- Chapter 13 - Implement Watershed Plan and Measure Program:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch13.pdf

EPA's Watershed Planning Process site also provides information for this step at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=64&navId=70&rightNavId=70>.

Results and Next Steps. At the end of this step, you should have completed the following:

- ✓ Prepared an annual work plan.
- ✓ Initiated implementation of management activities.
- ✓ Conducted monitoring and analyzed samples.
- ✓ Implemented information/educational activities to create awareness and change various behavior patterns within the watershed.
- ✓ Shared results from implementation activities throughout the watershed.

As part of implementation, you will continuously evaluate the progress of your efforts and determine if you need to make any changes to your watershed plan.



Step 6 Activities

- Track Progress
- Make Adjustments
- Define Results and Next Steps

Step 6 – Measure Progress and Make Adjustments

It is important to remember that watershed plans are living documents that need to be re-visited and adjusted as implementation progresses through the years. Determine a regular schedule, perhaps quarterly or biannually, for sitting down and reviewing the watershed plan in light of any changes in watershed conditions or other changes such as zoning changes or changes in personnel, organizations,

or governmental bodies. Stakeholders should also be convened regularly and the progress on the milestones and criteria should be provided and discussed during these meetings. After these periodic reviews, watershed plan adaptations may be necessary to improve implementation results.

Track Progress. Progress should be tracked and reviewed to address several key areas, including:

- **The process used to implement your program.** This process includes the administrative and technical procedures used to secure agreements with



landowners, develop specifications, hire staff, and engage contractors.

- **Progress on your work plan.** Check off items in your annual work plan that have been completed.
- **Implementation results.** Report where and when practices have been installed and have become operational, who installed them, and any lessons learned.
- **Monitoring data.** Two types of progress analyses should be considered: (1) routine summary analysis, conducted at least quarterly, that tracks progress of monitoring activities, assesses the quality of data relative to measurement quality objectives (whether the data are of adequate quality to answer the monitoring question), and provides early feedback on trends, changes, and problems in the watershed; and (2) intensive analysis, conducted at least yearly, to determine status, changes, trends, or other issues that measure the response to implementation of the watershed plan.
- **Feedback from landowners and other stakeholders.** Seek out and review information on the stakeholders' experience with the implementation process and with operation and maintenance of the practices through meetings, interviews, or other methods.

A simple way to gather some of this information is to provide worksheets or checklists to the project team at its regularly scheduled meetings to make it easy for project members to provide exactly the information needed. Maintain agendas, minutes, and other records so that important issues and decisions are well documented. Consider tying each meeting to a simple progress report so that all team members stay up-to-date.

Make Adjustments. Below are a few questions that should be answered to help determine if any adjustments need to be made to the plan.

- Are the implementation milestones and criteria being met?
- If milestones are not being met, is it because of the watershed plan itself, a lack of funding and resources, or out-of-the-ordinary weather conditions?
- What information can be learned from the environmental, social, and programmatic indicators?
- Are adjustments necessary to the watershed plan?
- Are additional management measures necessary?
- Do the management measure locations need to be adjusted?

Results and Next Steps. At the end of this step, you should have completed the following:

- ✓ Compared the actual implementation of activities and monitoring results against the watershed plan.

- ✓ Based on the progress made and results shown, made adjustments to the plan.

Watershed management is an extremely dynamic process, and the watershed plan is a living document that continually needs to be updated, modified, and refined. New tools are being created every day to assist watershed practitioners with developing and implementing watershed management plans to improve and protect our nation's water resources. So, as you continue to monitor the health of your watershed, you will repeat the steps outlined above and move toward more and more efficient and effective management of our watersheds.



Chapter 13 within the *EPA Handbook* addresses Step 6 – Measure Progress and Make Adjustments and its substeps

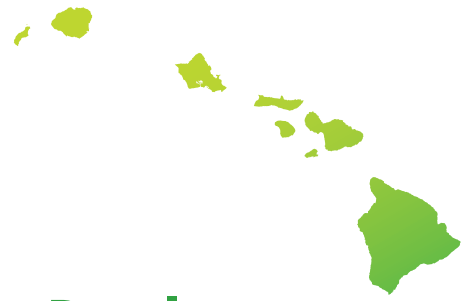
- Chapter 13 - Implement Watershed Plan and Measure Program:
www.epa.gov/owow/nps/watershed_handbook/pdf/ch13.pdf

EPA's Watershed Planning Process site also provides information for this step at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=109&navId=112&rightNavId=112>.



The nine minimum elements of a watershed management plan are incorporated throughout the *EPA Handbook*

- **Pollutant causes and sources** – See chapters 5, 6 and 7 within the *EPA Handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=37&navId=55&rightNavId=52>.
- **Pollutant loads** – Pollutant loads will vary depending on the land use type. For more information, see chapters 7, 8, 9, 10 and 11 within the *EPA Handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=74&navId=97&rightNavId=92>.
- **Management measure to achieve goals** – See chapters 9, 10, and 11 within the *EPA handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=35&navId=53&rightNavId=52>
- **Implementation schedule** – See chapter 12 within the *EPA handbook*. An example implementation matrix can be found at <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=77&navId=74&rightNavId=73>.
- **Milestones** – See the *EPA handbook's* Worksheet 12.3 for example milestones at www.epa.gov/nps/watershed_handbook/pdf/app_b.pdf. For more information see chapter 12 within the *EPA Handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=80&navId=75&rightNavId=73>.
- **Indicators** – See chapters 12 and 13 within the *EPA handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=81&navId=76&rightNavId=73>.
- **Monitoring** – see chapters 6, 12, and 13 within the *EPA handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=82&navId=77&rightNavId=73>.
- **Information and Education** – see Chapters 3 and 12 within the *EPA handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=83&navId=78&rightNavId=73>.
- **Technical and Financial Assistance** – For more information see chapter 12 in the *EPA handbook* and visit <http://iaspub.epa.gov/watershedplan/planningProcess.do?pagelId=85&navId=80&rightNavId=73>.



4.0 Staying Focused on Achieving Results

Watershed management requires sustained commitment by many over a long time to achieve results. Building partnerships, collecting and analyzing data, developing a watershed plan, and acquiring the financial resources needed to implement the plan can be daunting. It is easy for watershed efforts to lose steam in a long and lengthy process that does not seem to contribute to the restoring the health of the watershed. In order to stay focused on achieving results, remember to:

Conduct Targeted Information and Education. An I/E component is one of the nine key elements of effective watershed planning and implementation. In a survey of community stewardship groups in Hawai'i, over one-third of all community-based stewardship projects depended on education and outreach to achieve successful outcomes (See [*Hawai'i Community Stewardship Report \(2008\)*](#)). In fact, education and outreach were cited as important factors to success more often than financial or technical assistance, volunteer support, or partnering with other entities. At the same time, the I/E component must be targeted to engage stakeholders to achieve results. Too often, watershed management activities place emphasis on this component at the expense of activities designed to achieve measurable results in water quality.

Conduct Early Actions. Conducting small, short-duration, results-oriented projects can help keep stakeholders engaged within a larger and longer watershed process. Work with established or new partners to carve out small but high-impact projects that are consistent with the direction of the overall watershed planning effort.

Join Forces. Many efforts in a single watershed can lead to great impact through coordinated actions. A number of different groups may be working separately, each with different objectives, as well as different challenges. Joining forces provides a mechanism to share resources and increase the overall scope to gain both political and financial strength. If one group's activities became delayed through a loss of leadership, delay in funding, or obstacles in local government, other groups could continue to make progress within the watershed. This approach provides a steadier stream of success that keeps the entire community involved. Within a structure such as this one, it is critical to publicize successes and make sure that everyone within the community is recognized as contributing to those successes.

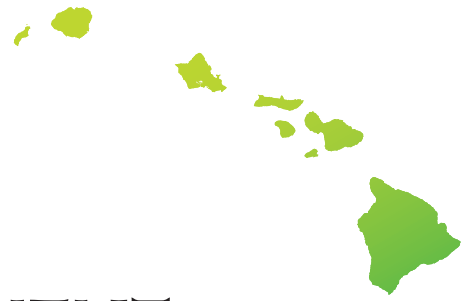
Collect Data and Monitor with a Clear Purpose. Data collection and monitoring take a lot of effort to be done well and can be costly. Specialized technical expertise may be needed

to review the quality of existing data. Make sure to carefully review the need to collect additional data and engage specialized technical experts as needed to help. Prepare a detailed sampling and analysis plan to ensure that the data you are collecting will help answer the questions you are asking.

Don't Reinvent the Wheel. From a technical perspective, the *Management Measures for Hawai'i's CNPCP* provide the most comprehensive menu of solutions to address nonpoint sources of pollution. What management measures and practices you select from the menu and how you package these to achieve results is what will be specific to your watershed. From a learning perspective, networking with other organizations, sharing ideas, experiences, and lessons learned will provide valuable insights in achieving results in your watershed.

Define a Schedule and Clear Roles and Responsibilities for Action. Keeping projects on schedule and individuals and organizations accountable for their responsibilities are critical to achieving results and sustaining momentum for watershed efforts. Regularly review work plan activities and milestones. Document issues, solutions, and lessons learned and use this information to improve implementation in your watershed and share with others.

Be Ready to Make Adjustments to Your Plan. Your watershed plan should serve as the basis for action; however, you will encounter obstacles and challenges as you implement actions and projects. Be ready to adjust your plan, and document the basis of this decision with sound information and data. Any number of changes may be required in your plan or implementation program that could result in delays and additional costs. Annual or bi-annual meetings should be conducted with stakeholders to review the plan, implementation progress, and lessons learned.



HAWAII'S MANAGEMENT MEASURES FOR THE COASTAL NONPOINT POLLUTION CONTROL PROGRAM

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Polluted Runoff Control Program

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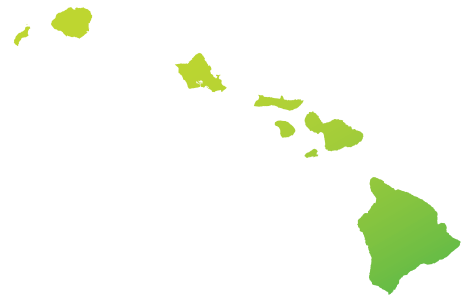
5.0 Hawaii's Management Measures

Hawaii's Management Measures (MMs) form the core of Hawaii's Coastal Nonpoint Source Pollution Control Program and provide goals for the management of NPS pollution to which various management practices are applied. MMs are defined in CZARA section 6217(g)(5) as "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives."

The measures are organized into six categories or sectors,

1. Agriculture;
2. Forestry (Silviculture);
3. Urban Areas;
4. Marinas and Recreational Boating;
5. Hydromodification Activities; and
6. Wetlands, Riparian Areas, and Vegetated Treatment Systems.

These measures are based on the federal guidance and will apply to the land use activities known to be major causes of NPS pollution. Not all of the identified MMs may be needed to address the NPSs at a specific site. For example, forestry and construction operations that do not use chemicals would not need to implement chemical-control MMs. Similarly, farms or other agriculture enterprises that do not have animals as part of the enterprise would not need to implement the MMs that address confined animal facilities or grazing. Other operations that have more than one source to address may need to employ two or more measures to address the multiple sources. Application of the measures should be coordinated to produce an overall system that adequately addresses all sources for the site in a cost-effective manner. The overall goal of implementing these measures is to protect or restore water quality and habitat.



5.1 Agriculture

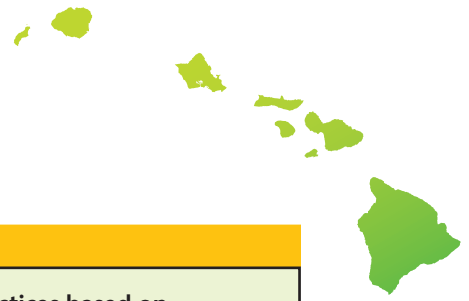
A. Introduction

There are six management measures that apply to agriculture. These management measures address the management of polluted runoff from all types of agricultural operations in Hawaii.

1. Erosion and Sediment Control	4. Pesticide
2. Wastewater and Runoff from Confined Facility	5. Grazing
3. Nutrients	6. Irrigation Water

The following table provides a brief overview of authorities that apply to the Agriculture management measures. A more detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure can be found in *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures*.

Authority		Responsible Agency	Erosion & Sed. Control	Confined Animals	Nutrient Mgt.	Pesticides Mgt.	Grazing Mgt.	Irrigation Mgt.
Local	Chapter 22-7, KCC, Grading, Grubbing and Stockpiling	Kauai County DPW	X					
	Chapter 10 HCC, Soil Erosion and Sediment Control	Hawaii County DPW	X					
	Chapter 20.08, MCC, Soil Erosion and Sedimentation Control	Maui County DPW	X					
	Chapter 14-13 to 14-16, ROH, Grading, Soil Erosion and Sediment Control	City and County of Honolulu	X					
State	Chapter 149A, HRS Hawaii Pesticides Law	DOA				X		X
	Chapter 171, HRS Mgt and Disposition of Public Lands	DLNR	X	X	X	X	X	X
	Chapter 180, HRS Soil and Water Conservation Districts	local SWCDs	X	X	X	X	X	X
	Chapter 342D, HRS Water Pollution	DOH	X	X	X	X	X	X
	Chapter 340E, HRS Safe Drinking Water	DOH		X	X	X		X
	Chapter 342H, HRS Solid Waste Pollution	DOH		X	X			
	Chapter 4-66, HAR Pesticides	DOA				X		X
	Chapter 11-21, HAR Cross Connection and Back-Flow Control	DOH		X	X	X		X
	Chapter 11-23, HAR Underground Injection Control	DOH		X	X	X		X
	Chapter 11-26, HAR Vector Control	DOH		X				
	Chapter 11-62, HAR Wastewater Systems	DOH		X				
	Farm*A*Syst Program, University of Hawaii Cooperative Extension Svc.	Univ. of Hawaii CES	X	X	X	X	X	X
	DOH Guidelines for Livestock Waste Management (1996)	DOH		X				
	Plant Nutrient Management in Hawaii's Soils: Approaches for Tropical and Subtropical Agriculture (2000)	Univ. of Hawaii CES			X			
Federal	NRCS's Hawaii Field Office Technical Guides (eFOTG)	NRCS	X	X	X	X	X	X



B. Management Measures

Erosion and Sediment Control Management Measure

Apply any combination of conservation structural and management practices based on U.S. Department of Agriculture – Natural Resources Conservation Service standards and specifications to minimize the delivery of sediment from agricultural lands to surface waters, or

Design and install a combination of management and structural practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to and including a 10-year, 24-hour frequency.

Applicability: This management measure applies to activities that cause erosion on agricultural land and on land that is converted from other land uses to agriculture. Agricultural lands include:

- Cropland;
- Irrigated cropland;
- Range and pasture;
- Orchards;
- Permanent hayland;
- Managed forests;
- Specialty crop production; and
- Nursery crop production.

The intent of the management measure is to protect surface and ground water quality. Some waterbodies, such as farm ponds, have been created to water livestock. Protecting the water quality of these artificial water storage areas does not have the same priority as protecting natural streams and waterbodies.

Practices: NRCS's *Hawaii Field Office Technical Guide* (eFOTG) contains many standards related to erosion and sediment control, among them: channel bank vegetation (322); deep tillage (324); conservation cover (327); conservation crop rotation (328); residue and tillage management (329); contour farming (330); cover crop (340); critical area planting (342); diversion (362); field border (386); filter strip (393); grade stabilization structure (410); grassed waterway (412); mulching (484); sediment basin (350); streambank and shoreline protection (580); strip-cropping (585); terrace (600); water and sediment control basin (638).

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Wastewater and Runoff from Confined Animal Facility Management Measure

Limit the discharge from the confined animal facility to surface waters by:

1. Containing both the wastewater and the contaminated runoff from confined animal facilities that is caused by storms up to and including a 25-year, 24-hour frequency storm event. Storage structures should be of adequate capacity to allow for proper wastewater utilization and constructed so they prevent seepage to groundwater; and
2. Managing stored contaminated runoff and accumulated solids from the facility through an appropriate waste utilization system.

Applicability: This management measure applies to all new confined animal facilities regardless of size and to all existing confined animal facilities that contain the following number of head or more:

	Head	Animal Units ¹
Beef Feedlots	50	50
Stables (horses)	100	200
Dairies	20	28
Layers	5,000	50 ² 165 ³
Broilers	5,000	50 165
Turkeys	5,000	900
Swine	100	40

Except those facilities that are required by Federal regulation 40 CFR 122.23 to apply for and receive discharge permits. That section applies to “concentrated animal feeding operations,” which are defined in 40 CFR Part 122, Appendix B. In addition, 40 CFR 122.23(c) provides that the Director of a National Pollutant Discharge Elimination System (NPDES) discharge permit program may designate any animal feeding operation as a concentrated animal feeding operation upon determining that it is a significant contributor of water pollution. This has the effect of subjecting the operation to the NPDES permit program requirements. If a confined animal facility has a NPDES permit, then it is exempt from this management measure.

Facilities containing fewer than the number of head listed above are not subject to the requirements of this management measure.

¹ *Animal unit:* A unit of measurement for any animal feeding operation calculated by adding the following numbers: the number of slaughter and feeder cattle multiplied by 1.0, plus the number of mature dairy cattle multiplied by 1.4, plus the number of swine weighing over 25 kilograms (approximately 55 pounds) multiplied by 0.4, plus the number of sheep multiplied by 0.1, plus the number of horses multiplied by 2.0 (40 CFR Part 122, Appendix B).

² If facility has a liquid manure system, as used in 40 CFR Section 122, Appendix B.

³ If facility has continuous overflow watering, as used in 40 CFR Section 122, Appendix B.



A *confined animal facility* is a lot or facility (other than an aquatic animal production facility) where the following conditions are met:

- Animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and
- Crops, vegetation forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility.

Two or more animal facilities under common ownership are considered, for the purposes of these guidelines, to be a single animal facility if they adjoin each other or if they use a common area or system for the disposal of wastes.

Confined animal facilities, as defined above, include areas used to grow or house the animals, areas used for processing and storage of product, manure and runoff storage areas, and silage storage areas.

Wastewater and runoff from confined animal facilities are to be controlled under this management measure. Runoff includes any precipitation that comes into contact with any manure, litter, or bedding. Wastewater is water discharged in the operation of an animal facility as a result of any or all of the following: animal or poultry watering; washing, cleaning, or flushing pens, barns, manure pits, or other animal facilities; washing or spray cooling of animals; and dust control.

Practices: NRCS's *Hawaii Field Office Technical Guide* (eFOTG) contains many standards related to confined animal facilities, among them: waste storage facility (313); composting facility (317); waste treatment lagoon (359); waste facility cover (367); roof runoff structure (558); heavy use area protection (561); amendments for treatment of agricultural waste (591); waste treatment (629); solid/liquid waste separation facility (632); waste utilization (633); and manure transfer (634).

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures
(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Nutrient Management Measure

Develop, implement, and periodically update a nutrient management plan to: (1) apply nutrients at rates necessary to achieve realistic crop yields, (2) improve the timing of nutrient application, and (3) use agronomic crop production technology to increase nutrient use efficiency. When the source of the nutrients is other than commercial fertilizer, determine the nutrient value. Determine and credit the nitrogen contribution of any legume crop. Soil and/or plant tissue testing should be used at a suitable interval. Nutrient management plans contain the following core components:

1. Farm and field maps showing acreage, crops, soils, and waterbodies.
2. Realistic yield expectations for the crop(s) to be grown, based on achievable yields for the crop. Individual producer constraints and other producer's yields would be considered in determining achievable yields.
3. A summary of the soil condition and nutrient resources available to the producer, which at a minimum would include:
 - An appropriate mix of soil (pH, P, K) and/or plant tissue testing or historic yield response data for the particular crop;
 - Nutrient analysis of manure, sludge, mortality compost (birds, pigs, etc.), or effluent (if applicable);
 - Nitrogen contribution to the soil from legumes grown in the rotation (if applicable); and
 - Other significant nutrient sources (e.g., irrigation water).
4. An evaluation of field limitations based on environmental hazards or concerns, such as:
 - Lava tubes, shallow soils over fractured bedrock, and soils with high leaching or runoff potential,
 - Distance to surface water,
 - Highly erodible soils, and
 - Shallow aquifers.
5. Best available information is used in developing recommendations for the appropriate mix of nutrient sources and requirements for the crops.
6. Identification of timing and application methods for nutrients to: provide nutrients at rates necessary to achieve realistic crop yields; reduce losses to the environment; and avoid applications as much as possible during periods of leaching or runoff.
7. Methods and practices used to prevent soil erosion or sediment loss.
8. Provisions for the proper calibration and operation of nutrient application equipment.

Applicability: This management measure applies to activities associated with the application of nutrients, including both manures and commercial fertilizers, to agricultural lands.

Practices: NRCS's *Hawaii Field Office Technical Guide* (eFOTG) contains a standard related to nutrient management (590), intended to help operators manage the amount, source, placement, form and timing of the application of plant nutrients and soil amendments.



Plant Nutrient Management in Hawaii's Soils: Approaches for Tropical and Subtropical Agriculture (2000) also describes best management practices that can be used to assure proper management of nutrients.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Pesticide Management Measure

To eliminate the unnecessary release of pesticides into the environment and to reduce contamination of surface water and ground water from pesticides:

1. Use integrated pest management strategies where available that minimize chemical uses for pest control.
2. Manage pesticides efficiently by:
 - a. calibrating equipment;
 - b. using appropriate pesticides for given situation and environment;
 - c. using alternative methods of pest control; and
 - d. minimizing the movement of pest control agents from target area.
3. Use anti-backflow devices on hoses used for filling tank mixtures.
4. Enhance degradation or retention by increasing organic matter content in the soil or manipulating soil pH.

Applicability: This management measure applies to activities associated with the application of pesticides to agricultural lands.

Practices: NRCS's *Hawaii Field Office Technical Guide* (eFOTG) contains several standards related to pesticides, including pest management (595). This standard outlines practices to utilize environmentally-sensitive prevention, avoidance, monitoring and suppression strategies to manage weeds, insects, diseases, animals and other organisms (including invasive and non-invasive species) that directly or indirectly cause damage or annoyance.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Grazing Management Measure

Protect range, pasture and other grazing lands:

1. By implementing one or more of the following to protect sensitive areas (such as streambanks, wetlands, estuaries, ponds, lake shores, near coastal waters/ shorelines, and riparian zones):
 - a. Exclude livestock,
 - b. Provide stream crossings or hardened watering access for drinking,
 - c. Provide alternative drinking water locations,
 - d. Locate salt and additional shade, if needed, away from sensitive areas, or
 - e. Use improved grazing management (e.g., herding) to reduce the physical disturbance and reduce direct loading of animal waste and sediment caused by livestock; and
2. By achieving either of the following on all range, pasture, and other grazing lands not addressed under (1):
 - a. Implement range and pasture conservation and management practices that apply the progressive planning approach of USDA-NRCS following the standards and specifications contained in the FOTG that achieve an acceptable level of treatment to reduce erosion, and/or
 - b. Maintain range, pasture, and other grazing lands in accordance with activity plans established by the Division of Land Management of DLNR, federal agencies managing grazing land, or other designated land management agencies.

Applicability: The management measure applies to activities on range, irrigated and non-irrigated pasture, and other grazing lands used by domestic livestock. Range is those lands on which the native vegetation (climax or natural potential plant community) is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing use. Range includes natural grassland, savannas, many wetlands, some deserts, tundra, and certain forb and shrub communities. Pastures are those lands that are primarily used for the production of adapted, domesticated forage plants for livestock. Other grazing lands include woodlands, native pastures, and croplands producing forages.

The major differences between range and pasture are the kind of vegetation and level of management that each land area receives. In most cases, range supports native vegetation that is extensively managed through the control of livestock rather than by agronomy practices, such as fertilization, mowing, irrigation, etc. Range also includes areas that have been seeded with introduced species, but which are extensively managed like native range. Pastures are represented by those lands that have been seeded, usually with introduced species or in some cases with native plants, and which are intensively managed using agronomy practices and control of livestock.

The intent of the management measure is to protect surface and ground water quality. Some waterbodies, such as farm ponds, have been created to water livestock. Protecting the water quality of these artificial water storage areas does not have the same priority as protecting natural streams and waterbodies.

Practices: Of particular interest to the implementation of this management measure is NRCS's standard and specifications for Prescribed Grazing (528). This specification



provides guidance for developing a grazing plan that conforms to all applicable federal, state, and local laws. It seeks measures to avoid adverse effects to endangered, threatened, and candidate species and their habitats; and identifies periods of grazing, resting, and other treatment activities for each management unit. It also recommends developing a (1) contingency plan that details potential problems (e.g., severe drought, flooding, wildfire) and serves as a guide for adjusting the grazing prescription to ensure resource management and economic feasibility without resource degradation and (2) monitoring plan with appropriate records to assess whether the grazing strategy is meeting objectives.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Irrigation Water Management Measure

To reduce nonpoint source pollution of surface waters caused by irrigation:

1. Operate the irrigation system so that the timing and amount of irrigation water applied match crop water needs. This will require, as a minimum: (a) the measurement of soil-water depletion volume and the volume of irrigation water applied; (b) uniform application of water; and (c) application rate which does not exceed infiltration rate in the field.
2. When chemigation is used, include backflow preventers for wells, minimize the harmful amounts of chemigated waters that discharge from the edge of the field, and control deep percolation. In cases where chemigation is performed with furrow irrigation systems, a tailwater management system may be needed.

The following limitations and special conditions apply:

1. In some locations, irrigation return flows are subject to other water rights or are required to maintain stream flow. In these special cases, on-site reuse could be precluded and would not be considered part of the management measure for such locations.
2. By increasing the water use efficiency, the discharge volume from the system will usually be reduced. While the total pollutant load may be reduced somewhat, there is the potential for an increase in the concentration of pollutants in the discharge. In these special cases, where living resources or human health may be adversely affected and where other management measures (nutrients and pesticides) do not reduce concentrations in the discharge, increasing water use efficiency would not be considered part of the management measure.
3. The time interval between the order for and the delivery of irrigation water to the farm may limit the irrigator's ability to achieve the maximum on-farm application efficiencies that are otherwise possible.
4. In some locations, leaching is necessary to control salt in the soil profile. Leaching for salt control should be limited to the leaching requirement for the root zone.
5. Where leakage from delivery systems or return flows supports wetlands or wildlife refuges, it may be preferable to modify the system to achieve a high level of efficiency and then divert the "saved water" to the wetland or wildlife refuge. This will improve the quality of water delivered to wetlands or wildlife refuges by preventing the introduction of pollutants from irrigated lands to such diverted water.
6. In some locations, sprinkler irrigation is used for crop cooling or other benefits (e.g., watercress). In these special cases, applications should be limited to the amount necessary for crop protection, and applied water should not contribute to erosion or pollution.

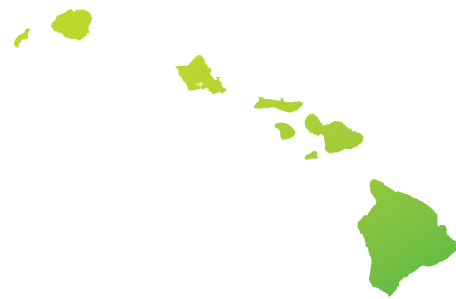
Applicability: This management measure applies to activities on irrigated lands, including agricultural crop and pasture land (except for isolated fields of less than 10 acres in size that are not contiguous to other irrigated lands); orchard land; specialty cropland; and nursery cropland. Those land users already practicing effective irrigation management in conformity with the irrigation water management measure may not need to purchase additional devices to measure soil-water depletion or the volume of irrigation water applied, and may not need to expend additional labor resources to manage the irrigation system.

Practices: NRCS's *Hawaii Field Office Technical Guide* (eFOTG) contains many standards related to irrigation water management, among them: irrigation water conveyance, high pressure (430DD); irrigation water conveyance, low pressure (430EE); irrigation water conveyance, steel pipeline (430FF); irrigation storage reservoir (436); irrigation system, micro-irrigation (441); irrigation system, sprinkler (442); irrigation system, surface and subsurface (443); irrigation water management (449); irrigation land leveling (464); irrigation regulating reservoirs (552); spring development (574); structure for water control (587); and water harvesting catchment (636).

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



5.2 Forestry

A. Introduction

There are ten management measures that apply to forestry. These management measures address the management of polluted runoff from all types of forestry operations in Hawaii.

1. Preharvest Planning	6. Site Preparation and Forest Regeneration
2. Streamside Management Zone	7. Fire management
3. Road Construction/Reconstruction	8. Re-vegetation of Disturbed Areas
4. Road Management	9. Forest Chemical Management
5. Timber Harvesting	10. Wetlands Forest Management

Hawaii's forestry program is a voluntary, incentive-driven program which uses a manual of forestry best management practices (BMPs). Forestry generally occurs on agricultural lands and conservation lands designed for commercial forest use.

All commercial forestry activities conducted on public (State) leased lands or undertaken on private lands as part of a cooperative Forest Stewardship project or Tree Farm plan must implement relevant BMPs contained in *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996). The manual was adopted by the Board of Land and Natural Resources (BLNR) at its October 10, 1997 meeting. The manual addresses the (g) guidance management measures and encourages implementation of appropriate best management practices.

While forestry operations are allowed within the "Resource" subzone of the State Conservation District, they are required to have a Conservation District Use Permit (CDUP) under Chapter 13-5, HAR, and implement an approved management plan. Forestry-related management activities (e.g., salvage logging) on State forest reserve lands also require a permit.

A significant portion of potential forestry operations in Hawaii will likely occur on private lands within the Agricultural District, which are outside the purview of DLNR. However, forestry activities involving earth movement would require a County grading and grubbing permit unless otherwise exempted from these requirements. In most cases, the landowner agrees to work with the local soil and water conservation district

(SWCD) to develop and implement an approved conservation plan in order to be exempted from the requirements of the respective county grading ordinances.

Hawaii Forest Stewardship Program

Hawaii's Forest Stewardship Program (FSP) was established under Chapter 195F, HRS, and is administered by DLNR's Department of Forestry and Wildlife (DOFAW) under Chapter 13-109, HAR. It provides technical and financial assistance to owners of non-industrial private forest land. To be eligible for the program, applicants must own or lease at least 5 contiguous acres of forested or formerly forest land and intend to actively manage the land to enhance forest resource values for both private and public benefit. The State will provide cost-share assistance to land manager to develop and/or implement a management plan under contract agreement. Environmental assessments are required if the management plan includes the establishment of timber with the intent of eventual harvesting or the construction of fences. Grant management objectives eligible for cost-share assistance are: forest stewardship management plan development; growth and management of forests for non-industrial timber and other forest products; native species restoration; agroforestry (the forestry component only); windbreaks (to protect forestry project areas); watershed, riparian, and/or wetland protection and improvement; forest recreation enhancement; native wildlife habitat enhancement; and native forest conservation. A *Forest Stewardship Handbook* (DLNR 2007) describes the program and project proposal and forest stewardship management plan formats. The program contains a penalty payback provision to be applied in the event that a landowner terminates any approved practice required under the forest stewardship management plan.

Tree Farm Plans

Chapter 186, HRS, "Tree Farms" provides a designation for lands engaged in sustained production of forest products in quantities sufficient to establish a business. Eligible lands are private or leased (20 years or more) lands within the agricultural district or on degraded forest and pasture lands within the permitted State conservation district subzone designated for forest use. DLNR administered the program under Chapter 13-106, HAR, "Rules for Establishing Tree Farms." Under these rules, land owners agree to manage land in accordance with a forest management plan approved by DLNR, which addresses the establishment, maintenance, and harvest of forest products in a sustained manner while exercising sound conservation prescriptions, in exchange for designation as a Tree Farm property. The statute also provides a "right to harvest" as an incentive. As an additional incentive, when a forestry operation has received approval of its management plan, it can petition the respective county to qualify for the lower property tax rate for tree farms. Failure to comply with the management plan and agreement with DLNR can result in the cancellation of the Tree Farm designation, which can have negative tax consequences.



Education and Outreach

Hawaii's Pollution Prevention Information Project (HAPPI) has been developed by the Water Quality program of the University of Hawaii Cooperative Extension Service (CES) to make the Farm*A*Syst and Home*A*Syst materials effective and useful in Hawaii. It is an assessment and educational tool that addresses specific pollution risks in Hawaii. The materials consist of fact sheets and worksheets. Their development was funded by CWA 319(h) funds through DOH's Polluted Runoff Control Program.

One of the publications developed under the HAPPI program is entitled *Minimizing Pollution Risk from Forest and Streamside Areas Management* (HAPPI-Farm 10; December 2000). The four-page publication is a combination of factual materials and suggestions, risk assessment table, and action plan table to be completed after the self-assessment is done. The text covers both forests and riparian areas and is intended for "owners and managers of properties with tree farms, forests, or large riparian areas of 1/2 acre or more." It points out that sediment is the most important NPS pollutant derived from these areas, advocates development of an operation-specific management plan, and refers to the BMP manual developed by DLNR.

CES also has a forestry extension specialist based out of the University of Hawaii at Hilo since 1998. The forestry extension program has been focusing on planting and growing activities, not on harvesting, since few local landowners are at the harvest stage yet.

The following table provides a brief overview of authorities that apply to the Forestry management measures. A more detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure can be found in *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures*.

Authority		Responsible Agency	Pre-harvest Planning	SMZs	Road Constr	Road Mgt	Timber Harvest	Site Prep & Forest Regen	Fire Mgt.	Reveg of Disturbed Areas.	Forest Chemical Mgt.	Wetland Forest Mgt.
Local	Chapter 22-7, KCC, Grading, Grubbing and Stockpiling	Kauai County DPW			X			X		X		
	Chapter 10 HCC, Soil Erosion and Sediment Control	Hawaii County DPW			X			X		X		
	Chapter 20.08, MCC, Soil Erosion and Sedimentation Control	Maui County DPW			X			X		X		
	Chapter 14-13 to 14-16, ROH, Grading, Soil Erosion and Sediment Control	City and County of Honolulu			X			X		X		
State	Chapter 149A, HRS Hawaii Pesticides Law	DOA									X	
	Chapter 171, HRS Mgt and Disposition of Public Lands	DLNR	X	X	X							
	Chapter 174C, HRS Hawaii Water Code	DLNR		X	X	X	X	X		X	X	X
	Chapter 180, HRS Soil and Water Conservation Districts	local SWCDs	X	X	X	X	X	X	X	X	X	X
	Chapter 183, HRS Forest Reserves, Water Development, Zoning	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 183C, HRS Conservation District	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 185, HRS Land Fire Protection Law	DLNR							X			
	Chapter 186, HRS Tree Farms	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 195F, HRS Forest Stewardship	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 342D, HRS Water Pollution	DOH	X	X	X	X	X	X	X	X	X	X
	Chapter 340E, HRS Safe Drinking Water	DOH									X	

Authority		Responsible Agency	Pre-harvest Planning	SMZs	Road Constr	Road Mgt	Timber Harvest	Site Prep & Forest Regen	Fire Mgt.	Reveg of Disturbed Areas.	Forest Chemical Mgt.	Wetland Forest Mgt.
State	Chapter 342H, HRS Solid Waste Pollution	DOH					X					
	Chapter 342J, HRS Hazardous Waste	DOH					X					
	Chapter 4-66, HAR Pesticides	DOA									X	
	Chapter 11-21, HAR Cross Connection and Back-Flow Control	DOH									X	
	Chapter 11-60.1, HAR Air Pollution Control	DOH							X			
	Chapter 13-5, HAR Conservation Districts	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 13-104, HAR Regulating Activities within Forest Reserves	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 13-106, HAR Rules for Establishing Tree Farms	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 13-109, HAR Rules for Establishing Forest Stewardship	DLNR	X	X	X	X	X	X	X	X	X	X
	Chapter 13-169, HAR Protection of Instream Uses of Water	DLNR		X	X	X	X	X		X	X	X
	Farm*A*Syst Program, University of Hawaii Cooperative Extension Svc.	Univ. of Hawaii CES		X								
	Best Management Practices for Maintaining Water Quality in Hawaii (February 1996)	DLNR	X	X	X	X	X	X	X	X	X	X
Federal	Section 404, CWA, permit	USACOE										X

B. Management Measures

Preharvest Planning Management Measure

Perform advance planning for forest harvesting that includes the following elements, where appropriate:

1. Identify the area to be harvested including location of waterbodies and sensitive areas such as wetlands, threatened or endangered aquatic species habitats, or high erosion hazard areas (landslide-prone areas) within the harvest unit.
2. Time the activity for the season or moisture conditions when the least impact occurs.
3. Consider potential water quality impacts and erosion and sedimentation control in the selection of silvicultural and regeneration systems, especially for harvesting and site preparation.
4. Reduce the risk of occurrence of landslides and severe erosion by identifying high erosion-hazard areas and avoiding harvesting in such areas, to the extent practicable.
5. Consider additional contributions from harvesting or roads to any known existing water quality impairments or problems in watersheds of concern.

Perform advance planning for forest road systems that includes the following elements, where appropriate:

1. Locate and design road systems to minimize, to the extent practicable, potential sediment generation and delivery to surface waters. Key components are:
 - locate roads, landings, and skid trails to avoid, to the extent practicable, steep grades and steep hillslope areas, and to decrease the number of stream crossings;
 - avoid, to the extent practicable, locating new roads and landings in Streamside Management Zones (SMZs); and
 - determine road usage and select the appropriate road standard.
2. Locate and design temporary and permanent stream crossings to prevent failure and control impacts from the road system. Key components are:
 - size and site crossing structures to prevent failure;
 - for fish-bearing streams, design crossings to facilitate fish passage.
3. Ensure that the design of road prism and the road surface drainage are appropriate to the terrain and that road surface design is consistent with the road drainage structures.
4. Use suitable materials to surface roads planned for all-weather use to support truck traffic.
5. Design road systems to avoid high erosion or landslide hazard areas. Identify these areas and consult a qualified specialist for design of any roads that must be constructed through these areas.

Each State should develop a process (or utilize an existing process) that ensures that the management measures in this chapter are implemented. Such a process should include appropriate notification, compliance audits, or other mechanisms for forestry activities with the potential for significant adverse nonpoint source effects based on the type and size of operation and the presence of stream crossings or SMZs.

Applicability: This management measures pertains to lands where silvicultural or forestry operations are planned or conducted. The planning process components of this management measure apply to commercial harvesting on areas greater than 5 acres and any associated road system construction or reconstruction conducted as part of normal silvicultural activities. The component for ensuring implementation of this management



measure applies to harvesting and road construction activities that are determined to be of a sufficient size to potentially impact the receiving water or that involve SMZs or stream crossings. This measure does not apply to harvesting conducted for pre-commercial thinning or noncommercial firewood cutting.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about pre-harvest planning:

“An effective pre-harvest plan will take into consideration all aspects of the timber harvest which may lead to water quality degradation and plan for the implementation of BMPs which will minimize or avoid the adverse effects of the operation. The objective of pre-harvest planning from the perspective of non-point source pollution is to determine which BMPs are necessary to protect water quality and how those BMPs will be implemented. The following is recommended:

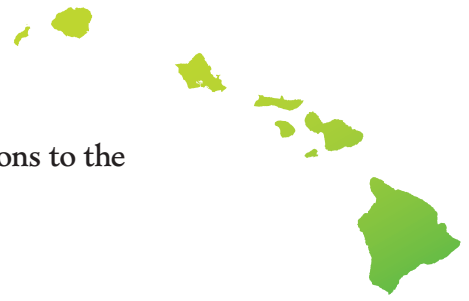
1. A pre-harvest plan should include the following information:
 - A. Physical and administrative description
 - Property boundaries & administrative boundaries (zoning, etc.)
 - Topography
 - Location of streams and drainages
 - Location of SMZs and buffer strips
 - Forest types
 - Soil types
 - Areas of ecological and/or archaeological concerns
 - B. Management Activities
 - Design and construction techniques for all new roads, skid trails, and landings or modification of existing roads, skid trails and landings.
 - Felling and bucking techniques
 - Yarding systems and layout
 - Planned stream crossings
 - Disposal of waste materials (machine lubricants)
 - Post-harvest site preparation
 - Reforestation activities
2. The use of topographic maps, road maps, aerial photos, forest type maps, and soil surveys in combination with field reconnaissance is essential to determine site conditions and plan operations.
3. Field reconnaissance with a trained forester or one who is knowledgeable about the specific area is highly recommended.

4. Preliminary planning should consider the maintenance of existing drainage patterns and the location of environmentally sensitive areas such as streams, wet areas, and high erosion hazard areas.
5. The design of roads, skid trails, and landings shall be integrated to minimize their impact.
6. The grade of logging roads and skid trails should be less than 10% when possible, with 3-5% being the norm. Long, straight, unbroken grades are to be avoided. Adequate surface drainage shall be provided.
7. Time the harvesting activity for the season or moisture conditions when the least impact occurs.
8. A final pre-harvest site review shall be conducted by management so that road alignments and other considerations can be visually checked prior to road construction. The reconnaissance plan shall be modified as necessary to make desirable adjustments based on the final site review."

The BMP manual also includes the following language specifically about the planning, design and location of access roads within forestry operations:

"A well planned access system is a sound method of reducing erosion and sedimentation in areas requiring frequent or temporary access. Proper location and construction of roads will provide for safety, longer operating periods, lower maintenance and operating costs, and minimal impacts to water quality. The value of the resource served and site characteristics will influence the choice of road construction standards and maintenance activities. The following practices are recommended:

1. Use a design to minimize damage to soil and water quality.
2. Roads should be designed no wider than necessary to accommodate the immediate anticipated use.
3. Design cut and fill slopes to minimize mass soil movement.
4. Provide culverts, dips, water bars, and cross drainages to minimize road bed erosion.
5. Design bridge and culvert installations using stream flow data, with a margin of safety proportional to the importance of the road and the protected resources.
6. Provide drainage where surface and groundwater cause slope instability.
7. Avoid diverting water from natural drainage ways. Dips, water bars, and cross drainage culverts should be placed above stream crossings so that water can be filtered through vegetative buffers before entering streams.



8. Locate roads to fit the topography and minimize alterations to the natural features.
9. Avoid marshes and wetlands.
10. Minimize the number of stream crossings.
11. Cross streams at right angles to the stream channel.
12. A road may not be located in a Streamside Management Zone (SMZ) except where access is needed to a water crossing, or where there is no feasible alternative. A road in any SMZ must be designed and located to minimize adverse effects on fish habitat and water quality."

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Streamside Management Zones (SMZs)

Establish and maintain a streamside management zone along surface waters, which is sufficiently wide and which includes a sufficient number of canopy species to buffer against detrimental changes in the temperature regime of the waterbody, to provide bank stability, and to withstand wind damage. Manage the SMZ in such a way as to protect against soil disturbance in the SMZ and delivery to the stream of sediments and nutrients generated by forestry activities, including harvesting. Manage the SMZ canopy species to provide a sustainable source of large woody debris needed for instream channel structure and aquatic species habitat.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to surface waters bordering or within the area of operation. SMZs should be established for perennial waterbodies as well as for intermittent streams that are flowing during the time of operation. Manmade structures that may function as streams and other natural waterbodies, such as livestock ponds, swales, and water distribution systems (*i.e.*, irrigation), are not considered perennial waterbodies or streams.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about streamside management zones (SMZs):

"SMZs should be maintained along all perennial streams or where forest disturbances occur and surface runoff will carry sediment loads. SMZs should be maintained around streams, ponds, perennial flowing natural springs, and all springs and reservoirs

serving as domestic water supplies. The following best management practices are recommended:

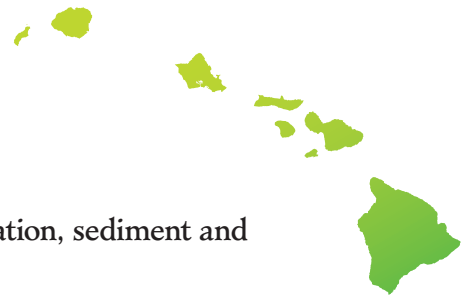
1. The width of SMZs should be determined depending on the following conditions: slope of land adjacent to stream, soil erodibility, precipitation, knowledge of particular area, sensitivity of stream, etc. These factors can be obtained from soil maps, on-the-ground evaluation and measurements, weather data, etc.
2. SMZs should be designed on a case-by-case basis. Most important is that SMZs be consistent with stream characteristics and wide enough to protect water quality.

Soil Type	Percent Slope	SMZ Width (each side)
Slightly erodible	0-5 %	35 ft.
Slightly erodible	5-20 %	35-50 ft.
Slightly erodible	20%+	50-160 ft.
Erodible	0-5 %	35-50 ft.
Erodible	5-20 %	80 ft. minimum
Erodible	20%+	160' minimum

Table 1. Recommended Widths for Streamside Management Zone

[NOTE: Please contact your local Natural Resources Conservation Service office to determine the erodibility factor of the soil before determining the proper width of the SMZ.]

3. On relatively flat terrain (0-5%) on slightly erodible soils, the width of an SMZ should be at least 35 feet wide on each side of a stream.
4. On relative flat terrain (0-5%) on erodible soils, the SMZ width should range between 35 to 50 feet on each side of a stream.
5. On slightly erodible soils with slopes ranging between 5 and 20 percent, the SMZ width should range between 35 to 50 feet wide on each side of a stream.
6. On erodible soils with slopes ranging between 5 and 20 percent, the SMZ width should range between 50 to 160 feet on each side of a stream.
7. On slightly erodible soils with slopes exceeding 20 percent, the SMZ width should be at least 80 feet on each side of a stream.
8. On erodible soils with slopes exceeding 20 percent, the SMZ width should be a minimum of 160 feet on each side of a stream.
9. Partial harvesting is acceptable. A minimum of 50% of the original crown cover or 50 square feet of basal area per acre, evenly distributed, should be retained in the SMZ. This may be adjusted to meet on-site conditions.



10. Clearcutting is always prohibited within the SMZ.
11. Designate SMZs to provide stream shading, soil stabilization, sediment and water filtering effects, and wildlife habitat.
12. Strive to protect the forest floor and understory vegetation from unnecessary damage. Do not remove (harvest) trees from banks, beds or slopes if it will destabilize the soil. Trees on the south and west banks provide the most critical shading of water.
13. Access roads should cross perennial or intermittent streams at or near a right angle.
14. Drainage structures such as ditches, cross drain culverts, water bars, rolling dips, and broad-based dips should be used on all roads prior to their entrance into an SMZ to intercept and properly discharge runoff waters.
15. SMZs may be desirable on intermittent streams for large drainage areas where wildlife is a major landowner concern or for other reasons.”

For further information see:

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Road Construction/Reconstruction Management Measure

1. Follow preharvest planning (as described under Management Measure A) when constructing or reconstructing the roadway.
2. Follow designs planned under Management Measure A for road surfacing and shaping.
3. Install road drainage structures according to designs planned under Management Measure A and regional storm return period and installation specifications. Match these drainage structures with terrain features and with road surface and prism designs.
4. Guard against the production of sediment when installing stream crossings.
5. Protect surface waters from slash and debris material from roadway clearing.
6. Use straw bales, silt fences, mulching, or other favorable practices on disturbed soils on unstable cuts, fills, etc.
7. Avoid constructing new roads in SMZs, to the extent practicable.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to road construction/ reconstruction operations for silvicultural purposes, including:

- *Clearing phase* - clearing to remove trees and woody vegetation from road right-of-way;
- *Pioneering phase* - excavating and filling the slope to establish road centerline and approximate grade;

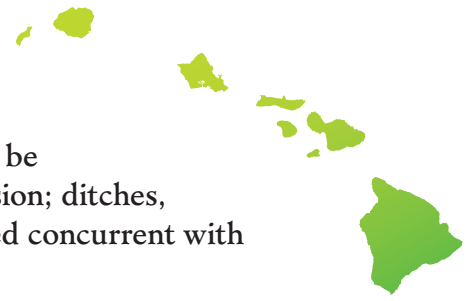
- *Construction phase* - final grade and road prism construction and bridge, culvert, and road drainage installation; and
- *Surfacing phase* - placement and compaction of roadbed, road fill compaction, and surface placement and compaction (if applicable).

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about road construction/reconstruction:

“Once the road’s location and design is staked out, road construction begins. Timber is out, logs and vegetation are removed and piled along the lower side of the right-of-way.

Most forest roads are built by excavating a road surface. Road design and layout on-the-ground show machine operators the proper cut slopes and indicate cut slope steepness. The bulldozer starts at the top of the cut slope, excavating and sidecasting material until the desired road grade and width is obtained. Material from cuts is often pushed in front of the blade to areas where fill is needed. Road fill is used to cover culverts and build up flat areas. Since fill must support traffic, it needs to be spread and compacted in layers to develop strength. The following practices are recommended:

1. Construct roads when moisture and soil conditions are not likely to result in excessive erosion or soil movement.
2. The boundaries of all SMZs shall be defined on the ground prior to the beginning of any earth-moving activity.
3. Construct a road sufficient to carry the anticipated traffic load with reasonable safety and with minimum environmental impact.
4. When using existing roads, reconstruct only to the extent necessary to provide adequate drainage and safety.
5. Avoid construction during wet periods, when possible, to minimize unnecessary soil disturbance and compaction.
6. Road grades should be kept at less than 10%, except where terrain requires short, steep grades.
7. Minimize the number of stream crossings. Stream crossing construction should minimize disturbance of the area in which the crossing is being constructed.



8. As slope increases, additional diversion ditches should be constructed to reduce the damages caused by soil erosion; ditches, adequate culverts, cross drains, etc., should be installed concurrent with construction.
9. To control erosion, cut and fill slopes should conform to a design appropriate for the particular soil type and topography.
10. Stumps, logs, and slash should be disposed of outside of the road prism; in no cases should they be covered with fill material and incorporated into road beds.
11. Stabilize the side banks of a road during construction to aid in the control of erosion and road deterioration; this may require mesh or other stabilizing material in addition to planting and/or seeding and other structural measures.
12. Water bars should be located to take advantage of existing wing ditches and cross drainage. Water bars should be constructed at an angle of 30 to 45 degrees to the road. Water bars should be periodically inspected and damage or breeches should be promptly corrected. Install water bars at recommended intervals to provide the drainage. Water bar spacing recommendations are as follows:

Grade of Road	Distance Between Water Bars
2%	250 ft.
5%	135 ft.
10%	80 ft.
15%	60 ft.
20%	45 ft.
25%	40 ft.
30%	35 ft.
40%	30 ft.

13. Water bars may need to be spaced closer together depending on soil type and rainfall.
14. Bridges and overflow culverts should be constructed to minimize changes in natural stream beds during high water.
15. Culverts on perennial streams should be installed low enough to allow passage of aquatic life during low water.”

For further information see:

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Road Management

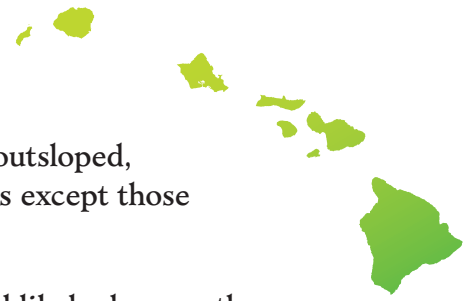
1. Avoid using roads, where possible, for timber hauling or heavy traffic during wet periods on roads not designed and constructed for these conditions.
2. Evaluate the future need for a road and close roads that will not be needed. Leave closed roads and drainage channels in a stable condition to withstand storms.
3. Remove drainage crossings and culverts if there is a reasonable risk of plugging or failure from lack of maintenance.
4. Following completion of harvesting, close and stabilize temporary spur roads and seasonal roads to control and direct water away from the roadway. Remove all temporary stream crossings.
5. Inspect roads to determine the need for structural maintenance. Conduct maintenance practices, when conditions warrant, including cleaning and replacement of deteriorated structures and erosion controls, grading or seeding of road surfaces, and, in extreme cases, slope stabilization or removal of road fills, where necessary to maintain structural integrity.
6. Conduct maintenance activities, such as dust abatement, so that chemical contaminants or pollutants are not introduced into surface waters, to the extent practicable.
7. Properly maintain permanent stream crossings and associated fills and approaches to reduce the likelihood that (a) stream overflow will divert onto roads, and (b) fill erosion will occur if the drainage structures become obstructed.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to active and inactive roads constructed or used for silvicultural activities.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about road management:

“Maintenance of active and inactive roads shall be sufficient to maintain a stable surface, keep the drainage system operating, and protect the quality of streams. The following are recommended:

1. Maintenance should include cleaning dips and crossdrains, repairing ditches, marking culverts inlets to aid in location, and clearing debris from culverts.
2. Keep culverts, flumes, and ditches functional before and during the rainy season to diminish danger of clogging and the possibility of washouts. This can be done by clearing away any sediment or vegetation that could cause a problem. Provide for practical and scheduled preventative maintenance programs for high risk sites that will address the problems associated with high intensity rainfall events.
3. Conduct road surface maintenance as necessary to minimize erosion of the surface and subgrade.



4. During operations, keep the road surface crowned or outsloped, and keep the downhill side of the road free from berms except those intentionally constructed for protection of fill.
5. Avoid using roads during wet periods if such use would likely damage the road drainage features.
6. Water bars should be inspected after major rain storms and damage or breeches should be promptly corrected.”

For further information see:

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Timber Harvesting

The timber harvesting management measure consists of implementing the following:

1. Timber harvesting operations with skid trails or cable yarding follow layouts determined under Management Measure A.
2. Install landing drainage structures to avoid sedimentation, to the extent practicable. Disperse landing drainage over sideslopes.
3. Construct landings away from steep slopes and reduce the likelihood of fill slope failures. Protect landing surfaces used during wet periods. Locate landings outside of SMZs. Minimize size of landing areas.
4. Protect stream channels and significant ephemeral drainages from logging debris and slash material.
5. Use appropriate areas for petroleum storage, draining, dispensing. Establish procedures to contain and treat spills. Recycle or properly dispose of all waste materials in accordance with State law.

For cable yarding:

1. Limit yarding corridor gouge or soil plowing by properly locating cable yarding landings.
2. Locate corridors for SMZs following Management Measure B.
3. Cable yarding should not be done across perennial or intermittent streams, except at improved stream crossings.

For groundskidding:

1. Within SMZs, operate groundskidding equipment only at stream crossings, to the extent practicable. In SMZs, fell and endline trees to avoid sedimentation.
2. Use improved stream crossings for skid trails which cross flowing drainages. Construct skid trails to disperse runoff and with adequate drainage structures.
3. On steep slopes, use cable systems rather than groundskidding where groundskidding may cause excessive sedimentation.
4. Groundskidding should not be done across perennial or intermittent streams, except at improved stream crossings.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to all harvesting, yarding, and hauling conducted as part of normal silvicultural activities on harvest units larger than 5 acres.

This measure does not apply to harvesting conducted for precommercial thinnings or noncommercial firewood cutting.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about timber harvesting:

“Timber harvesting is an integral part of most forest management programs. Harvesting operations cause a temporary disturbance in the forest as well as diminish water quality. However, it can be conducted in a manner where the impact to water quality is minimized and the re-establishment of vegetative cover is realized. Guidelines to help reduce the potential for nonpoint source pollution from harvesting trees are as follows:

Felling and Bucking

1. Careful felling can minimize the impact of subsequent phases of the logging operation.
2. Trees should not be felled into streams, except where no safe alternative exists. In the latter case, such trees should be removed promptly.

Skidding

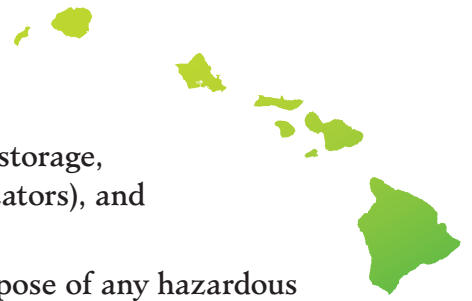
1. Skidding should be done so as to avoid disrupting natural drainage and to prevent excessive soil displacement
2. Stream channels or road ditches should not be used as skid trails.
3. Skid trails on steep slopes should have occasional water bars.
4. Servicing of equipment involving fuel, lubricants, or coolants should be performed in places where these materials cannot enter streams. Spent oil should be collected for proper disposal, never poured on the ground.
5. Upon completion of logging, erosion-prone areas should be mulched or seeded.

Disposal of Debris and Litter

1. Logging debris in streams should be removed immediately.
2. Debris from landings should not be pushed into drains, streams or Streamside Management Zones (SMZs)
3. All trash associated with the logging operation should be promptly removed (not buried) and hauled to a legal disposal site.”

The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996) also contains the following language about the proper storage and handling of oil products and fuel:

1. Locate facilities away from streams and be prepared to clean up spills.



2. Know and comply with regulations governing the storage, handling, application (including licensing of applicators), and disposal of hazardous substances.
3. Do not transport, handle, store, load, apply or dispose of any hazardous substance or fertilizer in such a manner as to pollute water supplies or cause damage or injury to land, including humans, desirable plants and animals.
4. Do not store, mix, or rinse hazardous substances or fertilizers within the streamside management zone or where they might enter streams or waterways.
5. Develop a contingency plan for hazardous substance spills, including cleanup procedures.
6. Report all spills to the Department of Health, Environmental Health Administration”.

Finally, the *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996) contains the following language about temporary access roads and landings during harvesting:

1. The location of temporary access roads (logging roads) should be planned before operations begin.
2. Road construction should be kept to a minimum.
3. Landings should be located to minimize the adverse impact of skidding on the natural drainage pattern.
4. Logging roads and landings should be located on firm ground.
5. Landings should be kept as small an area as possible.
6. When operations are completed, provisions should be made to divert water run-off from the landings and roads.”

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Site Preparation and Forest Regeneration Management Measure

Confine on-site potential nonpoint source pollution and erosion resulting from site preparation and the regeneration of forest stands. The components of the management measure for site preparation and regeneration are:

1. Select a method of site preparation and regeneration suitable for the site conditions.
2. Conduct mechanical tree planting and ground-disturbing site preparation activities on the contour of erodible terrain.
3. Do not conduct mechanical site preparation and mechanical tree planting in SMZs.
4. Protect surface waters from logging debris and slash material.
5. Suspend operations during wet periods if equipment used begins to cause excessive soil disturbance that will increase erosion.
6. Locate windrows at a safe distance from drainages and SMZs to control movement of the material during high runoff conditions.
7. Conduct bedding operations in high water-table areas during dry periods of the year. Conduct bedding in erodible areas on the contour.
8. Protect small ephemeral drainages when conducting mechanical tree planting.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to all site preparation and regeneration activities conducted as part of normal silvicultural activities on harvested units larger than 5 acres.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about site preparation and forest regeneration:

Mechanical Site Preparation

1. Avoid excessive soil compaction.
2. Minimize erosion and the movement of sediment into waters.
3. Prevent accumulation of debris in ponds, streams, or rivers.
4. Windrows, disking, bedding, and planting with “furrow” type mechanical planters should follow contours.
5. Avoid complete disking of steep slopes with extremely erodible soil.
6. Plant trees on contour.

Reforestation

Regeneration includes hand and machine planting and direct seeding. Since hand planting and direct seeding pose no water quality problems, BMPs are not necessary. Some mineral soil exposure does occur with machine planting and BMPs are offered:

1. Sites should receive the minimum preparation necessary to successfully control competing vegetation and establish a desirable timber stand. In general, the more intensive the treatment, the more concern for water quality.



2. When working on slopes, mechanical operations such as ripping, shearing, etc., should follow contours.
3. Hand planting, direct seeding or natural regeneration should be used on protected areas adjacent to streams or on slopes too steep to machine plant.”

For further information see:

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(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Fire Management

Prescribe fire or suppress wildfire in a manner which reduces potential nonpoint source pollution of surface waters:

1. Prescribed fire should not cause excessive sedimentation due to the combined effect of removal of canopy species and the loss of soil-binding ability of subcanopy and herbaceous vegetation roots, especially in SMZs, in streamside vegetation for small ephemeral drainages, or on very steep slopes.
2. Prescriptions for fire should protect against excessive erosion or sedimentation, to the extent practicable.
3. All bladed firelines, for prescribed fire and wildfire, should be plowed on contour or stabilized with water bars and/or other appropriate techniques if needed to control excessive sedimentation or erosion of the fireline.
4. Wildfire suppression and rehabilitation should consider possible nonpoint source pollution of watercourses, while recognizing the safety and operational priorities of fighting wildfires.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to all prescribed burning conducted as part of normal activities on all management units for wildfire suppression and rehabilitation on forest, brush, and watershed lands.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about fire management:

6.0 Wildfire Damage Control and Reclamation/Prescribed Burn

The prevention, control, and extinguishment of all wildfires on grass, brush, and watershed lands and the implementation of a prescribed fire program is a desirable goal. Where wildfires do occur, the first and foremost concern is to control the fire and limit the damage. Fire suppression activities can add to the problem of water quality protection.

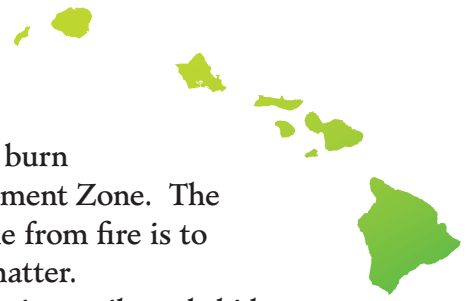
The loss of vegetative cover, destruction of soil-holding feature of root masses, the exposure of bare mineral soil, is a combination that makes the area burned a highly erodible one. The effects of suppression efforts and equipment operations necessary to control and stop the fire can magnify the erosion problem.

The following are best management practices for wildfire control and reclamation:

1. The first and foremost concern in wildfire control is to prevent harm or damage to people and property. Fireline best management practices should incorporate minimum impact strategies, which meet land and resource management objectives.
2. Areas with bare mineral soils should be revegetated and areas where vegetative cover has been killed or severely degraded should be regenerated with plant species appropriate for the soil conditions.
3. First priority for revegetation/reforestation should be given to banks of surface water bodies so that the SMZ is reestablished.
4. Firelines should be stabilized and, if necessary, revegetated. Erodible areas altered by suppression equipment activities should be repaired and revegetated as necessary.
5. Access road surfaces should be repaired and stabilized as necessary.
6. Whenever possible, avoid using fire suppression chemicals over watercourses and prevent their runoff into watercourses. Do not clean application equipment in watercourses or locations that drain into watercourses.
7. Provide advance planning and training for firefighters that consider water quality impacts when fighting wildfires. This can include increasing awareness so direct application of fire suppression chemicals to waterbodies is avoided and firelines are appropriately placed.
8. Include rehabilitative practices as part of suppression and post-suppression tactics and strategies to mitigate non-point source pollution.

6.1 Fireline Construction and Maintenance

Fireline construction and maintenance is an essential part of forest and other land management activities. It deals with site preparation burning, prescribed burning, and wildfire defense and control. A number of control practices can be implemented during fireline construction to prevent unnecessary erosion. Periodic inspection and proper maintenance can prevent potential erosion on established firelanes. The following are best management practices for fireline construction and maintenance:



1. Firelines should be constructed on the perimeter of the burn area and along the boundary of the Streamside Management Zone. The purpose of protecting the Streamside Management Zone from fire is to safeguard the filtering effects of the litter and organic matter.
2. Firelines should follow the guidelines established for logging trails and skid trails with respect to waterbars and wing ditches, and should be only as wide and as deep needed to permit safe prescribed burns or fire suppression needs.
3. Firelines which would cross a drainage should be turned parallel to the stream or have a wing ditch or other structure allowing runoff in the line to be dispersed rather than channeled directly into the stream.
4. All firelines should be assessed after the fire is controlled for appropriate stabilization, and if necessary, proper rehabilitation should be done while equipment and people are in place.

6.2 Prescribed Burn

1. Intense prescribed fire for site preparation shall be conducted only if it achieves desired results with minimum impacts to water quality.
2. Burning on steep slopes or highly erodible soils should be conducted when they are absolutely necessary and should follow carefully planned prescriptions.
3. Carefully plan burning to adhere to time of year, weather, topography, and fuel conditions that will help achieve the desired results and minimize impacts on water quality. With proper planning, prescribed fires should not cause excessive sedimentation due to the combined effect of removal of canopy species and the loss of soil-binding ability of the subcanopy and herbaceous vegetation roots, in streamside vegetation, small ephemeral drainages, or on very steep slopes.
4. Site preparation burning creates the potential for soil movement. Burning in the SMZ reduces the filtering capacity of the litter. All efforts should be made to plan burns to minimize impacts on the SMZ.
5. All bladed firelines, for prescribed fire and wildfire activities, should be built so as to minimize erosion. If necessary, the firelines should be stabilized with water bars and/or other appropriate techniques to control excessive sedimentation or erosion of the fireline. Include any erosion control practices in the construction of firelines.”

For further information see:

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Revegetation of Disturbed Areas

Reduce erosion and sedimentation by rapid revegetation of areas disturbed by harvesting operations or road construction:

1. Revegetate disturbed areas (using seeding or planting) promptly after completion of the earth-disturbing activity. Local growing conditions will dictate the timing for establishment of vegetative cover.
2. Use mixes of species and treatments developed and tailored for successful vegetation establishment for the region or area.
3. Concentrate revegetation efforts initially on priority areas such as disturbed areas in SMZs or the steepest areas of disturbance near drainages.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to all disturbed areas resulting from harvesting, road building, and site preparation conducted as part of normal silvicultural activities. Disturbed areas are those localized areas within harvest units or road systems where mineral soil is exposed or agitated (e.g., road cuts, fill slopes, landing surfaces, cable corridors, or skid trail ruts).

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains BMPs related to the revegetation of disturbed areas under the following headings:

"Road Construction

11. Stabilize the side banks of a road during construction to aid in the control of erosion and road deterioration; this may require mesh or other stabilizing material in addition to planting and/or seeding and other structural measures.

Harvesting - Temporary Access Roads and Landings

6. When operations are completed, provisions should be made to divert water run-off from the landings and roads.

Timber Harvesting - Skidding

5. Upon completion of logging, erosion-prone areas should be mulched or seeded.

Wildfire Control and Reclamation

2. Areas with bare mineral soils should be revegetated and areas where vegetative cover has been killed or severely degraded should be regenerated with plant species appropriate for the soil conditions.
3. First priority for revegetation/reforestation should be given to banks of surface water bodies so that the SMZ is reestablished.



4. Firelines should be stabilized and, if necessary, revegetated. Erodible areas altered by suppression equipment activities should be repaired and revegetated as necessary.”

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Forest Chemical Management

Use chemicals when necessary for forest management in accordance with the following to reduce nonpoint source pollution impacts due to the movement of forest chemicals off-site during and after application:

1. Conduct applications by skilled and, where required, licensed applicators according to the registered use, with special consideration given to impacts to nearby surface and ground waters.
2. Carefully prescribe the type and amount of pesticides appropriate for the insect, fungus, or herbaceous species.
3. Establish and identify buffer areas for surface waters. (This is especially important for aerial applications.)
4. Prior to applications of pesticides and fertilizers, inspect the mixing and loading process and the calibration of equipment, and identify the appropriate weather conditions, the spray area, and buffer areas for surface waters.
5. Immediately report accidental spills of pesticides or fertilizers into surface waters to the appropriate State agency. Develop an effective spill contingency plan to contain spills.

Applicability: This management measure pertains to lands where silvicultural or forestry operations are planned or conducted. It applies to all fertilizer and pesticide applications (including biological agents) conducted as part of normal silvicultural activities.

Practices: The *Best Management Practices for Maintaining Water Quality in Hawaii* (February 1996), which was adopted by the BLNR for implementation through its relevant programs and permit processes, contains the following specific language about forest chemical management:

A. Transportation

1. Inspect all containers prior to loading and ensure all caps, plugs and bungs are tightened
2. Handle containers carefully when loading them onto vehicles
3. Secure containers properly to prevent shifting during transport
4. Check containers periodically enroute
5. Limit access to containers during transport to prevent tampering
6. Educate and inform the driver of the proper transportation precautions
7. Never transport pesticides unless arrangements have been made to receive and store them properly

B. Storage

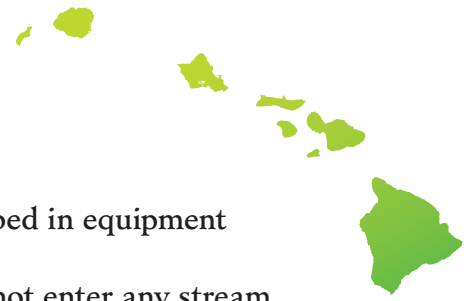
1. Chemicals should be managed and stored in accordance with all applicable federal, state, or local regulations. These would include:
 - The EPA container registration label, as printed on the label
 - Label instruction for use as provided by the manufacturer
 - Requirements or the use, application, and registration of pesticides
 - Requirements relating to the licensing of applicators
2. All containers should be labeled in accordance with applicable federal, state and local regulations.
3. Store pesticides in their original containers with labels intact.
4. Do not store pesticides for extended periods in buildings that cannot contain a complete spill from the largest container being stored.
5. Check containers prior to storage and periodically during storage to ensure that they are properly sealed.
6. Locate pesticide storage facilities at sites that minimize the possibility of impacts of water quality in case accidents or fires occur.
7. Use storage buildings that have floors constructed of concrete or other impermeable materials so that spills are easy to clean up.
8. Ensure that storage facilities can be secured under lock and key.
9. Post storage areas with a list of chemicals and quantities stored and notify the fire department about storage.

C. Mixing/Loading

1. Review the label before opening the container to ensure familiarity with current use directions.
2. Exercise care and caution during mixing and loading.
3. Replace pour caps and close bags or other containers immediately after use.
4. Mix chemicals and clean equipment only where possible spills would not enter streams, lakes or ponds.
5. Chemicals should not be applied where stream pollution is likely to occur through aerial drift.
6. Use a spray device capable of immediate shutoff.

D. Application

1. Refer to label directions before making a pesticide application.
2. Check all application equipment carefully, particularly for leaking hoses and connections and plugged or worn nozzles. Calibrate spray equipment periodically to achieve uniform distribution and rate.
3. Apply pesticides under favorable weather conditions. Never apply a pesticide when there is a likelihood of significant drift.
4. Always use pesticides in accordance with label instruction, and adhere to all Federal and State policies and regulations governing pesticide use.



E. Cleanup and Disposal

1. Before disposal, containers should be rinsed as described in equipment cleanup.
2. Cleanup should be in a location where chemicals will not enter any stream, pond, or where stream pollution might occur.
3. Rinse empty pesticide containers and mixing apparatus as many times as needed. This flushing should be applied in spray form to the treated area, NOT into the ground near streams.
4. Dispose of pesticide wastes and containers according to federal and state laws. Some pesticide wastes are specifically identified as hazardous wastes by law and must be handled and disposed of in accordance with hazardous waste regulations. For more information about proper management of waste pesticides, contact the Department of Health, Environmental Health Administration.”

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Wetland Forest Management

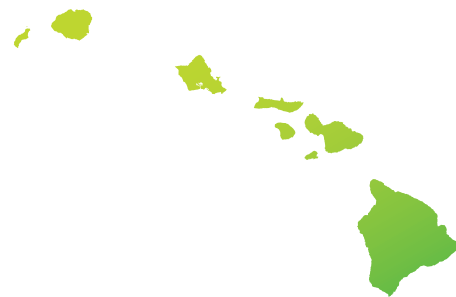
Plan, operate, and manage normal, ongoing forestry activities (including harvesting, road design and construction, site preparation and regeneration, and chemical management) to adequately protect the aquatic functions of forested wetlands.

Applicability: This management measure is intended for forested wetlands where silvicultural or forestry operations are planned or conducted. It applies specifically to forest management activities in forested wetlands and to supplement the previous management measures by addressing the operational circumstances and management practices appropriate for forested wetlands. This management measure applies specifically to forest management activities in forested wetlands, including those currently undertaken under the exemptions of Section 404(f) of the Federal Water Pollution Control Act (40 CFR, Part 232). Many normal, ongoing forestry activities are exempt under Section 404(f)(1) unless recaptured under the provisions of Section 404(f)(2). This management measure is not intended to prohibit these silvicultural activities but to reduce incidental or indirect effects on aquatic functions as a result of these activities.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



5.3 Urban Areas

A. Introduction

There are twelve management measures which apply to urban areas. Some management measures are similar with the National Pollutant Discharge Elimination System (NPDES) regulations. These management measures address the management of polluted runoff from all types of urban activities in Hawaii.

1. New Development	7. Pollution Prevention
2. Watershed Protection	8. Golf Course Management
3. Site Development	9. Planning, Siting and Developing Roads and Highways
4. Existing Development	10. Bridges
5. New Onsite Disposal Systems	11. Operation and Maintenance, Roads & Highways
6. Operating Onsite Disposal Systems	12. Runoff Systems for Roads, Highways and Bridges

The table beginning on page 123 provides a brief overview of authorities that apply to the Urban management measures. A more detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure can be found in *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures*.

The documentation of the implementation of the management measures is critical if associations are to be drawn between the coastal nonpoint pollution control program implementation and water quality improvements. Indicators for tracking management measure implementation are identified below. Specific precautions will be taken to ensure that sensitive data, such as specific names and locations of practices, is maintained in full confidence. If detailed information is required due to violation of water quality standards, this information may be acquired by formal request in accordance with the Freedom of Information Act.

Land Use Management Authorities

The Hawaii Land Use Law, Chapter 205, HRS, places all lands in the State into four districts: Urban, Agricultural, Rural and Conservation. Lands in the Conservation District are managed by the State, and the jurisdiction over Rural and Agricultural Districts is shared by the State Land Use Commission (LUC) and counties. The

responsibility for zoning within the Urban District is delegated to the counties. Currently, there are approximately 191,941 acres of land (4.7% of total land area) designated Urban, while 9,927 acres (0.2% of total land area) are classified Rural (small farms and low-density residential lots).¹ In the past, large-scale, urban-style developments have occurred in the Agricultural District, usually designed as a residential development and often surrounding a golf course. However, this use of agricultural lands has virtually halted as a result of the legal decision regarding the Hokulia development in South Kona on the Big Island of Hawaii.² As a result, landowners contemplating this type of development in the future will likely request LUC approval for a district boundary amendment to reclassify lands from Agricultural to Rural.

In urban areas, the counties have the lead in the control of erosion during site development, and ensuring proper site planning and stormwater management to protect sensitive natural features. The State Department of Health also regulates stormwater runoff through its NPDES permit process. The Hawaii Department of Transportation requires best management practices during construction of State roads, highways, and bridges. Finally, the State has overall authority to ensure implementation of the management measures throughout the 6217 management area.

Generally, all development within the counties must conform to the policies outlined in the county general plans and specific community development plans. The county general plans provide a coordinated set of guidelines within each county for decision-making regarding future growth and development and protection of natural and cultural resources. The general plans also guide revisions and updates to the county codes. They are given the effect of law through adoption by the respective county councils. Generally, all the county general plans have policies related to protecting the county's natural resources and minimizing adverse effects resulting from the inappropriate location, use, or design of sites and structures; protecting wetlands and riparian areas; and designing drainage systems to minimize polluted runoff, retain streambank vegetation, and maintain habitat and aesthetic values.

County general plans are implemented through the specific community development plans, budgeting and capital improvement programs (CIP) guided by the goals, objectives and policies of the general plans and community development plans, county laws amended to be consistent with the intent of the general plan components, and approval or disapproval of developments seeking zoning and other development approvals based on how they support the visions expressed in the general plans. The county planning departments prepare annual reports to monitor progress towards achieving general plan goals, objectives and policies. The annual reports are submitted to the mayors and county councils for review. General plans are subject to periodic

¹ Hawaii DBEDT. 1996 Databook.

² Circuit Court Judge Ibarra ruled in 2003 that Hokulia was an urban project being built illegally on agriculturally-designated lands. He based this conclusion on his findings that the State Land Use Law (Chapter 205, HRS) requires that housing on agricultural lands be related to agricultural use and such agriculture must be economically viable.



review and amendment, as specified by county procedures, with significant opportunities for input by the public.

When the coastal nonpoint pollution control program was first under development in Hawaii, there were very few watershed efforts taking place. Watershed planning and management was still in its infancy. Since the development of Hawaii's CNPCP management plan, many watershed and *abupua'a* management efforts have been initiated by a wide range of governmental and non-governmental entities. Some of the more recent efforts, not including the watershed management projects funded under Section 319(h) of the Clean Water Act or the Local Action Strategy, are described below. Each of these efforts has its own goals and priorities with respect to water quality and quantity.

Watershed Partnerships

Watershed partnerships are voluntary alliances of public and private landowners committed to protecting large areas of forested watersheds to support multiple ecosystem services such as water production and filtration, native habitat/species protection, erosion/sedimentation control, mitigation of climate change, and education, recreation and economic opportunities. Currently, over 900,000 acres (approximately one-fourth of the land area of the State) have been placed within these partnerships, mostly within the Conservation District, protecting the headwaters of countless streams. There are watershed partnerships for West Maui Mountains (50,000 acres), East Maui (100,000+ acres), Koolau (Oahu) (97,100 acres), Kauai (142,000 acres), Lanai (~20,000 acres), East Molokai (25,000+ acres), Three Mountain Alliance (Hawaii) (1,116,300 acres), Leeward Haleakala (Maui) (43,175), and Kohala (Hawaii) (32,573 acres). While DLNR is a partner on each of the watershed partnerships, it is the partnership as a whole that develops the management plan and decides on management priorities and strategies.

Board of Water Supply Watershed Management Plans

The City and County of Honolulu Board of Water Supply (BWS) is developing watershed management plans for the eight General Plan land use districts. These plans are prepared in accordance with the requirements of the State Water Code and Ordinance 90-62 of the City and County of Honolulu, which established the Oahu Water Management Plan. In 2006, BWS developed a draft watershed management plan for Waianae for public review and, in 2008, prepared a pre-final draft plan for Koolau Loa. The plans contain objectives to "Promote Sustainable Watershed" and "Protect and Enhance Water Quality and Quantity" and, in an implementation chapter, describe short (1-5 years), mid (6-15 years), and long-range (16-25 years or more) plans and programs for watershed management and water infrastructure development. The plans make reference to the CNPCP.

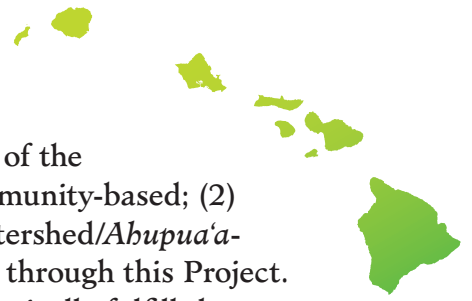
Water Resource Protection Plan

The *Water Resource Protection Plan* (WRPP) is one of five major plans that comprise the Hawaii Water Plan, established pursuant to Chapter 174C, HRS. The Commission of Water Resource Management (CWRM) is responsible for implementation of this plan. CWRM adopted the updated *Water Resource Protection Plan* on August 28, 2008. The plan describes the program to protect and conserve Hawaii's water resources. The updated document includes policies, program directives, resource inventories, and recommendations across a broad spectrum of resource management issues, including watershed protection and water quality. Some of the plan's recommendations include:

- Take a more active role in watershed protection, watershed partnerships, and the watershed partnership association.
- Support DOFAW's watershed management activities and the division's leadership role in watershed management.
- Study existing government and community efforts in watershed management and protection, and encourage sharing of information and experiences.
- Study other watershed planning approaches and lessons learned, including the EPA's watershed approach and that of other state governments.
- Pursue appropriate funding to support watershed protection programs and objectives to protect water resources.
- Encourage the collaboration of federal, State, and county agencies with existing watershed partnerships and Conservation Districts to map the relationships between land management programs, land use regulations, economic and agricultural issues, and water quality and resource protection programs.
- Improve communication and encourage dialogue between watershed interests to result in the development of common goals and an integrated watershed management framework. A successful framework will acknowledge and build upon existing programs and organizations to maximize funding, staff, and volunteer resources through watershed-scale management and protection programs.
- Develop innovative public outreach methods and encourage communication between watershed entities. The development of a website devoted to Hawaii watershed projects, organized by geographic location, should facilitate this coordination.

Community-Based Resource Management (CBRM) Project

The Hawaii CZM Program has developed an integrated planning framework for managing natural and cultural resources. The framework consists of the vision, a set of principles, and implementation options that will guide the Hawaii CZM Program toward the vision of the ORMP, a place-based, culture-based, and community-based approach to natural and cultural resource management throughout Hawaii. Based on the ORMP vision, the Hawaii CZM Program and partners developed principles—



guiding statements that define and describe the key concepts of the vision. The key concepts of these five principles are: (1) Community-based; (2) Collaborative; (3) Place-based; (4) Culture-based; and (5) Watershed/*Abupua'a*-based. The original principles were refined by input provided through this Project. Implementation options, which are recommendations to strategically fulfill the guiding principles, were primarily drawn from community group input received from the survey and workshop process. Intended to cultivate both Native Hawaiian and Western-based management practices, this integrated framework encourages an inclusive array of place-based, collaborative, community-based, culture-based, and watershed/*abupua'a*-based management approaches.

Building on the experiences and lessons learned provided by community groups, this section identifies five principles to serve as an integrated planning framework for natural and cultural resource management in Hawai'i. These principles also help to further define and operationalize what is meant by the terms "integrated place-based, culture-based, and community-based approaches" contained in the ORMP. The five principles are:

- **Principle 1. (*Community-Based*)** Support community-based management of natural and cultural resources and build community capacity to engage in stewardship activities and network with other community groups.
- **Principle 2. (*Collaborative*)** Develop long-term collaborative relationships between government and communities to learn from local knowledge to more effectively manage natural and cultural resources.
- **Principle 3. (*Place-Based*)** Design management strategies and programs to consider the unique characteristics (resources, weather, demographics, etc.) of each place and in terms flexible enough for management to quickly adapt to changing conditions.
- **Principle 4. (*Culture-Based*)** Incorporate consideration of the host culture's (Native Hawaiian) traditional practices and knowledge in management strategies and programs.
- **Principle 5. (*Watershed/Abupua'a-Based*)** Design management strategies and programs to recognize and incorporate the connection of land and sea.

The CZM Program recently published a request for proposals to develop a *Guidance Document on the Legal Framework for Natural and Cultural Resource Management in Hawaii*. The resulting products will include recommendations on changes to the statutes, administrative rules, and/or county ordinances that would encourage better support and implementation of an integrated planning approach.

Authority		Responsible Agency	New Dev't	Watershed Protection	Site Dev't	Existing Dev't	New OSDS	Operating OSDS	Pollution Prevention	Golf Course Mgt.	RHB Planning, Siting, Dev'g	Bridges	RHB O&M	RHB Runoff Systems
Local	Chapter 8, KCC Comprehensive Zoning Ordinance	Kauai County Planning Dept.		X	X						X			
	Chapter 9, KCC Subdivision	Kauai County Planning Dept.	X	X	X						X	X	X	
	Chapter 14, KCC	Kauai					X							
	Chapter 18, KCC Excavation and Repair of Streets & Sidewalks	Kauai County DPW											X	
	Chapter 20, KCC	Kauai County DPW							X					
	Chapter 22-7, KCC, Grading, Grubbing and Stockpiling	Kauai County DPW		X	X					X	X	X		
	Chapter 22-16, KCC Drainage	Kauai County DPW	X											
	SMA Rules and Regulations of the County of Kauai	Kauai County Planning Commission		X	X					X	X	X		
	<i>2000 Kauai General Plan</i>	Kauai County	X	X	X	X					X			
	<i>Interim Construction BMPs for Sediment and Erosion Control for the County of Kauai (April 2004)</i>	Kauai County DPW		X	X					X	X	X		
	<i>Kauai Storm Water Runoff Systems Manual (July 2001)</i>	Kauai County DPW	X											
	Chapter 4, HCC Animals	Hawaii County							X					
	Chapter 10 HCC, Soil Erosion and Sediment Control	Hawaii County DPW		X	X					X	X	X		
	Chapter 17, HCC Plumbing	Hawaii County DPW					X							
	Chapter 20, HCC Refuse	Hawaii County DPW							X					
	Chapter 22, HCC County Streets	Hawaii County DPW									X		X	

Authority		Responsible Agency	New Dev't	Watershed Protection	Site Dev't	Existing Dev't	New OSDS	Operating OSDS	Pollution Prevention	Golf Course Mgt.	RHB Planning, Siting, Dev'g	Bridges	RHB O&M	RHB Runoff Systems
Local	Chapter 23, HCC Subdivisions	Hawaii County Planning Dept.	X	X	X						X	X	X	
	Chapter 25, HCC Zoning	Hawaii County Planning Dept.	X	X	X						X			
	Chapter 27, HCC Floodplain Mgt	Hawaii County DPW	X	X	X		X				X	X		
	Rule 9, Hawaii County Planning Commission	Hawaii County Planning Commission		X	X					X	X	X		
	County of Hawaii General Plan (2005)	Hawaii County	X	X	X	X					X			
	Chapter 6.04, MCC Animal Control	Maui County							X					
	Chapter 12.04, MCC Street and Highway Excavation	Maui County DPW											X	
	Chapter 12.50, MCC Maintenance of Old Gov't Roads	Maui County DPW											X	
	Chapter 16.20A, MCC Plumbing Code	Maui County DPW					X							
	Chapter 18, MCC Subdivisions	Maui County DPW		X	X						X	X	X	
	Chapter 19, MCC Zoning	Maui County Planning Dept.		X	X						X			
	Chapter 20.08, MCC, Soil Erosion and Sedimentation Control	Maui County DPW		X	X					X	X	X		
	Chapter 20.20, MCC Litter Control	Maui County							X					
	MC-12-202, SMA Rules for Maui Planning Commission	Maui Planning Commission		X	X					X	X	X		
	MC-12-302, SMA Rules for Molokai Planning Commission	Molokai Planning Commission		X	X					X	X	X		

Authority		Responsible Agency	New Dev't	Watershed Protection	Site Dev't	Existing Dev't	New OSDs	Operating OSDs	Pollution Prevention	Golf Course Mgt.	RHB Planning, Siting, Dev'g	Bridges	RHB O&M	RHB Runoff Systems
Local	MC-12-402, SMA Rules for Lanai Planning Commission	Lanai Planning Commission		X	X					X	X	X		
	MC-15-4, Rules for the Design of Storm Drainage Facilities in the County of Maui	Maui County DPW		X	X						X	X		
	MC-15-?? (draft) Rules for the Design of Stormwater Treatment BMPs	Maui County DPW	X	X	X						X	X		
	MC -15-107, Rules for Flexible Design Standards	Maui County DPW		X	X									
	<i>Construction BMPs for the County of Maui</i> (May 2001)	Maui County DPW		X	X					X	X	X		
	<i>Maui County 2030 General Plan Update: Countrywide Policy Plan</i> (January 2008)	Maui County	X	X	X	X					X			
	Chapter 14-12, ROH Drainage, Flood and Pollution Control	City and County of Honolulu		X	X						X	X		
	Chapter 14-13 to 14-16, ROH, Grading, Soil Erosion and Sediment Control	City and County of Honolulu		X	X					X	X	X		
	Chapter 14-17, ROH Excavation & Repairs of Streets & Sidewalks	CCH-DPW											X	
	Chapter 14-20, ROH Cleaning & Maintaining Sidewalks	CCH-DPW											X	
	Chapter 14-32, ROH Maintenance of Private Streets and Roads	CCH-DPW											X	
	Chapter 21, ROH Land Use Ordinance	CCH Planning Dept.		X	X						X			

Authority		Responsible Agency	New Dev't	Watershed Protection	Site Dev't	Existing Dev't	New OSDS	Operating OSDS	Pollution Prevention	Golf Course Mgt.	RHB Planning, Siting, Dev'g	Bridges	RHB O&M	RHB Runoff Systems
	Chapter 22, ROH Subdivision of Land	CCH Planning Dept.		X	X								X	
	Chapter 25, ROH Special Mgt Area	CCH Planning Dept.		X	X					X	X	X		
	Chapter 29-4, ROH Litter Control	CCH							X					
	Chapter 30-4, ROH Water Conservation Measures	CCH					X							
	various <i>Development Plans</i> and <i>Sustainable Communities Plans</i> for Oahu	City and County of Honolulu		X	X	X					X			
	various fact sheets and programs related to pollution prevention	CCH Dept. of Env'l Services							X					
State	Chapter 46, HRS County Organization and Administration	Counties											X	
	Chapter 149A, HRS Hawaii Pesticides Law	DOA								X			X	
	Chapter 174C, HRS Hawaii Water Code	DLNR		X	X	X						X		
	Chapter 183C, HRS Conservation District	DLNR		X	X					X				
	Chapter 205A, HRS Coastal Zone Mgt	OP-CZM		X	X					X	X	X		
	Chapter 264, HRS Highways	DOT									X	X	X	
	Chapter 339, HRS Litter Control	DOH, with county enforcement							X					
	Chapter 340E, HRS Safe Drinking Water	DOH								X				
	Chapter 342D, HRS Water Pollution	DOH	X	X	X	X	X	X	X	X	X	X	X	
	Chapter 342G, HRS Integrated Solid Waste Management	DOH							X					

Authority		Responsible Agency	New Dev't	Watershed Protection	Site Dev't	Existing Dev't	New OSDS	Operating OSDS	Pollution Prevention	Golf Course Mgt.	RHB Planning, Siting, Dev'g	Bridges	RHB O&M	RHB Runoff Systems
State	Chapter 342H, HRS Solid Waste Pollution	DOH							X					
	Chapter 342I, HRS Special Wastes Recycling	DOH							X				X	
	Chapter 342J, HRS Hazardous Waste	DOH							X				X	
	Chapter 343, HRS Environmental Impact Statements	OEQC		X	X					X	X	X		
	Chapter 4-66, HAR Pesticides	DOA								X			X	
	Chapter 11-21, HAR Cross Connection and Back-Flow Control	DOH								X				
	Chapter 11-23, HAR Underground Injection Control	DOH					X			X				
	Chapter 11-54, HAR Water Quality Standards	DOH	X	X	X					X	X	X		
	Chapter 11-55, HAR Water Pollution Control	DOH	X	X	X					X	X	X		
	Chapter 11-58.1, HAR Solid Waste Mgt Control	DOH							X					
	Chapter 11-62, HAR Wastewater Systems	DOH					X	X		X				
	Chapter 11-200, HAR Environmental Impact Statement Rules	OEQC		X	X					X	X	X		
	Chapter 13-5, HAR Conservation Districts	DLNR		X	X					X				
	Chapter 13-169, HAR Protection of Instream Uses of Water	DLNR		X	X	X						X		

Authority		Responsible Agency	New Dev't	Watershed Protection	Site Dev't	Existing Dev't	New OSDS	Operating OSDS	Pollution Prevention	Golf Course Mgt.	RHB Planning, Siting, Dev'g	Bridges	RHB O&M	RHB Runoff Systems
State	Chapter 15-150, HAR Special Mgt Areas/ Shoreline Areas	OP-CZM		X	X					X	X	X		
	Chapter 19-127.1, HAR Design, Construction, and Maintenance of Public Streets and Hwys	DOT									X	X	X	
	HAPPI Home Series, University of Hawaii Cooperative Extension Svc.	Univ. of Hawaii CES							X					
	<i>The Hawaii Guide to Alternatives & Disposal of Household Hazardous Wasted (1996)</i>	DOH							X					
	various factsheets and bulletins	DOH							X					
	<i>Standard Specifications for Road and Bridge Construction (2005)</i>	DOT	X	X	X						X	X	X	
	<i>Construction BMPs Field Manual (January 2008)</i>				X						X	X	X	
	<i>Storm Water Permanent BMP Manual (2007)</i>	DOT	X										X	
	<i>Onsite Wastewater Treatment Survey and Assessment (March 2008)</i>	CZM Program, DOH					X	X						
	<i>Guidelines Applicable to Golf Courses in Hawaii (July 2002 – Version 6)</i>	DOH								X				
Federal	Section 404, CWA, permit	USACOE								X		X		
	Section 10, Rivers and Harbors Act of 1899	USACOE										X		

B. Management Measures

Urban Runoff

New Development Management Measure

1. By design or performance:
 - a. construction has been completed and the site is permanently stabilized, reduce the average annual total suspended solid (TSS) loadings by 80%. For the purposes of this measure, an 80% TSS reduction is to be determined on an average annual basis,* or
 - b. Reduce the postdevelopment loadings of TSS so that the average annual TSS loadings are no greater than predevelopment loadings, and
2. To the extent practicable, maintain postdevelopment peak runoff rate and average volume at levels that are similar to predevelopment levels.

Sound watershed management requires that both structural and nonstructural measures be employed to mitigate the adverse impacts of storm water. Both the Watershed Protection and Site Development Management Measure can be effectively used in conjunction with New Development to reduce both the short- and long-term costs of meeting the treatment goals of this management measure.

Applicability: This management measure applies to control urban runoff and treat associated pollutants generated from new development, redevelopment, and new and relocated roads, highways, and bridges. For design purposes, post-development peak runoff rate and average volume should be based on the 2-year/24-hour storm. Watershed planning and implementation efforts considering new development issues should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-2a.html>

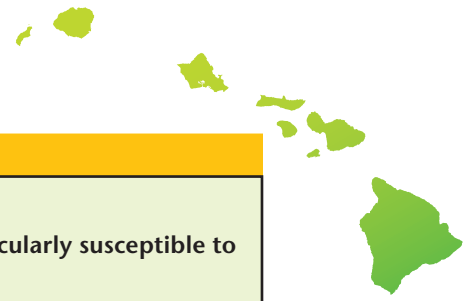
Description: This management measure is intended to accomplish the following: (1) decrease the erosive potential of increased runoff volumes and velocities associated with development-induced changes in hydrology; (2) remove suspended solids and associated pollutants entrained in runoff that result from activities occurring during and after development; (3) retain hydrological conditions to closely resemble those of the predisturbance condition; and (4) preserve natural systems including in-stream habitat. For the purposes of this management measure, “similar” is defined as “resembling though not completely identical.”

Practices: Suggested New Development practices can be found at the following location: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch05.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

**Watershed Protection Management Measure**

Develop a watershed protection program to:

1. Avoid conversion, to the extent practicable, of areas that are particularly susceptible to erosion and sediment loss;
2. Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota; and
3. Site development, including roads, highways, and bridges, to protect to the extent practicable the natural integrity of waterbodies and natural drainage systems.

Applicability: This management measure applies to new development or redevelopment including construction of new and relocated roads, highways, and bridges that generate nonpoint source pollutants. Watershed planning and implementation efforts should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-2b.html>

Description: The purpose of this management measure is to reduce the generation of nonpoint source pollutants and to mitigate the impacts of urban runoff and associated pollutants that result from new development or redevelopment, including the construction of new and relocated roads, highways, and bridges. The measure is intended to provide general goals for States and local governments to use in developing comprehensive programs for guiding future development and land use activities in a manner that will prevent and mitigate the effects of nonpoint source pollution.

A watershed is a geographic region where water drains into a particular receiving waterbody. As discussed in the introduction, comprehensive planning is an effective nonstructural tool available to control nonpoint source pollution. Where possible, growth should be directed toward areas where it can be sustained with a minimal impact on the natural environment (Meeks, 1990). Poorly planned growth and development have the potential to degrade and destroy entire natural drainage systems and surface waters (Mantel et al., 1990). Defined land use designations and zoning direct development away from areas where land disturbance activities or pollutant loadings from subsequent development would severely impact surface waters. Defined land use designations and zoning also protect environmentally sensitive areas such as riparian areas, wetlands, and vegetative buffers that serve as filters and trap sediments, nutrients, and chemical pollutants.

Areas such as streamside buffers and wetlands may also have the added benefit of providing long-term pollutant removal capabilities without the comparatively high costs usually associated with structural controls. Conservation or preservation of these areas is important to water quality protection. Land acquisition programs help to preserve areas critical to maintaining surface water quality. Buffer strips along streambanks provide protection for stream ecosystems and help to stabilize the stream and prevent streambank erosion (Holler, 1989). Buffer strips protect and maintain near-stream vegetation that attenuates the release of sediment into stream channels and prevent

excessive loadings. Levels of suspended solids increase at a slower rate in stream channel sections with well-developed riparian vegetation (Holler, 1989).

Practices: Suggested Watershed Protection practices can be found at the following location: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch03.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Site Development Management Measure

Plan, design, and develop sites to:

1. Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;
2. Limit increases of impervious areas, except where necessary;
3. Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and
4. Limit disturbance of natural drainage features and vegetation.

Applicability: This management measure applies to all site development activities including those associated with roads, highways, and bridges.

Practices: Suggested Site Development practices can be found at the following location: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch04.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

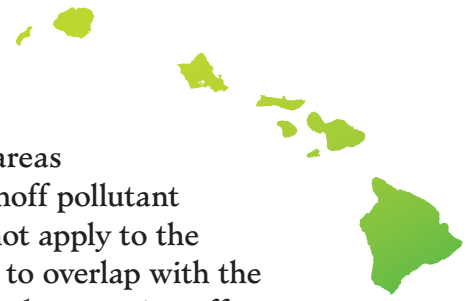
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Existing Development

Existing Development Management Measure

Develop and implement watershed management programs to reduce runoff pollutant concentrations and volumes from existing development:

1. Identify priority local and/or regional watershed pollutant reduction opportunities, e.g., improvements to existing urban runoff control structures;
2. Contain a schedule for implementing appropriate controls;
3. Limit destruction of natural conveyance systems; and
4. Where appropriate, preserve, enhance, or establish buffers along surface waterbodies and their tributaries.



Applicability: This management measure applies to all urban areas and existing development in order to reduce surface water runoff pollutant loadings from such areas. This management measures does not apply to the urbanized areas within the City and County of Honolulu due to overlap with the NPDES storm water regulations. Watershed planning and implementation efforts addressing existing development issues should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-4.html>

Description: The purpose of this management measure is to protect or improve surface water quality by the development and implementation of watershed management programs that pursue the following objectives:

1. Reduce surface water runoff pollution loadings from areas where development has already occurred;
2. Limit surface water runoff volumes in order to minimize sediment loadings resulting from the erosion of streambanks and other natural conveyance systems; and
3. Preserve, enhance, or establish buffers that provide water quality benefits along waterbodies and their tributaries.

Maintenance of water quality becomes increasingly difficult as areas of impervious surface increase and urbanization occurs. For the purpose of this guidance, urbanized areas are those areas where the presence of “man-made” impervious surfaces results in increased peak runoff volumes and pollutant loadings that permanently alter one or more of the following: stream channels, natural drainageways, and in-stream and adjacent riparian habitat so that predevelopment aquatic flora and fauna are eliminated or reduced to unsustainable levels and predevelopment water quality has been degraded. Increased bank cutting, streambed scouring, siltation damaging to aquatic flora and fauna, increases in water temperature, decreases in dissolved oxygen, changes to the natural structure and flow of the stream or river, and the presence of anthropogenic pollutants that are not generated from agricultural activities, in general, are indications of urbanization.

Practices: Suggested Existing Development practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch10.pdf

For further information see:

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Onsite Disposal Systems

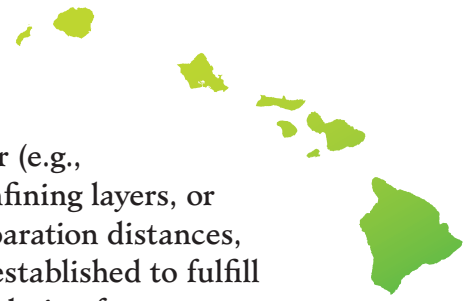
New Onsite Disposal Systems Management Measure

1. Ensure that new Onsite Disposal Systems (OSDS) are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives: (a) discourage the installation of garbage disposals to reduce hydraulic and nutrient loadings; and (b) where low-volume plumbing fixtures have not been installed in new developments or redevelopments, reduce total hydraulic loadings to the OSDS by 25%. Implement OSDS inspection schedules for preconstruction, construction, and post-construction;
2. Direct placement of OSDS away from unsuitable areas. Where OSDS placement away from unsuitable areas is not practicable, ensure that the OSDS is designed or sited at a density so as not to adversely affect surface waters or ground water that is closely hydrologically connected to surface water. Unsuitable areas include, but are not limited to, areas with poorly or excessively drained soils; areas with shallow water tables or areas with high seasonal water tables; areas overlaying fractured bedrock that drain directly to ground water; areas within floodplains; or areas where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive waterbodies;
3. Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative OSDS. The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective setbacks cannot be achieved, site development with OSDS so as not to adversely affect waterbodies and/or contribute to a public health nuisance;
4. Establish protective separation distances between OSDS system components and groundwater which is closely hydrologically connected to surface waters. The separation distances should be based on soil type, distance to ground water, hydrologic factors, and type of OSDS;
5. Where conditions indicate that nitrogen-limited surface waters may be adversely affected by excess nitrogen loadings from ground water, require the installation of OSDS that reduce total nitrogen loadings by 50% to groundwater that is closely hydrologically connected to surface water.

Applicability: This management measure applies to all new OSDSs, including package plants and small-scale or regional treatment facilities not covered by NPDES regulations, in order to manage the siting, design, installation, and operation and maintenance of all such OSDSs. Watershed planning and implementation efforts addressing the use of denitrifying OSDSs should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-5a.html>

Description: The purpose of this management measure is to protect waters from pollutants discharged by OSDS. The measure requires that OSDS be sited, designed, and installed so that impacts to waterbodies will be reduced, to the extent practicable. Factors such as soil type, soil depth, depth to water table, rate of sea level rise, and topography must be considered in siting and installing conventional OSDS.

The objective of the management measure is to prevent the installation of conventional OSDS in areas where soil absorption systems will not provide adequate treatment of effluents containing solids, phosphorus, pathogens, nitrogen, and nonconventional



pollutants prior to entry into surface waters and ground water (e.g., highly permeable soils, areas with shallow water tables or confining layers, or poorly drained soils). In addition to soil criteria, setbacks, separation distances, and management and maintenance requirements need to be established to fulfill the requirements of this management measure. Guidance on design factors to consider in the installation of OSDS is available in EPA's Design Manual for Onsite Wastewater Treatment and Disposal Systems (1980), currently under revision. This measure also requires that in areas experiencing pollution problems due to OSDS-generated nitrogen loadings, OSDS designs should employ denitrification systems or some other nitrogen removal process that reduces total nitrogen loadings by at least 50 percent. Additionally, hydraulic loadings to OSDS can be reduced by up to 25 percent by installing low-volume plumbing fixtures and enforcing water conservation measures. Garbage disposals are to be discouraged in all new development or redevelopment where conventional OSDS are employed as another means of reducing overloading and ensure proper operation of the OSDS. Regularly scheduled maintenance and pumpout of OSDS will prolong the life of the system and prevent degradation of surface waters.

Practices: Suggested New Onsite Sewage Disposal System practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch06.pdf

For further information see:

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(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Operating Onsite Disposal Systems Management Measure

1. Establish and implement policies and systems to ensure that existing OSDS are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives, encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15% (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replaced, or modified where the OSDS fails, or threatens or impairs surface waters;
2. Inspect OSDS at a frequency adequate to ascertain whether OSDS are failing;
3. Consider replacing or upgrading OSDS to treat influent so that total nitrogen loadings in the effluent are reduced by 50%. This provision applies only:
 - a. where conditions indicate that nitrogen-limited surface waters may be adversely affected by significant groundwater nitrogen loadings from OSDS, and
 - b. where nitrogen loadings from OSDS are delivered to groundwater that is closely hydrologically connected to surface water.

Applicability: This management measure applies to all operating OSDSs. Watershed planning and implementation efforts related to OSDS inspections should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-5b.html>

Description: The purpose of this management measure is to minimize pollutant loadings from operating OSDS. This management measure requires that OSDS be modified, operated, repaired, and maintained to reduce nutrient and pathogen loadings in order to protect and enhance surface waters. In the past, it has been a common practice to site conventional OSDS in coastal areas that have inadequate separation distances to ground water, fractured bedrock, sandy soils, or other conditions that prevent or do not allow adequate treatment of OSDS-generated pollutants. Eutrophication in surface waters has also been attributed to the low nitrogen reductions provided by conventional OSDS designs.

Poorly designed or operating systems can cause ponding of partially treated sewage on the ground that can reach surface waters through runoff. In addition to oxygen-demanding organics and nutrients, these surface sources contain bacteria and viruses that present problems to human health. Although ground-water contamination from toxic substances is more often life-threatening, the majority of ground-water-related health complaints are associated with pathogens from septic tank systems (Yates, 1985).

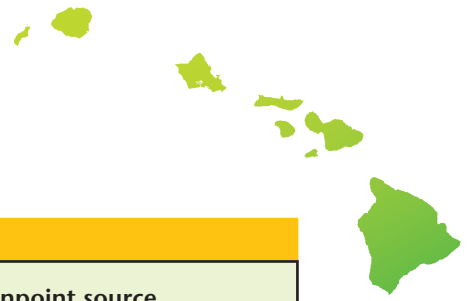
Where development utilizing OSDS has already occurred, States and local governments have a limited capability to reduce OSDS pollutant loadings. One way to reduce the possibility of failed systems is to required scheduled pumpouts and regular maintenance of OSDS. Frequent inspections and proper operation and maintenance are the keys to achieving the most cost-effective OSDS pollutant reductions. Inspections upon resale or change of ownership of properties are also a cost-effective solution to ensure that OSDS are operating properly and meet current standards necessary to protect surface waters from OSDS-generated pollutants. Where phosphorus is a problem, phosphate bans can reduce phosphorus loadings by 14 to 17 percent (USEPA, 1992). Garbage disposal restrictions and low-volume plumbing fixtures can help ensure that conventional systems continue to operate properly. Low-volume plumbing fixtures have been shown to reduce hydraulic loadings to OSDS by 25 percent.

Practices: Suggested Existing Onsite Sewage Disposal System practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch06.pdf

For further information see:

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Pollution Prevention

Pollution Prevention Management Measure

Implement pollution prevention and education programs to reduce nonpoint source pollutants generated from the following activities, where applicable:

- a. The improper storage, use, and disposal of household hazardous chemicals, including automobile fluids, pesticides, paints, solvents, etc.;
- b. Lawn and garden activities, including the application and disposal of lawn and garden care products, and the improper disposal of leaves and yard trimmings;
- c. Turf management on golf courses, parks, and recreational areas;
- d. Improper operation and maintenance of onsite disposal systems;
- e. Discharge of pollutants into storm drains including floatables, waste oil, and litter;
- f. Commercial activities including parking lots, gas stations, and other entities not under NPDES purview; and
- g. Improper disposal of pet excrement.

Applicability: This management measure is intended to be applied to reduce the generation of polluted runoff in all areas within the coastal nonpoint pollution control program management area. The adoption of the Pollution Prevention Management Measure does not exclude applicability of other management measures to those sources covered by this management measure.

Practices: Suggested Pollution Prevention practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch09.pdf

For further information see:

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Golf Course Management Measure

1. Develop and implement grading and site preparation plans to:
 - a. Design and install a combination of management and physical practices to settle solids and associated pollutants in runoff from heavy rains and/or from wind;
 - b. Prevent erosion and retain sediment, to the extent practicable, onsite during and after construction;
 - c. Protect areas that provide important water quality benefits and/or are environmentally-sensitive ecosystems;
 - d. Avoid construction, to the extent practicable, in areas that are susceptible to erosion and sediment loss;
 - e. Protect the natural integrity of waterbodies and natural drainage systems by establishing streamside buffers; and
 - f. Follow, to the extent practicable, the amended U.S. Golfing Association (USGA) guidelines for the construction of greens.
2. Develop nutrient management guidelines appropriate to Hawaii for qualified superintendents to implement so that nutrients are applied at rates necessary to establish and maintain vegetation without causing leaching into ground and surface waters.
3. Develop and implement an integrated pest management plan. Follow EPA guidelines for the proper storage and disposal of pesticides.
4. Develop and implement irrigation management practices to match the water needs of the turf.

Applicability: This management measure applies to all golf courses in Hawaii that are in operation, under construction, or to be built in the future. It should be noted that the other urban management measures also apply to the construction and operation of golf courses.

This management measure is an additional measure developed specifically for Hawaii and is not contained in EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Regardless of the current state and quality of management and maintenance of golf courses, this land use has the potential to be a significant source of polluted runoff due to the proportion of land area involved, the intensity of its management and the quantity of chemicals used.

Practices: The *Guidelines Applicable to Golf Courses in Hawaii* (July 2002 – Version 6) recommends the following measures to prevent groundwater and surface water pollution, soil contamination, chemical spills, noise and solid waste nuisances, and unsafe exposure to applied chemicals:

1. A groundwater or soil water monitoring plan for the purpose of preventing or minimizing groundwater contamination should be established with the following components:
 - a. Baseline groundwater quality;
 - b. Monitoring locations consisting of monitoring wells or lysimeters, or combination of both;



- c. Routine groundwater and/or soil water monitoring at frequencies such as quarterly, semiannually, or annually depending on the use of chemicals and the detection of contaminants;
 - d. A list of chemicals and fertilizers that will be or have been used that may affect soil or groundwater adversely, and the analyses for such contaminants;
 - e. Recordkeeping of monitoring results and a system of tracking trends in order to prevent, minimize, or mitigate occurrences of contamination;
 - f. A procedure to notify all affected parties and DOH of occurrences of contamination that pose, or may pose, a threat to public health or the environment.
 - g. Availability of monitoring data to any interested person.
2. A surface water monitoring plan, if applicable, for the purpose of preventing or minimizing surface water contamination should be established using the principles of item No. 1.
3. If the golf course uses recycled water (treated wastewater) for irrigation, please refer to the Department of Health's Guidelines for the Treatment and Use of Recycled Water, May 15, 2002, for recycled water requirements.
4. The use of an above-ground storage tank with applicable safety considerations for petroleum products, used for fueling golf carts, maintenance vehicles, or emergency generators, should be preferred over an underground storage tank in order to easily detect leaks and minimize the risk of soil and groundwater contamination resulting from a leaking storage tank.
5. Buildings used to store fertilizers, pesticides, algicides, fungicides, herbicides, and other chemicals especially in liquid form should be designed purposely for the containment and recovery of a catastrophic spill or leak of contents. An early warning system for spill or leak detection is advantageous.
6. Noise and dust from maintenance or construction activities should not disturb neighbors. Maintenance or construction activities should be scheduled and conducted accordingly.
7. Solid wastes should be managed without creating a nuisance. Furthermore, all green waste generated by the golf course should be reused on-site. Shredding and composting are activities that precede the reuse of green waste as a soil conditioner or a ground cover for weed control. Space and equipment should be provided to accomplish these activities. Additionally, where practicable, locally produced compost and soil amendments should be used whenever available.

8. Chemicals should be handled and applied according to instructions, and offsite drift during application should not occur. Methods of application and weather conditions should be chosen to optimize success.
9. A Best Management Practices (BMP) plan should be made for the golf course. The BMP plan functions as a hands-on environmental and worker safety maintenance manual that describes in plain English the elements and procedures for irrigation, chemical use, processing and reuse of green wastes, minimizing or preventing runoff, soil erosion and nuisance conditions, and sustaining worker safety. Use of the BMP should prevent the occurrence or recurrence of environmental or safety problems. The BMP should be available to any interested person.
10. Agencies or organizations such as the State Department of Agriculture, the National Resource Conservation Service, and the Golf Course Superintendents Association of America may provide ideas or practices that would help to achieve the intent of these guidelines. Inquiries to these sources of information are advantageous.

For further information see:

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(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Roads, Highways, and Bridges

According to Chapter 264, HRS, all roads, alleys, streets, ways, lanes, bikeways, bridges, and all other real property highway related interests in the State, opened, laid out, subdivided, consolidated, acquired and built by the government are public highways. Public highways are of two types: (1) State highways, having an alignment or possession of a real property highway related interest as established by law, subdivided and acquired in accordance with policies and procedures of the department of transportation (DOT), separate and exempt from any county subdivision ordinances, and all those under the jurisdiction of DOT; and (2) County highways, which are all other public highways.

All roads, alleys, streets, ways, lanes, trails, bikeways, and bridges in the State, opened, laid out, or built by private parties and dedicated or surrendered to the public use, are declared to be public highways as follows: (1) dedication of public highways shall be by deed of conveyance naming the State as grantee in the case of a state highway and naming the county as grantee in the case of a county highway; and (2) surrender of public highways shall be deemed to have taken place if no act of ownership by the owner of the road, alley, street, bikeway, way, lane, trail, or bridge has been exercised for five years and when, in the case of a county highway, the county council of that county adopts, by resolution, the same as a county highway.



Hawaii Department of Transportation (DOT) has jurisdiction over State roadways. According to Section 264-8, HRS, specifications, standards and procedures to be followed in the installation and construction of connections for streets, roads and driveways, concrete curbs and sidewalks, structures, drainage systems, landscaping or grading within the highway rights-of-way, excavation and backfilling of trenches or other openings in state highways, and in the restoration, replacement, or repair of the base course, pavement surfaces, highway structures, and other highway improvements shall be prescribed by the director of transportation. The updated 2005 *Standard Specifications for Road and Bridge Construction* requires written, site-specific BMPs describing activities to minimize water pollution and soil erosion into State waters, drainage or sewer systems, and a plan indicating location of the BMPs, areas of soil disturbance, areas where vegetative practices are to be implemented, and drainage patterns. It requires contractors to follow guidelines in the *Construction Best Management Practices Field Manual* (dated January 2008) in developing, installing and maintaining BMPs for all projects.

State roads are under the jurisdiction of DOT, while county – or local – roads are under the jurisdiction of the respective counties. Many of the counties also have many miles of homestead roads or “paper” roads. Under the terms of the Highways Act of 1892 and Chapter 264, HRS, all roads existing at the time of adoption of the Highways Act were declared to be public highways. In addition, public highways include all roads, alleys, streets, ways, lanes, bikeways, and bridges laid out on paper or built by the Territorial, State or County governments since 1892. A 1999 State Attorney General opinion clarified that all public highways are County highways unless declared by Chapter 264, HRS to be under State jurisdiction.

Management Measure for Planning, Siting, and Developing Roads and Highways

Plan, site, and develop roads and highways to:

1. Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;
2. Limit land disturbance such as clearing, grading and cut and fill to reduce erosion and sediment loss; and
3. Limit disturbance of natural drainage features and vegetation.

Applicability: This management measure applies to site development and land disturbing activities for new, relocated, and reconstructed (widened) roads (including residential streets) and highways in order to reduce the generation of nonpoint source pollutants and to mitigate the impacts of urban runoff and associated pollutants from such activities. Watershed planning and implementation efforts addressing planning, siting and developing roads and highways should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-7a.html>

The best time to address control of NPS pollution from roads and highways is during the initial planning and design phase. New roads and highways should be located with consideration of natural drainage patterns and planned to avoid encroachment on surface waters and wet areas. Where this is not possible, appropriate controls will be needed to minimize the impacts of NPS runoff on surface waters.

This management measure emphasizes the importance of planning to identify potential NPS problems early in the design process. This process involves a detailed analysis of environmental features most associated with NPS pollution, erosion and sediment problems such as topography, drainage patterns, soils, climate, existing land use, estimated traffic volume, and sensitive land areas. Highway locations selected, planned, and designed with consideration of these features will greatly minimize erosion and sedimentation and prevent NPS pollutants from entering watercourses during and after construction. An important consideration in planning is the distance between a highway and a watercourse that is needed to buffer the runoff flow and prevent potential contaminants from entering surface waters. Other design elements such as project alignment, gradient, cross section, and the number of stream crossings also must be taken into account to achieve successful control of erosion and nonpoint sources of pollution.

Practices: Suggested Planning, Siting and Developing Roads, Highways and Bridges practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch07.pdf

For further information see:

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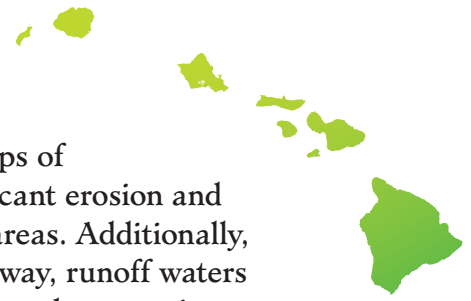
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Management Measure for Bridges

Site, design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

Applicability: This management measure applies to new, relocated, and rehabilitated bridge structures in order to control erosion, streambed scouring, and surface runoff from such activities. Watershed planning and implementation efforts related to bridges should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-7b.html>

Description: This measure requires that NPS runoff impacts on surface waters from bridge decks be assessed and that appropriate management and treatment be employed to protect critical habitats, wetlands, fisheries, shellfish beds, and domestic water supplies. The siting of bridges should be a coordinated effort among the



States, the FHWA, the U.S. Coast Guard, and the Army Corps of Engineers. Locating bridges in coastal areas can cause significant erosion and sedimentation, resulting in the loss of wetlands and riparian areas. Additionally, since bridge pavements are extensions of the connecting highway, runoff waters from bridge decks also deliver loadings of heavy metals, hydrocarbons, toxic substances, and deicing chemicals to surface waters as a result of discharge through scupper drains with no overland buffering. Bridge maintenance can also contribute heavy loads of lead, rust particles, paint, abrasive, solvents, and cleaners into surface waters. Protection against possible pollutant overloads can be afforded by minimizing the use of scuppers on bridges traversing very sensitive waters and conveying deck drainage to land for treatment. Whenever practical, bridge structures should be located to avoid crossing over sensitive fisheries and shellfish-harvesting areas to prevent washing polluted runoff through scuppers into the waters below. Also, bridge design should account for potential scour and erosion, which may affect shellfish beds and bottom sediments.

Practices: Suggested Bridge practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch07.pdf

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Management Measure for Operation and Maintenance

Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

Applicability: This management measure applies to existing, restored, and rehabilitated roads, highways, and bridges. This management measure does not apply to urban City and County of Honolulu due to overlap with NPDES storm water regulations. Watershed planning and implementation efforts related to bridges should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-7e.html>

Description: Substantial amounts of eroded material and other pollutants can be generated by operation and maintenance procedures for roads, highways, and bridges, and from sparsely vegetated areas, cracked pavements, potholes, and poorly operating urban runoff control structures. This measure is intended to ensure that pollutant loadings from roads, highways, and bridges are minimized by the development and implementation of a program and associated practices to ensure that sediment and toxic substance loadings from operation and maintenance activities do not impair coastal surface waters. The program to be developed, using the practices described in this management measure, should consist of and identify standard operating procedures for nutrient and pesticide management, road salt use minimization, and maintenance

guidelines (e.g., capture and contain paint chips and other particulates from bridge maintenance operations, resurfacing, and pothole repairs).

Practices: Suggested Operation and Maintenance practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch11.pdf

For further information see:

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Management Measure for Road, Highway, and Bridge Runoff Systems

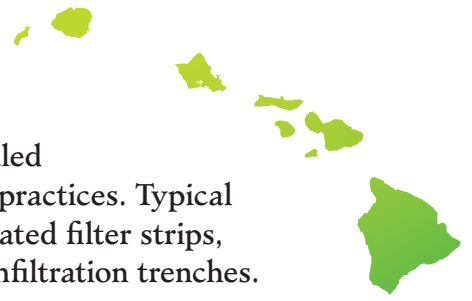
Develop and implement runoff management systems for existing roads, highways, and bridges to reduce runoff pollutant concentrations and volumes entering surface waters.

1. Identify priority and watershed pollutant reduction opportunities (e.g., improvements to existing urban runoff control structures); and
2. Establish schedules for implementing appropriate controls.

Applicability: This management measure applies to existing, resurfaced, restored, and rehabilitated roads, highways, and bridges that contribute to adverse effects in surface waters. This management measure does not apply to urban City and County of Honolulu due to overlap with NPDES storm water regulations. Watershed planning and implementation efforts related to road, highways and bridge runoff systems should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter4/ch4-7f.html>

Description: This measure requires that operation and maintenance systems include the development of retrofit projects, where needed, to collect NPS pollutant loadings from existing, reconstructed, and rehabilitated roads, highways, and bridges. Poorly designed or maintained roads and bridges can generate significant erosion and pollution loads containing heavy metals, hydrocarbons, sediment, and debris that run off into and threaten the quality of surface waters and their tributaries. In areas where such adverse impacts to surface waters can be attributed to adjacent roads or bridges, retrofit management projects to protect these waters may be needed (e.g., installation of structural or nonstructural pollution controls). Retrofit projects can be located in existing rights-of-way, within interchange loops, or on adjacent land areas. Areas with severe erosion and pollution runoff problems may require relocation or reconstruction to mitigate these impacts.

Runoff management systems are a combination of nonstructural and structural practices selected to reduce nonpoint source loadings from roads, highways, and bridges. These systems are expected to include structural improvements to existing runoff control structures for water quality purposes; construction of new runoff control

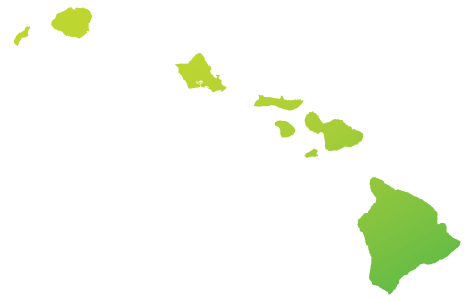


devices, where necessary to protect water quality; and scheduled operation and maintenance activities for these runoff control practices. Typical runoff controls for roads, highways, and bridges include vegetated filter strips, grassed swales, detention basins, constructed wetlands, and infiltration trenches.

Practices: Suggested Runoff System practices can be found at: http://water.epa.gov/polwaste/nps/urban/upload/2005_12_08_NPS_urbanmm_urban_ch07.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures
(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



5.4 Marinas and Recreational Boating

A. Introduction

There are fifteen management measures that apply to marinas and recreational boating.

Siting and Design	Marina and Boat Operation and Maintenance
1. Marina Flushing	8. Solid Waste Management
2. Water Quality Assessment	9. Fish Waste Management
3. Habitat Assessment	10. Liquid Material Management
4. Shoreline Stabilization	11. Petroleum Control
5. Storm Water Runoff	12. Boat Cleaning
6. Fueling Station Design	13. Public Education
7. Sewage Facility Management	14. Maintenance of Sewage Facilities
	15. Boat Operation

The management measures for marinas are applicable to the facilities and their associated shore-based services that support recreational boats and boats for hire. The following operations/ facilities are covered by these management measures:

- any facility that contains 10 or more slips, piers where 10 or more boats may tie up, or any facility where a boat for hire is docked;
- boat maintenance or repair yards that are adjacent to the water;
- any federal, State, or local facility that involves recreational boat maintenance or repair that is on or adjacent to the water;
- public or commercial boat ramps;
- any residential or planned community marina with 10 or more slips; and
- any mooring field where 10 or more boats are moored.

The following table provides a brief overview of authorities that apply to the Marinas and Recreational Boating management measures. A more detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure can be found in *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures*.

Authority		Responsible Agency	Marina Flushing	Water Quality Assessment	Habitat Assessment	Shoreline Stabilization	Stormwater Management	Fueling Station Design	Sewage Facilities	Solid Waste Management	Fish Waste Management	Liquid Material Mgt.	Petroleum Control	Boat Cleaning	Public Education	Maint of Sewage Facilities	Boat Operation
Local	Chapter 12-202, MCC SMA Rules for Maui Planning Commission	Maui Plng Commission	X	X	X			X	X								
	Chapter 12-302, MCC SMA Rules for Molokai Planning Commission	Molokai Plng Commission	X	X	X			X	X								
	Chapter 12-402, MCC SMA Rules for Lanai Planning Commission	Lanai Plng Commission	X	X	X			X	X								
	Chapter 25, ROH Special Mgt Area	CCH	X	X	X			X	X								
	Rule 9, Hawaii Cty Planning Commission	Hawaii Cty Plng Commission	X	X	X			X	X								
	SMA Rules and Regs of the County of Kauai	Kauai Plng Commission	X	X	X			X	X								
State	Chapter 171, HRS Mgt & Disposition of Public Lands	DLNR	X	X	X												
	Chapter 183C, HRS Conservation District	DLNR	X	X	X	X	X	X	X								
	Chapter 190, HRS Marine Life Conservation Progr	DLNR															X

Authority		Responsible Agency	Marina Flushing	Water Quality Assessment	Habitat Assessment	Shoreline Stabilization	Stormwater Management	Fueling Station Design	Sewage Facilities	Solid Waste Management	Fish Waste Management	Liquid Material Mgt.	Petroleum Control	Boat Cleaning	Public Education	Maint of Sewage Facilities	Boat Operation
State	Chapter 200, HRS Ocean Recreation & Coastal Areas Progr.	DLNR-DOBOR	X	X	X			X	X								
	Chapter 205A, HRS Coastal Zone Mgt	OP-CZM	X	X	X	X	X	X	X								
	Chapter 342D, HRS Water Pollution	DOH	X	X	X	X	X	X	X	X	X	X	X	X		X	X
	Chapter 342I, HRS Special Wastes Recycling	DOH								X		X					
	Chapter 342J, HRS Hazardous Waste	DOH										X	X				
	Chapter 343, HRS Environmental Impact Statements	OEQC	X	X	X			X	X								
	Chapter 11-54, HAR Water Quality Standards	DOH		X	X	X											
	Chapter 11-55, HAR Water Pollution Control	DOH				X											
	Chapter 11-200, HAR EIS Rules	OEQC	X	X	X			X	X								

Authority		Responsible Agency	Marina Flushing	Water Quality Assessment	Habitat Assessment	Shoreline Stabilization	Stormwater Management	Fueling Station Design	Sewage Facilities	Solid Waste Management	Fish Waste Management	Liquid Material Mgt.	Petroleum Control	Boat Cleaning	Public Education	Maint of Sewage Facilities	Boat Operation
State	Chapter 11-281, HAR Underground Storage Tanks	DOH						X				X					
	Chapter 13-5, HAR Conservation District	DLNR	X	X	X	X	X	X	X								
	Chapter 13-231, HAR Operation of Boats, Small Boat Harbors, & Permits	DLNR-DOBOR															X
	Chapter 13-232, HAR Sanitation and Fire Safety	DLNR-DOBOR	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Chapter 13-235, HAR Offshore Mooring Rules and Areas	DLNR-DOBOR							X							X	
	Chapter 13-243, HAR Vessel Equipment Requirements	DLNR														X	
	Chapter 13-244, HAR Rules of the Road	DLNR-DOBOR															X
	Chapter 13-256, HAR Ocean Rec Mgt Rules	DLNR-DOBOR															X

Authority		Responsible Agency	Marina Flushing	Water Quality Assessment	Habitat Assessment	Shoreline Stabilization	Stormwater Management	Fueling Station Design	Sewage Facilities	Solid Waste Management	Fish Waste Management	Liquid Material Mgt.	Petroleum Control	Boat Cleaning	Public Education	Maint of Sewage Facilities	Boat Operation
	Chapter 15-150, HAR SMA/Shoreline Areas	OP	X	X	X			X	X								
	<i>National Mgt Measures to Control NPS Pollution from Marinas and Rec'l Boating (2001)</i>	DLNR and EPA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	<i>Managing Boat Wastes: A Guide for Hawaii Boaters (2005)</i>	DLNR-DOBOR, DOH, Hawaii Sea Grant													X	X	
	<i>Hawaii Recreational Harbors with MSD pumpouts (2006)</i>	DLNR-DOBOR													X	X	
Federal	Section 404, CWA	USACOE	X	X	X	X	X										
	Section 10, Rivers and Harbors Act of 1899	USACOE	X	X	X	X	X										

B. Management Measures

Siting and Design

Marina Flushing Management Measure

Site and design marinas such that tides and/or currents will aid in flushing of the site or renew its water regularly.

Applicability: This management measure applies to the siting and design of new and expanding marinas.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about marina flushing:

- Ensure that the bottom of the marina and the entrance channels are not deeper than adjacent navigable channels
- Consider design alternatives in poorly flushed waterbodies to enhance flushing
- Design new marinas with as few enclosed water sections or separated basins as possible to promote circulation within the entire basin.
- Consider the value of entrance channels in promoting flushing when designing or reconfiguring a marina.
- Establish two openings at the most appropriate locations within the marina to promote flow-through currents.
- Consider mechanical aerators to improve flushing and water quality where basin and entrance channel configuration cannot provide adequate flushing.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

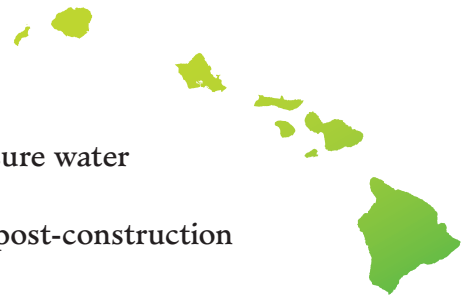
(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Water Quality Assessment Management Measure

Assess water quality as part of marina siting and design.

Applicability: This management measure applies to the siting and design of new and expanding marinas.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about water quality assessment:



- Use water quality sampling and/or monitoring to measure water quality conditions.
- Use a water quality modeling methodology to predict post-construction water quality conditions.
- Monitor water quality using indicators.
- Use rapid bioassessment techniques to monitor water quality.
- Establish a volunteer monitoring program.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Habitat Assessment Management Measure

Site and design marinas to protect against adverse effects on coral reefs, shellfish resources, wetlands, submerged aquatic vegetation, or other important riparian and aquatic habitat areas as designated by local, State, or federal governments.

Applicability: This management measure applies to the siting and design of new and expanding marinas where site changes may have an impact on important marine species, coral reefs, wetlands, or other important habitats. The habitats of non-indigenous nuisance species are not considered important habitats.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about habitat assessment:

- Conduct habitat surveys and characterize the marina site, including identifying any exotic or invasive species.
- Assess habitat function (e.g., spawning area, nursery area, feeding area) to minimize indirect effects.
- Use rapid bioassessment techniques to assess effects on biological resources.
- Redevelop waterfront sites that have been previously disturbed and expand existing marinas.
- Consider alternative sites where adverse environmental effects will be minimized or positive effects will be maximized.
- Create new habitats or expand habitats in the marina basin.
- Minimize disturbance of riparian areas.
- Use dry stack storage.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Shoreline Stabilization Management Measure

Where shoreline erosion is a serious nonpoint source pollution problem, shorelines may need to be stabilized. Vegetative methods are strongly preferred. Structural methods may be necessary where vegetative methods cannot work and where they do not interfere with natural beach processes or harm other sensitive ecological areas.

Applicability: This management measure applies to siting and design of new and expanding marinas where site changes may result in shoreline erosion. For further information see: Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures (http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about shoreline and streambank stabilization:

- Use vegetative plantings, wetlands, beaches, and natural shorelines where space allows.
- Where shorelines need structural stabilization and where space and use allow, riprap revetment is preferable to a solid vertical bulkhead.
- Where reflected waves will not endanger shorelines or habitats and where space is limited, protect shorelines with structural features such as vertical bulkheads.
- At boat ramps, retain natural shoreline features to the extent feasible and protect disturbed areas from erosion.

For further information see:

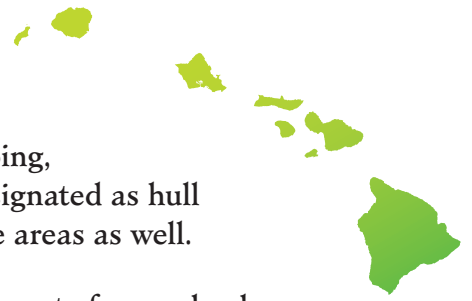
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Storm Water Runoff Management Measure

Implement effective runoff control strategies which include the use of pollution prevention activities and the proper design of hull maintenance areas.

Reduce the average annual loadings of total suspended solids (TSS) in runoff from hull maintenance areas by 80%. For the purposes of this measure, an 80% reduction of TSS is to be determined on an average annual basis.

Applicability: This management measure applies to new and expanding marinas, and to existing marinas for at least the hull maintenance areas. (Hull maintenance areas are areas whose primary function is to provide a place for boats during the scraping,



sanding, and painting of their bottoms.) If boat bottom scraping, sanding, and/or painting is done in areas other than those designated as hull maintenance areas, the management measure applies to those areas as well.

This measure does not apply to runoff that enters the marina property from upland sources. Upland sources are addressed by the management measures for agriculture, forestry, urban areas, hydromodifications, and wetland and riparian areas.

NOTE: This management measure does not apply to existing, new, or expanding facilities that have a NPDES permit for their stormwater discharges.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about stormwater runoff management:

- Perform as much boat repair and maintenance work as possible inside work buildings.
- Where an inside work space is not available, perform abrasive blasting and sanding within spray booths or tarp enclosures.
- Where buildings or enclosed areas are not available, provide clearly designated land areas for boat repair and maintenance.
- Design hull maintenance areas to minimize contaminated runoff.
- Use vacuum sanders both to remove paint from hulls and to collect paint dust and chips.
- Restrict the types and/or amount of do-it-yourself work done at the marina.
- Clean hull maintenance areas immediately after any maintenance to remove debris, and dispose of collected material properly.
- Capture and filter pollutants out of runoff water with permeable tarps, screens, and filter cloths.
- Sweep or vacuum around hull maintenance areas, roads, and driveways frequently.
- Sweep parking lots regularly.
- Plant grass between impervious areas and the marina basin.
- Construct new or restore former wetlands where feasible and practical.
- Use porous pavement where feasible.
- Install oil/grit separators and/or vertical media filters to capture pollutants in runoff.
- Use catch basins where storm water flows to the marina basin in large pulses.
- Add filters to storm drains that are located near work areas.
- Place absorbents in drain inlets.
- Use chemical and filtration treatment systems only where necessary.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Fueling Station Design Management Measure

Design fueling stations to allow for ease in cleanup of spills.

Applicability: This management measure applies to new and expanding marinas where fueling stations are to be added or moved.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about fueling station design:

- Use automatic shutoffs on fuel lines and at hose nozzles to reduce fuel loss.
- Remove old-style fuel nozzle triggers that are used to hold the nozzle open without being held.
- Install personal watercraft (PWC) floats at fuel docks to help drivers refuel without spilling.
- Regularly inspect, maintain, and replace fuel hoses, pipes, and tanks.
- Install a spill monitoring system.
- Train fuel dock staff in spill prevention, containment, and cleanup procedures.
- Install easy-to-read signs on the fuel dock that explain proper fueling, spill prevention, and spill reporting procedures.
- Locate and design boat fueling stations so that spills can be contained, such as with a floating boom, and cleaned up easily.
- Write and implement a fuel spill recovery plan.
- Have spill containment equipment storage, such as a locker attached or adjacent to the fuel dock, easily accessible and clearly marked.

For further information see:

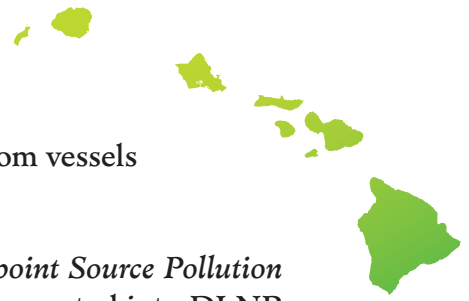
Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Sewage Facility Management Measure

Install pumpout, dump station, and restroom facilities where needed at new and expanding marinas to reduce the release of sewage into surface waters. Design these facilities to allow ease of access and post signage to promote use by the boating public.

Applicability: This management measure applies to new and expanding marinas in areas where adequate marine sewage collection facilities do not exist. Marinas that do not provide services for vessels that have marine sanitation devices (MSDs) do not need to have pumpouts, although dump stations for portable toilets and restrooms should be



available. This measure does not address direct discharges from vessels covered under Section 312, CWA.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about sewage facility management:

- Install pumpout facilities and dump stations. Use a system compatible with the marina's needs.
- Provide pumpout service at convenient times and at a reasonable cost.
- Keep pumpout stations clean and easily accessible, and consider having marina staff do pumpouts.
- Provide portable toilet dump stations near small slips and launch ramps.
- Provide restrooms at all marinas and boat ramps.
- Consider declaring marina waters to be a “no discharge” area.
- Establish practices and post signs to control pet waste problems.
- Avoid feeding wild birds in the marina.
- Establish no discharge zones to prevent any boat sewage from entering boating waters.
- Establish equipment requirement policies that prohibit the use of Y-valves on boats on inland waters.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Marina and Boat Operation and Maintenance

Solid Waste Management Measure

Properly dispose of solid wastes produced by the operation, cleaning, maintenance, and repair of boats to limit entry of solid wastes into surface waters.

Applicability: This management measure applies to the operation and maintenance of new and expanding marinas.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about solid waste management:

- Encourage marina patrons to avoid doing any hull maintenance while their boats are in the water.

- Place trash receptacles in convenient locations for marina patrons. Covered dumpsters and trash cans are ideal.
- Provide trash receptacles at boat launch sites.
- Provide facilities for collecting recyclable materials.
- Encourage fishing line collection and recycling or disposal.
- Provide boaters with trash bags.
- Use a reusable blasting medium.
- Require patrons to clean up pet wastes and provide a specific dog walking area at the marina.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Fish Waste Management Measure

Promote sound fish waste management through a combination of fish-cleaning restrictions, public education, and proper disposal of fish waste.

Applicability: This management measure applies to marinas where fish waste is determined to be a source of water pollution.

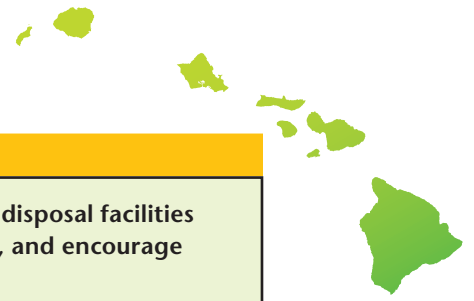
Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about fish waste management:

- Clean fish offshore where the fish are caught and discard of the fish waste at sea (if allowed by the state).
- Install fish cleaning stations at the marina and at boat launch sites.
- Compost fish waste where appropriate.
- Freeze fish parts and reuse them as bait or chum on the next fishing trip.
- Encourage catch and release fishing, which does not kill the fish and produces no fish waste.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



Liquid Material Management Measure

Provide and maintain appropriate storage, transfer, containment, and disposal facilities for liquid material, such as oil, harmful solvents, antifreeze, and paints, and encourage recycling of these materials.

Applicability: This management measure applies to the operation and maintenance of marinas where liquid materials used in the maintenance, repair, or operation of boats are stored.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about liquid material management:

- Build curbs, berms, or other barriers around areas used for liquid material storage to contain spills.
- Store liquid materials under cover on a surface that is impervious to the type of material stored.
- Storage and disposal areas for liquid materials should be located in or near repair and maintenance areas, undercover, protected from runoff, with berms or secondary containment, and away from flood areas and fire hazards.
- Store minimal quantities of hazardous materials.
- Provide clearly labeled, separate containers for the disposal of waste oils, fuels, and other liquid wastes.
- Recycle liquid materials where possible.
- Change engine oil using nonspill vacuum-type systems to perform spill-proof oil changes or to suction oily water from bilges.
- Use antifreeze and coolants that are less toxic to the environment.
- Use alternative liquid materials where practical.
- Follow manufacturer's directions and use nontoxic or low-toxicity pesticides.
- Burn used oil used as a heating fuel.
- Prepare a hazardous materials spill recovery plan and update it as necessary.
- Keep adequate spill response equipment where liquid materials are stored.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Petroleum Control Management Measure

Reduce the amount of fuel and oil from boat bilges and fuel tank air vents entering marina and surface waters.

Applicability: This management measure applies to boats that have inboard fuel tanks.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about petroleum control:

- Promote the installation and use of fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel spilled into surface waters during fueling.
- Avoid overfilling fuel tanks.
- Provide “doughnuts” or small petroleum absorption pads to patrons to use while fueling to catch splashback and the last drops when the nozzle is transferred back from the boat to the fuel dock.
- Keep engines properly maintained for efficient fuel consumption, clean exhaust, and fuel economy. Follow the manufacturer’s specifications.
- Routinely check for engine fuel leaks and use a drip pan under engines.
- Avoid pumping any bilge water that is oily or has a sheen. Promote the use of materials that capture or digest oil in bilges. Examine these materials frequently and replace as necessary.
- Extract used oil from absorption pads if possible, or dispose of it in accordance with petroleum disposal guidelines.
- Prohibit the use of detergents and emulsifiers on fuel spills.

For further information see:

Responsible Agencies and Authorities: **A Supplemental For Hawaii Management Measures**

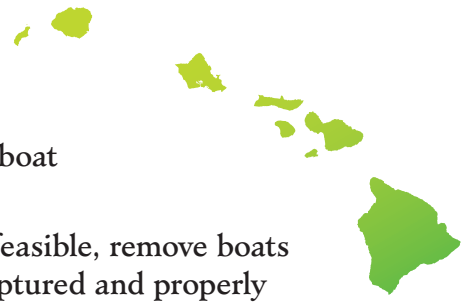
(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Boat Cleaning Management Measure

For boats that are in the water, perform cleaning operations to minimize, to the extent practicable, the release to surface waters of harmful cleaners, solvents and paint from in-water hull cleaning.

Applicability: This management measure applies to marinas where boat topsides are cleaned and marinas where hull scrubbing in the water has been shown to result in water or sediment quality problems.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR



rules in 2004, contains the following specific language about boat cleaning:

- Wash boat hulls above the waterline by hand. Where feasible, remove boats from the water and clean them where debris can be captured and properly disposed of.
- Attempt to wash boats frequently enough that the use of cleansers will not be necessary.
- If using cleansers, buy and use ones that will have minimal impact on the aquatic environment.
- Switch to long-lasting and low-toxicity or nontoxic antifouling paints.
- Avoid in-the-water hull scraping or any abrasive process done underwater that could remove paint from the boat hull.
- Ensure that adequate precautions have been taken to minimize the spread of exotic and invasive species when boats are transferred from one waterbody to another.
- Minimize the impacts of wastewater from pressure washing.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Public Education Management Measure

Public education/outreach/training programs should be instituted for boaters, as well as marina owners and operators, to prevent improper disposal of polluting material.

Applicability: This management measure applies to all environmental control authorities in areas where marinas are located.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about public education:

- Use signs to inform marina patrons of appropriate clean boating practices.
- Establish bulletin boards for environmental messages and idea sharing.
- Promote recycling and trash reduction programs.
- Hand out pamphlets or flyers, send newsletters, and add inserts to bill mailings with information about how recreational boaters can protect the environment and have clean boating waters.
- Organize and present enjoyable environmental education meetings, presentations, and demonstrations and consider integrating them into ongoing programs.

- Educate and train marina staff to do their jobs in an environmentally conscious manner and to be good role models for marina patrons.
- Insert language into facility contracts that promotes tenants' using certain areas and clean boating techniques when maintaining their boats. Use a contract that ensures that tenants will comply with the marina's best management practices.
- Have a clearly written environmental best management practices agreement for outside contractors to sign as a precondition to working on any boat in the marina.
- Participate with an organization that promotes clean boating practices.
- Provide MARPOL placards.
- Paint signs on storm drains.
- Establish and educate marina patrons about rules governing fish cleaning.
- Educate boaters about good fish cleaning practices.
- Provide information on local waste collection and recycling programs.
- Hold clinics on safe fueling and bilge maintenance.
- Teach boaters how to fuel boats to minimize fuel spills.
- Stock phosphate-free, nontoxic cleaners and other environmentally friendly products.
- Place signs in the water and label charts to alert boaters about sensitive habitat areas.
- Educate boaters to thoroughly clean their boats before boating in other waterbodies.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures
http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf

Maintenance of Sewage Facilities Management Measure

Ensure that sewage pumpout facilities are maintained in operational condition and encourage their use.

Applicability: This management measure applies to marinas where marine sewage disposal facilities exist.

Practices: The *National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating* (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about maintenance of sewage facilities:

- Regularly inspect and maintain sewage facilities.
- Disinfect the suction connection of a pumpout station (stationary or portable) by dipping it into or spraying it with disinfectant.



- Maintain convenient, clean, dry, and pleasant restroom facilities in the marina.
- Maintain a dedicated fund and issue a contract for pumpout and dump station repair and maintenance.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Boat Operation Management Measure (applies to boating only)

Restrict boating activities where necessary to decrease turbidity and physical destruction of shallow-water habitat.

Applicability: This management measure applies in non-marina surface waters where evidence indicates that boating activities are impacting shallow-water habitats.

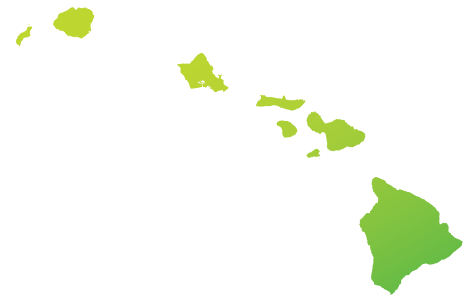
Practices: The National Management Measures to Control Nonpoint Source Pollution from Marinas and Recreational Boating (2001), which was incorporated into DLNR-DOBOR rules in 2004, contains the following specific language about boat operation:

- Restrict boater traffic in shallow-water areas.
- Establish and enforce no wake zones to decrease turbidity, shore erosion, and damage in marinas.

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



5.5 Hydromodification

A. Introduction

There are four management measures that apply to hydromodification.

1. Physical and Chemical Characteristics of Surface Waters	3. Protection of Surface Water Quality and Instream and Riparian Habitat from Dams
2. Instream and Riparian Habitat Restoration	4. Eroding Streambank and Shorelines

According to the Environmental Protection Agency's (EPA) *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, **hydromodification** means "alteration of the hydrologic characteristics of coastal and non-coastal waters, which in turn could cause degradation of water resources" (p 6-90). In other words, any alteration to a stream or coastal waters, whether a diversion, channel, dam, or levee is considered a hydromodification. The hydromodification management measures affect all land use activities, especially those associated with agriculture, forestry and urban development. Therefore, these management measures should be considered in conjunction with the management measures for agriculture, forestry, urban areas and, to a lesser extent, marinas.

For the purposes of this chapter, the following definitions will be used.

- A **stream** is any natural water course in which water usually flows in a defined bed or channel. The flow can be constant, uniform, or uninterrupted, regardless of whether the stream has been altered or channelized.
- A **perennial stream** carries water at all times.
- An **intermittent stream** carries water most of the time but periodically ceases to flow when evaporation or seepage into the stream's bed and banks exceed the available streamflow. For the purposes of this management measure, intermittent streams will also include:
 - ephemeral streams that carry water only after rains; and
 - interrupted streams that carry water generally through their length but may have sections with dry streambeds.
- A **channel** is a natural or constructed waterway that continuously or periodically passes water.
- A **streambank** is the side slopes of a channel between which the streamflow is normally confined.

The following table provides a brief overview of authorities that apply to the Hydromodification management measures. A more detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure can be found in *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures*.

Authority		Responsible Agency	Phys & Chem Characteristics Surface Water	Instream & Riparian Habitat Rest'n	Prot'n of Surface of WQ & Instream/ Riparian Habitat	Eroding Streambanks and Shorelines
Local	Chapter 12-202, MCC, SMA Rules for Maui Png Comm.	Maui Png Commission	X	X	X	X
	Chapter 12-302 MCC, SMA Rules for Molokai Png Comm.	Molokai Png Commission	X	X	X	X
	Chapter 12-402, MCC, SMA Rules for Lanai Png Comm.	Lanai Png Commission	X	X	X	X
	<i>2030 General Plan Update: Draft Countywide Policy Plan (2008)</i>	Maui County				X
	Chapter 14-12, ROH Drainage, Flood & Pollution Control	CCH – DPW	X	X	X	X
	Chapter 25, ROH Special Mgt Area	CCH Png Commission	X	X	X	X
	Chapter 41-26, ROH Maint. of Channels, Streambeds, Streambanks etc.	CCH – DPW	X	X	X	X
	various sustainable communities and development plans for Oahu	CCH				X
	Rule 9, Hawaii County Planning Commission	Hawaii Cty. Png Comm.	X	X	X	X
	<i>Hawaii County General Plan (2005)</i>	Hawaii County				X
	SMA Rules and Regs of the County of Kauai	Kauai Png Commission	X	X	X	X
	<i>The Kauai General Plan (2000)</i>	Kauai County				X
State	Chapter 46, HRS General Provisions, County Org'n and Admin	Counties	X	X		

Authority		Responsible Agency	Phys & Chem Characteristics Surface Water	Instream & Riparian Habitat Rest'n	Prot'n of Surface of WQ & Instream/ Riparian Habitat	Eroding Streambanks and Shorelines
State	Chapter 174C, HRS Hawaii Water Code	DLNR-CWRM	X	X	X	X
	Chapter 179D, HRS Dams and Reservoirs	DLNR			X	
	Chapter 183C, HRS Conservation District	DLNR	X	X		
	Chapter 205A, HRS Coastal Zone Management	OP-CZM	X	X	X	X
	Chapter 342D, HRS Water Pollution	DOH	X	X	X	X
	Chapter 343, HRS Env'l Impact Statements	OEQC	X	X	X	X
	Chapter 11-54, HAR Water Quality Standards	DOH	X	X	X	
	Chapter 11-55, HAR Water Pollution Control	DOH	X	X	X	X
	Chapter 11-200, HAR EIS Rules	OEQC	X	X	X	X
	Chapter 13-5, HAR Conservation District	DLNR	X	X		
	Chapter 13-169, HAR Protection of Instream Uses of Water	DLNR-CWRM	X	X	X	X
	Chapter 13-231, HAR Operation of Boats, Small Boat Harbors, and Permits	DLNR-DOBOR				X
	Chapter 13-244, HAR Rules of the Road	DLNR-DOBOR				X
	Chapter 13-256, HAR Ocean Rec Mgt Rules & Areas	DLNR-DOBOR				X
	Chapter 15-150, HAR SMA/Shoreline Areas	OP	X	X	X	X
Federal	Section 404, CWA	USACOE	X	X	X	X
	Section 10, Rivers and Harbors Act of 1899	USACOE	X	X	X	X

B. Management Measures

Channelization and Channel Modification

Management Measure for Physical and Chemical Characteristics of Surface Waters

1. Evaluate the potential effects of proposed channelization and channel modification on the physical and chemical characteristics of surface waters in coastal areas;
2. Plan and design channelization and channel modification to reduce undesirable impacts; and
3. Develop an operation and maintenance program for existing modified channels that includes identification and implementation of opportunities to improve physical and chemical characteristics of surface waters in those channels.

Applicability: This management measure applies to public and private channelization and channel modification activities to prevent the degradation of physical and chemical characteristics of surface waters from such activities. This management measure applies to any proposed channelization or channel modification projects, including levees, as well as existing modified channels. Watershed planning and implementation efforts related to the physical and chemical characteristics of surface waters associated with modified channels should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter6/ch6-2a.html>

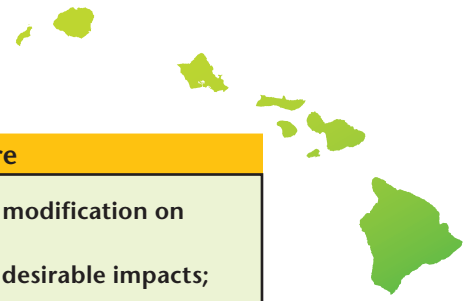
Description: The purpose of this management measure is to ensure that the planning process for new hydromodification projects addresses changes to physical and chemical characteristics of surface waters that may occur as a result of the proposed work. Implementation of this management measure is intended to occur concurrently with the implementation of Instream and Riparian Habitat Restoration. For existing projects, the purpose of this management measure is to ensure that the operation and maintenance program uses any opportunities available to improve the physical and chemical characteristics of the surface waters. Changes created by channelization and channel modification activities are problematic if they unexpectedly alter environmental parameters to levels outside normal or desired ranges. The physical and chemical characteristics of surface waters that may be influenced by channelization and channel modification include sediment, turbidity, salinity, temperature, nutrients, dissolved oxygen, oxygen demand, and contaminants.

Practices: Suggested practices related to physical and chemical characteristics of channelization and channel modification: http://www.epa.gov/owow/NPS/hydromod/pdf/Chapter_3_Channelization_web.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

**Instream and Riparian Habitat Restoration Management Measure**

Evaluate the potential effects of proposed channelization and channel modification on instream and riparian habitat in coastal areas;
Plan and design channelization and channel modification to reduce undesirable impacts; and
Develop an operation and maintenance program with specific timetables for existing modified channels that includes identification of opportunities to restore instream and riparian habitat in those channels.

Applicability: This management measure applies to any proposed channelization or channel modification project to determine changes in instream and riparian habitats and to existing modified channels to evaluate possible improvements to these environments. Watershed planning and implementation efforts related to instream and riparian habitat associated with modified channels should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter6/ch6-2b.html>

Description: The purpose of this management measure is to correct or prevent detrimental changes to instream and riparian habitat from the impacts of channelization and channel modification projects. Implementation of this management measure is intended to occur concurrently with the implementation of Physical and Chemical Characteristics of Surface Waters management measure.

Contact between floodwaters and overbank soil and vegetation can be increased by a combination of setback levees and use of compound-channel designs. Levees set back away from the streambank (setback levees) can be constructed to allow for overbank flooding, which provides surface water contact to important streamside areas (including wetlands and riparian areas). Additionally, setback levees still function to protect adjacent property from flood damage. Compound-channel designs consist of an incised, narrow channel to carry surface water during low (base)-flow periods, a staged overbank area into which the flow can expand during design flow events, and an extended overbank area, sometimes with meanders, for high-flow events. Planting of the extended overbank with suitable vegetation completes the design.

Preservation of ecosystem benefits can be achieved by site-specific design to obtain predefined optimum or existing ranges of physical environmental conditions. Mathematical models can be used to assist in site-specific design. Instream and riparian habitat alterations caused by secondary effects can be evaluated by the use of models and other decision aids in the design process of a channelization and channel modification activity. After using models to evaluate secondary effects, restoration programs can be established.

Practices: Suggested practices related to instream and riparian habitat restoration of channelization and channel modification: http://www.epa.gov/owow/NPS/hydromod/pdf/Chapter_3_Channelization_web.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Dams

Management Measure for Protection of Surface Water Quality and Instream and Riparian Habitat

Develop and implement a program to manage the operation of dams in coastal areas that includes an assessment of:
Surface water quality and instream and riparian habitat and potential for improvement; and
Significant nonpoint source pollution problems that result from excessive surface water withdrawals.

Applicability: This management measure applies to dam operations that result in the loss of desirable surface water quality, and of desirable instream and riparian habitat. Dams are defined as constructed impoundments which are either:

- a. 25 feet or more in height and greater than 15 acre-feet in capacity, or
- b. 6 feet or more in height and greater than 50 acre-feet in capacity.

Practices: Suggested practices related to dams: http://www.epa.gov/owow/NPS/hydromod/pdf/Chapter_4_Dams_web.pdf

For further information see:

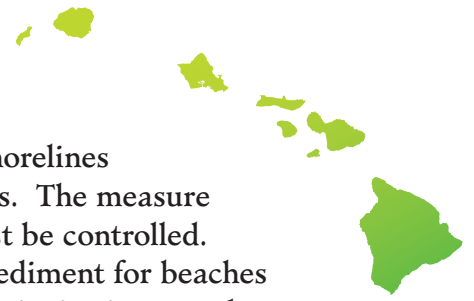
Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Streambank and Shoreline Erosion

Management Measure for Eroding Streambanks and Shorelines

1. Where streambank or shoreline erosion is a serious nonpoint source pollution problem, streambanks and shorelines may need to be stabilized. Vegetative methods are strongly preferred. Structural methods may be necessary where vegetative methods cannot work and where they do not interfere with natural processes or harm other sensitive ecological areas.
2. Protect streambank and shoreline features with the potential to reduce nonpoint source pollution.
3. Protect streambanks and shorelines from erosion due to uses of either the shorelands or adjacent surface waters.
4. Where artificial fill is eroding into adjacent streams or coastal waters, it should be removed.



Applicability: This management measure applies to eroding shorelines in coastal bays and to eroding streambanks in coastal streams. The measure does not imply that all shoreline and streambank erosion must be controlled. Some amount of natural erosion is necessary to provide the sediment for beaches in estuaries and coastal bays, for point bars and channel deposits in rivers, and for substrate in tidal flats and wetlands. The measure, however, applies to eroding shorelines and streambanks that constitute a nonpoint source pollution problem in surface waters. It is not intended to hamper the efforts of any States or localities to retreat rather than to harden the shoreline. Watershed planning and implementation efforts related to streambank and shoreline erosion should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter6/ch6-4.html>

Description: Several streambank and shoreline stabilization techniques will be effective in controlling coastal erosion wherever it is a source of nonpoint pollution. Techniques involving marsh creation and vegetative bank stabilization ("soil bioengineering") will usually be effective at sites with limited exposure to strong currents or wind-generated waves. In other cases, the use of engineering approaches, including beach nourishment or coastal structures, may need to be considered. In addition to controlling those sources of sediment input to surface waters which are causing NPS pollution, these techniques can halt the destruction of wetlands and riparian areas located along the shorelines of surface waters. Once these features are protected, they can serve as a filter for surface water runoff from upland areas, or as a sink for nutrients, contaminants, or sediment already present as NPS pollution in surface waters.

Stabilization practices involving vegetation or coastal engineering should be properly designed and installed. These techniques should be applied only when there will be no adverse effects to aquatic or riparian river habitat, or to the stability of adjacent shorelines, from stabilizing a source of shoreline sediments. Finally, it is the intent of this measure to promote institutional measures that establish minimum set-back requirements or measures that allow a buffer zone to reduce concentrated flows and promote infiltration of surface water runoff in areas adjacent to the shoreline.

Practices: Suggested practices related to streambank and shoreline erosion: http://www.epa.gov/owow/NPS/hydromod/pdf/Chapter_5_Erosion_web.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures
(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



5.6 Wetlands, Riparian Areas, and Vegetated Treatment Systems

A. Introduction

There are three management measures that apply to wetlands, riparian areas, and vegetated treatment systems.

1. Protection of Wetlands and Riparian Areas
2. Restoration of Wetlands and Riparian Areas
3. Vegetated Treatment Systems

For the purposes of Hawaii's coastal nonpoint pollution control program, **wetlands** are defined as:

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.³

For the purposes of the coastal nonpoint pollution control program, **riparian areas** are defined as:

Vegetated ecosystems along a waterbody through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent waterbody. These systems encompass wetlands, uplands, or some combination of these two land forms. They will not in all cases have all of the characteristics necessary for them to be classified as wetlands.⁴

Wetlands and riparian areas can play a critical role in reducing polluted runoff by intercepting surface runoff, subsurface flow, and certain groundwater flows. Their role in quality improvement includes processing, removing, transforming, and storing such pollutants as sediment, nitrogen, phosphorus, and certain heavy metals. Thus, wetlands

³ This definition is consistent with the Federal definition at 40 CFR 230.3, promulgated December 24, 1980. As amendments are made to the wetland definition, they will be considered applicable to this program.

⁴ This definition is adapted from the definitions offered previously by Mitsch and Gosselink (1986) and Lowrance et al. (1988).

and riparian areas buffer receiving waters from the effects of pollutants, or they prevent the entry of pollutants into receiving waters.

The following table provides a brief overview of authorities that apply to the Wetlands, Riparian Areas, and Vegetated Treatment Systems management measures. A more detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure can be found in *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures*.

Authority		Responsible Agency	Protection of Wetlands & Riparian Areas	Restoration of Wetlands & Riparian Areas	Vegetated Treatment Systems
Local	Chapter 12-202, MCC, SMA Rules for Maui PIng Comm.	Maui PIng Commission	X	X	
	Chapter 12-302 MCC, SMA Rules for Molokai PIng Comm.	Molokai PIng Commission	X	X	
	Chapter 12-402, MCC, SMA Rules for Lanai PIng Comm.	Lanai PIng Commission	X	X	
	<i>2030 General Plan Update: Draft Countywide Policy Plan (2008)</i>	Maui County	X		
	Chapter 25, ROH Special Mgt Area	CCH PIng Commission	X	X	
	various sustainable communities and development plans for Oahu	CCH	X		
	Rule 9, Hawaii County Planning Commission	Hawaii Cty. PIng Comm.	X	X	
	<i>Hawaii County General Plan (2005)</i>	Hawaii County	X		
	SMA Rules and Regs of the County of Kauai	Kauai PIng Commission	X	X	
	<i>The Kauai General Plan (2000)</i>	Kauai County	X		
State	Chapter 173A, HRS Acquisition of Resource Value Lands	DLNR	X	X	
	Chapter 174C, HRS Hawaii Water Code	DLNR – CWRM	X	X	
	Chapter 183, HRS Forest Reserves, Water Dev't and Zoning	DLNR	X	X	
	Chapter 183C, HRS Conservation District	DLNR	X	X	
	Chapter 195, HRS Natural Area Reserves System	DLNR	X	X	

Authority		Responsible Agency	Protection of Wetlands & Riparian Areas	Restoration of Wetlands & Riparian Areas	Vegetated Treatment Systems
State	Chapter 195D, HRS Conservation of Aquatic Life, Wildlife & Land Plants	DLNR	X	X	
	Chapter 198, HRS Conservation Easements	DLNR	X	X	
	Chapter 205A, HRS Coastal Zone Management	OP-CZM	X	X	
	Chapter 342D, HRS Water Pollution	DOH	X	X	
	Chapter 11-54, HAR Water Quality Standards	DOH	X	X	
	Chapter 13-5, HAR Conservation District	DLNR	X	X	
	Chapter 13-169, HAR Protection of Instream Uses of Water	DLNR – CWRM	X	X	
	Chapter 15-150, HAR SMAs/Shoreline Areas	OP	X	X	
Federal	Section 404, CWA	USACOE	X	X	
	Section 10, Rivers and Harbors Act of 1899	USACOE	X	X	

B. Management Measures

Management Measure for Protection of Wetlands and Riparian Areas

Protect from adverse effects wetlands and riparian areas that are serving a significant nonpoint source pollution abatement function and maintain this function while protecting the other existing functions of these wetlands and riparian areas as measured by characteristics such as vegetative composition and cover, hydrology of surface water and ground water, geochemistry of the substrate, and species composition.

Applicability: This management measure applies to protecting wetlands and riparian areas from adverse nonpoint source pollution impacts. Watershed planning and implementation efforts related to the protection of wetlands and riparian areas should rely upon information found at: <http://www.epa.gov/owow/NPS/MMGI/Chapter7/ch7-2a.html>

The purpose of this management measure is to protect the existing water quality improvement functions of wetlands and riparian areas as a component of NPS programs. The overall approach is to establish a set of practices that maintains functions of wetlands and riparian areas and prevents adverse impacts to areas serving

an NPS pollution abatement function. The ecosystem and water quality functions of wetlands and riparian areas serving an NPS pollution abatement function should be protected by a combination of programmatic and structural practices.

The term *NPS pollution abatement function* refers to the ability of a wetland or riparian area to remove NPS pollutants from runoff passing through the wetland or riparian area. Acting as a sink for phosphorus and converting nitrate to nitrogen gas through denitrification are two examples of the important NPS pollution abatement functions performed by wetlands and riparian areas.

This management measure provides for NPS pollution abatement through the protection of wetland and riparian functions. The permit program administered by the U.S. Army Corps of Engineers, EPA, and approved States under Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into waters of the United States, including wetlands. The measure and section 404 program complement each other, but the focus of the two is different.

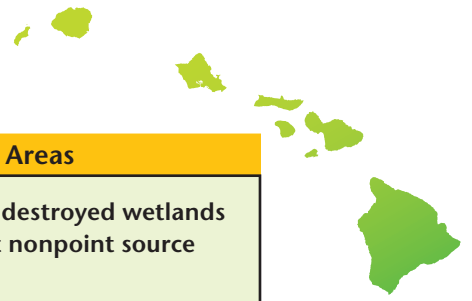
The measure focuses on nonpoint source problems in wetlands, as well as on maintaining the functions of wetlands that are providing NPS pollution abatement. The nonpoint source problems addressed include impacts resulting from upland development and upstream channel modifications that erode wetlands, change salinity, kill existing vegetation, and upset sediment and nutrient balances. The Section 404 program focuses on regulating the discharge of dredged or fill materials in wetlands, thereby protecting wetlands from physical destruction and other pollutant problems that could result from discharges of dredged or fill material. The nonpoint source pollution abatement functions performed by wetlands and riparian areas are most effective as parts of an integrated land management system that combines nutrient, sediment, and soil erosion control. These areas consist of a complex organization of biotic and abiotic elements. Wetlands and riparian areas are effective in removing suspended solids, nutrients, and other contaminants from upland runoff, as well as maintaining stream channel temperature.

Practices: Suggested practices related to the protection of wetlands and riparian areas: http://water.epa.gov/polwaste/nps/wetmeasures/upload/2005_08_19_NPS_wetmeasures_ch4.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures

(http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)



Management Measure for Restoration of Wetlands and Riparian Areas

Promote the restoration of the pre-existing functions in damaged and destroyed wetlands and riparian systems in areas where the systems will serve a significant nonpoint source pollution abatement function.

Applicability: This management measure applies to restoring the full range of wetland and riparian functions in areas where the systems have been degraded and destroyed, and where they can serve a significant nonpoint source pollution abatement function.

Practices: Suggested practices related to the restoration of wetlands and riparian areas: http://water.epa.gov/polwaste/nps/wetmeasures/upload/2005_08_19_NPS_wetmeasures_ch5.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures (http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Management Measure for Vegetated Treatment Systems

Promote the use of engineered vegetated treatment systems such as constructed wetlands or vegetated filter strips where these systems will serve a significant nonpoint source pollution abatement function.

Applicability: This management measure applies in cases where engineered systems of wetlands or vegetated treatment systems can treat polluted runoff. Constructed wetlands and vegetated treatment systems often serve a significant pollution abatement function.

Practices: Suggested practices related vegetated treatment systems: http://water.epa.gov/polwaste/nps/wetmeasures/upload/2005_08_19_NPS_wetmeasures_ch6.pdf

For further information see:

Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures (http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Monitoring and Tracking Techniques

Monitoring Implementation:

The overall management objective of section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) is to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters. The principal monitoring objective is to assess over time the success of the management measures in reducing pollution loads and improving water quality.

The objective above identifies the need for the monitoring: (1) to assess changes in pollution loads over time and (2) to assess changes in water quality over time. The State relies upon multiple efforts to assist in determining changes over time in pollutant loadings as well as changes in water quality.

1. State Comprehensive Water Quality Monitoring Strategy: As required by EPA, the State has developed a monitoring strategy to address ten elements of a state water monitoring and assessment program critical for an effective water quality monitoring program (<http://water.epa.gov/type/watersheds/monitoring/index.cfm>). The State's monitoring strategy will assist in determining how water quality is changing over time, identify problem areas in need restoration and high quality areas in need of protection, and determine the effectiveness of clean water projects and programs.
2. Projects supported with Section 319 funding: The State currently imposes several requirements related to the monitoring objectives stated above for projects supported with Section 319 funding. Watershed planning efforts are required to develop watershed plans which address Nine Elements (stated in the 2004 EPA Section 319 Funding Guidance) to insure these plans have adequate information to support implementation and a reasonable expectation the plans, once implemented, will result in water quality improvements. Watershed plans as well as implementation projects are required to document current pollutant loads and expected pollutant load reductions associated with implementation activities. This information is tracked by DOH for each project supported with Section 319 funding through the EPA Grants Reporting and Tracking System (GRTS).
3. Water Quality Monitoring and Integrated Water Quality Assessment: As part of its water quality monitoring program, DOH currently conducts baseline monitoring in several priority watersheds to assist with watershed plan development as well as eventual water quality trend analysis. Water quality monitoring priorities are coordinated within the DOH Clean Water Branch on at least an annual basis and are reflected in the State's Clean Water Act Section 106 and Section 319 workplans. The State addresses water quality assessment requirements of Section 305(b) of the Clean Water Act and the identification of impaired waters of Section 303(d) of the Clean Water Act through the State Integrated Water Quality Report. The



Integrated Report represents water quality assessment decisions made relative to the State's water quality standards and is based upon analysis of water quality monitoring data. This information is used to establish priorities for watershed planning and implementation as well as the development of Total Maximum Daily Loads. (See http://hawaii.gov/health/environmental/env-planning/wqm/2006_Integrated_Report/2006_Integrated_Report.pdf)

4. **Watershed Planning/Implementation:** All watershed plans supported with Section 319 funding from DOH must include a monitoring and evaluation component. This information is critical in determining if recommended actions have been adequate to reduce pollutant loads and improve water quality. Where the approach and/or recommended actions have not been adequate to reduce pollutant loads and improve water quality, monitoring and evaluation data provide the foundation for adaptive management and refinement of the plan to insure water quality goals are met.

Tracking Implementation:

The documentation of management measure implementation is critical if associations are to be drawn between implementation of the coastal nonpoint pollution control program and water quality improvements. Tracking of management measure implementation will be required as part of watershed management efforts in priority watersheds (through the Hawaii Watershed Guidance). Data will be compiled in DOH's Section 319 Annual Report to EPA to convey monitoring and tracking information where watershed implementation efforts have been initiated. Data will include tracking of management measures implemented and associated pollutant load reductions. DOH will consider a contract in the short-term to conduct a management measure inventory in a priority watershed as a pilot project to verify that the identified indicators are readily tracked. Indicators for tracking management measure implementation are identified in the tables below.

Indicators for Tracking Implementation-Agriculture Management Measures

Organization	Indicator
County Dept. of Public Works	Erosion and sediment control: number of permits for agricultural grubbing and grading issues each fiscal year by island; number of violations reported
Soil and Water Conservation Districts (SWCD)/ NRCS	Number of conservation plans related to agricultural operations approved annually by watershed, with acreage covered; BMPs for erosion and sediment control, confined animal facilities wastewater management, nutrient and pest management, grazing management and irrigation management reported by acreage; results of periodic inspections to ensure both technical specifications and maintenance standards have been met
Dept. of Health	Number of plans approved for livestock feeding or processing operations and waste systems under Chapter 11-62, HAR, for each fiscal year by island;
Dept. of Health	Number of water quality violations that were caused by erosion from agricultural lands

Indicators for Tracking Implementation-Forestry Management Measures

Organization	Indicator
Soil and Water Conservation Districts (SWCD)/ NRCS	Number of conservation plans related to forestry operations approved annually by Soil and Water Conservation District, with acreage covered; BMPs for forestry operations; results of periodic inspections to ensure both technical specifications and maintenance standards have been met
Hawaii Dept. of Land and Natural Resources	Number of conservation plans approved annually for Conservation District Use Permits for forestry operations, and under the Forest Stewardship and Tree Farms programs, with acreage covered; BMPs for forestry operations; results of periodic inspections to ensure both technical specifications and maintenance standards have been met
Dept. of Health	Number of water quality violations that were caused by runoff from forestry operations

Indicators for Tracking Implementation-Urban Management Measures

Organization	Indicator
County Dept. of Public Works	Numbers of site plans, drainage plans, and erosion and sediment control plans reviewed and approved for each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported
County Planning Depts.	Number of Special Management Area (SMA) permits issued for each fiscal year by island; types of BMPs/conditions required to address urban sources of polluted runoff
DOT Highways	Number of BMP plans for roads, highways and bridge construction reviewed and approved for each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported
Dept. of Health	Number of watershed plans developed for each fiscal year by island; number of plans being implemented with summary of BMPs used
Dept. of Health	Number of water quality violations that were caused by urban sources of polluted
County Wastewater Divisions	Database of pumped cesspools and septic systems, including location and volume
DOH	Database of individual wastewater permits issued; database of cesspools and septic systems, by Tax Map Key parcel, with any inspections and problems noted

Indicators for Tracking Implementation-Marinas and Recreational Boating Management Measures

Organization	Indicator
DLNR-Division of Boating & Ocean Recreation	Numbers of Conservation District Use Applications (CDUAs) related to marina activity reviewed and approved for each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported; number of on-site inspections for marina operations and maintenance; number of violations reported
County Planning Depts.	Number of Special Management Area (SMA) permits issued for marina development for each fiscal year by island; types of BMPs/conditions required to address sources of polluted runoff from marinas
Dept. of Health	Number of water quality violations that were caused by polluted runoff from marina activities



Indicators for Tracking Implementation-Hydromodification Management Measures

Comm Water Resources Management	Number of Stream Channel Alteration Permits (SCAPs) issued for each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported
USACOE	Number of Section 404 permits issued each fiscal year by island for hydromodifications; number of on-site inspections of BMPs conducted; number of violations reported
USACOE	Number of Section 10 permits issued each fiscal year by island for hydromodifications; number of on-site inspections of BMPs conducted; number of violations reported
Dept. of Land and Natural Resources	Number of Conservation District Use Permits (CDUPs) issued for each fiscal year by island for hydromodifications; number of on-site inspections of BMPs conducted; number of violations reported
County Planning Depts.	Number of Special Management Area (SMA) permits issued for each fiscal year by island; types of BMPs/conditions required to address urban sources of polluted runoff
Counties	Number of linear feet of channels inspected and maintained each fiscal year by island
Dept. of Health	Number of water quality violations that were caused by hydromodifications

Indicators for Tracking Implementation-Wetlands, Riparian Areas and Vegetated Treatment Systems Management Measures

Comm Water Resources Management	Number of Stream Channel Alteration Permits (SCAPs) issued for each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported
USACOE	Number of Section 404 permits issued each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported
USACOE	Number of Section 10 permits issued each fiscal year by island; number of on-site inspections of BMPs conducted; number of violations reported
Dept of Land and Natural Resources	Number of Conservation District Use Permits (CDUPs) issued for each fiscal year by island that affect wetlands or riparian areas; number of on-site inspections of BMPs conducted; number of violations reported
County Planning Depts.	Number of Special Management Area (SMA) permits issued for each fiscal year by island that affect wetlands or riparian areas; types of BMPs/conditions required to address urban sources of polluted runoff
Dept. of Health	Number of water quality violations that affected wetlands or riparian areas

Critical Coastal Areas and Additional Management Measures

The overall objective of Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) is to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters. CZARA also calls for the implementation of additional management measures where coastal water quality is impaired or threatened even after the implementation of the management measures.

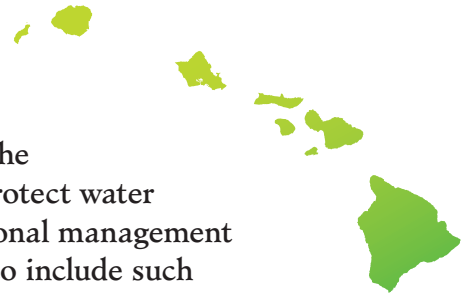
These additional measures apply both to existing land and water uses that cause or contribute to water quality impairment and to new or substantially expanding land uses within critical coastal areas adjacent to impaired or threatened coastal waters.

The State of Hawaii has determined the watershed protection approach is the most effective way to address these issues. The watershed protection approach is an integrated strategy for protecting and restoring beneficial uses of state waters. A focus on the development of plans in specific watersheds will aid in identifying critical areas requiring management measure implementation to address nonpoint source pollution. The approach will also identify watersheds where management measure implementation has not been adequate to address water quality impairments. The information below outlines the basics of the State's watershed protection approach efforts and how these efforts address the need to identify critical coastal areas and additional management measures.

Targeting Watersheds: The State will target the use of the watershed guidance to watersheds identified through a recently developed prioritization process. The prioritization process identifies a subset of the State's watersheds based upon several environmental characteristics including: hydrology, land cover, human land use, soils, receiving water quality classification, and high quality biological resources. The use of this process enables the State to focus its resources on watersheds most in need of management measure implementation to protect high quality ecosystems and prevent or restore water quality impairment. In essence, the prioritization process identifies critical watersheds where application of the watershed guidance and implementation of the management measures will be most beneficial to water quality and ecosystem health.

Developing Watershed Plans: The Hawaii watershed guidance will be used to assist with the development of watershed plans in areas identified by the prioritization process mentioned above. Each watershed plan will focus on a specific watershed where it will identify critical areas, which require management measure implementation. Watershed plans will be required to address EPA's nine elements for watershed plans and include mapping as well as description of critical areas requiring management measure implementation to achieve required load reductions and meet water quality standards. In addition, watershed planning efforts will be required to ensure protection of critical areas posed by anticipated future polluted runoff issues.

Watershed plans will also identify and implement additional management measures where coastal water quality remains impaired or threatened, after the implementation of all categories of management measures. Watershed plans are required to include a monitoring and evaluation component as well as an adaptive management process. Collectively, this information will be used by those implementing watershed



plans to identify specific instances where implementation of the management measures has not been adequate to restore or protect water quality. Through this adaptive management approach, additional management measures will be identified and the watershed plan modified to include such measures.

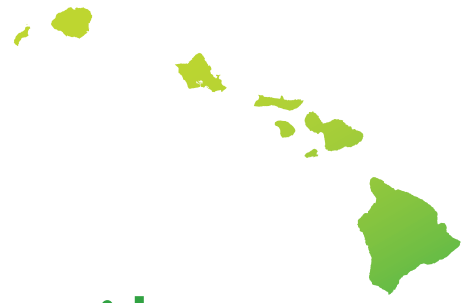
Appendix A: Glossary

Baseline	An initial set of observations or data used for comparison or as a control; a starting point.
Best management practice (BMP)	A method that has been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.
Criteria	Standards that define minimum conditions, pollutant limits, goals, and other requirements that the waterbody must attain or maintain to support its designated use or uses. Criteria describe physical, chemical, and biological attributes or conditions as measurable (such as parts per million of a certain chemical) or narrative (for example, no objectionable odors) water quality components.
CWA Section 303(d)	Section of the Clean Water Act under which states, territories, and authorized tribes are required to develop lists of impaired waters.
CWA Section 305(b)	Section of the Clean Water Act under which states are required to prepare a report describing the status of their water quality every 2 years.
CWA Section 319	Section of the Clean Water Act under which EPA has developed guidelines to help states, territories, and tribes implement nonpoint source pollutant management programs and provide grants to fund the programs.
Delineation	The process of identifying a watershed boundary on the basis of topographic information.
Designated use	Simple narrative description of water quality expectations or water quality goals. A designated use is a legally recognized description of a desired use of the waterbody, such as (1) support of communities of aquatic life, (2) body contact recreation, (3) fish consumption, and (4) public drinking water supply. The state or authorized tribe wants the waterbody to be healthy enough to fully support these uses. The Clean Water Act requires that waterbodies attain or maintain the water quality needed to support designated uses.



Information/education (I/E) activities	Public outreach.
Impaired waterbody	A waterbody that does not meet the criteria that support its designated use.
Indicator	Direct or indirect measurements of some valued component or quality in a system. Can be used to measure the current health of the watershed and to provide a way to measure progress toward meeting the watershed goals.
Management measure	A group of cost-effective practices implemented cooperatively to achieve more comprehensive goals, such as reducing the loads of sediment from a field to receiving waters.
Nine minimum elements	Components that EPA has identified as critical for achieving improvements in water quality. EPA requires that these nine elements be addressed for Section 319 funded watershed plans and strongly recommends they be included in all watershed plans that are intended to remediate water quality impairments.
Nonpoint source	<p>Diffuse pollution source; a source without a single point of origin or not introduced into a receiving stream from a specific outlet.</p> <p>The pollutants are generally carried off the land by stormwater.</p> <p>Common nonpoint sources are agriculture, forestry, urban areas, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.</p>
Point source	A stationary location or fixed facility that discharges pollutants; any single identifiable source of pollution, such as a pipe, ditch, ship, ore pit, or factory smokestack.
Pollutant	A contaminant in a concentration or amount that adversely alters the physical, chemical, or biological properties of the natural environment.
Pollutant load	The amount of pollutants entering a waterbody. Loads are usually expressed in terms of a weight and a time frame, such as pounds per day (lb/d).
Stakeholder	Individual or organization that has a stake in the outcome of the watershed plan.

Total Maximum Daily Load (TMDL)	The amount, or load, of a specific pollutant that a waterbody can assimilate and still meet the water quality standard for its designated use. For impaired waters, the TMDL reduces the overall load by allocating the load among current pollutant loads (from point and nonpoint sources), background or natural loads, a margin of safety, and sometimes an allocation for future growth.
Water quality standards	Standards that set the goals, pollution limits, and protection requirements for each waterbody. These standards are composed of designated (beneficial) uses, numeric and narrative criteria, and antidegradation policies and procedures.
Watershed	Land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.
Watershed approach	A flexible framework for managing water resource quality and quantity within specified drainage area, or watershed. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology.
Watershed plan	A document that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to development and implementation of the plan.



Appendix B: Government Agencies with Watershed Responsibilities

Government Entity	Areas of Responsibility	Website
County Government		
City and County of Honolulu, Department of Environmental Services (O'ahu)	<ul style="list-style-type: none"> Monitors and maintains sewage system, treatment facility, ocean outfall, storm water conveyance systems, and solid waste management system Regulates nonpoint source pollutant runoff through permits for construction, grading, and other development activities 	www.cleanwaterhonolulu.com/storm
Board of Water Supply (O'ahu)	<ul style="list-style-type: none"> Manages water resource distribution Develops watershed management plans for county water use Participates in watershed partnerships 	www.hbws.org/cssweb/
Hawai'i State Department of Business Economic Development and Tourism (DBEDT)		http://hawaii.gov/dbedt/
Office of Planning	<ul style="list-style-type: none"> Balances economic development and conservation interests Ensure comprehensive planning and coordination to enhance quality of life 	http://hawaii.gov/dbedt/op/
Hawai'i Coastal Zone Management Program	<ul style="list-style-type: none"> Manages coastal zone management program Establishes management measures and best management practices for non point source pollution Coordinating agency for implementation and update of the Hawai'i Ocean Resources Management Plan (ORMP) Can help fund watershed implementation projects through Sections 310, 306, and 306A, depending on the type of activity 	http://hawaii.gov/dbedt/czm/

Government Entity	Areas of Responsibility	Website
Hawai'i State Department of Health		http://hawaii.gov/health/
Clean Water Branch	<ul style="list-style-type: none"> Reviews and revises water quality standards for state waters Monitors water quality and point and nonpoint source pollutant discharges to state waters Coordinates outreach activities for nonpoint polluted runoff control program 	http://hawaii.gov/health/environmental/waste/ust/environmental/water/cleanwater/wqsmaps/index.html http://hawaii.gov/health/environmental/waste/ust/environmental/water/cleanwater/index.html
Environmental Planning Office	<ul style="list-style-type: none"> Monitors and assesses waterbody attainment of water quality standards Identifies impaired waters Establishes total maximum daily loads (TMDL) that, when implemented, lead to the attainment of water quality standards 	http://hawaii.gov/health/environmental/env-planning/index.html
Hawai'i State Department of Land and Natural Resources		http://hawaii.gov/dlnr/
Division of Forestry and Wildlife	<ul style="list-style-type: none"> Manages natural resources, preservation lands, endangered species, and critical habitats, including wetlands Provides technical and financial support to the Watershed Partnerships Program 	www.state.hi.us/dlnr/dofaw/pubs/BMPs_bestmanagement.pdf http://hawaii.gov/dlnr/dofaw/wpp
Division of Conservation and Resource Enforcement	<ul style="list-style-type: none"> Enforces state laws and rules for forest reserves, aquatic life and wildlife areas, coastal zones, conservation districts, and other state properties 	http://hawaii.gov/dlnr/docare/index.html
Division of Boating and Ocean Recreation	<ul style="list-style-type: none"> Manages and oversees statewide ocean recreation and coastal areas programs pertaining to the ocean waters and navigable streams 	http://hawaii.gov/dlnr/dbor/rules/amendment13232.htm
Division of Aquatic Resources	<ul style="list-style-type: none"> Coordinates Hawai'i Coral Program and Land based source of pollution working group that can assist planning and implementation of watershed projects targeting coral reef protection 	http://hawaii.gov/dlnr/dar/coral/coral_las_lbsp.html
Hawai'i State Department of Agriculture		http://hawaii.gov/hdoa/
Agricultural Resource Management	<ul style="list-style-type: none"> Monitors water diversions Manages irrigation systems Administers development and management of agricultural resources 	http://hawaii.gov/hdoa/arm/arm

Government Entity	Areas of Responsibility	Website
Hawai'i State Department of Transportation		http://hawaii.gov/dot
Highways Division	<ul style="list-style-type: none"> Monitors and maintains state highway system including litter, debris, and other nonpoint source discharges 	http://stormwaterhawaii.com/
Harbors Division	<ul style="list-style-type: none"> Maintains and operates 10 commercial harbors and supports waterfront facilities available to the public 	http://hawaii.gov/dot/harbors/library/storm-management-plan
U.S. Environmental Protection Agency		www.epa.gov/ www.epa.gov/region9/
NPDES Wastewater and Stormwater Permits	<ul style="list-style-type: none"> Regulates point and nonpoint source discharges through National Pollutant Discharge Elimination System (NPDES) 	www.epa.gov/region9/water/npdes/
Watershed Priorities	<ul style="list-style-type: none"> Provides guidance and training for watershed planning and implementation 	www.epa.gov/region9/water/watershed/index.html
Monitoring, Assessment and TMDLs	<ul style="list-style-type: none"> Provides guidance and assistance in the development and implementation of TMDL studies 	www.epa.gov/region9/water/tmdl/index.html
U.S. Coast Guard		www.uscg.mil/
Hawai'i District	<ul style="list-style-type: none"> Maintains contingency plan Responds to oil spills 	www.uscg.mil/top/missions/marineenvironmentalprotection.asp
U.S. Fish and Wildlife Service		www.fws.gov/
Pacific Region	<ul style="list-style-type: none"> Identifies and protects endangered species and critical habitats Manages National Wildlife Refuges 	www.fws.gov/angered/ www.fws.gov/refuges/
U.S. Department of Agriculture		http://goo.gl/S7SV4
Conservation Planning	<ul style="list-style-type: none"> Develops best management practices for farm and livestock operations to minimize soil erosion and polluted surface water runoff Assists agri-business implement best management practices 	www.nrcs.usda.gov/
U.S. Geological Survey		www.usgs.gov/
Pacific Islands Region	<ul style="list-style-type: none"> Conducts studies and assessments of hydrologic conditions and water quality Mapping Hawai'i's water resources 	www.usgs.gov/water/
U.S. Army Corps of Engineers		http://corpslakes.usace.army.mil/nrm.cfm
Pacific Ocean Division	<ul style="list-style-type: none"> Helps state and local agencies fund and implement projects related to flood control and ecological restoration 	www.poh.usace.army.mil/CW/CWProjects.htm

Appendix C: Sources of Data Typically Used in Watershed Characterization

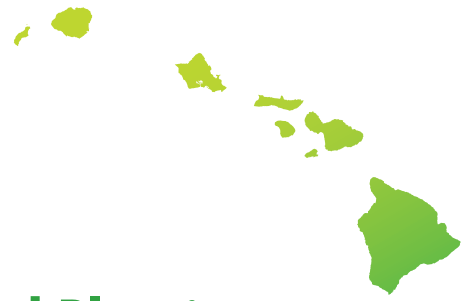
Data Type	Typical Uses of Data	Data Sources
Physical and Natural Features		
Watershed boundaries	<ul style="list-style-type: none"> • Provide geographic boundaries for evaluation and source control • Delineate drainage areas at desired scale 	<ul style="list-style-type: none"> • USGS NWIS - http://wdr.water.usgs.gov/nwisgmap/?state=hi • DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm
Hydrology	<ul style="list-style-type: none"> • Define hydrologic units • In-stream flow standards assessment report • Identify the locations of waterbodies • Identify the spatial relationship of waterbodies, including what segments are connected and how water flows through the watershed (for example, delineate drainage areas contributing to wetlands) 	<ul style="list-style-type: none"> • Hawaii State Water Commission on Water Resources- http://hawaii.gov/dlnr/cwrm/sw_hydrounits.htm • Hawaii State Water Commission on Water Resources- http://hawaii.gov/dlnr/cwrm/sw_ifsar.htm • USGS PIWSC - http://hi.water.usgs.gov/ • DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm
Topography	<ul style="list-style-type: none"> • Derive slopes of stream segments and watershed areas (to identify unstable areas and to characterize segments and subwatersheds in watershed modeling) • Evaluate altitude changes (necessary when extrapolating precipitation from one area to another) 	<ul style="list-style-type: none"> • USGS - http://ncgmp.usgs.gov/ • DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm

Data Type	Typical Uses of Data	Data Sources
Soils	<ul style="list-style-type: none"> Identify potential areas with higher erosion rates, poor drainage, or steep slopes Use to delineate subwatersheds and develop input data for models Use detailed soil maps and obtain other information 	<ul style="list-style-type: none"> USDA NRCS - www.pia.nrcs.usda.gov/soils.html USDA NRCS - http://websoilsurvey.nrcs.usda.gov/app/ CTAHR - www.ctahr.hawaii.edu/Deenik/downloads.asp
Climate	<ul style="list-style-type: none"> Provide climate and storm data for use in modeling applications Drive simulation of rainfall-runoff processes in watershed models 	<ul style="list-style-type: none"> NOAA - www.csc.noaa.gov/digitalcoast/ NWS - www.weather.gov/climate/local_data.php?wfo=hnl
Habitat	<ul style="list-style-type: none"> Identify management measures for projects involving critical habitats, including coastal and terrestrial habitats Determine applicable state laws for critical habitats Identify spatial boundaries of critical habitats and preservation areas 	<ul style="list-style-type: none"> DLNR DAR - http://hawaii.gov/dlnr/dar/coral/coral_las_lbsp.html DLNR DOFAW - http://hawaii.gov/dlnr/dofaw DLNR DOCARE - http://hawaii.gov/dlnr/docare/index.html DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm
Species	<ul style="list-style-type: none"> Identify special wildlife species to be protected Identify potential sources of bacteria and nutrients Identify vegetation, forest products, game management, recreation management classifications and maps by island 	<ul style="list-style-type: none"> DLNR DOFAW - http://hawaii.gov/dlnr/dofaw DLNR DAR - http://hawaii.gov/dlnr/dar/index.html DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm DLNR DOFA - www.state.hi.us/dlnr/dofaw/guidelines/mg_jw03/index.html
Land Use and Population Characteristics		
Land use and land cover	<ul style="list-style-type: none"> Identify spatial boundaries of various land use types, including change in land use over time Evaluate population data for potential use in modeling applications 	<ul style="list-style-type: none"> Hawaii LUC - http://luc.state.hi.us/luc_maps.htm DPP LUO - ftp://gisftp.hicentral.com/Layers/Zoning_Regulatory/ DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm USGS Aerials - http://hawaii.wr.usgs.gov/index.html DBEDT - http://hawaii.gov/dbedt/info/census/

Data Type	Typical Uses of Data	Data Sources
Existing land management practices	<ul style="list-style-type: none"> Identify current control practices and potential targets for future management Identify potential watershed pollutant sources 	<ul style="list-style-type: none"> Hawaii LUC - http://luc.state.hi.us/admin_rules.htm EPA NPDES Directory - www.epa.gov/enviro/html/pcs/pcs_query_java.html DOH SDWB - http://hawaii.gov/health/environmental/water/sdwb/conmaps/conmaps.html DOH UIC - http://hawaii.gov/health/environmental/water/sdwb/uic/uicprogrm.html C&C BWS - www.hbws.org/cssweb/display.cfm?sid=1406
Watershed Conditions		
Water quality standards	<ul style="list-style-type: none"> Identify protected uses of the waterbody and associated water quality standards 	<ul style="list-style-type: none"> DOH CWB - http://hawaii.gov/health/environmental/water/cleanwater/wqsmaps/index.html EPO - http://hawaii.gov/health/environmental/env-planning/wqm/wqsbrochure.pdf HAR - http://gen.doh.hawaii.gov/sites/har/AdmRules1/11-54.pdf
305(b) Report	<ul style="list-style-type: none"> Identify the status of designated use support in watershed waterbodies Identify potential causes and sources of impairment 	<ul style="list-style-type: none"> Hawaii 305(b) - http://hawaii.gov/health/environmental/water/cleanwater/contact/reports/reports.html
303(d) List	<ul style="list-style-type: none"> Identify known pollutant impairments in the watershed Identify geographic extent of impaired waterbody segments Identify potential causes and sources of impairment reports 	<ul style="list-style-type: none"> Hawaii 303(d) - http://hawaii.gov/health/environmental/env-planning/wqm/2006_Integrated_Report/2006_Integrated_Report.pdf
Existing TMDL Reports	<ul style="list-style-type: none"> Provide information on watershed characteristics, waterbody conditions, sources, and pollutant loads (for specific waterbodies and pollutants) 	<ul style="list-style-type: none"> EPO - http://hawaii.gov/health/environmental/env-planning/wqm/wqm.html
Source water assessments	<ul style="list-style-type: none"> Identify water supply areas to be protected Identify potential sources of contamination to the water supply 	<ul style="list-style-type: none"> C&C BWS - www.hbws.org/cssweb/display.cfm?sid=1059

Data Type	Typical Uses of Data	Data Sources
Pollutant Sources		
Point sources	<ul style="list-style-type: none"> Characterize potential point sources for quantifying loads 	<ul style="list-style-type: none"> Hawaii 303(d) - http://hawaii.gov/health/environmental/env-planning/wqm/2006_Integrated_Report/2006_Integrated_Report.pdf EPO - http://hawaii.gov/health/environmental/env-planning/wqm/wqm.html EPA NPDES Directory - www.epa.gov/enviro/html/pcs/pcs_query_java.html
Nonpoint sources	<ul style="list-style-type: none"> Characterize potential nonpoint sources for quantifying loads 	<ul style="list-style-type: none"> DOH CWB - http://hawaii.gov/health/environmental/water/cleanwater/contact/reports/prc/index.html DOH CWB IP - http://hawaii.gov/health/environmental/water/cleanwater/prc/prc/prc/implan-index.html CZM CNPCP - http://Hawaii.gov/dbedt/czm/initiative/nonpoint.php CZM CNPCP MP - www.state.hi.us/dbedt/czm/initiative/nonpoint_mgmt_plan.php
Waterbody Monitoring Data		
Water quality and flow	<ul style="list-style-type: none"> Characterize water quality and flow conditions throughout the watershed Provide information on critical conditions, temporal trends, spatial variations, and magnitude of impairment 	<ul style="list-style-type: none"> NRCS - www.pia.nrcs.usda.gov/technical/water_quality.html Hawaii 305(b) - http://hawaii.gov/health/environmental/water/cleanwater/contact/reports/reports.html Hawaii 303(d) - http://hawaii.gov/health/environmental/env-planning/wqm/2006_Integrated_Report/2006_Integrated_Report.pdf USGS NWIS - http://waterdata.usgs.gov/hi/nwis/
Biology	<ul style="list-style-type: none"> Provide information on general health of the watershed, considering long-term effects 	<ul style="list-style-type: none"> DOH CWB - http://emdweb.doh.hawaii.gov/CleanWaterBranch/WaterQualityData/default.aspx USGS PIWSC - http://hi.water.usgs.gov/ DLNR DAR - http://hawaii.gov/dlnr/dar/index.html Bishop Museum – Atlas of Hawai'i's Watersheds www.hawaiiwatershedatlas.com/

Data Type	Typical Uses of Data	Data Sources
Geomorphology	<ul style="list-style-type: none"> Describe river or stream pattern, profile, and dimension Characterize drainage basin, channel/bank morphology Classify river or stream type, based on morphology Assess changes to morphology over time Identify spatial boundaries and locations of waterbodies 	<ul style="list-style-type: none"> USGS PIWSC - http://hi.water.usgs.gov/ DBEDT GIS Clearinghouse - www.state.hi.us/dbedt/gis/download.htm
Other Information Sources	<ul style="list-style-type: none"> Total Maximum Daily Load Studies are prepared by consultants and the Hawai'i DOH (http://hawaii.gov/health/environmental/env-planning/wqm/wqm.html) Instream Flow Standard Assessment Reports developed by the State of Hawai'i Commission on Water Resource Management (http://hawaii.gov/dlnr/cwrms/sw_ifsar.htm) Rapid Watershed Assessments conducted by the U.S. Department of Agriculture Natural Resources Conservation Service (www.pia.nrcs.usda.gov/technical/rwa.html) Watershed plans and strategies developed by the U.S. Army Corps of Engineers, (www.stormwaterpa.org/assets/media/news/doc2010-02-22-102758.pdf) Environmental assessment documents submitted to fulfill the requirements of Hawai'i's Environmental Impacts Statements statute, see Standard comments relating to Environmental Health programs, (http://hawaii.gov/health/environmental/oeqc/index.html) Watershed management plans developed by the Honolulu Board of Water Supply and other counties Community development plans developed by Hawai'i County and other counties (www.hcrc.info/) 	



Appendix D: Additional Watershed Planning Resources

The following organizations, publications and Websites provide helpful information related to watershed planning in Hawai'i.

- *The Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (www.epa.gov/owow/nps/watershed_handbook/#contents)

As referred to throughout this document, the U.S. Environmental Protection Agency (EPA) *Handbook* is intended to help communities, watershed organizations, and state, local, tribal and federal environmental agencies develop and implement watershed plans to meet water quality standards and protect water resources. It was designed to help any organization undertaking a watershed planning effort, and it should be particularly useful to those working with impaired or threatened waters. The *EPA Handbook* is intended to supplement existing watershed planning guides and is generally more specific than other guides with respect to guidance on quantifying existing pollutant loads, developing estimates of the load reductions required to meet water quality standards, developing effective management measures, and tracking progress once the plan is implemented.

- *Application of Watershed Ecological Risk Assessment Methods to Watershed Management* (<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=162845>)

This report supplements the *Guidelines for Ecological Risk Assessment* (EPA 1998a) by addressing issues commonly encountered in conducting watershed ecological assessments.

- *Responsible Agencies and Authorities: A Supplemental For Hawaii Management Measures* (http://hawaii.gov/dbedt/czm/initiative/nonpoint/Responsible_Agencies_and_Authorities.pdf)

Provides a detailed description of the specific authorities, relevant language, regulatory and non-regulatory mechanism for each management measure.

- *The Center for Watershed Protection* (www.cwp.org/)

The Center for Watershed Protection works to protect, restore and enhance streams, rivers, lakes, wetlands and bays. The center offers trainings, webcasts, print resources, and model ordinances, among other tools.

- Hawai'i Association of Conservation Districts (www.hacdhawaii.org/waterquality.html)

The Hawai'i Association of Conservation Districts (HACD) was organized in September 1954 to serve as the state instrument and voice for the conservation movement in Hawai'i. It maintains and promotes relations with organizations and government agencies; publishes information about districts; works with youth, agriculture, urban programs, the environment, industry, and other fields; and provides specialized services to the Districts. HACD manages a Clean Water Act Section 319 Water Quality Grant through the State of Hawai'i Department of Health - Clean Water Branch (DOH-CWB). With this grant, HACD is able to assist the DOH-CWB conduct nonpoint source pollution (NPS) control activities in a number of different ways, including development of conservation plans, design and implementation of watershed plans, and public outreach activities related to polluted runoff and water quality.

- Hawai'i Coastal Zone Management (CZM) – Coastal Nonpoint Pollution Source Control (<http://hawaii.gov/dbedt/czm/initiative/nonpoint.php>)

Hawai'i Coastal Zone Management (CZM) Program focuses its work on the complex resource management problems of coastal areas in the part of the state that is under the highest stress. Within a framework of cooperation among federal, state and local levels, the Hawai'i CZM Program employs a wide variety of regulatory and non-regulatory techniques to address coastal issues and uphold environmental law. Among them are stewardship, planning, permitting, education and outreach, technical assistance to local governments and permit applicants, policy development and implementation, and identification of emerging issues and exploration of solutions.

- Natural Resources Conservation Service – Conservation and Area-wide Planning (www.nrcs.usda.gov/programs/planning/)

The Natural Resources Conservation Service (NRCS) provides conservation planning and technical assistance to clients (individuals, groups, and units of government). These clients develop and implement conservation plans to protect, conserve, and enhance natural resources (soil, water, air, plants, and animals) within their related social and economic interests. The NRCS promotes sound use and management of soil, water, air, plant, and animal resources to prevent their degradation and ensure their sustained use and productivity while also considering related human social and economic needs.

- National Oceanic and Atmospheric Administration Coastal Services Center – Pacific Islands (www.csc.noaa.gov/regions/pacific.html)

The National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center works with various branches of NOAA and other federal agencies to bring information, services and technology to the nation's coastal resource managers. The center is a partner in more than 100 ongoing projects



geared to resolve site-specific coastal issues. Among the resources listed on this site are the Ahupua'a Management Toolkit and Watershed Management Technical Support. The Ahupua'a's Management Toolkit integrates traditional Hawaiian knowledge and practices with watershed management products and services that have been developed for Hawai'i. Assistance is provided to organizations that plan to address land-based pollution sources through the Watershed Management Technical Support.

- The Watershed Plan Builder

(<http://iaspub.epa.gov/watershedplan/planBuilder.do?pageId=51&navId=39>)

EPA's Watershed Plan Builder is designed for users who are just beginning to develop a watershed plan, are in the process of developing a watershed plan, or are updating an existing plan. The plan builder guides users through a series of questions designed to collect watershed-specific information. The information provided is used to produce a customized watershed plan outline. The outline includes recommended content for each section of the plan and related data links and contact information. This plan can be a valuable resource to guide the watershed planning process with stakeholders and to help assign components of the plan to colleagues.

- The Watershed Planning Process Website

(<http://iaspub.epa.gov/watershedplan/planningProcess.do?pageId=33&navId=33>)

EPA's Watershed Planning Process Website provides step-by-step guidance for creating a watershed plan. The information on this Website is based on the *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. Icons at the top of the screen link to information on each of the six planning steps. Each step's page includes links to information on sub-steps that can be viewed by clicking on the appropriate heading in the right-hand topics box.

- Watershed Central Wiki

(https://wiki.epa.gov/watershed2/index.php/Main_Page)

EPA's Watershed Central Wiki is an excellent online resource of user-generated information related to watershed planning. Since going live in March 2009, the website's number of registered users, pages of content, and audience have grown substantially. The website features relevant information related to watershed planning from actual practitioners and is great place to find "lessons learned" from watershed projects around the country.

- Watershed Central – Watershed Management Process

(www.epa.gov/owow/watershed/watershedcentral/process.html)

Located on EPA's Watershed Central Website, the Watershed Management Process section closely resembles the Watershed Planning Process Website. One key difference is that the Watershed Central site includes links to resources and models.

■ The Watershed Academy (www.epa.gov/owow/watershed/wacademy/)

EPA's Watershed Academy provides training and information on implementing watershed approaches. The academy's self-paced training modules and webcast seminars provide current information from national experts across a broad range of watershed topics. Below is a listing of some of the more than 100 modules and webcasts that address introductory watershed planning and analysis topics.

Modules:

- Introduction to the Clean Water Act: www.epa.gov/watertrain/cwa/
- Introduction to the Watershed Planning Process:
www.epa.gov/watertrain/planning/
- Key Concepts of Impaired Waters and Developing TMDLs:
www.epa.gov/watertrain/tmdl_concepts.html
- Watershed Modeling: www.epa.gov/watertrain/modeling/

Watershed Academy Webcasts

(www.epa.gov/owow/watershed/wacademy/webcasts/):

- The ABCs of TMDLs for Stakeholders Introduction to the Clean Water Act Monitoring Watershed Program Effectiveness
- Opportunities for Citizen Involvement in the Clean Water Act Plan2Fund: A Tool to Organize Your Watershed Funding
- Using EPA's Draft Handbook for Developing Watershed Plans to Restore and Protect Our Waters
- Watershed Plan Builder: EPA's Interactive Web-based Tools Designed to Promote the Development of Comprehensive Watershed Plans